CY2014 PADUCAH GASEOUS DIFFUSION PLANT ANNUAL SITE ENVIRONMENTAL REPORT (ASER):

Student Summary

Contents

LIST OF FIGURES

LIST OF TABLES

MESSAGE FROM THE STUDENTS

Dear Reader,

We hope that our summary environmental report, *U.S. DEPARTMENT OF ENERGY PADUCAH GASEOUS DIFFUSION PLANT CALENDAR YEAR 2014 ANNUAL SITE ENVIRONMENTAL REPORT (ASER)*, December 2015 (FPDP-RPT-0004)*: Student Summary Report* helps you understand what industrial operations related to uranium enrichment occurred at the U.S. Department of Energy's (DOE) Gaseous Diffusion Plant (PGDP), how past operations impacted the environment, what the DOE is doing to address environmental impacts, and what monitoring indicates about current environmental conditions. Our AP Ecology Class is thankful to have been chosen to learn about the history of the PGDP, uranium enrichment as a large-scale industrial operation, Western Kentucky's history and the Cold War, historical environmental impacts at the PGDP, and work being conducted to remediate environmental impacts that have occurred during the plant's operations.

Sincerely,

MCHS 2016-17 Ecology Class

MESSAGE FROM THE DEPARTMENT OF ENERGY

The U.S. Department of Energy (DOE) conducts comprehensive environmental monitoring at the Paducah Gaseous Diffusion Plant (PGDP) site and nearby areas to ensure protection of human health and the environment. Every year environmental monitoring data is summarized and presented by the PGDP site in a comprehensive annual environmental report. This year Marshall County (Kentucky) High School AP Ecology and AP Science students participated in classroom and field activities related to the DOE's *PGDP 2014 Annual Site Environmental Report (ASER)*. The students compiled the results of their ASER review in the document *U.S. DEPARTMENT OF ENERGY PADUCAH PLANT 2014 ANNUAL SITE ENVIRONMENTAL REPORT (ASER): Student Summary*.

Environmental work at DOE's facilities is technically complex and challenging. The scale of the PGDP industrial complex, its infrastructure and impacts on the surface and subsurface environment magnify the technical complexities faced by the DOE in its management and cleanup efforts. Beginning in 2014 DOE's challenges increased with the shutdown of enrichment operations and the preparation for the dismantling of enrichment process facilities.

The annual Student Summary Report is important to DOE as a tool to clearly and concisely explain the comprehensive PGDP environmental monitoring and remediation programs to stakeholders. PGDP environmental data collected from soil, surface water, sediment, air, and groundwater during 2014 indicated that the site is in compliance with regulatory and human health standards and is actively pursuing the remediation of on-site sources of environmental contamination.

The PGDP site sincerely appreciates the work of the students and staff at Marshall County High School in the production of the *PGDP 2014 Annual Site Environmental Report Student: Student Summary*. On behalf of the entire Department of Energy, we congratulate each of you for your effort, enthusiasm, and willingness to support DOE with this project.

We hope that you enjoy the *PGDP 2014 Annual Site Environmental Report: Student Summary.*

Sincerely,

Jennifer Woodard, DOE Paducah Site Lead

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ACRONYMS

AEC	Atomic Energy Commission
ASER	Annual Site Environmental Report
bgs	below ground surface
BWCS	B&W Conversion Services, LLC
CAA	Clean Air Act
CAB	Paducah Citizens Advisory Board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
CY	calendar year
D&D	decontamination and decommissioning
DNAPL	dense non-aqueous-phase liquid
DOE	United States Department of Energy
DOECAP	Department of Energy Consolidated Audit Program
EIC	Environmental Information Center
EIS	environmental impact statement
EM	environmental management
EMP	Environmental Monitoring Plan
EMS	Environmental Management System
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FFA	Federal Facility Agreement
FY	fiscal year
GDP	gaseous diffusion plant
GHG	greenhouse gas
GW	Groundwater
KAR	Kentucky Administrative Regulations
KCHFS	Kentucky Cabinet for Health and Family Services
KDAQ	Kentucky Division for Air Quality
KDENF	Kentucky Division of Enforcement
KDEP	Kentucky Department for Environmental Protection
KDOW	Kentucky Division of Water
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
LATA	Los Alamos Technical Associates Environmental Services of Kentucky, LLC
LLW	low-level radioactive waste
MCL	maximum contaminant level
MEI	maximum exposed individual
MW	monitoring well
ND	not detected
NEPA	National Environmental Policy Act
NEPCS	Northeast Plume Containment System
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFA	no further action
NOV	Notice of Violation

NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NWPGS	Northwest Plume Groundwater System
OREIS	Oak Ridge Environmental Information System
PGDP	Paducah Gaseous Diffusion Plant
PEGASIS	Paducah Environmental Geographic and Spatial Information System
PPPO	Portsmouth/Paducah Project Office
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
FFS	focused feasibility study
RGA	Regional Gravel Aquifer
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act
SMP	Site Management Plan
SSP	site sustainability plan
SST	Swift & Staley Team
SWMU	solid waste management unit
TCE	trichloroethylene
TLD	thermoluminescent dosimeter
TSCA	Toxic Substances Control Act
TVA	Tennessee Valley Authority
UCRS	Upper Continental Recharge System
UDS	Uranium Disposition Services, LLC
USEC	United States Enrichment Corporation
UST	underground storage tank
VOC	volatile organic compound
WKWMA	West Kentucky Wildlife Management Area
WMP	Watershed Monitoring Plan
WMPP	Waste Minimization/Pollution Prevention

1. Introduction

The purpose of this Annual Site Environmental Report is to summarize United States Department of Energy (DOE) Calendar Year 2014 environmental management activities at the Paducah Gaseous Diffusion Plant (PGDP) and its surroundings. Environmental management activities include effluent monitoring, environmental surveillance, and environmental compliance. Additionally the report is intended to highlight significant site environmental program efforts. DOE implements programs to measure impacts that operations have on the environment or the public and reports on those programs annually. Surveillance under DOE programs includes analyses of surface water, groundwater, sediment, ambient air, and direct radiation. DOE conducts PGDP environmental management activities under the requirements of DOE Order 231.1B (Environment, Safety, and Health Reporting), Federal and State requirements (Chapter 2).

There are 2 types of environmental monitoring at the PGDP: effluent monitoring and environmental surveillance. Effluent monitoring is collecting and analyzing samples of liquid and gaseous discharges to the environment. Environmental Surveillance is collecting and analyzing samples of surrounding air, surface water, soil, groundwater, and sediment. In order to address and remediate environmental damage, both effluent monitoring and environmental surveillance are conducted. Effluent and environmental samples are collected, tested for radioactivity, chemical constituents and physical properties, and evaluated relative to compliance with regulations that address environmental impacts and safety.

The main goals of DOE's environmental management at the PGDP are to keep visitors, workers, communities, wildlife and the environment safe from exposure to and impacts from harmful chemicals and radiation related to the site, and to maintain full compliance with current environmental regulations. In July 1993, DOE leased the production areas of the site to the United States Enrichment Corporation (USEC). In October 2014 USEC terminated its lease with DOE to operate the PGDP and all facilities were returned to DOE control. This report does not include USEC environmental monitoring. In 2014, DOE awarded a contract to Fluor Federal Services, Inc., Paducah Deactivation Project for deactivation activities at the Paducah Site.

1.1 Site Background

The Paducah Gaseous Diffusion Plant (PGDP) is a retired uranium enrichment facility located west of Paducah, Kentucky ***(Figure 1.1)*** that is owned by the United States Department of Energy (DOE), operated and managed by DOE contractors. The PGDP enrichment plant was constructed and began operations in the early 1950's to support the nation's Cold War nuclear efforts.

Enrichment operations at PGDP were carried out on an industrial site of more than one square mile. The industrial site contains facilities required for material preparation, material storage, enrichment process components, water treatment, process system cooling, fire suppression, steam generation, and sanitary and industrial waste disposal ***(Figure 1.2; Figure 1.3)***. The enrichment process required its own source of electrical power that was supplied through construction and operation of the Tennessee Valley Authority's Shawnee Steam Plant, immediately north of the PGDP on the Ohio River and the construction and operation of the Electrical Energy Incorporated's Joppa Steam Plant in southern Illinois.

Historical industrial operations at the PGDP created industrial process waste that contained radioactive and hazardous materials. Over the course of PGDP operations, the routine handling, storage and disposal of radioactive and hazardous materials resulted in contamination of soil, surface water and groundwater, which DOE now actively monitors and remediates. Since 1988 and the discovery of the radionuclide technetium-99 (Tc-99) in residential water wells near the site, DOE has been investigating, monitoring, and remediating the origin, extent and impacts of PGDP's uranium enrichment operations on workers, the public and the environment.

1.2 Site Location

The PGDP industrial site occupies one square mile of a 3,556 acre DOE Reservation approximately 10 miles west of Paducah, and 3.0 miles south of the Ohio River (Figure 1.3). Of the 3,556 acres: 837 acres are within a fenced security area (industrial site), 600 outside of it, 133 are in acquired easements, and 1,986 surrounding acres are licensed to the Commonwealth of Kentucky as part of the West Kentucky Wildlife Management Area (WKWMA). The WKWMA is popular for deer hunting, waterfowl hunting, hunting-dog training and competition, horseback riding, fishing and general outdoor recreation.

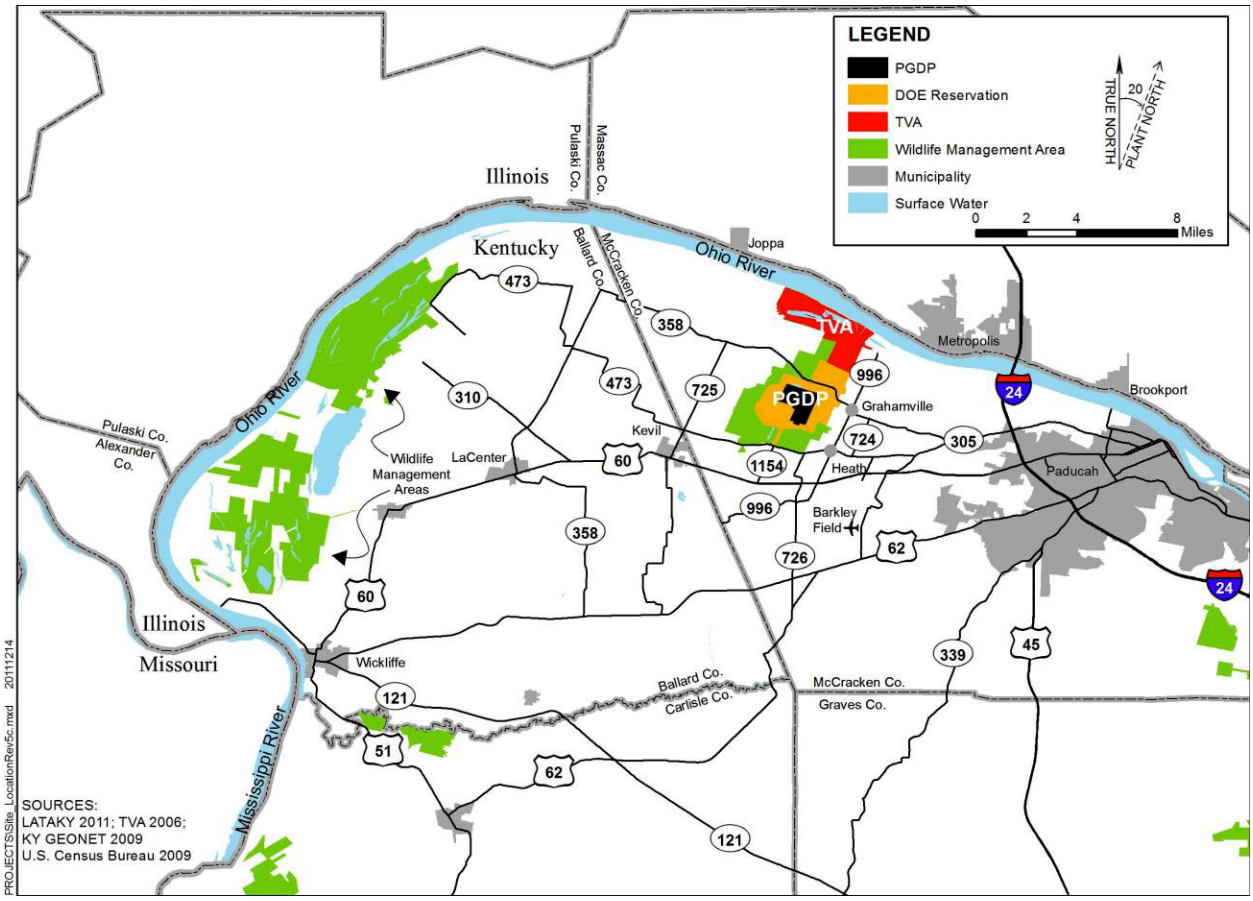

Figure 1.1 Location of the Paducah Site

1.3 General Environmental Setting

The Paducah Plant site is located in the eastern United States humid continental zone where summers are warm and winters are moderately cold. Precipitation averages 49 inches per year, and prevailing wind is from the south-southwest at 10 miles per hour.

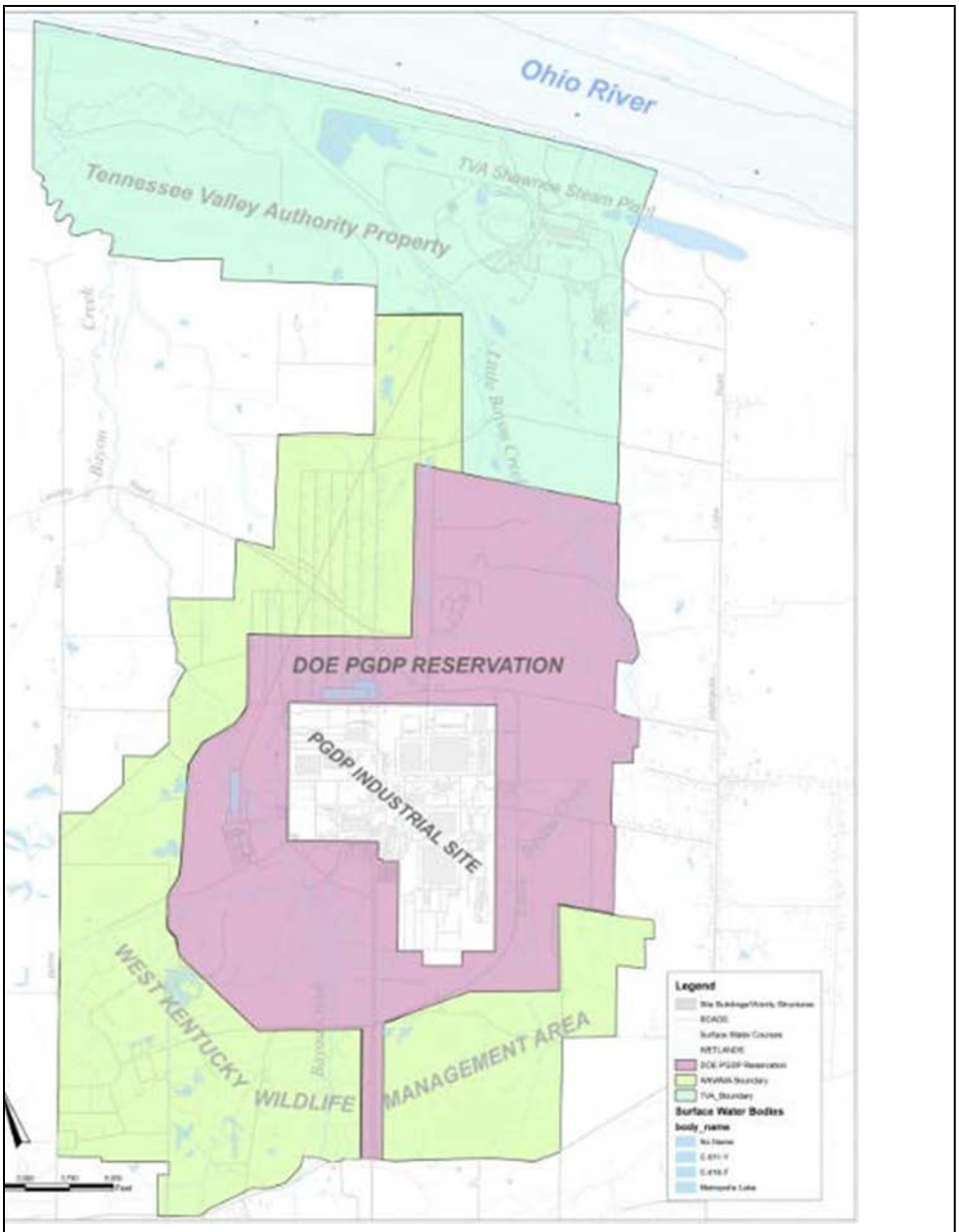

Figure 1.2 PGDP Industrial Site, PGDP Reservation, West Kentucky Wildlife Management Area and TVA Property boundaries.

1.3.1 Surface Water Drainage

The Paducah Plant is located approximately 3.0 miles south of the Ohio River in the lower Ohio River Basin. The Cumberland and Tennessee Rivers join the Ohio River approximately 15 miles upstream of the PGDP. The confluence of the Ohio and Mississippi Rivers is about 35 (river) miles downstream of the PGDP.

The PGDP DOE Reservation occupies portions of Bayou Creek and Little Bayou Creek watersheds. Water in the PGDP industrial area enters ditches that convey the water through permitted surface water outfalls to Bayou and Little Bayou Creeks. Surface water from the East side of the plant flows east-

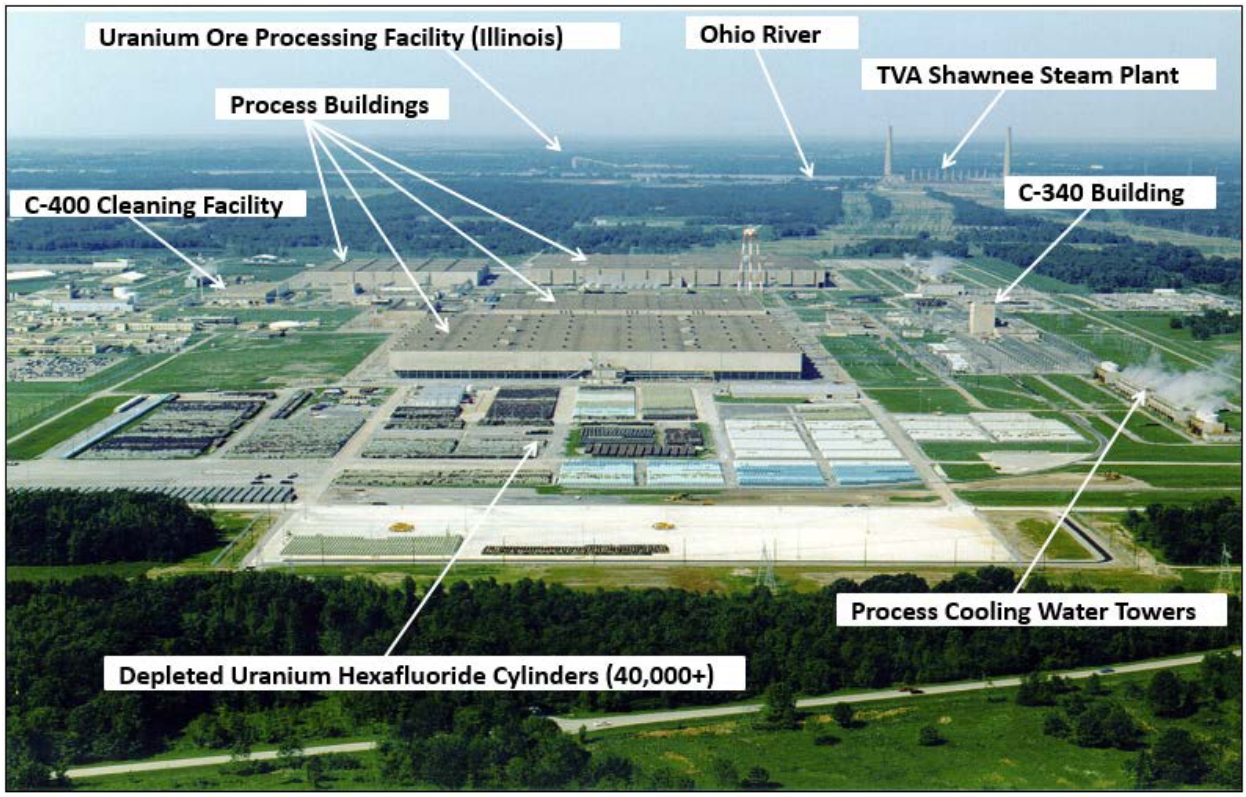

Figure 1.3 Flyover view of the PGDP Industrial Site and associated facilities (circa 2006). (Currently, the C-340 building has been demolished and the number of depleted Uranium Hexafluoride cylinders has increased to approximately 53,000.)

The PGDP DOE Reservation occupies portions of Bayou Creek and Little Bayou Creek watersheds. Surface water from the East side of the plant flows east-northeast into Little Bayou Creek. Surface water from the West side of the plant flows west-northwest into Bayou Creek. Bayou and Little Bayou Creeks converge 3 miles north of the plant before emptying into the Ohio River.

