PRS-ENM-0035/R2

Environmental Monitoring Plan
Fiscal Year 2010
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

This document is approved for public release per review by:

H. T. Anderson — 6-2-10

Paducah Classification and Control Office — Date
Swift and Staley Team

APPROVALS

Environmental Monitoring Plan
Fiscal Year 2010
Paducah Gaseous Diffusion Plant
Paducah, Kentucky

PRS