1.3.2 Wetlands

More than 1,100 separate wetlands, totaling over 1,600 acres, are found in the 12,000 acres around the PGDP. More than 60% of the total wetland area is forested. As part of activities associated with the 2014 PGDP Annual Site Environmental Report: Student Summary Project, MCHS students provided hands-on assistance to the University of Kentucky and the West Kentucky Wildlife Management area in the assessment and delineation of amphibian wetland habitat in the vicinity of the PGDP.

1.3.3 Soils and Hydrogeology

Naturally occurring soils in the vicinity of the Paducah Plant are predominantly silty loam soils that are poorly drained, acidic, and have little organic content. Groundwater from the aquifer that underlies PGDP is utilized extensively for agriculture and domestic purposes in areas that have not been impacted by PGDP activities. The local groundwater flow system and aquifer at the Paducah Site are described in Chapter 6.

1.3.4 Vegetation

Much of the vegetation in the vicinity of the PGDP has been impacted by human activity and is now old field succession. Open grassland areas are managed by West Kentucky Wildlife Management Area (WKWMA) and are burned periodically to promote native species growth. Field scrub-shrub communities consist of sun tolerant wooded species. Upland mixed hardwood forests contain a variety of upland and transitional species.

1.3.5 Wildlife

Wildlife species present in the vicinity of the PGDP are indigenous to hardwood forest, scrub-shrub and open grassland communities. Both migratory waterfowl and amphibian species seasonally utilize the area surrounding the PGDP. Many types of sunfish and shiners inhabit the creeks and open water.

1.3.6 Threatened and Endangered Species

A threatened and endangered species investigation identified federally listed, proposed, or candidate species potentially occurring at or near the Paducah Site. Eleven of these species (TABLE 1.1) are listed as "endangered", one is "threatened", and one is proposed for listing.

Table 1.1 Threatened and Endangered Species Potentially Present in the vicinity of the PGDP

Group	Common Name	Scientific Name	Endangered Species Act Status
Mammals	Indiana Bat	*Myotis sodalis*	Endangered
	Northern Long-eared Bat	*Myotis septentrionalis*	Proposed
Mussels	Fanshell	*Cyprogenia stegaria*	Endangered
	Pink Mucket	*Lampsilis abrupta*	Endangered
	Ring Pink	*Obovaria retusa*	Endangered
	Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered
	Clubshell	*Pleurobema clava*	Endangered
	Rough Pigtoe	*Pleurobema plenum*	Endangered
	Fat Pocketbook	*Potamilus capax*	Endangered
	Spectaclecase	*Cumberlandia monodonta*	Endangered
	Sheepnose	*Plethobasus cyphyus*	Endangered
	Rabbitsfoot	*Quadrula c. cylindrical*	Threatened
Birds	Interior Least Tern	*Sterna antillarum athalassos*	Endangered

* All of the listed species are identified as an Endangered, Threatened, or Candidate Species known or with the potential to be located within McCracken County, Kentucky, by the U.S. Fish and Wildlife Service (FWS 2014).

1.4 Demographic Information

The population of McCracken County, Kentucky, including the city of Paducah, is 65,000. The population within a 50 mile radius of the Paducah Site is about 534,000. Within a 10 mile radius it is 89,000.

1.5 Site Mission

DOE created the Portsmouth/Paducah Project Office (PPPO) to provide leadership for environmental management activities at the Portsmouth, Ohio and Paducah, Kentucky Gaseous Diffusion Plants.

The main goals of the PPPO's PGDP activities are to protect human health and the environment, accelerate the site environmental cleanup, eliminate potential environmental threats, reduce DOE's footprint, and reduce life-cycle site management costs. In order to achieve these goals there will be ongoing environmental remediation, waste management cleanup, decontamination and decommission (D&D) activities, and conversion of the depleted Uranium Hexafluoride (DUF6).

1.5.1 Primary Operations and Activities at the Paducah Site

Two major programs are used to help DOE oversee the Paducah site, the Environmental Management (EM) and Uranium programs. The EM program includes Environmental Restoration, Waste Management, and Decontamination and Decommissioning projects. The Uranium program manages storage of the DUF6 and the operation of the PGDP DUF6 Conversion Facility. The Conversion Facility separates DUF6 to a stable oxide of uranium and hydrofluoric acid. The stable uranium oxide is safe for disposal or re-use and the hydrofluoric acid is sold to industry for re-use.

The Environmental Restoration Project (ER) manages environmental investigations and responses to releases from past site operations and operates to ensure that human health and the environment are protected. A Federal Facilities Agreement between DOE, the U.S. Environmental Protection Agency (EPA), and Commonwealth of Kentucky is in place to help with the management and State and Federal environmental law compliance.

The Waste Management Program is in place to make sure that waste is disposed of properly in a manner protective of human health and the environment. The D&D Project was put in place to eliminate unused facilities in a manner protective of human health and the environment.

2. Environmental Regulations & Compliance

The main goals of DOE's environmental management at the PGDP are to keep visitors, workers, communities, wildlife and the environment safe from potential exposure to and impacts from harmful chemicals and radiation related to the site, and to maintain full compliance with current environmental regulations. The Federal and State laws, regulations, and DOE internal environmental management requirements are discussed in this section. DOE with its site contractors Los Alamos Technical Associates of Kentucky (LATA) and FLUOR Federal Services conducted environmental management and compliance activities at the PGDP during calendar year 2014.

The U.S EPA, Region 4, and the Kentucky Department for Environmental Protection (KDEP) are the principal regulatory agencies that facilitate the following: issuing permits, reviewing compliance reports, reviewing and providing input on remediation strategies, participating in joint monitoring programs, inspecting facilities and operations, and overseeing compliance with applicable laws and regulations.

2.1 Environmental Restoration and Waste Management

2.1.1 Comprehensive Environmental Response, Compensation, and Liability Act

The DOE and EPA Region 4 work through an Administrative Consent Order (ACO) required under Sections 104 and 106 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The ACO was put in place in response to the off-site groundwater contamination detected at the Paducah site, July 1988.

On May 31, 1994 the PGDP was placed on the EPA National Priorities List (NPL). The list identifies sites with the highest priority for site remediation based on potential impacts to human health and the environment. EPA uses the Hazard Ranking System to determine sites that should be included on the NPL.

CERCLA Section 120 requires federal agencies responsible for an NPL site to enter into a Federal Facilities Agreement (FFA) with the EPA. The FFA coordinates CERCLA remedial action requirements with Resource Conservation and Recovery Act (RCRA) regulatory requirements that are the responsibility of the State. The PGDP FFA has been in place since 1998 when DOE, EPA, and KDEP agreed to terminate the CERCLA ACO and manage PGDP environmental decision making under the FFA.

DOE submits an annual FFA Site Management Plan to the EPA and KDEP. The Plan summarizes pending remediation work, outlines remedial priorities, and contains schedules for completing future work. Significant milestones required under CERCLA and the FFA for 2014 are listed in Table 2.1.

2.1.2 Superfund Amendments and Reauthorization Act

CERCLA was amended in 1986 by the Superfund Amendments and Reauthorization Act. The Act placed EPA's experience administering the complex Superfund program into law, put increased focus on human health problems posed by hazardous waste sites, and encouraged greater citizen participation in making decisions on how sites should be cleaned up.

Table 2.1 CERCLA and FFA Significant Milestones for CY 2014

Milestone	Date Agreed	Date Completed
SMP for FY 2014—D2	2/5/2014	2/5/2014
C-400 Steam Treatability Study Work Plan—D2	2/18/2014	2/18/2014
C-400 Phase IIb Steam Injection Treatability Study Design—D1	3/24/2014	3/24/2014
CERCLA Five-Year Remedy Review—D2	4/3/2014	4/2/2014
C-340 Removal Action Report—D2	4/25/2014	4/25/2014
FFA Semiannual Progress Report—First Half of FY 2014	4/30/2014	4/29/2014
C-400 Phase IIb Steam Injection Treatability Study Design—D2	5/27/2014	5/23/2014
CERCLA Five-Year Remedy Review—D2/R1	6/2/2014	5/30/2014
Burial Grounds Operable Unit Feasibility Study (FS) Report for Solid Waste Management Units (SWMUs) 2, 3, 7, and 30—D2	6/14/2014	6/12/2014
C-400 Phase IIb Steam Injection Treatability Study Design—D2/R1	7/18/2014	7/18/2014
Southwest Plume SWMU 1 (Soil Mixing) Remedial Action Work Plan—D2/A1/R1	7/23/2014	7/23/2014
Sitewide Evaluation Work Plan for Anomalies Located outside the Limited Area—D2	8/31/2014	8/29/2014
Soils Operable Unit Remedial Investigation (RI)/FS Work Plan Addendum-RI 2—D2/R2/A1/R1	8/31/2014	8/29/2014
Transmittal of the Revised Waste Management Plan (Section 13) of the Work Plan for the Burial Grounds Operable Unit RI/FS	9/16/2014	9/16/2014
SMP for FY 2014—D2/R1	9/30/2014	8/25/2014
FFA Semiannual Progress Report—Second Half of FY 2014	10/30/2014	10/28/2014
SMP for FY 2015—D1	11/15/2014	11/14/2014
C-400 Phase IIb Steam Injection Treatability Study Fieldwork Start	1/10/2015	12/19/2014

2.1.3 Resource Conservation and Recovery Act

Regulatory standards for characterization, treatment, storage, and disposal of solid and hazardous wastes are established by the Resource Conservation and Recovery Act (RCRA). Owners and operators generating hazardous waste are required to obtain permits for the handling, treatment, storage and disposal of hazardous wastes. The PGDP generates solid, hazardous, and mixed waste (hazardous waste with radioactivity), and operates three permitted hazardous waste storage and treatment facilities. The C-404 Landfill which contains hazardous and radioactive waste from enrichment process activities is also managed under RCRA.

2.1.4 Resource Conservation and Recovery Act Hazardous Waste Permit

Part A and Part B of RCRA permit applications for storage and treatment of hazardous wastes at PGDP were submitted for the Paducah Site in the late 1980s. The current hazardous waste management facility permit was issued to DOE on September 30, 2004. The permit became effective on October 31, 2004, and was valid until October 31, 2014 and a new permit application was submitted to KDEP in May 2014 but had not been put in place at the end of the calendar year. The conditions of the expired permit remain in effect until the new permit is approved. There were no Notices of Violation (NOVs) issued for the Hazardous Waste Facility Permit during 2014.

2.1.5 Federal Facility Compliance Act-Site Treatment Plan

The Federal Facility Compliance Act (FFCA) was enacted in October 1992. The FFCA waived immunity from fines and penalties for federal facilities for violations of RCRA hazardous waste management.

Mixed waste contains hazardous waste and radioactive waste components and the FFCA requires development of site treatment plans (STPs) for the treatment of DOE mixed waste generated at the PGDP. In September 1997 the DOE and KDEP entered and Agreed Order to manage PGDP's mixed waste. In 2014 an annual inventory of PGDP mixed waste was updated and mixed waste was prepared for off-site shipment and treatment in early calendar year 2015.

2.1.6 National Environment Policy Act

An evaluation of the potential environmental impacts of proposed federal activities is required by the National Environmental Policy Act (NEPA). PGDP evaluates proposed non-CERCLA actions and determines if they require preparation of an Environmental Impact Statement (EIS), Environmental Assessment (EA), or receive a categorical exclusion (CX) from EIS or EA preparation.

During calendar year 2014, the PPPO continued to prepare an EA for environmental impacts associated with potential transfer of PGDP property to third parties for future economic development. Many minor PGDP activities including routine maintenance, small-scale facility modifications, site characterization, facility deactivation, and utility consolidation were within the scope of an approved EIS, EA, or approved CXs during 2014. The DOE Paducah Site Office and the PPPO NEPA compliance officer approve and monitor the internal applications of previously approved CX determinations.

2.1.7 Toxic Substances Control Act

The Toxic Substances Control Act was enacted in 1976 to ensure that information on the production, use, environmental and health effects of chemical substances or mixtures is obtained by the EPA and that EPA has the information to regulate the substances and mixtures. Many familiar substances with potential environmental and health impacts are utilized and handled at the PGDP including polychlorinated biphenyls (PCBs), chlorofluorocarbons, asbestos and lead.

2.1.8 Polychlorinated Biphenyls

The PGDP complies with PCB regulations under a Toxic Substances Control Act – Federal Facilities Compliance Agreement. The major PCB-related activities conducted at the PGDP are documented in a Uranium Enrichment Toxic Substances Control Act Compliance Agreement Annual Report.

2.2 Radiation Protection

The Atomic Energy Act of 1954 provides authority to DOE for Radiation Protection of the Public and the Environment (DOE Order 458.1) and Radioactive Waste Management (DOE Order 435.1). Under these orders, DOE establishes the requirements for protection of the public and the environment against any undue risk from radiation associated with its activities handling and disposing of radioactive materials.

2.2.1 DOE Order 458.1, Radiation Protection of the Public and the Environment

LATA implements an Environmental Radiation Protection Program (ERPP) to comply with DOE Order 458.1. The goals of the ERPP are to: 1) conduct radiological activities so that exposure to members of the public is maintained within the dose limits established by the Order; 2) control the radiological clearance of real and personal property; 3) ensure that potential radiation exposures to members of the public are As Low As Reasonably Achievable; 4) monitor routine and non-routine radiological releases and to access the radiation does to members of the public; and 5) provide protection of the environment from the effects of radiation and radioactive material.

2.2.2 DOE Order 435.1, Radioactive Waste Management

The PGDP manages low-level and transuranic waste in compliance with DOE Order 435.1.

2.3 AIR QUALITY AND PROTECTION

2.3.1 Clean Air Act

The PGDP complies with Federal and Commonwealth of Kentucky rules by implementing the Clean Air Act (CAA) and its amendments. EPA Region 4 and/or the Kentucky Division for Air Quality have authority for enforcing compliance with the CAA. There are 3 air emission permits that the PGDP complies with: 1) the DUF6 Conversion Facility Conditional Major Air Permit; 2) CERCLA; and 3) Deactivation Title V Air Permit. The Title V permit includes 38 emission units including boilers, process stacks, fugitive emissions sources, process cooling systems, and emergency power generators. The Northwest Plume Groundwater System (NWPGS) and Northeast Plume Containment System (NEPCS) facilities are permitted air emission sources at the PGDP related to ongoing containment and treatment of contaminated groundwater.

2.3.2 National Emission Standards for Hazardous Air Pollutants Program

The National Emission Standards for Hazardous Air Pollutants Program (NESHAPS) addresses air emissions of radionuclides regulated and requires the PGDP to operate under an EPA-approved release management plan. Potential radionuclide air release sources at the PGDP were PGDP deactivation activities, the DUF6 Conversion Facility, NEPCS, NWPGS, fugitive and diffuse sources. DOE conducted ambient air monitoring at nine solar-powered locations surrounding the PGDP to verify a low emission rates for radionuclides in off-site air.

2.4 WATER QUALITY AND PROTECTION

2.4.1 Clean Water Act

The Clean Water Act (CWA) was established in 1972 through the Federal Water Pollution Control Act Amendments. The four major CWA programs are: 1) Regulation of point-source discharges into waters of the United States; 2) Control and preventions of oil and hazardous substances spills; 3) Regulation of dredge and fill materials discharges into waters of the United States; and 4) Financial assistance for construction of publicly owned sewage treatment works. PGDP surface water discharges are regulated through two (2) Kentucky Pollutant Discharge Elimination System (KPDES) permits.

2.4.2 Kentucky Pollutant Discharge Elimination System (KPDES)

The Kentucky Division of Water (KDOW) issues a Kentucky Pollutant Discharge Elimination System (KPDES) permit to the PGDP through its authority under the CWA. The permit applies to all non-radiological DOE discharges to surface water and requires monitoring of discharge-related effects in the receiving streams and adoption of Best Management Practices (BMPs) to minimize discharges. The PGDP complies with its KPDES permits through the application of Environmental Management System and work control BMPs.

Two Notices of Violation (NOVs) were received during CY 2014 for alleged KPDES permit exceedances. Each NOV was for alleged exceedances of a toxicity-based water quality standard. Native plants and

supplemental wetland varieties were installed to provide natural filtering capacity along the PGDP outfall ditch 017 to mitigate Zinc as the suspected source of toxicity failures. PGDP conducted focused sampling to address toxicity exceedances in PGDP outfall ditch 001, which resulted in termination of the toxicity sampling requirement. Table 2.2 summarizes 2014 KPDES permit exceedances (noncompliances) and measures taken to address them.

*Table 2.2 KPDES Noncompliances in CY 2014**

Permit Type	Outfall	Parameter	Number of Permit Exceedances	Number of Samples Taken	Number of Compliant Samples	Percent Compliance	Month(s) of Exceedance(s)	Description/ Solution
KPDES (KY0004049)	001	Chronic Toxicity	2	15	13	87%	February and March	Failures in toxicity testing are believed to have been caused by a naturally occurring pathogen. An alternate laboratory method subsequently was used to reduce/eliminate the influence due to naturally occurring pathogens. These tests did not indicate failure.
KPDES	020	Total Suspended Solids	1	13	12	92%	November	It is suspected that sediment from the bottom of a leachate tank was transferred with the leachate to the treatment facility due to sparse rainfall and a low-level of leachate generation. Maintenance activities, such as pressure washing and replacing filters have been performed to reduce the likelihood of future exceedances.

*Table 2.2 lists exceedance that occurred in CY 2014. The table does not include NOVs received in 2014 for actual exceedances in 2013. An exceedance is listed for total suspended solids at Outfall 020 in November 2014; an NOV was issued for this exceedance in 2015.

2.4.3 Storm Water Management and the Energy Independence and Security Act of 2007

The PGDP implements energy and water audits to comply with the Energy Independence and Security Act.

2.4.4 Safe Drinking Water Act

The PGDP utilizes the Ohio River as the source for on-site drinking water and treats the water prior to on-site distribution. The drinking water treatment and distribution system was operated and managed by DOE contractors in accordance with the Safe Drinking Water Act (SDWA) regulations.

The SDWA establishes a framework for the Underground Injection Control program to control the injection of wastes into groundwater, which includes injections associated with the implementation of

remediation actions. The PGDP utilized subsurface electrical conductivity during the C-400 Cleaning Building Interim Remedial Action (Figure 2.1) to generate heat, which in turn volatilizes trichloroethene (TCE) contamination in soil and aquifer materials. The remedial action required re-injection of treated groundwater to maintain electrical conductivity targets at subsurface electrodes.

Figure 2.1 Remedial operations at the C-400 Cleaning Facility.

2.5 OTHER ENVIRONMENTAL STATUTES

2.5.1 Endangered Species Act

The Endangered Species Act of 1973 addresses the designation and protection of endangered and threatened animals, plants, and their ecosystems. Endangered species that may be present in the vicinity of the PGDP are listed in Table 2.3. No DOE project at the Paducah Site during 2014 impacted any of the identified species or their potential habitats.

2.5.2 National Historic Preservation Act

The National Historic Preservation Act of 1966 (NRHP) requires federal agencies to identify and protect historic properties eligible to be placed on the National Register of Historic Places. A PGDP Cultural Resources Management Evaluation and Plan identified process buildings; electrical switchyards; the C-100 Administration Building; recirculating process cooling towers and pump houses; security facilities; water treatment facilities; storage tanks; and support, maintenance, and warehouse buildings as NRHP eligible.

*Table 2.3 Federally Listed, Proposed, and Candidate Species Potentially Occurring within the Paducah Site Study Area**

Group	Common Name	Scientific Name	Endangered Species Act Status
Mammals	Indiana Bat	*Myotis sodalis*	Endangered
	Northern Long-eared Bat	*Myotis septentrionalis*	Proposed
Mussels	Fanshell	*Cyprogenia stegaria*	Endangered
	Pink Mucket	*Lampsilis abrupta*	Endangered
	Ring Pink	*Obovaria retusa*	Endangered
	Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered
	Clubshell	*Pleurobema clava*	Endangered
	Rough Pigtoe	*Pleurobema plenum*	Endangered
	Fat Pocketbook	*Potamilus capax*	Endangered
	Spectaclecase	*Cumberlandia monodonta*	Endangered
	Sheepnose	*Plethobasus cyphyus*	Endangered
	Rabbitsfoot	*Quadrula c. cylindrical*	Threatened
Birds	Interior Least Tern	*Sterna antillarum athalassos*	Endangered

[a] All of the listed species are identified as an Endangered, Threatened, or Candidate Species known or with the potential to be located within McCracken County, Kentucky, by the U.S. Fish and Wildlife Service (FWS 2014).

2.5.3 Migratory Bird Treaty Act

The U.S. Fish and Wildlife department and DOE updated a Memorandum of Understanding that requires further implementation of the Migratory Bird Treaty Act of 1918 under Executive Order 13186. Under the Act, DOE must take measures to minimize impacts to migratory birds in the course of site and environmental operations.

2.5.4 Asbestos Program

Facilities at the PGDP contain asbestos material that requires compliance with programs addressing identification, monitoring, abatement, and disposal of asbestos materials. The PGDP maintains compliance with EPA, Occupational Safety and Health Administration, and Kentucky regulatory requirements regarding asbestos. During D&D of the C-340 Metals Plant, insulation containing asbestos was abated.

2.5.5 Pollutants and Sources Subject to Regulation

The PGDP DUF6 conversion facility has the potential to emit more than 10 tons of hydrogen fluoride per year but its emissions are managed to release no more than 9 tons per year. The DUF6 conversion facility and other facilities and activities with the potential to release more than 10 tons/year of any hazardous air pollutant (HAPs) or 25 tons/year of any combination of HAPs are operated under air permits.

2.5.6 Stratospheric Ozone Protection

Clean Air Act Title VI Stratospheric Ozone Protection provisions require reporting and management of ozone-depleting substances. Prior to October 2014, DOE operated only refrigeration units that contain less than 50 lbs. refrigerants and coolant. USEC operated PGDP's process cooling systems, including the very large R-114 cooling system and the storage of millions of pounds of refrigerant in railcars. With the transition of the PGDP process facilities back to DOE in 2014, Clean Air Act Title VI became DOE's management and reporting responsibility.

2.5.7 Floodplain/Wetlands Environmental Review Requirements

The Code of Federal Regulations, 10 CFR 1022, and Executive Orders 11988 and 11990 require compliance to protect Floodplains and Wetlands. DOE activities did not result in significant impacts to floodplains or wetlands in 2014.

2.5.8 Underground Storage Tanks Managed under RCRA Kentucky UST Regulations

Eighteen (18) PGDP Underground Storage Tanks (USTs) were used during plant construction and operations to store petroleum products. The UST's are regulated under RCRA Subtitle I (40 *CFR* § 280) and Kentucky UST regulations (401 *KAR* Chapter 42). Fourteen (14) USTs have been closed under regulatory closure plans, two USTs were determined not to exist, and the two (2) operational USTs were inactive and undergoing closure in 2015.

USTs at the PGDP are monitored by the PGDP and the Kentucky Division of Waste Management. Of the 18 underground storage tanks once in service at the PGDP, only 2 were still in operation during 2014.

2.5.9 Solid Waste Management

During 2014, office waste generated at the PGDP was taken off-site for disposal by Waste Path Services, LLC, in Calvert City, Kentucky. The City of Kevil picks up the office waste from the office complexes in Kevil, Kentucky that house administrative personnel who support activities at the site.

In addition to off-site waste disposal, the DOE operates a contained landfill at the PGDP under a Solid Waste Permit issued by the KDWM.

2.6 DEPARTMENT SUSTAINABILITY; FEDERAL LEADERSHIP IN ENVIRONMENTAL ENERGY, AND ECONOMIC PERFORMANCE

2.6.1 Department Sustainability

The PGDP, through DOE Order 436.1, pursues the U.S. Green Building Council's Leadership in Energy and Environmental Design guidelines. The PGDP currently has no buildings or proposed construction that fall under this order.

2.6.2 Federal Leadership in Environmental, Energy and Economic Performance

In support of DOE's goals to reduce greenhouse gas emissions, PGDP contractor Swift and Staley submitted a Site Sustainability Plan in December 2014, and FPDP submitted a Site Sustainability Plan in December 2014.

2.7 Emergency Planning and Community Right-to-Know Act - Environmental Regulations and Compliance

The main goals of DOE's environmental management at the PGDP are to keep visitors, communities, wildlife and the environment safe from exposure to and impacts from harmful chemicals and radiation related to the site, and to maintain full compliance with current environmental regulations. The Federal and State laws, regulations, and DOE internal environmental management requirements are discussed

in this section. DOE and its site contractors LATA and FLUOR conducted environmental management and compliance activities at the PGDP during 2014.

The U.S EPA, Region 4, and the KDEP are the principal regulatory agencies that facilitate the following: issuing permits, reviewing compliance reports, participating in joint monitoring programs, inspecting facilities and operations, and overseeing compliance with applicable laws and regulations.

2.8 OTHER MAJOR ENVIRONMENTAL ISSUES AND ACTIONS

2.8.1 Green and Sustainable Remediation

Green and sustainable remediation (GSR) is the practice of using sustainable methods to reduce environmental and social impacts of remedial cleanup and closure activities in a cost-effective way. GSR also offers opportunities to meet compliance obligations at lower overall cost and environmental impact. The DOE issued DOE Order 436.1 in 2011 to ensure its commitment to pursue GSR.

Executive Order 13514 requires federal agencies to manage greenhouse gas emissions (GHG).

2.8.2 Adapting to Climate Change

Normal power usage, fleet exhaust, and process power make up the majority of GHG emitted during PGDP operations and are subject to planning.

2.8.3 Continuous Release Reporting

Section 103(a) of CERCLA requires that hazardous substance releases in excess of a reportable quantity be reported immediately to the National Response Center.

2.8.4 Unplanned Releases

Approximately 25 gal of propylene glycol (antifreeze) was released to a gravel area at the DUF6 Conversion Facility in April 2014. Under the PGDP's KPDES permit the release was reported to KDEP because the DUF6 facility is in the Outfall 017 watershed and was also reported as a CERCLA release. Effluent in Outfall 017 was sampled for propylene glycol immediately following the event and none was detected. There were no other reportable, unplanned environmental releases for at the Paducah Site during CY 2014.

Table 2.4 Permits Maintained by DOE for the Paducah Site for CY 2014

Permit Type	Issued By	Permit Number	Issued To
State Agency Interest ID# 3059			
Clean Water Act			
Kentucky Pollutant Discharge Elimination System	KDOW	KY0004049	DOE/LATA Kentucky/BWCS
		KY0102083	DOE/FFS
Permit to Withdraw Public Water	KDOW	0900	FFS
Water Treatment Registration (Public Water System	KDOW	PWS No. 0732457	FFS
Clean Air Act			
Conditional Major Operating Air Permit	KDAQ	F-10-035 R1	BWCS
Title V Air Permit	KDAQ	V-07-031	FFS
RCRA—Solid Waste			
Residential Landfill (closed)	KDWM	SW07300014	DOE/LATA Kentucky
Inert Landfill (closed)	KDWM	SW07300015	DOE/LATA Kentucky
Solid Waste Contained Landfill (construction/operation)	KDWM	SW07300045	DOE/LATA Kentucky
RCRA—Hazardous Waste			
Hazardous Waste Facility Permit	KDWM	KY8-890-008-982	DOE/LATA Kentucky
Underground Storage Tank Registration	KDWM	6319-073	DOE
Hazardous and Solid Waste Amendments Portion of the RCRA Permit	EPA	KY8-890-008-982	DOE/LATA Kentucky

3. Environmental Management System

The Environmental Management System (EMS) is a management approach that the PGDP site uses to integrate its environmental protection, environmental compliance, pollution prevention, health and safety work. The EMS addresses all work conducted by the DOE, DOE contractors, LATA, FLUOR and the Swift and Staley. The site's EMS was audited and found to satisfy DOE requirements. The major elements of the PGDP EMS are policy, planning, implementation and operation, and checking and management review as outlined by the International Organization for Standardization. The PGDP EMS environmental stewardship scorecard for FY 2014 was green.

3.1 Environmental Operating Experience and Performance Measurement

The DOE and site contractors conduct an environmental monitoring program for the PGDP, which is described in the Environmental Monitoring Plan (EMP). The EMP identifies how effluent monitoring, environmental surveillance, and air monitoring around the plant will be conducted during the year. Site contractor LATA implemented the PGDP 2014 environmental monitoring program and executed EMP activities.

3.1.1 Site Sustainability Plan

The Site Sustainability Plant (SSP provides information concerning the requirements and responsibilities of managing sustainability on the Paducah Site including: to ensure DOE carries out its missions in a sustainable manner that addresses national energy security and global environmental challenges, while advancing sustainable, reliable and efficient energy for the future; to initiate wholesale cultural change to factor sustainability and greenhouse gas (GHG reductions into all of DOE's corporate management decisions; and to ensure that DOE achieves the sustainability goals established in its SSP pursuant to any applicable laws, regulations, Executive Orders (EO's), sustainability initiatives, and related performance scorecards.

Another objective is to increase awareness in workers and the community about sustainability opportunities through public outreach and training. Table 3.1 is taken from the *Fiscal Year 2015 Site Sustainability Plan, Paducah Gaseous Diffusion Plant* and contains a brief summary of FY 2014 performance and long-term planned actions to attain FY 2020 SSP goals.

3.1.2 Waste Minimization/Pollution Prevention

The PGDP Waste Minimization/Pollution Prevention Program provides guidance and objectives for minimizing waste generation at the site. The program complies with RCRA requirements, the Pollution Prevention Act, as well as Commonwealth of Kentucky and U.S. Environmental Protection Agency rules, DOE orders, EO's, and the Site Treatment Plan. PGDP site wastes are minimized using source reduction, segregation, reuse of materials, recycling, and procurement of recycled-content products.

Table 3.1 DOE Goal Summary Table

DOE 2020 Goal	Site Performance Status	Site Planned Actions and Contributions
GHG Reduction and Comprehensive GHG Inventory		
28% Scope 1 and 2 GHG reductions by FY 2020 from a FY 2008 baseline (2014 target: 19%).	15.1% below FY 2008 baseline	The Site is below the FY 2008 baseline for this goal for the third year in a row. The Site's method to achieve the long-term Scope 1 and 2 GHG emissions goal by FY 2020 is to reduce electrical and petroleum consumption.
13% Scope 3 GHG reduction by FY 2020 from the FY 2008 baseline (2014 target: 5%).	5.7% below FY 2008 baseline	There has been a loss of progress on Scope 3 emissions since last year. The increase in personnel is the main factor. According to the Consolidated Energy Data Report and FY 2008 estimates of Scope 3 emissions, the Site is currently 22% below the FY 2008 Baseline, which exceeds the goal.
Building, Energy Savings Performance Contracts Initiative Schedule, and Regional and Local Planning		
30% energy intensity (Btu per gross ft^2) reduction by FY 2015 from the FY 2003 baseline (2014 target: 27%).	173.4% up from the 2003 baseline.	Overall site energy intensity increase is due to a loss in energy consuming gross ft^2 from the original baseline. Small operational energy initiatives are acted upon as they arise; however, nothing large scale is planned.
EISA Section 432 energy and water evaluations.	100%	EISA evaluations will continue to be accomplished across the site.
Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015) (2014 target: 90% and 50%, respectively).	81% of electricity. 100% of natural gas (met). 0% of water. Steam and chilled water [not applicable (N/A)].	Water and electrical meters have no return on investment. There are no plans to meter those utilities on-site.
Cool roofs, unless uneconomical, for roof replacements unless project already has Critical Decision-2 approval. New roofs must have thermal resistance of at least R-30.	No cool roofs were installed in FY 2014.	Trailers are an uneconomical place for cool roofs; however, a cool roof upgrade is being assessed and will be considered for the C-103 Building because the life cycle will require a replacement. The remaining facilities are being evaluated, but may not have the surface square footage or effective lifespan to achieve a return on investment.
15% of existing buildings larger than 5,000 gross ft^2 to be compliant with the five guiding principles of HPSB by FY 2015 (2014 target: 13%).	Initiated as life cycle allows.	No existing buildings meet the guiding principles.
All new construction, major renovations, and alterations of buildings greater than 5,000 gross ft^2 must comply with the guiding principles.	The Site currently has no projects planned that fit the requirements.	No existing buildings meet the guiding principles.
Efforts to increase regional and local planning coordination and involvement.	The Site currently has no projects planned that fit the requirements.	The past year primarily was spent preparing for the USEC turnover. The coming years will offer better opportunities for coordination.

Table 3.2 DOE Goal Summary Table (cont.)

DOE 2020 Goal	Site Performance Status	Site Planned Actions and Contributions
Fleet Management		
10% annual increase in fleet alternative fuel consumption by FY 2015 relative to the FY 2005 baseline (2014 target: 136% cumulative since 2005).	2.3% increase from last year.	In FY 2005 there was no E85 present at the site, making the baseline zero. This year, the site was up 2.3% from FY 2013. The performance status should increase as the FY 2015 fleet requirements increase.
2% annual reduction in fleet petroleum consumption by FY 2020 relative to the FY 2005 baseline (2014 target: 18% cumulative since 2005).	5,705% over FY 2005 baseline.	Increases in personnel and work operations at the site have led to an increase in fleet and petroleum consumption. Historical data provided in the Consolidated Energy Data Report shows the Paducah Site having very low petroleum consumption in FY 2005. It will be extremely difficult to meet this goal.
100% of light-duty vehicle purchases must consist of alternative fuel vehicles (AFVs) by FY 2015 and thereafter (7 5% FY 2000–2015).	With the recent fleet expansion, 80% of the new vehicles are AFVs.	The site has requested that General Services Administration send more AFVs/hybrids as other vehicles leave the site.
Water Use Efficiency and Management		
26% potable water intensity (gal per gross ft^2) reduction by FY 2020 from a FY 2007 baseline (2014 target: 14%).	Goal is met.	To meet the standard, the contractors have installed low-flow systems and ceased all landscape watering. This site estimates this goal has been met.
20% water consumption (gal) reduction of industrial, landscaping, and agricultural (ILA) by FY 2020 from the FY 2010 baseline (2014 target: 8%).	N/A	FY 2010 baseline is 0. The site still is not consuming water for ILA purposes; thus, there is no reduction to record.
Pollution Prevention and Waste Reduction		
Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015.	56% diversion rate in FY 2014.	The site has met the goal this year with a 56% diversion rate. The site intends to use best practices and innovation to continue to decrease municipal landfill waste.
Divert at least 50% of construction and demolition materials and debris by FY 2015.	Currently 3.1%.	Noncontaminated waste is recycled and reused when applicable. The site historically recycles a large amount of construction and demolition waste when it is not contaminated. This year, the majority of construction and demolition waste was contaminated and not eligible for recycling.
Sustainable Acquisition		
Procurements meet requirements by including necessary provisions and clauses in 95% of applicable contracts (Sustainable Procurements/Biobased Procurements).	Goal is met.	Environmentally Preferred Purchasing Program allows the subcontractors to monitor all purchase orders and make additions to the list for new products. All contracts presently contain sustainable acquisition clauses.

Table 3.3 DOE Goal Summary Table (cont.)

DOE 2020 Goal	Site Performance Status	Site Planned Actions and Contributions
Electronic Stewardship and Data Centers		
All data centers are metered to measure monthly power usage effectiveness (PUE) of 100% by FY 2015 (2014 target: 90%).	N/A	Presently the Paducah Site has a server room located in the Kevil, KY, building; however, it does not qualify as a data center.
Core data centers maximum annual weighted average PUE of 1.4 by FY 2015 (2014 target: 1.50).	N/A	The Paducah Site does not have any data centers in which to monitor PUE.
Power Management—100% of eligible personal computers, laptops, and monitors with power management actively implemented and in use by FY 2012.	Goal is met.	Power management is actively implemented on all computers.
Electronic Stewardship—95% of eligible electronics acquisitions meet Electronic Product Environmental Assessment Tool (EPEAT®) standards.	Goal is met.	All electronic acquisitions met EPEAT® standards in FY 2014.
Renewable Energy		
20% of annual electricity consumption from renewable sources by FY 2020 (2014 target: 7.5%).	Presently at 27.1% from Renewable Energy Certificates (RECs) purchased.	PPPO purchases RECs for the Paducah and Portsmouth sites. This year 2,000 MWh was purchased.
Climate Change Adaption		
Climate Change Adaption—Address DOE Climate Adaption Plan goals.	N/A	Paducah has no specific actions for Climate Change Adaptation. Presently, no natural risks or vulnerabilities have been identified at the Paducah Site.
Energy Performance Contracts		
Utilization of energy performance contracts.	None	There are presently no Energy Savings Performance Contracts in place at the Paducah Site.

NOTE: Information is taken from Table 1 of the *Fiscal Year 2015 Site Sustainability Plan, Paducah Gaseous Diffusion Plant* (SST 2014).

The PGDP's SSP has the following goals and objectives:

- Eliminate or reduce the amount and toxicity of all waste generated at the site;
- Comply with federal and state regulations and DOE requirements for waste minimization;
- Reuse or recycle materials when possible;
- Identify waste reduction opportunities;
- Integrate Waste Minimization/Pollution Prevention technologies into ongoing projects;
- Coordinate recycling programs; and
- Track and report results.

The following are the accomplishments of the Waste Minimization/Pollution Prevention Program in 2014:

(1) Placed emphasis on using and/or recycling by-products.

(2) Drained filters, reused gasoline products, and recycled oil.

(3) Handled light bulbs as universal waste and recycled them.

(4) Purchased green tip (low mercury) bulbs.

(5) Continued to review purchases for substitute products with lesser hazard concerns and minimized inventory of supplies to only what is necessary.

(6) Continued to reduce the amount of radioactive waste through recognized best work practices such as allowing only material and tools required to perform work into radiologically posted areas.

(7) Verified recyclables to be free of radiological contamination prior to off-site release.

The PGDP Waste Minimization/Pollution Prevention Program efforts for the site are reported in DOE's Consolidated Energy Data Report. During CY 2014, the PGDP recycled 34,808 pounds of materials.

3.1.3 Depleted Uranium Hexafluoride Cylinder Program

A part of the EMS was an explanation of a program known as "The Depleted Uranium Hexafluoride Cylinder Program". This program describes DUF6, a product of the uranium enrichment process, which is solid at ambient temperatures and stored in large metal cylinders. The mission of this program is to safely store the DOE-owned DUF6 inventory until its reclamation, re-use or disposition. By the end of 2014, the PGDP had an inventory of an estimated 53,200 cylinders stored in outdoor facilities which represents the largest stockpile of mined uranium in the world. The facilities used to store the cylinders are commonly referred to as cylinder storage yards. At the end of 2014 the BWCS-managed cylinder count included the addition of approximately 8,000 cylinders that were transferred to DOE from USEC in October 2014. BWCS converted approximately 1,000 cylinders (12,344 metric tons) of DUF6 to a more stable oxide and HF during 2014.

3.1.4 Environmental Restoration, Waste Disposition, and D&D

The environmental restoration program supports: investigations and environmental response actions, D&D of facilities no longer in use, projects designed to demonstrate or test advancements in remedial technologies, and other projects related to actions taken for the protection of human health and the environment.

The following list summarizes Environmental Restoration, Waste Disposition and D&D significant accomplishments during 2014.

1. Completed Phase IIa of electrical resistance heating near the C-400 Cleaning Building to remove TCE from subsurface soil and groundwater.
2. Initiated Phase IIb at the C-400 Cleaning Building to evaluate steam-enhanced remediation of TCE.
3. Completed all preparatory work for deep soil mixing at SWMU 1 for the Southwest Plume Remedial Action.
4. Initiated SWMU 4 Phase III supplemental fieldwork.

5. Obtained regulatory approval of the Soils OU RI 2 work plan documents.
6. Characterized, packaged, and shipped over 27,000 ft3 of contaminated debris and equipment.
7. Continued D&D of the C-410/C-420 Feed Plant Complex by removing transite, superheaters, screw reactors, redactors, and UF6 reactors from C-420; demolished C-420 stacks; and placed controlled low-strength material (i.e., flowable fill) in some of the basements and pits to create safe work areas for personnel and equipment. Figure 3.1 illustrates D&D of the C-410/C-420 Feed Plant Complex.

3.1.5 Emergency Management

Emergency Management is a systematic effort at the PGDP in which members of the Paducah Site Emergency Response Organization include the Emergency Operations Center cadre, the crisis manager, an incident commander, and the Emergency Squad. The PGDP Joint Public Information Center provides timely and accurate information to the community during emergency situations. The PGDP maintains a fully staffed fire department, protective security force and staffed medical facility. Emergency response procedures are regularly practiced during training exercises.

3.1.6 Facility Stabilization, Deactivation, and Infrastructure Optimization

The PGDP was transferred from United States Enrichment Corporation to the Fluor Paducah Deactivation Project on October 21, 2014. The U.S. Nuclear Regulatory Commission (NRC) terminated its certificate of compliance for PGDP and the PGDP enrichment facilities are now regulated under DOE Orders. Several enrichment facility modifications occurred to support the transition of the site to the DOE including switchyard redesign, permit modification to support boilers, and the development of a new steam generation system.

Figure 3.1 C-410/420 uranium feed plant building Demolition.

3.2 Awards and Recognition

3.2.1 Public Awareness Program

The DOE gained community recognition through their activities conducted at the PGDP. A comprehensive DOE department, Community Relations and Public Participation, provides the public with opportunities to become involved in decisions relating to environmental issues at the site.

3.2.2 Community/Educational Outreach

The DOE has supported several educational and community outreach activities during 2014 including the PGDP Marshall County High School Student ASER Program. The DOE along with several area and national businesses and entities sponsored the Western Kentucky Regional Science Bowl for area high schools and middle schools. Two area schools, Calloway County High School and Lone Oak Middle School, went on to compete in DOE's National Science Bowl. In August, the DOE participated in a public meeting facilitated by the NRC to explain the NRC process for termination of the certificate authorizing uranium enrichment operations at PGDP. A formal transition of regulatory authority for PGDP from the NRC back to DOE took place at the August meeting.

In September and October 2014, LATA and S.M. Stoller Corp. Paducah Site scientists and environmental sampling personnel interacted with students at Ballard County Elementary School and McCracken County Middle Schools to demonstrate and discuss groundwater systems and contamination. PGDP

scientists and samplers used models, sampling tools, videos, and illustrations to help students connect classroom science to real world careers (Figure 3.2).

Figure 3.2 DOE contractor personnel demonstrate mechanisms for environmental impacts on groundwater to area elementary and middle school students.

3.2.3 Citizens Advisory Board

The Paducah Citizens Advisory Board (CAB) is a site-specific advisory board chartered by DOE under the Federal Advisory Committees Act. The PGDP CAB completed its 18th year of operation in September 2014. During the previous year, the CAB held five regular board meetings and additional subcommittee meetings. PGDP CAB subcommittees review issues for the following areas:

1. Burial Grounds (landfills, etc)
2. Waste Disposal Options
3. Historical Preservation
4. Integrated DOE Risk Priority List
5. Groundwater
6. Future Use/Adaptive Reuse

PGDP CAB meetings are open to the public and all regular board meetings are publicly advertised. In addition to its voting members, the CAB also has liaison members representing EPA Region 4, KDWM, Kentucky Cabinet for Health and Family Services, and WKWMA.

The CAB is composed of up to 18 members chosen to reflect the diversity of the PGDP area. The CAB reflects the community concerns regarding the environmental management of the PGDP site. The CAB

meets bimonthly to focus on early citizen participation in environmental cleanup priorities and related issues at the DOE facility.

3.2.4 Environmental Information Center

DOE's activities at the PGDP generate numerous technical, project and regulatory documents. The DOE Environmental Information Center provides the public centralized access to electronic documents that are part of the Administrative Records (www.paducaheic.com). Documents for public comment are available in the McCracken County Public Library (formerly the Paducah Public Library).

3.2.5 Additional Awards

LATA received an award for Performance Excellence, Level II—Commitment, from the Kentucky Center for Performance Excellence. The organization honors organizations based on the demonstration of performance excellence practices at one of four levels: interest, commitment, achievement, and excellence.

LATA received a Certificate of Achievement for Superiority from DOE and NRC for its reporting to the Nuclear Materials Management and Safeguards System. The reward is linked to LATA's accounting of equipment removed from the C-410/C-420 Feed Plant Complex during D&D work. In November 2014, the LATA team celebrated 3 million work hours without a lost workday (Figure 3.3).

Figure 3.3 DOE Contractors Celebrate a Safety Milestone

4. Environmental Radiological Protection Program and Dose Assessment

Background

Some radionuclides are the unstable forms of a chemical element that release energy as radiation. DOE Orders require the PGDP to monitor airborne and waterborne releases of radionuclides and radioactive materials. The monitoring is described in the PGDP EMP.

When the nucleus of a radionuclide isotope breaks down it releases energy as radiation and material containing that isotope is radioactive material. The breakdown of one isotope into another is the process of nuclear decay. When an isotope does not undergo nuclear decay, the isotope is stable. When decay does occur the radionuclide isotope is referred to as unstable. When the decay of an unstable isotope removes electrons from an atom, the atom is ionized and ionizing radiation is released. The rate of decay for unstable isotope material is measured in Curies (Ci) which represent the number of decays per second. Ionizing subatomic particles from radioactivity include alpha particles, beta particles and neutrons and gamma rays.

Each ionizing subatomic particle for each isotope has very specific energy that is released during decay. The energy releases of the subatomic particles are used to identify and quantify the isotope or isotopes in radioactive material. The energy releases are measured by detectors used in the field or by radiochemistry laboratory instruments.

When radioactive particles, i.e. ionizing radiation, interact with the human body, some or all of the energy from the radiation is passed to body tissue. The amount of radiation energy passed to the body per unit weight of organ or tissue is referred to as dose. Dose may be measured in millirems (mrem) and is expressed relative to varying units of time such as millirems per year (mrem/yr). Different types of radiation exposure can affect the human body in different ways by interacting with tissue in different ways. DOE Order 458.1A sets a dose limit to a member of the public at 100 mrem per year through all exposure pathways from DOE operations.

4.1 Environmental Radiological Monitoring Program

Many operations at the PGDP can potentially result in the release of radioactive materials into the environment by atmospheric and liquid pathways. The releases have the potential to result in a radiation exposure to people in the community. DOE Order 458.1, *Radiation Protection of the Public and the Environment,* requires an environmental surveillance program be in place at every DOE site including the PGDP. Each environmental surveillance program includes radiation monitoring of the pathways which could result in an exposure to the public. Environmental radiation surveillance at the PGDP includes the following pathways: surface water, groundwater, sediment, direct radiation, and ambient air.

4.1.1 DOSE

Exposure to radiation results in a dose to an exposed individual. A dose is the amount of energy absorbed by the human body as a result of exposure to a source of radiation. DOE Order 458.1 establishes an acceptable dose limit for the public of 100 mrem per year. The PGDP monitors the

presence and releases of radiation as well as the amount of radiation that the general public receive. The PGDP utilizes the radiation monitoring data to confirm that doses from site operations are below the public and dose limits established in DOE Order 458.1.

In October 2014, uranium enrichment operations at the PGDP ended and enrichment facilities became the responsibility of DOE. The enrichment facilities included the process buildings and their air emissions and 10 surface water outfalls.

The public is routinely exposed to natural and man-made sources of ionizing radiation as illustrated in Figure 4.1. DOE has established dose limits to the public so that DOE operations will not contribute significantly to the average annual exposure. Each year, the DOE operations in Paducah contribute to the public dose through their radiological releases (Figure 4.1). The Paducah Site calculates annual dose amount through:

- The use of effluent release date
- Direct radiation monitoring data
- Environmental monitoring data (along with relevant site specific data)

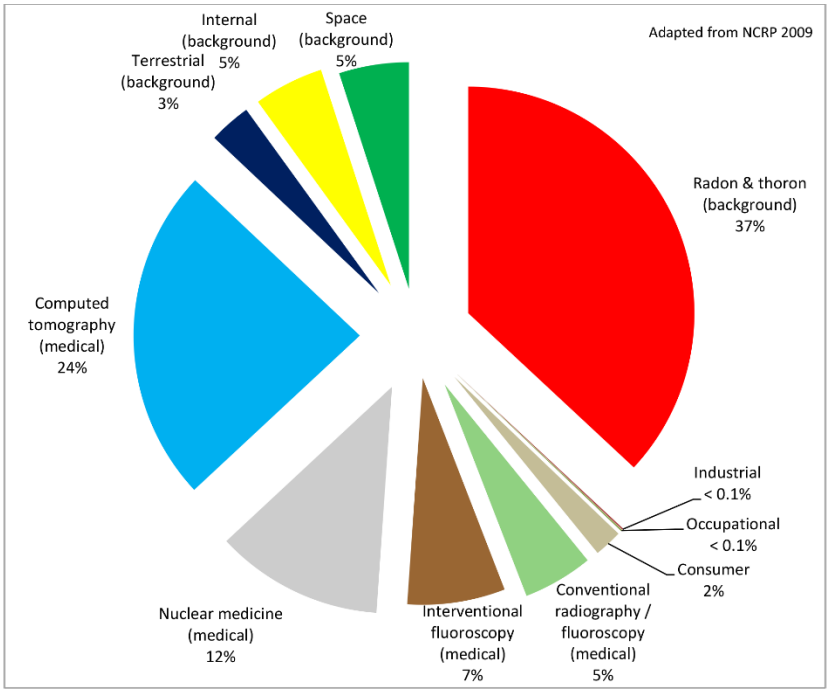

Figure 4.1 The percentage of dose received by individuals from all sources of ionizing radiation.

4.1.2 Radioactive Materials at the Paducah Site

Uranium is a common element found in very small quantities in the environment. Technetium is a man-made element that is a byproduct of the fission process in nuclear reactors. Uranium and technetium were introduced into the environment from the PGDP enrichment process.

Uranium and technetium are also two of the many elements that consist of radioactive isotopes or radioisotopes. The radioisotopes of an element have different numbers of neutrons in the nucleus but

all isotopes of an element have the same number of protons in the nucleus of each atom. The atomic number of an element indicates the number of protons in the nucleus and the number of electrons in a stable atom of the element.

4.1.3 What is an Exposure Pathway?

An exposure pathway is the route for released radioactive material to be transported by an environmental medium from a source to a receptor (a receptor is a plant, person, or animal). Routine operations at the PGDP and DUF6 facilities release incidental radioactive materials into the environment through atmospheric and liquid discharges. The principal routes by which people potentially are exposed are summarized by the following bullets and Figure 4.2:

- Inhalation of gases and particulates;
- Ingestion of vegetables, crops, venison, milk, and fish;
- Ingestion of surface water and groundwater;
- Skin absorption (also called dermal absorption); and
- External exposure to ionizing radiation.

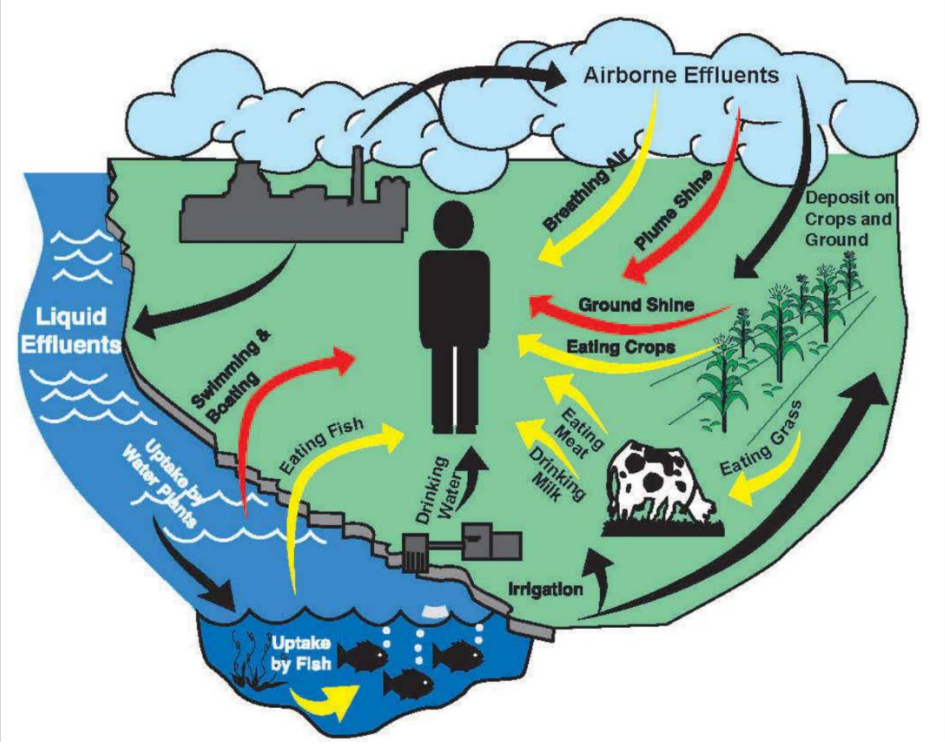

Figure 4.2 Radioactive material exposure pathways.

4.1.4 Dose Assessment Methodology

Measurements of radionuclide concentrations in liquids and air released from the PGDP are modeled to estimate the maximum exposure to an individual in a year. The population living within a 50-mile radius of Paducah Site is evaluated in the Site's assessment of compliance with public off-site dose limits. In the assessment the maximally exposed individual (MEI) is the hypothetical resident who has the greatest probability of being affected by a radiological release. The MEI is exposed to air releases at the

highest concentration of radionuclides that were measured in air during a year. The MEI consumes milk, meat, and vegetables produced at that location; spends time on or near Bayou or Little Bayou Creek, hunts on the wildlife reservation and consumes hunted wildlife. Groundwater consumption is not considered for the MEI because all persons downgradient of the Paducah Site are provided water from the local public water supply system.

Dose from ingestion of surface water is calculated at the nearest public withdrawal location in Cairo Illinois. Dose from sediment ingestion and incidental contact with surface water is based on assumptions for recreational use of the Bayou and Little Bayou Creeks on the reservation. Dose associated with airborne releases are calculated for the hypothetical MEI located at the nearest plant neighbor.

Additional assumptions related to the Paducah Site MEI are that surface water is not used for irrigation of crops. Little Bayou Creek is an ephemeral stream and does not support aquatic life for consumption. Fish are not caught and consumed from Bayou Creek so fish ingestion is not considered.

4.1.5 Air Monitoring and Estimated Dose from Airborne Effluents

DOE operations that may result in airborne radionuclide releases included CERCLA remedial actions and fugitive emissions. Several potential radionuclide sources were evaluated at the PGDP in 2014 including both groundwater treatment facilities and the DUF6 Conversion facilities.

Radionuclide sources were added to DOE's 2014 dose assessments as a result of the enrichment facilities becoming DOE's responsibility during the year and include:

- C-400 Group (which includes the following C-400 Cleaning Building sources: the C-400 decontamination spray booth, the C-400 No. 5 dissolver/rotary vacuum filter, and the C-400 laundry);
- C-400 Cylinder Drying Station;
- C-709/C-710 Laboratory Hoods;
- C-310 Product Withdrawal Building stack
- Seal Exhaust/Wet Air Group
- C-360 Transfer Facility

Specific activities that could generate fugitive emissions include transport and disposal of waste, demolition of contaminated facilities such as the C-410 Feed Plant (demolished in 2014), decontamination of contaminated equipment, and most environmental remediation activities. Ambient air monitoring, which monitors fugitive emissions from all Paducah Site operations (including DUF6 Conversion Facility operations), is conducted using nine continuous air monitors surrounding the Paducah Site reservation. One of these air monitors collects data from a background location. See Figure 4.3 for air sampling locations.

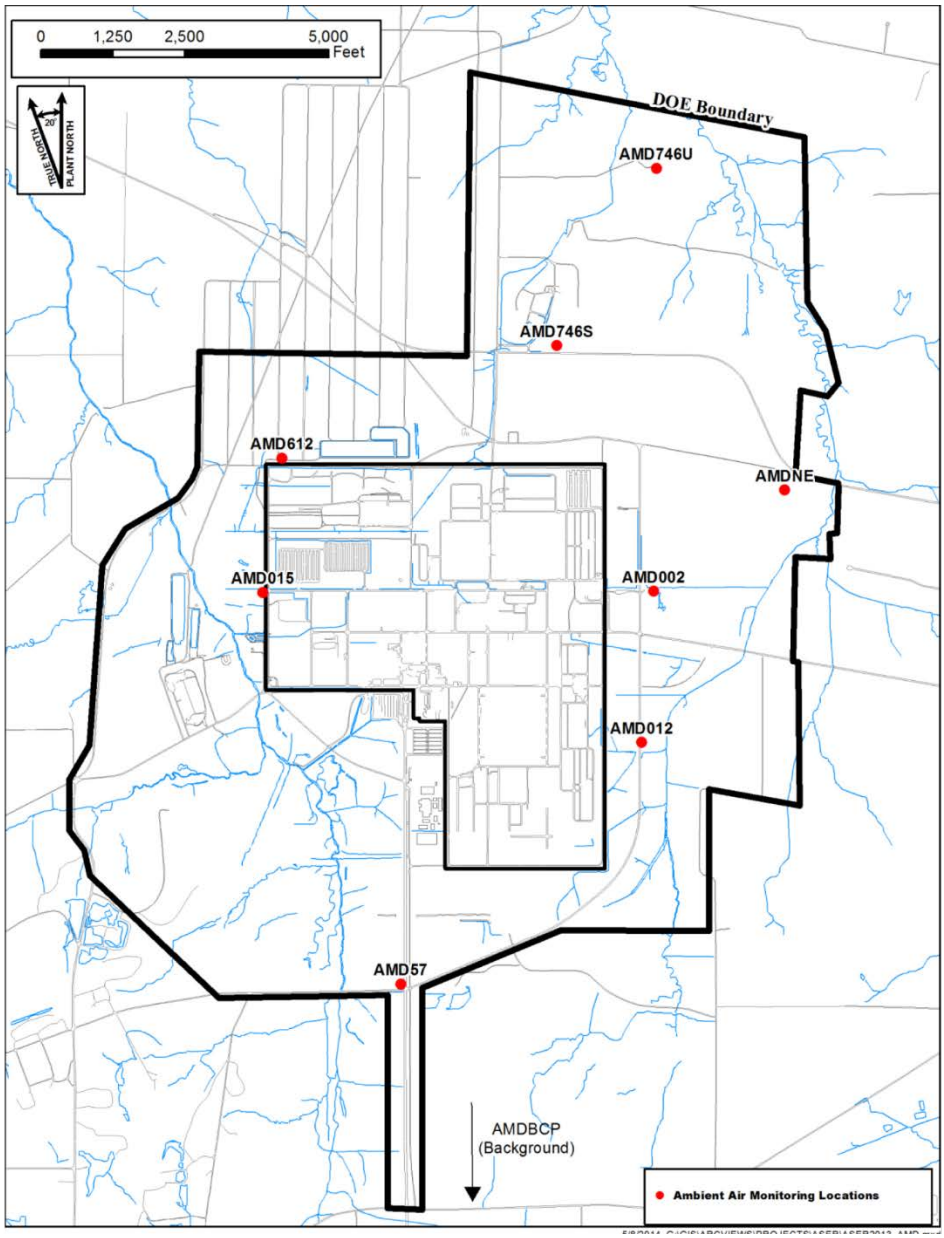

Figure 4.3 Air Monitoring Locations.

4.1.6 Liquid Discharge Monitoring and Estimated Dose from Liquid Effluents

4.1.6.1 Surface Water

Radioactive materials released to surface water may remain dissolved or suspended in surface water. Those materials may be deposited in sediment, deposited on ground or vegetation by irrigation, absorbed by plants and animals, or they may infiltrate to groundwater. Surface water leaving the Paducah Site includes runoff from rainfall, runoff from cylinder yards and landfills, and discharged effluent from site processes. Paducah Site surface water flows through site ditches and into Bayou and Little Bayou Creeks. Bayou and Little Bayou Creeks discharge into the Ohio River.

DOE Order 458.1 sets the requirements for limiting radioactivity in liquid releases from the PGDP that are protective of human health. The Derived Concentration Technical Standard (DCS) is a calculation for each radioisotope in a media which converts the concentration to a dose and the doses are summed to determine the dose to the MEI.

*Table 4.1 Radionuclide Atmospheric Releases for CY 2014 (in Curies) for the Paducah Site**

Nuclide	NWPGS	NEPCS ATU	C-400 Group	C-400 Cylinder Drying Station	C-709 & C-710	C-310	Seal Exhaust/ Wet Air Group	C-360	DUF_6 Conversion Facility	Total Site Emissions
U-234	0	0	6.45E-05	7.45E-07	1.45E-04	7.86E-06	6.46E-05	3.40E-08	1.46E-07	2.83E-04
U-235	0	0	2.24E-06	2.59E-08	5.05E-06	2.73E-07	2.24E-06	1.18E-09	6.66E-09	9.84E-06
U-238	0	0	2.65E-05	1.23E-06	1.35E-05	8.15E-07	1.70E-05	3.53E-09	3.57E-07	5.95E-05
Tc-99	1.20E-04	6.91E-06	2.39E-03	8.54E-09	0	2.26E-05	1.72E-06	0	0	2.54E-03
Th-230	0	0	1.20E-06	1.04E-07	0	9.30E-07	6.97E-09	0	0	2.24E-06
Th-231	0	0	0	0	0	0	0	0	3.08E-08	3.08E-08
Th-234	0	0	0	0	0	0	0	0	2.81E-06	2.81E-06
Np-237	0	0	4.97E-06	1.02E-10	0	1.75E-06	2.16E-06	0	0	8.87E-06
Pu-239	0	0	2.11E-08	8.77E-10	0	3.60E-07	0	0	0	3.82E-07
Pa-234m	0	0	0	0	0	0	0	0	2.81E-06	2.81E-06
Total Curies/Year	**1.20E-04**	**6.91E-06**	**2.49E-03**	**2.12E-06**	**1.64E-04**	**3.46E-05**	**8.78E-05**	**3.88E-08**	**6.16E-06**	**2.91E-03**

*Values are taken from *National Emissions Standard for Hazardous Air Pollutants Annual Report for 2014* (LATA Kentucky 2015c).

Table 4.2 Dose Calculations for Airborne Releases

Emission Sources	Dose to the Maximum Exposed Individual for the Plant (mrem)
DOE Emission Sources	
NWPGS	1.9E-04
NEPCS ATU	2.9E-06
C-400 Group	1.5E-03
C-400 Cylinder Drying Station	3.2E-06
C-709 & C-710	7.3E-05
C-310	2.6E-05
Seal Exhaust/Wet Air Group	5.1E-05
C-360	5.9E-09
DUF_6 Conversion Facility	6.2E-08
Total from All Sources	**1.8E-03**

Table 4.3 Calculated Radiation Doses from Airborne Releases for the Paducah Site

Effective Dose to MEI (mrem)	Percent of Standard (%)	Collective Effective Dose (person-rem)
0.0018	0.02	0.016

During 2014, surface water monitoring was conducted quarterly at four locations (Figure 4.4), one background location, and downstream Ohio River location near Cairo, Illinois public water supply withdrawal location. Locations were prioritized for areas of public access, introduction of plant effluents to the environment and verification of the effectiveness of the effluent discharge controls.

In addition to the surface water locations, samples were taken at the five KPDES-permitted outfalls where DOE was responsible for compliance throughout 2014 and at ten outfalls where DOE was

responsible for compliance from October through December 2014. Table 4.4 summarizes the analysis of surface water and outfalls.

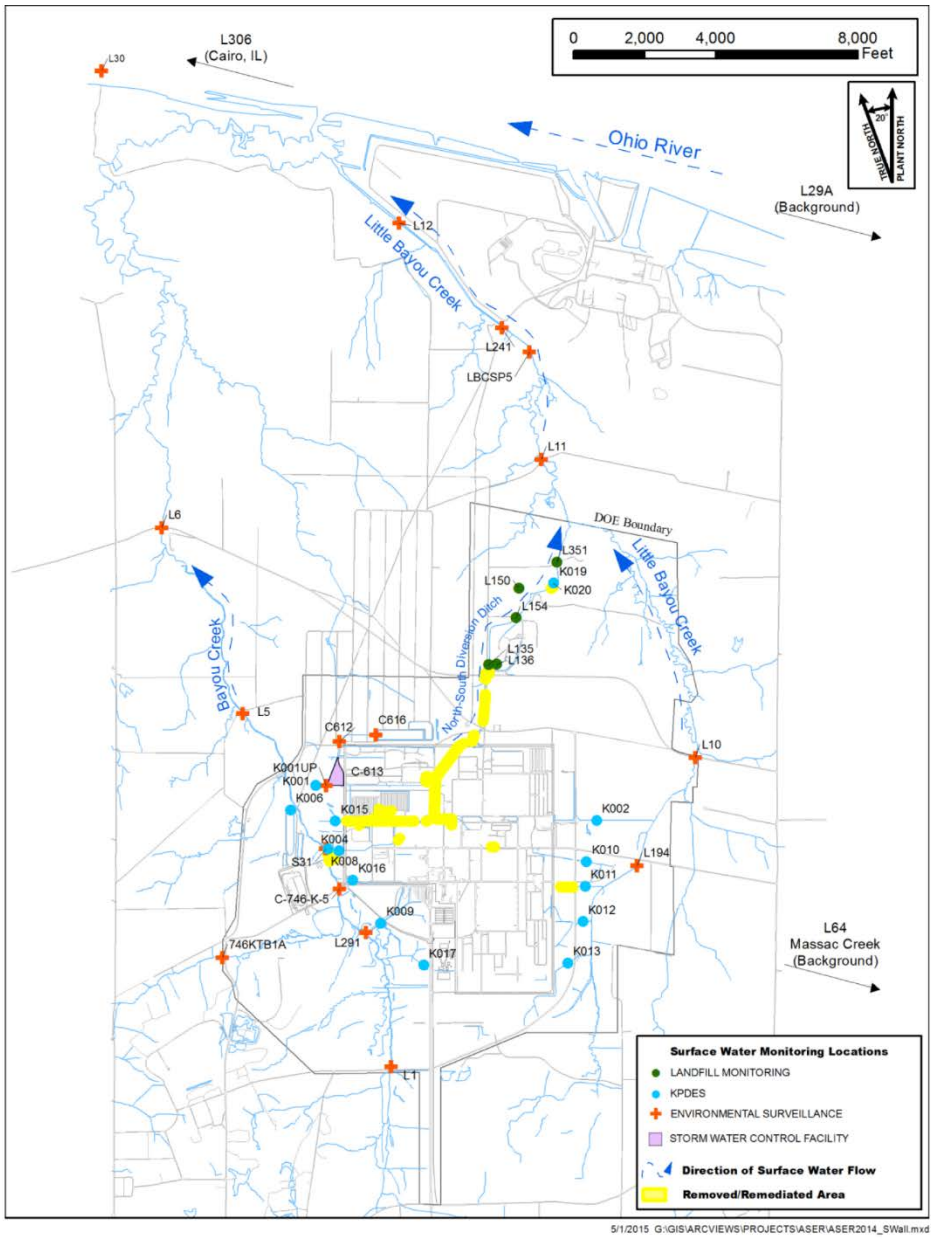

Figure 4.4 PGDP 2014 Surface Water Monitoring Locations.

4.1.6.2 Drinking Water

Surface water from the Paducah Site is not used as a drinking water source, but it is eventually discharged into the Ohio River, which is used as a public drinking water source at Cairo, Illinois, located downstream of Bayou Creek at the confluence of the Ohio and Mississippi Rivers. The concentrations of radionuclides detected near the surface water collection inlet at Cairo during CY 2014 were used to calculate the dose to the MEI resulting from consumption of surface water.

Table 4.4 Ranges of Detected Radionuclides in 2014 Surface Water Samples

Isotope	Range
Technetium-99 (pCi/L)	16.8–59.5*
Thorium-234 (pCi/L)	52.5–52.5
Uranium-234 (pCi/L)	0.414–36.8*
Uranium-235 (pCi/L)	0.775–4.92*
Uranium-238 (pCi/L)	0.662–216*

*Maximum results are from radiological monitoring locations near K020 (see Figure 4.4 for location).

Sources of radionuclides other than the PGDP may contribute to the concentrations reported at Cairo's drinking water withdrawal location. Background sampling for radionuclides was not conducted at a location upstream of the PGDP on the Ohio River during 2014 so all radionuclides in the Cairo samples were assumed to come from the PGDP. Industries and agriculture in the upstream watersheds of the Ohio, Tennessee and Cumberland Rivers potentially act as sources for radionuclides in the Ohio River at Cairo. Uranium-234 and uranium-238 were detected in the Cairo samples below the DCS limits. Other radionuclides were below detection limits.

The detection of uranium isotopes in 2014 Cairo samples is the first detection since 2010 and is believed to be anomalous. The uranium isotope detections were used in the annual dose calculation assuming that the MEI consumed 100% of their drinking water from the Cairo water supply. The Cairo water supply is treated prior to distribution for consumption. The maximum annual dose to an individual was calculated to be 0.45 mrem in 2014, which is significantly less than the 100 mrem/yr limit.

4.1.6.3 Incidental Ingestion of Surface Water

Dose to the hypothetical MEI is calculated based on incidental ingestion of surface water due to wading or swimming in Bayou and Little Bayou Creeks and their tributaries. The assumptions in the incidental ingestion of surface water dose assessment are that a recreator may swim or wade 45 days/year, 2.6 hours/day, and ingest 0.05 liters per hour. The highest monthly surface water results from the various sampling locations are utilized to calculate the upper level bounding concentration and resulting dose. *The 2014 annual incidental ingestion of surface water dose to the MEI was 0.14 mrem/year.*

4.1.6.4 Landfill Leachate

During 2014, 1,000 tons of waste from six different waste streams was disposed of in the C-746-U Landfill. The waste included building demolition debris, asbestos debris from the C-410 Feed Plant, soils, personal protective equipment, and investigation-derived wastes. Concentration limits known as authorized limits (Section 4.2) have been established for the disposal of materials with residual radioactive contamination in the C-746-U Landfill. Waste containing radioactive material may be disposed of in the Landfill if it is below the established limits. Leachate from the Landfill is sampled routinely and compared to the DCSs set forth by DOE.

4.1.6.5 Groundwater

Groundwater wells that supplied drinking water downgradient of PGDP have been replaced with public drinking water and the groundwater is not used as a drinking water source.

4.1.7 Sediment Monitoring and Estimated Dose

Sediment is an important component of the aquatic environment. Radionuclides can be transported by surface as suspended and dissolved constituents. They can adsorb on suspended organic/inorganic solids or be assimilated by plants and animals. Suspended solids, dead biota, and excreta settle to the bottom and potentially impact the bottom-dwelling community of organisms and can play a significant role in aquatic ecological ecosystem by serving as a repository for radioactive substances.

4.1.7.1 Sediment Surveillance Program

Radiological and nonradiological sediment sampling at the Paducah Site was conducted in June 2014. The sampling was conducted at locations chosen to assess areas of public access, introduction of plant effluents to the environment, unplanned releases, and verification of the effectiveness of the PGDP's effluent controls (Figure 4.5). The sediment concentration results for CY 2014 are similar to those measured during previous years (Table 4.5). Uranium isotope activity was above background activity in Bayou and Little Bayou Creeks in the immediate vicinity of the PGDP industrial site and downstream. Other radionuclides were detectable in trace concentrations.

4.1.7.2 Sediment Dose

The sediment dose to the hypothetical MEI assumes potential exposure to contaminated sediment in Bayou and Little Bayou Creeks during hunting, fishing and other recreational activities. Exposure is assumed to occur through incidental ingestion of 100 mg/day contaminated sediment at one creek location every other day during the hunting season (104 days/year). Exposure calculations for sediment include the ingestion, inhalation, and external gamma pathways. The downstream location with the maximum dose is assumed to represent the dose received from this pathway by the MEI for the sediment pathway. The highest annual sediment exposure pathway dose was calculated at Little Bayou Creek location S2 (0.052 mrem/yr) downstream of the PGDP (Table 4.5). The sediment exposure pathway is the major contributor to the dose received by the MEI (Table 4.6).

*Table 4.5 Radiological Activities for Sediment Sampling**

Parameter	S1	S2	S2 (duplicate)	S20 (background)	S27	S33	S34
Alpha activity	2.28E+01	2.20E+01	2.48E+01	1.24E+01	2.60E+01	5.12E+00	2.03E+01
Beta activity	3.30E+01	3.63E+01	2.96E+01	1.29E+01	2.78E+01	1.15E+01	1.74E+01
Cesium-137	5.52E-02[b]	6.20E-02[b]	2.52E-02[b]	3.66E-02[b]	1.95E-02[b]	6.68E-02[b]	2.34E-02[b]
Neptunium-237	3.00E-01[b]	-3.99E-02[b]	-7.59E-02[b]	2.15E-03[b]	1.30E-02[b]	2.71E-02[b]	-4.90E-02[b]
Plutonium-238	-4.63E-02[b]	1.49E-01[b]	1.03E-01[b]	-1.67E-02[b]	-2.99E-02[b]	-3.02E-02[b]	-1.72E-02[b]
Plutonium-239/240	-4.62E-02 [b]	-1.79E-02[b]	2.17E-01[b]	0.00E+00[b]	1.41E-01[b]	1.73E-01[b]	1.26E-01[b]
Potassium-40	5.66E+00	5.19E+00	5.69E+00	5.69E+00	5.13E+00	5.31E+00	6.70E+00
Technetium-99	3.07E+01[b]	3.49E-01[b]	2.32E+01[b]	-8.59E+00[b]	2.69E+01[b]	4.11E+00[b]	7.10E+00[b]
Thorium-228	9.41E-01	5.84E-01	5.38E-01	8.08E-01	7.20E-01	1.00E+00	1.26E+00
Thorium-230	6.35E-01[b]	9.30E-01	7.58E-01	3.53E-01[b]	2.87E+00	1.49E+00	1.62E+00
Thorium-232	5.46E-01	7.53E-01	5.59E-01	8.45E-01	6.55E-01	7.92E-01	8.42E-01
Thorium-234	7.34E+00	7.81E+00	7.40E+00	1.09E+00[b]	5.96E+00	2.07E+00	2.45E+00
Total Uranium	8.12E+00	8.06E+00	1.21E+01	1.28E+00	9.31E+00	2.91E+00	3.67E+00
Uranium-234	3.26E+00	1.23E+00	1.71E+00	4.16E-01	2.12E+00	1.23E+00	1.25E+00
Uranium-235	-1.93E-02[b]	8.48E-02[b]	1.13E-01[b]	3.80E-02[b]	2.16E-01[b]	6.59E-02[b]	-4.71E-02[b]
Uranium-238	4.88E+00	6.75E+00	1.03E+01	8.29E-01	6.97E+00	1.62E+00	2.46E+00

[a] Units are in pCi/g.
[b] Result reported at concentrations less than the laboratory's reporting limit.

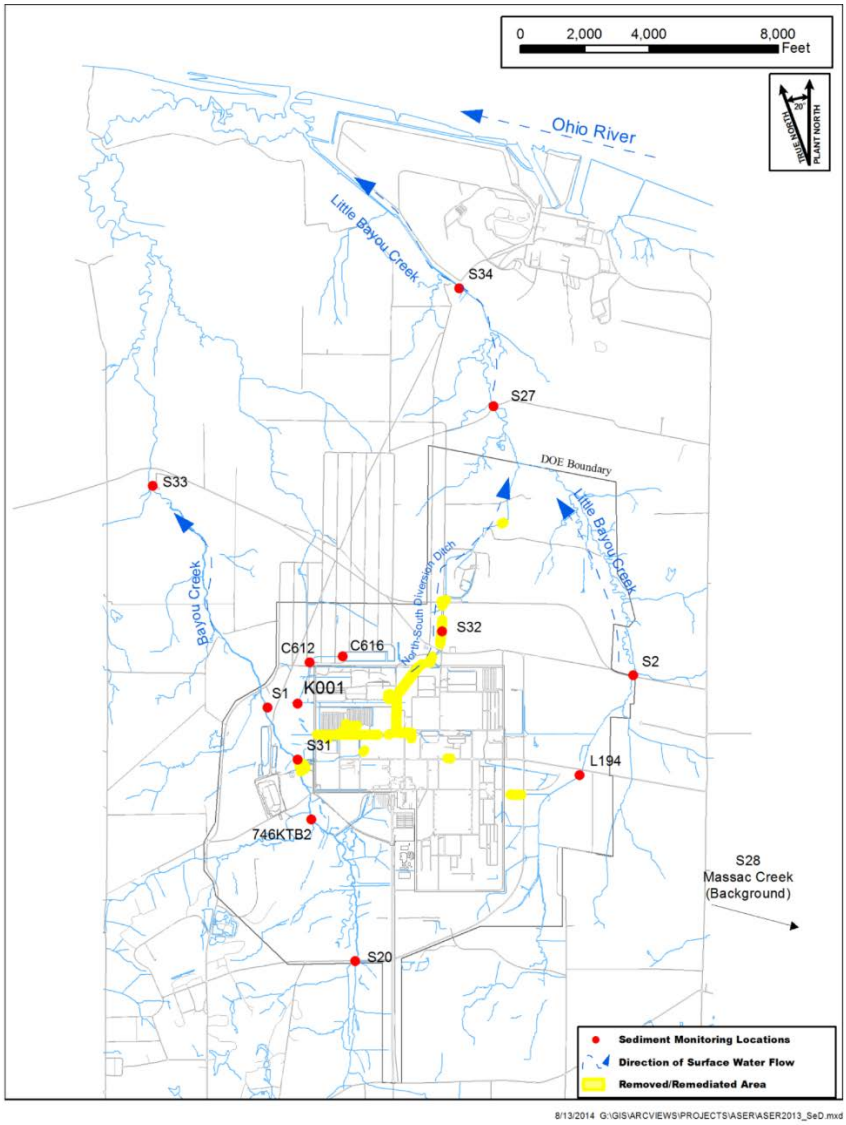

Figure 4.5 PGDP sediment monitoring locations

Table 4.6 CY 2014 Average Annual Dose Estimates for Ingestion of Sediment

	Committed Effective Dose Equivalent (mrem)—Sediment Ingestion									
Location	**Cs-137**	**Np-237**	**Pu-238**	**Pu-239/ Pu-240**	**Tc-99**	**Th-230**	**U-234**	**U-235**	**U-238**	**Total (mrem)**
S20 (background)	5.87E-03	1.05E-04	0.00E+00	0.00E+00	0.00E+00	6.17E-04	1.70E-04	1.53E-03	5.02E-03	1.33E-02
S1 [b]	2.99E-03	1.45E-02	0.00E+00	0.00E+00	3.15E-04	4.93E-04	1.17E-03	0.00E+00	2.46E-02	4.40E-02
S2 [b]	1.12E-03	0.00E+00	2.35E-04	2.03E-04	1.21E-04	8.58E-04	4.32E-04	2.45E-03	4.66E-02	5.21E-02
S27 [b]	0.00E+00	5.29E-04	0.00E+00	2.87E-04	2.76E-04	4.40E-03	6.98E-04	7.15E-03	3.72E-02	5.06E-02
S33 [b]	4.85E-03	1.22E-03	0.00E+00	3.52E-04	4.22E-05	1.99E-03	3.34E-04	1.12E-03	4.79E-03	1.47E-02
S34 [b]	0.00E+00	0.00E+00	0.00E+00	2.57E-04	7.28E-05	2.22E-03	3.42E-04	0.00E+00	9.88E-03	1.28E-02
Net Exposure from Paducah Site to maximally exposed individual [a,b,c,d] (Downstream Little Bayou) =										**5.2E-02**

[a] Maximum allowable exposure is 100 mrem/year for all contributing pathways and 25 mrem/year from one source (DOE Order 458.1).
[b] Radionuclide dose from S20 is considered background and has been subtracted from Paducah Site-related doses. If location dose is less than background dose, the dose is specified as 0.00E+00 mrem.
[c] Dose calculated as ratio of listed dose for Adult Recreator in Table A.8 in *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant* (DOE 2014b), which includes the ingestion, inhalation, and external gamma pathways.
[d] When more than one sample is present at the listed location, the doses of each sample are averaged.

4.1.8 Terrestrial Environment Monitoring and Estimated Dose

As part of PGDP environmental surveillance, wildlife and farm-raised animal meat, eggs, and milk are evaluated from contamination via uptake through animal ingestion of contaminated water, sediment, other animals, or direct contact with contaminated areas. Irrigation and deposition through waterborne radionuclides is an incomplete pathway because municipal water is supplied to nearby residents for household and agricultural use. The estimated dose for these pathways is included with the calculations for airborne releases addressed in Section 4.1.1.

4.1.9 Wildlife

Deer monitoring has been eliminated from the Paducah Site monitoring program. This exposure route and its associated dose are assessed through airborne release food chain models discussed in Section 4.1.1.

4.1.10 Direct Radiation Monitoring and Estimated Dose

4.1.10.1 Direct Radiation Surveillance

The external gamma and neutron radiation monitoring program is designed to provide data on external radiation exposure from DOE operations to members of the public. Sources of external radiation exposure at the Paducah Site include the cylinder storage yards, the operations inside the cascade building, and small items such as instrument calibration sources. Cylinder storage yards pose the largest potential dose to the public because of their proximity to the PGDP industrial area security fence. Thermoluminescent dosimeters (TLDs) were placed at direct radiation surveillance locations and were collected quarterly and analyzed throughout 2014 (Figure 4.6).

Direct radiation monitoring results indicate that 16 of 52 locations were consistently above background levels and most of the locations were in the vicinity of UF6 cylinder storage yards and the PGDP industrial area security fence. Security protocols prohibit the public from gaining prolonged access to the PGDP industrial area fence. Therefore the potential radiation doses in close proximity to the fence were not considered a significant contributor to the public dose.

4.1.10.2 Direct Radiation Dose

Due to Paducah Site security protocols in CY 2014, no members of the public were routinely allowed near the security fence. The external radiation doses measured by TLDs in areas accessible to the public were not statistically above background. Therefore the possible contribution to public dose are considered to be negligible.

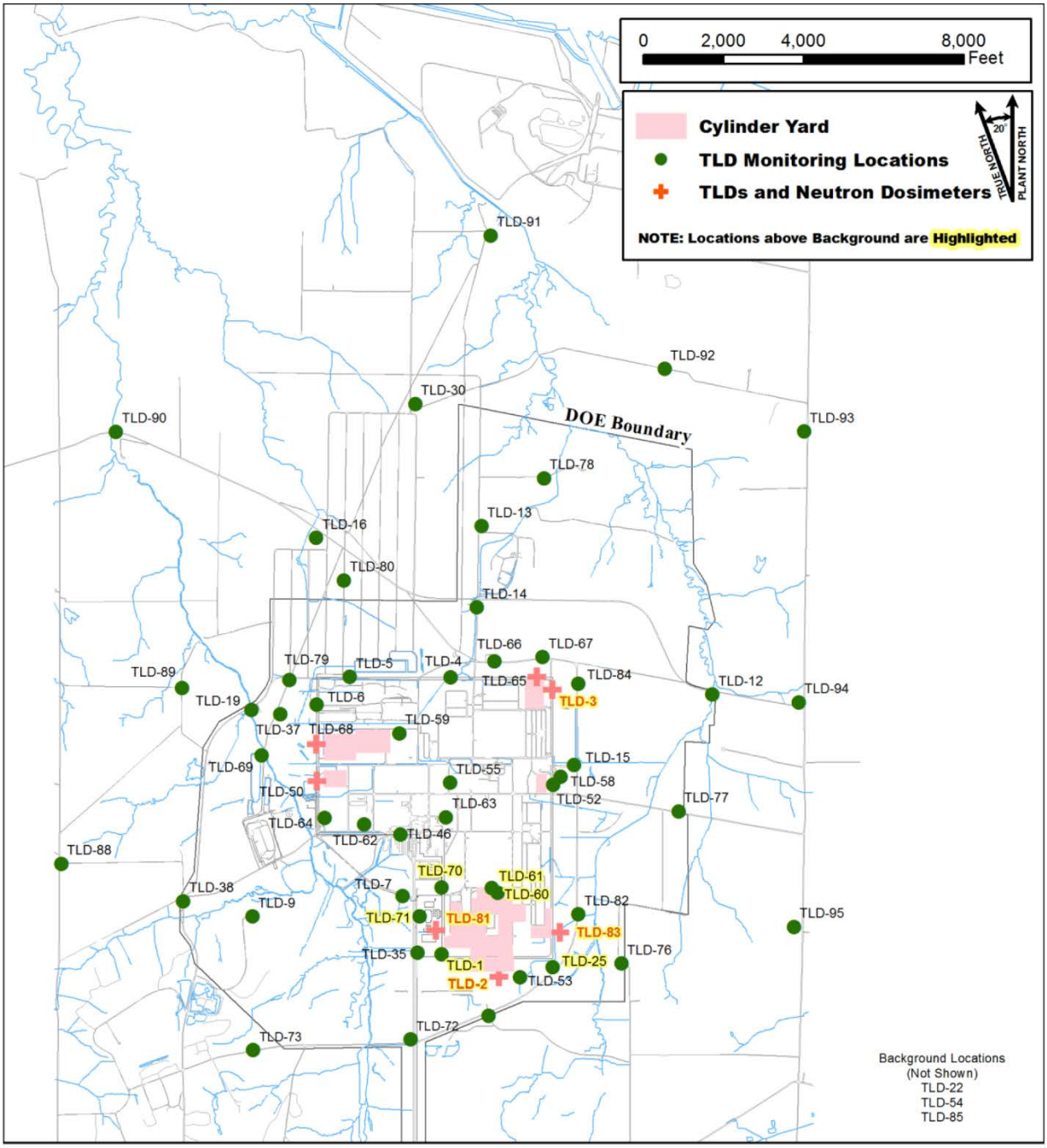

Figure 4.6 TLD direct radiation exposure sampling surveillance locations.

4.1.10.3 Cumulative Dose Survey

This section discusses cumulative doses to individuals in the surrounding population from atmospheric emissions releases, liquid releases, and direct radiation exposure. Table 4.7 provides a summary of the PGDP 2014 radiological that could be received by a member of the public represented by the hypothetical MEI as described in previous sections. The largest contributor to the cumulative dose is from ingestion of drinking water. The combined (internal and external) dose to an individual member of

the public represented by the MEI was calculated to be 0.64 mrem, which is well below the DOE annual dose limit of 100 mrem/year to members of the public. The airborne releases to the MEI were determined to be 0.0018 mrem/year which is also well below the EPA airborne dose limit of 10 mrem/year (Table 4.7).

*Table 4.7 Summary of Potential Radiological Dose to the MEI from the Paducah Site for CY 2014**

Pathway	Dose to Maximally Exposed Individual[b] (mrem/year)	Percent of Total	Percent of DOE 100 mrem/yr Limit
Incidental ingestion of surface water	0.14	22	0.14
Ingestion of drinking water (Cairo, Illinois)	0.45	70	0.45
Incidental ingestion of sediments	0.052	8	0.052
Direct radiation	0.00	0	0.00
Atmospheric releases[c]	0.0018	< 1	0.0018
Ingestion of groundwater[d]	not applicable	not applicable	not applicable
Total annual dose above background (all relevant pathways)[a]	**0.64**	**100**	**0.64**

[a] Pathways defined in previous sections.
[b] Maximum allowable exposure from all sources is 100 mrem/year (DOE Order 458.1).
[c] Doses associated with atmospheric releases also include ingestion pathways considered in the AirDose EPA food chain modeling routines.
[d] Groundwater is not a viable pathway for the MEI due to DOE providing public water to downgradient residents.

The cumulative dose to members of the public residing within 50 miles of the Paducah Site has also been determined. Population dose was calculated for each exposure pathway and is summed to determine the cumulative population dose from all relevant pathways. The annual cumulative population dose, based on representative assumptions is 1.29 person-rem. Table 4.8 provides a summary of the representative population dose calculations.

*Table 4.8 Summary of Potential Radiological Dose to the Population within 50 Miles of the Paducah Site for CY 2014 **

Pathway	Population Dose (person-rem/year)	Percent of Total
Incidental ingestion of surface water[c]	not applicable	not applicable
Ingestion of drinking water (Cairo, Ill)	1.27[f]	99
Incidental ingestion of sediments[c]	not applicable	not applicable
Direct radiation	0.00	0
Atmospheric releases[b,e]	0.016	1
Ingestion of groundwater[d]	not applicable	not applicable
Total annual dose above background (all relevant pathways)[a]	**1.29**	**100**

[a] Pathways defined in previous sections.
[b] DOE source emissions were from NWPGS, NEPCS ATU, DUF_6 conversion activities and includes USEC emissions.
[c] Incidental ingestion of surface water and sediment within plant creeks and ditches is not applicable for calculation of collective dose to residents who reside within 50 miles of the Paducah Site.
[d] Groundwater is not a viable pathway for the calculation of collective dose due to DOE providing public water to downgradient residents.
[e] Doses associated with atmospheric releases also include ingestion pathways considered in the AirDose EPA food chain modeling routines.
[f] Population dose for ingestion of drinking water from Cairo, Illinois, is based on a representative assumption using the estimated population of Cairo, Illinois, only.

4.1.11 Biota Monitoring and Estimated Dose

4.1.11.1 Biota Surveillance

Radionuclides from natural and man-made sources may be found in environmental media such as water, sediments, and soils. Contaminants may accumulate in animals from eating contaminated feed, drinking contaminated water, and breathing contaminated air. Contaminants may accumulate in fish when they eat contaminated foods or live in contaminated waters. Because plant and animal populations residing in or near these media or taking food or water from these media may be exposed to a greater extent than humans, DOE prepared a technical standard that provides methods and guidance to be used to evaluate doses from ionizing radiation to populations of aquatic animals, riparian animals (i.e., those that live along banks of streams or rivers), terrestrial plants, and terrestrial animals.

Because measured concentrations associated with radionuclides of concern at the Paducah Site in animals and fish are low, routine site-specific pathway assessments, to include biota sampling, are not performed. Biota in the watersheds have been sampled extensively in the past, to the point that further collection of aquatic organisms could result in a deleterious effect on the aquatic community.

4.1.11.2 Biota Dose

Methods in the DOE Technical Handbook were used to evaluate radiation doses to aquatic and terrestrial biota from 2014 operations. Doses were assessed for compliance with: 1) the limit in DOE Order 458.1 for native aquatic animal organisms (1 rad/day); 2) the thresholds for terrestrial plants (1 rad/day); and 3) the thresholds for terrestrial animals (0.1 rad/day. The RESRAD-BIOTA computer model is a calculation tool approved by DOE for implementing the technical standard and compares existing radionuclide concentration data from environmental sampling with biota concentration guideline (BCG) screening values to estimate upper bounding doses to biota.

Dose to biota was evaluated for Bayou and Little Bayou Creeks. Data from water and sediment sampling locations on Bayou and Little Bayou Creeks were entered into the RESRAD-BIOTA computer model to calculate dose to biota from Paducah Site operations. The value for each radionuclide was divided by its corresponding BCG to calculate a partial fraction for each nuclide in each medium. Partial fractions for each medium were added to produce a sum of fractions. Exposures from the aquatic pathway may be assumed to be less than the aquatic dose limit from DOE Order 458.1 if the sum of fractions for the water plus that for the sediment is less than 1.0.

A screening was conducted using the maximum radionuclide concentrations from surface waters and sediments. Table 4.9 summarizes the radiological dose to aquatic and terrestrial biota for Bayou Creek. Table 4.10 summarizes the radiological dose to aquatic and terrestrial biota for Little Bayou Creek. The sum of fractions for each assessment was less than 1.0, indicating that the applicable BCGs were met for both the aquatic and terrestrial evaluations.

4.2 Clearance of property containing residual radioactive material

DOE contractors use the processes, guidelines, and limits found in DOE Order 458.1 and associated guidance for the clearance of residual radioactive material. Surface Contaminated Object Limits are used for clearance of objects with the potential for surface contamination, while specific Authorized Limits

have been derived to control whether items with potential volumetric contamination are released (Table 4.11). In those cases where volumetric Authorized Limits have not been established, release is determined based on a comparison to established background radionuclide concentrations.

Table 4.9 Bayou Creek 2014 Evaluation of Dose to Aquatic and Terrestrial Biota

Aquatic Animal						
	Water			Sediment		
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Concentration (pCi/g)	BCG (pCi/g)	Ratio
Cs-137	8.04E-01	1.05E+03	7.67E-04	6.68E-02	4.93E+04	1.35E-06
K-40	3.11E+01	2.90E+03	1.07E-02	5.69E+00	5.79E+04	9.82E-05
Np-237	-1.35E-02	6.85E+01	-1.97E-04	3.00E-01	7.86E+04	3.82E-06
Pu-238	3.40E-01	1.76E+02	1.93E-03	-1.67E-02	3.95E+06	-4.23E-09
Pu-239	6.30E-03	1.87E+02	3.37E-05	1.73E-01	7.05E+06	2.46E-08
Tc-99	2.76E+02	2.47E+06	1.12E-04	3.07E+01	4.59E+05	6.69E-05
Th-228	1.03E-01	3.74E+02	2.76E-04	1.00E+00	1.64E+04	6.08E-05
Th-230	7.81E-02	2.57E+03	3.04E-05	1.49E+00	2.74E+06	5.43E-07
Th-232	1.91E-02	3.07E+02	6.23E-05	8.45E-01	3.23E+06	2.62E-07
Th-234	1.55E+01	2.66E+05	5.83E-05	7.34E+00	4.32E+04	1.70E-04
U-234	4.23E+00	2.02E+02	2.09E-02	3.26E+00	3.03E+06	1.08E-06
U-235	4.28E-01	2.18E+02	1.97E-03	6.59E-02	1.10E+05	6.01E-07
U-238	1.17E+00	2.24E+02	5.23E-03	4.88E+00	4.29E+04	1.14E-04
Summed	-	-	**4.20E-02**	-	-	**5.17E-04**
Riparian Animal						
	Water			Sediment		
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio	Concentration (pCi/g)	BCG (pCi/g)	Ratio
Cs-137	8.04E-01	4.27E+01	1.88E-02	6.68E-02	3.13E+03	2.14E-05
K-40	3.11E+01	2.49E+02	1.25E-01	5.69E+00	4.42E+03	1.29E-03
Np-237	-1.35E-02	1.16E+04	-1.17E-06	3.00E-01	7.63E+03	3.93E-05
Pu-238	3.40E-01	5.51E+02	6.18E-04	-1.67E-02	5.73E+03	-2.92E-06
Pu-239	6.30E-03	6.22E+02	1.01E-05	1.73E-01	5.87E+03	2.95E-05
Tc-99	2.76E+02	6.67E+05	4.14E-04	3.07E+01	4.14E+04	7.42E-04
Th-228	1.03E-01	2.04E+03	5.05E-05	1.00E+00	8.05E+02	1.24E-03
Th-230	7.81E-02	1.39E+04	5.63E-06	1.49E+00	1.04E+04	1.43E-04
Th-232	1.91E-02	1.69E+03	1.13E-05	8.45E-01	1.22E+03	6.91E-04
Th-234	1.55E+01	3.80E+06	4.08E-06	7.34E+00	4.32E+03	1.70E-03
U-234	4.23E+00	6.84E+02	6.19E-03	3.26E+00	5.27E+03	6.18E-04
U-235	4.28E-01	7.37E+02	5.81E-04	6.59E-02	3.79E+03	1.74E-05
U-238	1.17E+00	7.57E+02	1.55E-03	4.88E+00	2.49E+03	1.96E-03
Summed	-	-	**1.53E-01**	-	-	**8.49E-03**

Property potentially containing radioactive material will not be cleared from the Paducah Site unless the property is demonstrated not to contain residual radioactive material. The property is evaluated and appropriately monitored or surveyed to determine that any residual radioactive material levels are within acceptable limits.

In 2014, LATA authorized 57 releases of non-real property that were assessed for contamination, and Fluor authorized 15 such releases. Several of these releases were in support of reuse and recycling efforts and deactivation operations. Multiple radiological surveys were performed to measure and assess the radiological status of the property. Items released included, but were not limited to: heavy equipment, vehicles, containers, tanks, monitoring equipment, activated carbon, batteries, recovered Freon, transformers, light ballasts, unused chemicals, and mobile offices. Items with the potential for

volumetric contamination were assessed to determine if sampling was necessary to support the release. The results of volumetric samples were compared to established background concentrations.

Table 4.10 Little Bayou Creek 2014 Evaluation of Dose to Aquatic and Terrestrial Biota

Aquatic Animal						
	Water			Sediment		
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio*	Concentration (pCi/g)	BCG (pCi/g)	Ratio
Cs-137	N/A	1.05E+03	N/A	6.20E-02	4.93E+04	1.26E-06
K-40	N/A	2.90E+03	N/A	6.70E+00	5.79E+04	1.16E-04
Np-237	N/A	6.85E+01	N/A	1.30E-02	7.86E+04	1.65E-07
Pu-238	N/A	1.76E+02	N/A	1.49E-01	3.95E+06	3.78E-08
Pu-239	N/A	1.87E+02	N/A	2.17E-01	7.05E+06	3.08E-08
Tc-99	1.74E+02	2.47E+06	7.05E-05	2.69E+01	4.59E+05	5.86E-05
Th-228	2.85E-02	3.74E+02	7.63E-05	1.26E+00	1.64E+04	7.66E-05
Th-230	-2.01E-01	2.57E+03	-7.82E-05	2.87E+00	2.74E+06	1.05E-06
Th-232	-9.78E-02	3.07E+02	-3.19E-04	8.42E-01	3.23E+06	2.61E-07
Th-234	N/A	2.66E+05	N/A	7.81E+00	4.32E+04	1.81E-04
U-234	6.96E-01	2.02E+02	3.45E-03	2.12E+00	3.03E+06	7.00E-07
U-235	5.51E-01	2.18E+02	2.53E-03	2.16E-01	1.10E+05	1.97E-06
U-238	4.85E+00	2.24E+02	2.17E-02	1.03E+01	4.29E+04	2.40E-04
Summed	-	-	**2.74E-02***	-	-	**6.77E-04**
Riparian Animal						
	Water			Sediment		
Nuclide	Concentration (pCi/L)	BCG (pCi/L)	Ratio*	Concentration (pCi/g)	BCG (pCi/g)	Ratio
Cs-137	N/A	4.27E+01	N/A	6.20E-02	3.13E+03	1.98E-05
K-40	N/A	2.49E+02	N/A	6.70E+00	4.42E+03	1.51E-03
Np-237	N/A	1.16E+04	N/A	1.30E-02	7.63E+03	1.70E-06
Pu-238	N/A	5.51E+02	N/A	1.49E-01	5.73E+03	2.60E-05
Pu-239	N/A	6.22E+02	N/A	2.17E-01	5.87E+03	3.70E-05
Tc-99	1.74E+02	6.67E+05	2.61E-04	2.69E+01	4.14E+04	6.50E-04
Th-228	2.85E-02	2.04E+03	1.40E-05	1.26E+00	8.05E+02	1.57E-03
Th-230	-2.01E-01	1.39E+04	-1.45E-05	2.87E+00	1.04E+04	2.75E-04
Th-232	-9.78E-02	1.69E+03	-5.78E-05	8.42E-01	1.22E+03	6.89E-04
Th-234	N/A	3.80E+06	N/A	7.81E+00	4.32E+03	1.81E-03
U-234	6.96E-01	6.84E+02	1.02E-03	2.12E+00	5.27E+03	4.02E-04
U-235	5.51E-01	7.37E+02	7.48E-04	2.16E-01	3.79E+03	5.70E-05
U-238	4.85E+00	7.57E+02	6.41E-03	1.03E+01	2.49E+03	4.14E-03
Summed	-	-	**8.38E-03***	-	-	**1.12E-02**

*N/A in this table indicates radionuclide was not analyzed. Ratios were not included and not summed for radionuclides that were not analyzed.

Table 4.11 C-746-U Landfill Authorized Limit Disposals at C-746-U Landfill

Cumulative Activity from 2014 Disposals			Total Activity from Disposals 5/21/03 to 12/31/14			
Isotope	**Activity (Curies)**		**Isotope**	**Activity (Curies)**	**Inventory Limit (Curies)**	**Percent Utilized**
Am-241	0.000022057		Am-241	0.00758613	79	0.01%
Cs-137	0.000697594		Cs-137	0.01192674	43	0.03%
Np-237	0.000025759		Np-237	0.01216573	12	0.10%
Pu-238	0.000109231		Pu-238	0.00441895	88	0.01%
Pu-239/240	0.000058094		Pu-239/240	0.01476525	162	0.01%
Tc-99	0.002126505		Tc-99	1.10865472	117	0.95%
Th-228	0.002996821		Th-228	0.07496820	9	0.83%
Th-230	0.001372353		Th-230	0.21043677	230	0.09%
Th-232	0.002996821		Th-232	0.07554932	9	0.84%
U-234	0.016741414		U-234	0.35760057	360	0.10%
U-235	0.002343325		U-235	0.01674294	15	0.11%
U-238	0.012192267		U-238	0.37940007	360	0.11%
Waste Streams Disposed of (2014)	6		Waste Streams Disposed of (2003–2014)	243		
Mass Disposed of (2014)	1,000 tons		Mass Disposed of (2003–2014)	121,000 tons		
			Volume of Current Cells	386,169 yd^3		
			Remaining Cell Volume	68,680 yd^3		

In 2014, BWCS continued off-site shipment of HF produced by the DUF6 Conversion Facility, which converts DUF6 into uranium oxide and HF. Each shipment must meet the release limit of less than 3 pCi/mL of total uranium activity. During 2014, the total uranium activity of each shipment was below the detection limit.

In addition to off-site releases, DOE also placed 1,000 tons of waste with residual radioactive contamination into the on-site C-746-U Landfill during 2014. The C-746-U Landfill waste acceptance criteria includes established Authorized Limits that govern disposal. Authorized Limits for the C-746-U Landfill initially were established in 2003, re-evaluated in 2011. Waste streams disposed of within the C-746-U Landfill during 2014 include, but are not limited to, building demolition and asbestos removal debris from the C-410/C-420 Feed Plant Complex, soils, personal protective equipment, investigation-derived wastes, and other various items. Table 4.11 provides a summary of Authorized Limit disposals at the C-746-U Landfill during CY 2014 and the cumulative totals since Authorized Limit inception in May 2003.

4.3 Unplanned Radiological Releases

There were no unplanned radiological releases at the PGDP in 2014.

5. ENVIRONMENTAL NONRADIOLOGICAL PROGRAM

5.1 Air Monitoring

Steam plant emissions are the largest permitted non-radiological point source at this site. FPDP assumed responsibility for this and other former USEC emission points following de-lease of PDGP by USEC on October 21, 2014. The only other point source required to perform monitoring is the DUF6 Conversion Facility.

5.2 Surface Water Monitoring

At the Paducah site, CWA regulations were used through issuance of a KPDES permit for discharges to Bayou Creek and Little Bayou Creek. Surface water locations and the monitoring program at the Paducah site are listed in Table 5.1 and Figure 4.4. Surface runoff will be examined to make sure landfill waste are not releasing into nearby streams.

5.3 Sediment Monitoring

Total PCBs were detected in sediment during 2014 ranging from 1.81 µg/kg to 162 µg/kg, far less than risk criteria; the no action level for total PCBs is 284 µg/kg and the action level is 28,400 µg/kg for the teen recreation user. The teen recreational user is used for comparison because it is the most reasonably anticipated scenario.

Table 5.1. CY 2014 PGDP Surface Water Monitoring Summary.

Program and Reporting Location	Number of Locations
Effluent Watershed Monitoring Program	
C-746-S and C-746-T Landfill Surface Water *Quarterly Compliance Monitoring Reports*: http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00374 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00418 http://paducaheic.com/Search.aspx?accession=ENV 1.J.-00476 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00581	3*
C-746-U Landfill Surface Water *Quarterly Compliance Monitoring Reports*: http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00375 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00419 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00492 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00580	3*
KPDES Monthly Discharge Monitoring Reports Additional Monthly Discharge Monitoring Reports (beginning October 2014)	 5 10
C-613 Northwest Storm Water Control Facility Reported to KDWM via electronic mail	1
Environmental Surveillance Watershed Monitoring Program	
Surface Water	19
Seep	1

*One location is listed for both C-746-S and C-746-T and for C-746-U.

Table 5.1 Ranges of Detected Analytes in 2014 Surface Water Samples.

Analyte	Range
Anions	
Chloride (mg/L)	0.63–71.3
Nitrate as Nitrogen (mg/L)	2.4–3.49
Sulfate (mg/L)	3.19–52.6
Wet Chemistry Parameters	
Ammonia as Nitrogen (mg/L)	0.142–0.854
Carbonaceous Biochemical Oxygen Demand (mg/L)	1.21–15
Chemical Oxygen Demand (mg/L)	24.7–109
Dissolved Solids (mg/L)	78.6–1,330
Fecal Coliform (CFU/100mL)	1–1
Hardness—Total as $CaCO_3$ (mg/L)	29.7–573
Suspended Solids (mg/L)	0.6–176
Total Organic Carbon (mg/L)	1.23–20.7
Total Organic Halides (µg/L)	3.52–56
Total Solids (mg/L)	113–334
Semivolatile Organic Compounds	
Benz(a)anthracene (µg/L)	0.012–0.012
Benzo(k)fluoranthene (µg/L)	0.011–0.011
Volatile Organic Compounds	
Trichloroethene (µg/L)	0.32–47.5
Pesticides/PCBs	
Heptachlor (µg/L)	0.0116–0.0116
PCB-1260 (µg/L)	0.0393–0.0393
Total PCBs (µg/L)	0.0393–0.0393
Other Organics	
Oil and Grease (mg/L)	1.1–9.67
Metals	
Antimony (mg/L)	0.00112–0.00112
Arsenic (mg/L)	0.00117–0.00296
Barium (mg/L)	0.0442–0.158
Chromium (mg/L)	0.0023–0.0023
Copper (mg/L)	0.00055–0.022
Iron (mg/L)	0.0366–192
Lead (mg/L)	0.0005–0.00274
Nickel (mg/L)	0.00075–0.0108
Phosphorous (mg/L)	0.0469–1.24
Selenium (mg/L)	0.0021–0.0112
Sodium (mg/L)	1.17–7.57
Uranium (mg/L)	0.000314–42.2
Zinc (mg/L)	0.00451–0.76

5.4 Biota Monitoring

Biological monitoring (i.e., fish or benthic macroinvertebrate sampling) was not required under the specifications listed in KPDES permits. The watershed monitoring plan was also revised to reflect the changes in the renewed permit.

5.4.1 Aquatic Life

Starting in 1987, aquatic or biological monitoring of Bayou Creek and Little Bayou Creek had been conducted following guidelines set forth in the PGDP Watershed Monitoring Plan. Initially, the permit required sampling of fish and benthic macroinvertebrates in the receiving creeks as well as chronic and acute toxicity sampling at KPDES outfalls. In 2009, KDOW issued a new KPDES permit eliminating the required sampling because they found nothing in the previous samples. KDOW issued a new KPDES permit in 2009, eliminating the requirements for the fish and benthic macroinvertebrate sampling; however, the chronic and acute toxicity sampling remained a KPDES permit condition. DOE continued the benthic macroinvertebrate sampling efforts through 2010 in order to provide data for future ecological assessments.

Warning signs are posted along Bayou and Little Bayou Creeks to warn members of the public about the possible risks posed by recreational contact with these waters, stream sediments, and fish caught in the creeks.

6. Groundwater Protection Program

The Regional Gravel Aquifer (RGA) is the shallowest unit of usable groundwater underlying the PGDP and its immediate vicinity. The RGA is the aquifer tapped for local agriculture and domestic groundwater use (Figure 6.1). The primary contaminants identified in groundwater underlying the PGDP are TCE and Tc-99 which are related to historical PGDP industrial activities. TCE was used until 1993 as an industrial degreasing solvent to routinely clean miles of piping and equipment from the uranium enrichment process. Tc-99 is a radioactive nuclear fission by-product that arrived at the PGDP when used or "spent" nuclear fuel rods were recycled for re-enrichment. Although spent fuel rods have not been used in the enrichment process since the 1970's, Tc-99 remains present in PGDP industrial site groundwater and in one of three groundwater plumes related to the site. Known or potential sources of TCE and Tc-99 include former test areas, spills, leaks, buried waste, and leachate derived from contaminated scrap metal that was stored on-site.

Investigations of the on-site TCE groundwater contamination source areas at the PGDP continued in 2014. The main source areas and highest concentrations of TCE in groundwater are near the C-400 Cleaning Building where TCE was delivered by rail in tank cars, stored, transferred and used in large baths to clean process piping and equipment. Cleaning process TCE was discharged through the PGDP sanitary sewer system for transport to the site's waste water treatment facility.

TCE has a low solubility in water and a higher density than water making it a dense non-aqueous phase liquid (DNAPLs). Because of its density DNAPL typically sinks through the subsurface materials and water. Along its path of travel, some DNAPL will remain in interstitial pore spaces of subsurface material and may pool on top of less permeable layers of subsurface materials. It may also pool at the base of materials that make up an aquifer. DNAPLs in subsurface interstitial spaces and pools are a continuous source of TCE contamination within the aquifer as TCE DNAPL dissolves very slowly. In the subsurface and in aquifers, treatment of TCE DNAPL contamination is extremely difficult.

Surveillance monitoring at the PGDP is used to detect the nature and extent of contamination, the types and concentrations of groundwater contaminants and the movement of groundwater. Data obtained from PGDP groundwater monitoring supports the decision making process regarding the treatment of groundwater contamination and the management and treatment of groundwater contaminant sources. Groundwater compliance monitoring is conducted at the PGDP to ensure that the site is in compliance with environmental and health regulations. Figure 6.2 identifies the surveillance and compliance monitoring wells sampled in 2014 and shows the 2014 TCE plumes associated with the Paducah Site.

6.1 Geologic and Hydrogeological Setting

The local groundwater flow system underlying and surrounding the PGDP is managed and monitored through evaluation of areas with unique subsurface materials which impact how water (and contamination) are transmitted.

The groundwater flow system at the PGDP consists of the following components (from shallowest to deepest): the Terrace Gravel and Eocene Sand flow system, Upper Continental Recharge System (UCRS), the Regional Gravel Aquifer (RGA), and the McNairy flow system (Figure 6.1). PGDP surface spills, subsurface leaks, and leaching from contaminated wastes in the UCRS have the potential to impact groundwater quality in the RGA. Contaminants travel through silt and clay materials of the Upper Continental Recharge System and enter the gravel and sand of the RGA.

RGA groundwater at the PGDP generally flows from south to north. Subsurface groundwater flow originates south of the PGDP in the Terrace Gravel and Eocene Sands. Terrace Gravel groundwater discharges to local streams and recharges the RGA. Groundwater flow through the UCRS is predominantly downward, also recharging the RGA. From the plant site, groundwater generally flows northward in the RGA toward the Ohio River, which is the local base level for the system. Flow in the McNairy beneath the Paducah Site also is northward to discharge into the Ohio River.

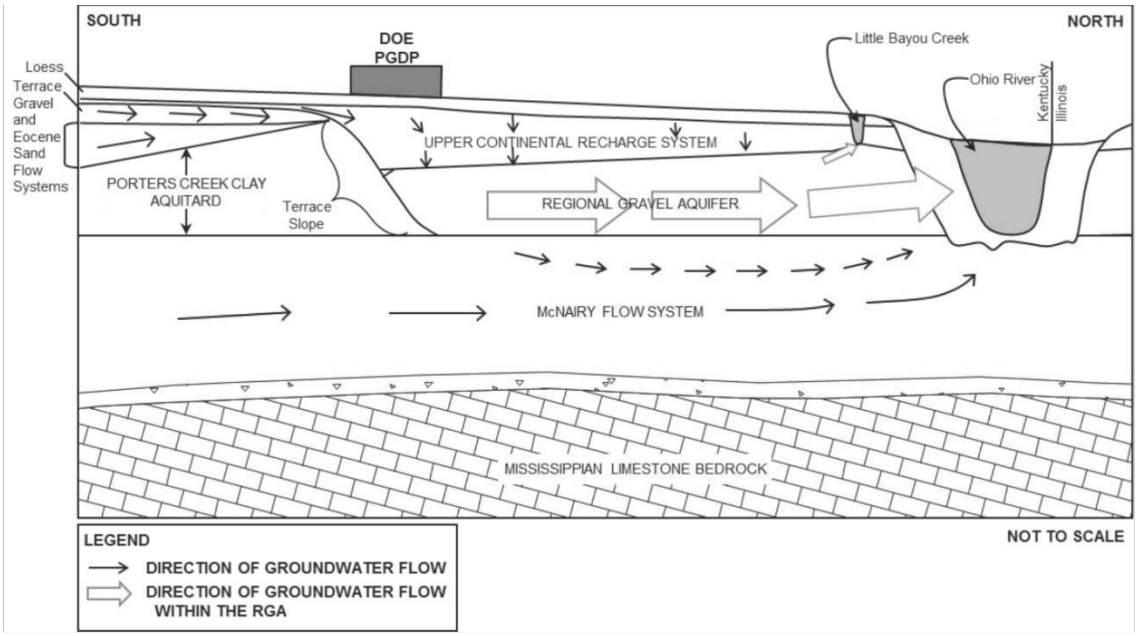

Figure 6.1 Conceptual Diagram of the PGDP subsurface, groundwater flow and the Regional Gravel Aquifer.

6.2 Uses of Groundwater in the Vicinity

Only the West Kentucky Wildlife Management Area and some lightly populated farmlands occupy tracts of land in the immediate vicinity of the PGDP. Homes are sparsely located along rural roads. Two communities, Grahamville and Heath, lie within 2 miles east of the plant.

Historically, groundwater was the primary source of drinking water for residents and businesses in the vicinity of the plant area. In areas where the groundwater either is known to be contaminated or has the potential to become contaminated in the future, DOE has provided water hookups to the West McCracken County Water District and pays water bills for affected residences and businesses. Residential wells have been capped and locked except for those that are used by DOE for monitoring (per license agreement between DOE and each resident; renewed every five years).

The Paducah Site uses surface water from the Ohio River for process waters and on-site drinking water. The nearest community downstream of Paducah using surface water for drinking water is Cairo, Illinois, which is located at the confluence of the Mississippi and Ohio Rivers.

6.3 Groundwater Monitoring Program

Monitoring wells are used extensively at the PGDP to assess the impacts of plant operations on groundwater quality (Figure 6.2). The primary objectives of groundwater monitoring at the Paducah Site

is early detection of contamination from past and present PGDP activities. The PGDP site-wide approach for groundwater surveillance, monitoring and compliance is outlined in the PGDP Groundwater

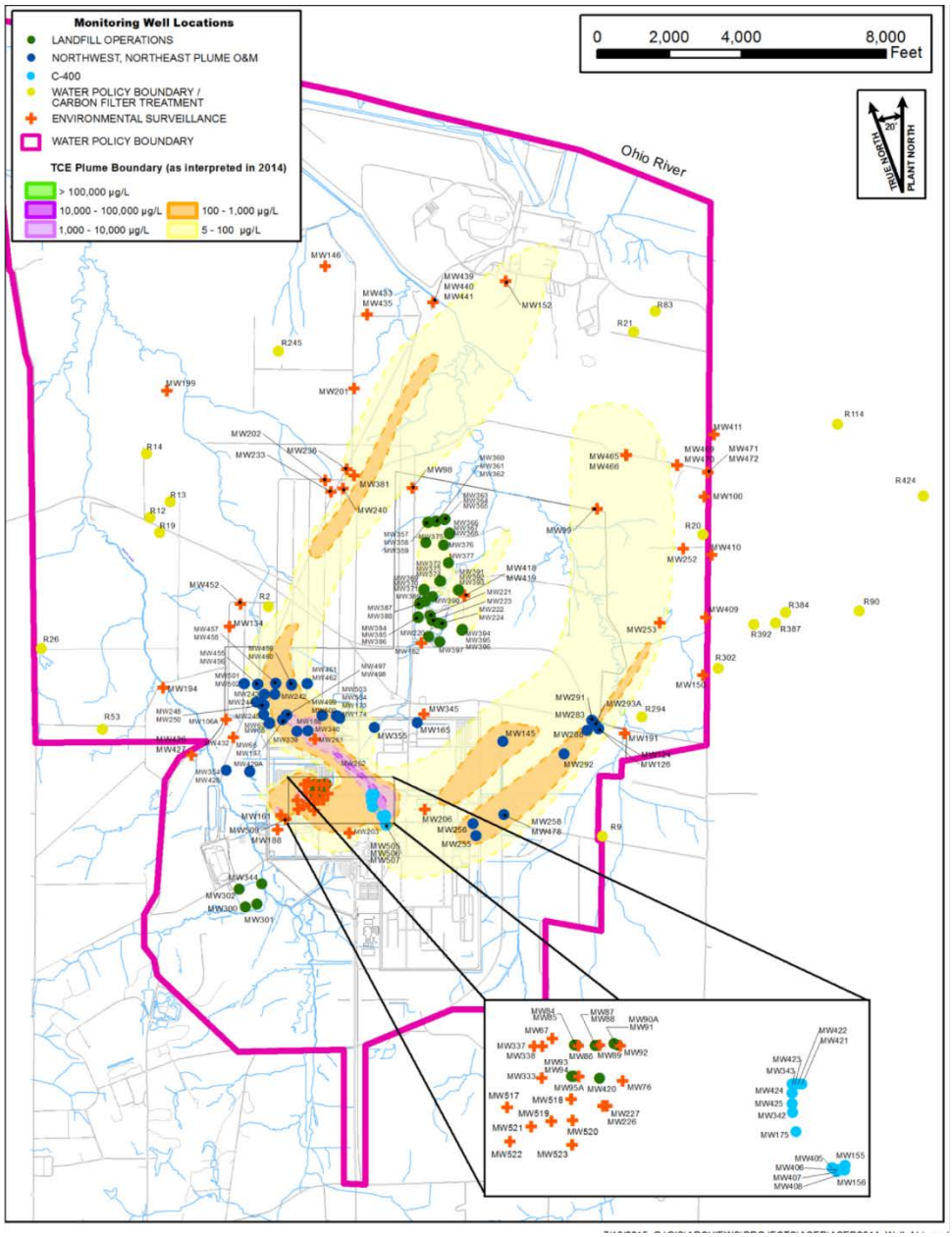

Figure 6.2 2014 PGDP Groundwater surveillance and compliances wells.

Protection Plan and the Paducah Site EMP. During 2014 over 300 monitoring wells and residential water supply wells were sampled in accordance with DOE Orders, Federal, State, and local requirements. Table 6.1 identifies the groundwater monitoring and surveillance programs, number of wells and flow system components for 2014.

Table 6.1 Groundwater monitoring conducted at the PGDP in 2014.

Program and Reporting Location	Number of Wells				
	Terrace Gravel[a]	RGA	UCRS	Rubble Zone	Total
Groundwater Monitoring Program for Landfill Operations					
C-746-S and C-746-T Landfill Wells *Quarterly Compliance Monitoring Reports*: http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00374 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00418 http://paducaheic.com/Search.aspx?accession=ENV 1.J.-00476 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00581	0	18	5[b]	0	23[c]
C-746-U Landfill Wells *Quarterly Compliance Monitoring Reports*: http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00375 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00419 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00492 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00580	0	13	8[b]	0	21
C-404 Landfill Wells (required by permit) *Semiannual C-404 Groundwater Monitoring Reports:* http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00420 http://paducaheic.com/Search.aspx?accession=ENV 1.J.1-00582	0	5	4	0	9
C-404 Landfill Wells (noncommitted)	0	11	0	0	11[d]
C-746-K Landfill Wells *Semiannual FFA Progress Reports:* http://paducaheic.com/Search.aspx?accession=ENV 1.A-00663 http://paducaheic.com/Search.aspx?accession=ENV 1.A-00791	4	0	0	0	4[e]
Northeast Plume Operations and Maintenance Program *Semiannual FFA Progress Reports:* (see above for links)					
Semiannual Wells	0	11	0	0	11
Quarterly Wells	0	5	0	0	5
Northwest Plume Operations and Maintenance Program *Semiannual FFA Progress Reports:* (see above for links)					
Semiannual Wells	0	33	0	0	33[f]
C-400 Cleaning Building Interim Remedial Action Monitoring Wells *Semiannual FFA Progress Reports:* (see above for links)					
Semiannual Wells	0	8	0	0	8
Quarterly Wells	0	9	0	0	9

Program and Reporting Location	Number of Wells				
	Terrace Gravel[a]	RGA	UCRS	Rubble Zone	Total
Water Policy Boundary Monitoring Program *ASER*					
Northwestern Wells	0	22	0	0	22
Northeastern Wells	0	11	0	0	11[f]
Carbon Filter Treatment System *ASER*	0	1	0	0	1
Environmental Surveillance Groundwater Monitoring Program[g] *ASER*					
Annual Wells	0	23	1	1	25[d,f]

[a] Includes Eocene Sands.
[b] Not all wells had a sufficient amount of water to obtain samples.
[c] The total number of wells where sampling is required by the permit associated with the C-746-S&T Landfills is 25; however, 2 of these wells are required by the permit only for water level measurement. The total number of analytically measured wells, therefore, is 23.
[d] The total number of wells associated with the C-404 Landfill noncommitted wells is 11; however, these wells also are included in the Environmental Surveillance Groundwater Monitoring Program.
[e] One well, MW301, was abandoned in August 2014 and not replaced because a review of the data suggested that MW300 data is statistically similar to data obtained from MW301.
[f] Not all wells were sampled due to well being inoperable or inaccessible.
[g] Biennial wells and Geochemical Environmental Surveillance were not sampled in CY 2014.

6.4 Groundwater Monitoring Results

The Environmental Surveillance Groundwater Monitoring Program was reviewed during 2014. 2014 groundwater monitoring at the PGDP was conducted at current and inactive landfills (compliance monitoring), groundwater plume pump-and-treat operations (performance monitoring), C-400 Cleaning Building Interim Remedial Action (performance monitoring) and area residential wells (surveillance

monitoring). Results are compiled in the Paducah Oak Ridge Environmental Information System (OREIS) database. A summary of detected analytes in 2014 are shown in Table 6.2.

6.4.1 PGDP Groundwater Contaminant Plumes

PGDP groundwater plume maps are revised every two years to incorporate routine groundwater monitoring and characterization data, demonstrate the progress of groundwater cleanup, and facilitate planning for ongoing groundwater cleanup. Plume maps depict the general footprint of the TCE and Tc-99 contamination in the RGA and convey the general magnitude and distribution of contamination within the plumes.

Table 6.2 Analytes Detected in PGDP Groundwater in CY 2014

Analyte	Range
Anions	
Bromide (mg/L)	0.101–1.33
Chloride (mg/L)	1.3–170
Fluoride (mg/L)	0.0486–0.721
Nitrate as Nitrogen (mg/L)	0.034–4.1
Sulfate (mg/L)	5.1–1,720
Wet Chemistry Parameters	
Alkalinity (mg/L)	76.6–332
Chemical Oxygen Demand (mg/L)	6.69–190
Dissolved Solids (mg/L)	119–671
Iodide (mg/L)	0.16–0.789
Sulfide (mg/L)	0.0557–0.0557
Total Organic Carbon (mg/L)	0.412–10.6
Total Organic Halides (µg/L)	3.38–240
Volatile Organic Compounds	
1,1,1-Trichloroethane (µg/L)	0.48–0.57
1,1,2-Trichloroethane (µg/L)	0.4–1.64
1,1-Dichloroethane (µg/L)	0.36–56.8
1,1-Dichloroethene (µg/L)	0.35–82.4
1,2-Dichloroethane (µg/L)	0.35–0.87
1,2-Dimethylbenzene (µg/L)	3.9–3.9
2-Butanone (µg/L)	2.87–2.87
Benzene (µg/L)	0.35–1.3
Carbon tetrachloride (µg/L)	0.33–7.84
Chloroform (µg/L)	0.32–19.6
cis-1,2-Dichloroethene (µg/L)	0.31–38,500*
Ethylbenzene (µg/L)	2.2–2.2
m,p-Xylene (µg/L)	3.9–3.9
Tetrachloroethene (µg/L)	0.32–1.18
Toluene (µg/L)	0.35–37.3
trans-1,2-Dichloroethene (µg/L)	0.31–8.79*
Trichloroethene (µg/L)	0.33–81,800*
Vinyl chloride (µg/L)	0.98–244
Xylene (µg/L)	7.8–7.8
PCBs	
PCB-1242 (µg/L)	0.0385–0.251
PCB-1248 (µg/L)	0.0531–0.0867
Total PCBs (µg/L)	0.0385–0.251

* Maximum results are from C-400 Cleaning Building Interim Remedial Action MWs.

Analyte	Range
Metals	
Aluminum (mg/L)	0.015–15.4
Arsenic (mg/L)	0.00102–0.0143
Barium (mg/L)	0.0102–0.451
Beryllium (mg/L)	0.00021–0.00524
Boron (mg/L)	0.00437–2.18
Cadmium (mg/L)	0.00013–0.00013
Calcium (mg/L)	6.39–487
Chromium (mg/L)	0.00201–0.543
Cobalt (mg/L)	0.0001–0.0231
Copper (mg/L)	0.00035–0.0135
Iron (mg/L)	0.0331–276
Lead (mg/L)	0.00054–0.00621
Magnesium (mg/L)	3.35–99.2
Manganese (mg/L)	0.00105–19.5
Mercury (mg/L)	0.000069–0.000069
Molybdenum (mg/L)	0.00017–0.0073
Nickel (mg/L)	0.00053–0.683
Potassium (mg/L)	0.117–38
Selenium (mg/L)	0.0015–0.0232
Silver (mg/L)	0.00027–0.00047
Sodium (mg/L)	12.9–191
Thallium (mg/L)	0.00049–0.00049
Uranium (mg/L)	0.000077–0.00737
Vanadium (mg/L)	0.00109–0.0149
Zinc (mg/L)	0.00361–0.0371
Arsenic, Dissolved (mg/L)	0.00181–0.0125
Barium, Dissolved (mg/L)	0.00786–0.428
Cadmium, Dissolved (mg/L)	0.00015–0.00015
Chromium, Dissolved (mg/L)	0.00201–0.0186
Lead, Dissolved (mg/L)	0.00083–0.00083
Selenium, Dissolved (mg/L)	0.00232–0.00586
Uranium, Dissolved (mg/L)	0.000067–0.0071
Radionuclides	
Alpha activity (pCi/L)	6.34–10.6
Beta activity (pCi/L)	5.05–965
Radium-226 (pCi/L)	0.245–1.13
Radium-228 (pCi/L)	4.11–4.77
Technetium-99 (pCi/L)	15.8–10,400*
Thorium-230 (pCi/L)	2.81–5.33
Thorium-232 (pCi/L)	1.97–1.97
Uranium-234 (pCi/L)	0.273–2.39
Uranium-238 (pCi/L)	0.0453–1.08

Records of decision are in place at the PGDP to clean up the Northwest Plume, the Northeast Plume, the C-400 Cleaning Building source area, and sources to the Southwest Plume (Figure 6.3). Table 6.3 lists the cumulative TCE removed through all of these remedial projects. Graphs in Figures 6.4 and 6.5 illustrate the cumulative TCE removed by the NWPGS and the NEPCS. Figure 6.6 shows site preparation to begin implementing the remedy for sources to the Southwest Plume.

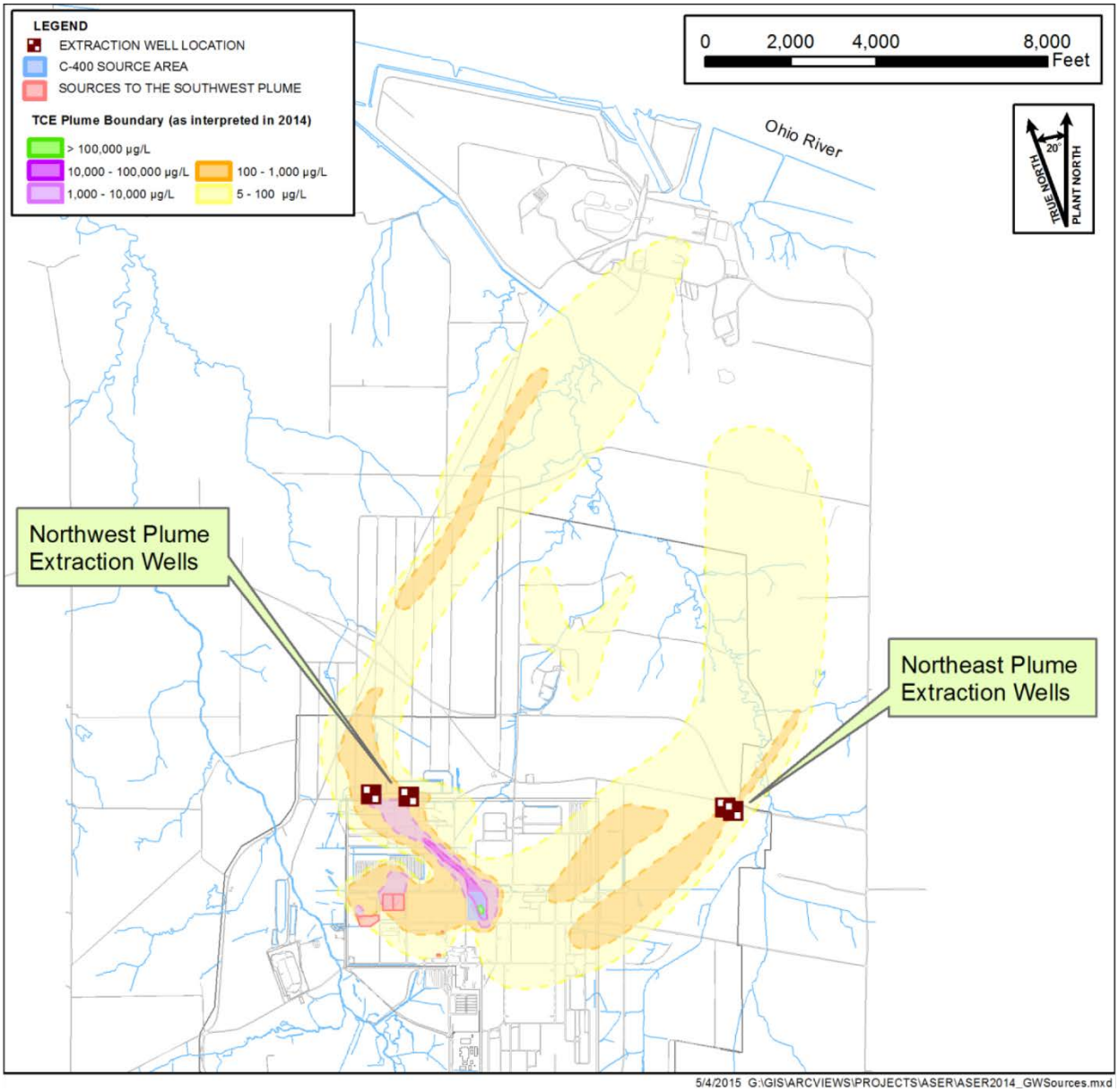

Figure 6.3 PGDP extraction well locations in the Northwest and Northeast Plumes.

Table 6.3 Cumulative TCE removed from the PGDP subsurface and groundwater by Remedial Actions

Source Area	Cumulative TCE Removed (gal)
NWPGS	3,339[a]
NEPCS	292[a]
C-400 Cleaning Building Interim Remedial Action (including treatability study)	3,558[b]
Southwest Plume[c]	0
Other sources (i.e., SWMU 91, LASAGNA™)	246[b]

[a] Cumulative through December 31, 2014. Value taken from DOE 2015b.
[b] Cumulative through September 30, 2014. Value taken from DOE 2014c.
[c] No remedial action implemented to date.

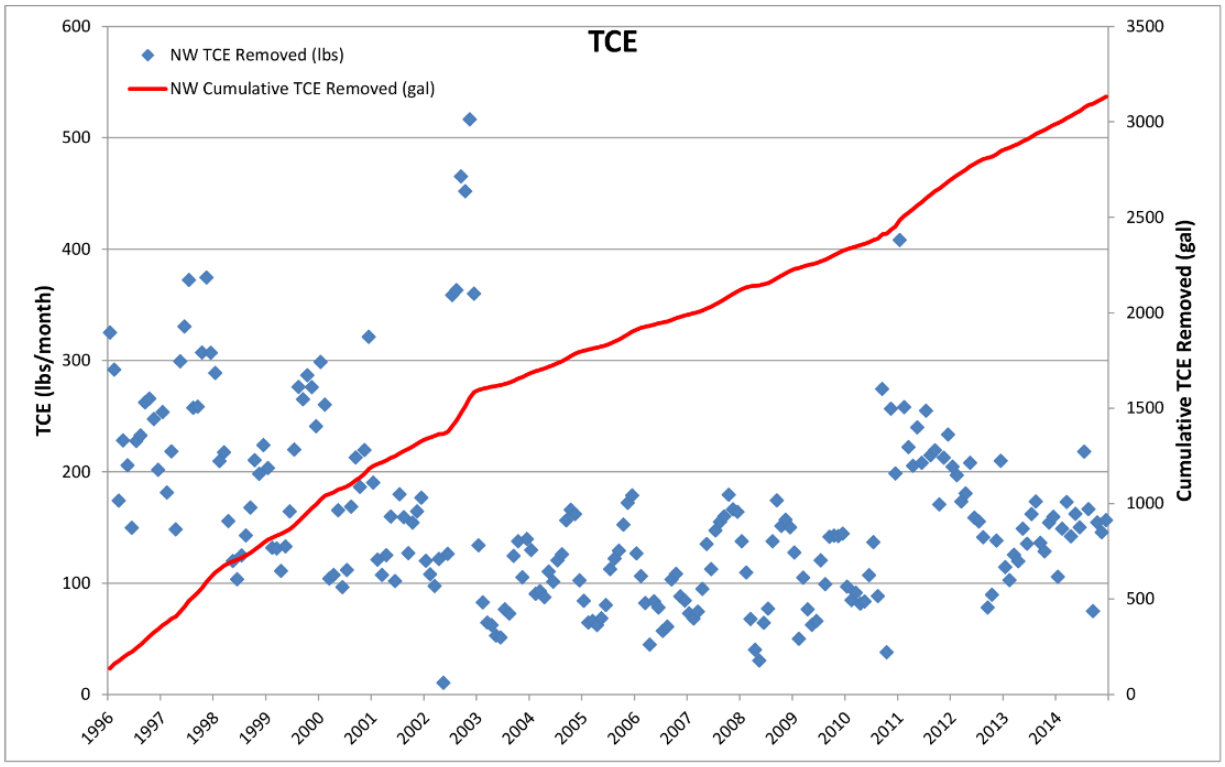

Figure 6.4 Cumulative TCE removal for the Northwest Plume Groundwater Treatment System.

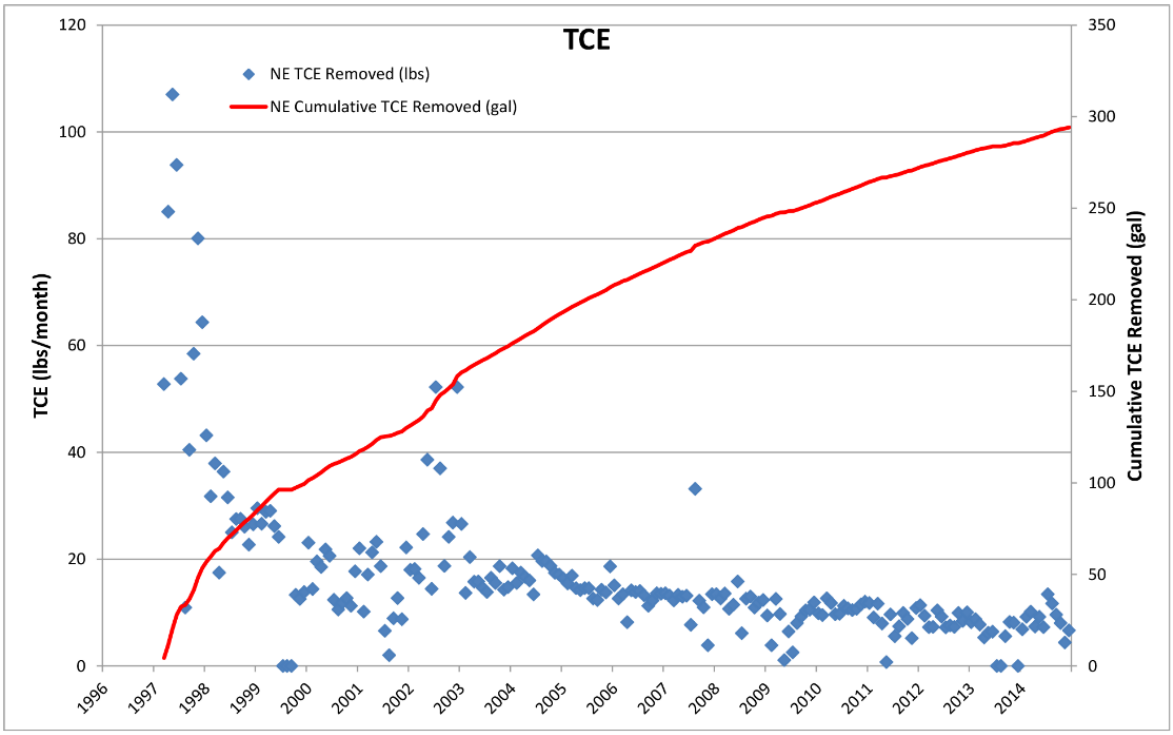

Figure 6.5 Cumulative TCE removal for the Northeast Plume Groundwater Treatment System

Figure 6.6 Remedy implementation at SWMU 1, a former oil landfarm and source of TCE groundwater contamination to the Southwest Plume.

The groundwater maximum contaminant level (MCL) for TCE is 5 ug/L and exceedances of that MCL at the PGDP C-746 landfill complex are listed in Table 6.4. A Groundwater Assessment Report documented that there was no evidence of release from the C-746-U Landfill. The report found that the beta activity (associated with Tc-99) and TCE in the wells were sourced from upgradient of the C-746-U Landfill and associated with migration of historical plumes. Statistical analyses also are used to evaluate compliance MWs at the landfills. Each report (see Table 6.1) lists any statistical exceedance that is found.

Table 6.4 CY 2014 Exceedances of Groundwater MCL's at the C-746 Landfills.

C-746-S and C-746-T Landfills		
UCRS	**Upper RGA**	**Lower RGA**
MW390: beta activity	MW372: beta activity, trichloroethene MW384: beta activity MW387: beta activity MW391: trichloroethene MW394: trichloroethene	MW373: beta activity, trichloroethene MW385: beta activity MW388: beta activity MW392: trichloroethene
C-746-U Landfill		
UCRS	**Upper RGA**	**Lower RGA**
None	MW357: trichloroethene MW372: beta activity, trichloroethene	MW358: trichloroethene MW361: trichloroethene MW373: trichloroethene

Shading indicates a background MW.

7. Quality Assurance

The Paducah Site provides a Quality Assurance/Quality Control (QA/QC) Program to ensure the accuracy and reproducibility of information generated within the Environmental Monitoring Program. Each part of the program must agree with the requirements and codes. The Quality Control Program specifies standards to control equipment, data, etc. Guidelines and requirements for the QA/QC program can be found in the following:

- DOE Order 414.1D, *Quality Assurance*;
- *Quality Assurance Program and Implementation Plan for the Paducah Environmental Remediation Project,*, PAD-PLA-QM-001;
- Commonwealth of Kentucky and federal regulations and guidance from EPA;
- American National Standards Institute;
- American Society of Mechanical Engineers;
- American Society for Testing and Materials (ASTM); and
- American Society for Quality Control.

The QA/QC Program sets up controls for equipment, design, documents, data, non-conformances, and records. Emphasis is placed on planning, implementing, and assessing activities and implementing effective corrective actions, as necessary. Requirements are included in project-specific QA plans and other planning documents. The Paducah Site uses DOE Consolidated Audit Program (DOECAP)-audited laboratories. DOECAP implements annual performance qualification audits of environmental analytical laboratories and commercial waste treatment, storage, and disposal facilities to support complex-wide DOE mission activities. Field forms, inter-personnel communications, sample chain-of-custody, data assessment, and logbooks are all maintained according to their respective QA procedures.

7.1 Field Sampling Quality Control

7.1.1 Data Quality Objectives and Sample Planning

Data quality objectives (DQOs) are important for identifying the number of samples, the sampling location, methods, schedules, and coordination of samples. DQOs are documented in the Paducah site EMP. Each sample is also given a specific identification number. A statement of work (SOW) for the analytical laboratory was generated from the Paducah Integrated Data System as DQOs for a project progressed from planning to implementation. The PGDP Project Environmental Measurements System (PEMS) database was used to store sample information data including identification number, location, methods, container, and preservation method. The database is then used to produce labels and chain-of-custody forms for each sample.

7.1.2 Field Measurements

Field measurements for the groundwater and surface water monitoring program are collected in the field and include:

- water level measurements
- pH
- conductivity

- flow rate
- turbidity
- temperature
- dissolved oxygen
- total residual chlorine
- ORP (oxidation/reduction potential)
- barometric pressure

Environmental conditions, such as ambient temperature and weather, also are recorded. Field measurements are collected, downloaded electronically, recorded on appropriate field forms or recorded in logbooks, and input into PEMS.

7.1.3 Sampling Procedures

Samples are collected using media-specific procedures according to EPA sampling methods. Sample media consist of surface water, groundwater, and sediment. Sample information recorded during a sampling event consists of the sample identification number, station (or location), date collected, time collected, and person who performed the sampling. This information is documented in a logbook or data form, on a chain-of-custody form, and on the sample container label, then is input directly into PEMS. Chain-of-custody forms are maintained from the point of sampling, and the samples are protected until they are placed in the custody of an analytical laboratory.

7.1.4 Field Quality Control Samples

The QC program for both groundwater and environmental monitoring has a target rate of 5%, or 1 per 20 environmental samples. Table 7.1 shows the types of field QC samples collected and analyzed. Analytical results of field QC samples are evaluated to determine if the sampling activities biased the sample results.

Table 7.1 Field and Laboratory Quality Control Samples.

Field QC Samples	Laboratory QC Samples
Field blanks[a]	Laboratory duplicates
Field duplicates	Reagent blanks
Trip blanks[a]	Matrix spikes[b]
Equipment rinseates[c]	Matrix spike duplicates
	Performance evaluations
	Laboratory control samples

[a] Blanks = Samples of deionized water used to assess potential contamination from a source other than the media being sampled.
[b] Spikes = Samples that have been mixed with a known quantity of a chemical to measure overall method effectiveness during the analysis process, as well as possible sample/matrix interferences.
[c] Rinseates = Samples of deionized water that have been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling. It is used to assess adequate decontamination of sampling equipment.

7.2 Analytical Laboratory Quality Control

7.2.1 Analytical Procedures

When available or appropriate, EPA's SW-846 methods are used for sample analysis, else other nationally recognized methods such as those from DOE or ASTM are used. Analytical methods are identified in a statement of work for laboratory services.

7.2.2 Laboratory Quality Control Samples

Laboratory Quality Control Samples are prepared and analyzed by the analytical methods used. If the samples do not meet QC standards, appropriate action according to the analytical method is taken. Typical laboratory QC samples are identified in Table 7.1.

7.2.3 Independent Quality Control

The Paducah Site is required to participate in independent QC programs, and voluntarily participates in independent programs to improve QC. These programs generate data and provide other labs a review of their performance. Data that does not meet the criteria are investigated and documented. EPA and KDOW require a laboratory QA study. Each laboratory performing analyses to demonstrate KPDES permit compliance is required to participate. Final results for the Discharge Monitoring Report QA Study were "acceptable".

7.2.4 Laboratory Audits/Sample and Data Management Organization

Laboratory audits are performed to ensure labs comply with regulations, methods, and procedures. Audited laboratories are included on the DOE-audited listing for use by the PGDP sample and data management organizations. When labs are audited, the audit findings are documented and addressed by the audited laboratory through corrective actions.

7.3 Data Management

7.3.1 Project Environmental Measurements System

Data generated from sampling events is stored in the Project Environmental Management System (PEMS) which is used to manage field-generated data, import laboratory-generated data, and input data qualifiers identified during the data review process. PEMS data is transferred to the Paducah OREIS database for reporting.

7.3.2 Paducah Oak Ridge Environmental Information System

The Paducah Oak Ridge Environmental Information System (OREIS) is the database used to consolidate data generated by the Environmental Monitoring Program including Paducah Site environmental data. This consolidation consists of the activities necessary to prepare the data for users. The data manager is responsible for notifying the project team and other data users of the available data, and this data is then used in reports to external agencies.

7.3.3 Paducah Environmental Geographic Analytical Spatial Information System

Another system that deals with sample data is the PPPO Environmental Geographic Analytical Spatial Information System (PEGASIS). This system allows access to environmental sampling data and geographic information system features through the Internet. Environmental data loaded to Paducah OREIS has been assessed, verified, and validated – if applicable. Environmental data from Paducah OREIS is loaded into PEGASIS on a monthly basis, http://pegasis.ffspaducah.com/.

7.3.4 Electronic Data Deliverables

In addition to data management, the EDD (Electronic Data Deliverables) is what is requested for all samples analyzed by each laboratory. Discrepancies in data are reported immediately to the laboratory so corrections can be made or new EDDs can be issued. Approximately 10% of the EDDs are checked randomly to verify that the laboratory continues to provide adequate EDDs.

7.3.5 Data Packages

A “forms only” Level III data package is requested from the laboratory when data validation is to be performed on a specific sampling event or media. The contents of the data package and the chain-of-custody forms are compared and discrepancies identified. Discrepancies are reported so corrections can be made. Data packages are requested from labs when data validation is to be performed on certain samples.

7.3.6 Laboratory Contractual Screening

Laboratory contractual screening evaluates a set of data against the requirements specified to ensure all data is received. The contractual screening includes, but is not limited to, the chain-of-custody form, requested analytes, method used, units, holding times, and reporting limits achieved.

7.3.7 Data Verification, Validation, and Assessment

Data verification helps compare the data set against a standard requirement. It includes contractual screening and other criteria specific to the data. Data validation is the process performed by a qualified individual for a data set, independent from sampling, laboratory, project management, or other decision making personnel. Data validation evaluates laboratory adherence to analytical method requirements. The data assessment process is then assured that the type, quality, and quantity of data are appropriate for its use. Data assessment follows data verification and data validation (if applicable) and must be performed at a rate of 100% to ensure data are useable. Rejected data are noted in the Paducah OREIS.

8. APPENDIX A MCHS 2016-17 ASER PROJECT ACTIVITIES

Figure 8.1 MCHS students study wildlife in the field at the WKWMA

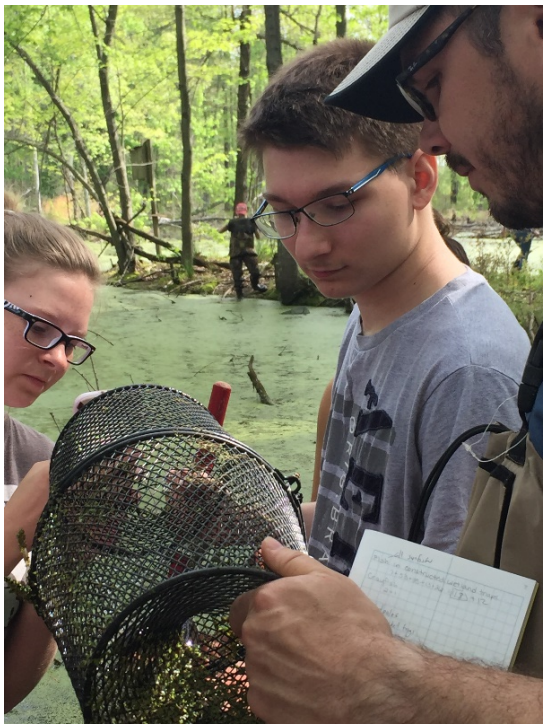

Figure 8.2 MCHS student learn how wildlife is trapped for study in the WKWMA

Figure 8.3 MCHS student examines an amphibian at the WKWMA

Figure 8.4 Students learning in the field at the WKWMA

Figure 8.5 MCHS students getting an introduction to PGDP site before a tour.

Figure 8.6 Jennifer Woodard, the DOE Paducah site lead, gives a group of MCHS students a presentation on history and security procedures

Figure 8.7 Dr. Steven Price of UK Agriculture presents on the wildlife of the WKWMA

Figure 8.8 MCHS students handle animals native to the WKWMA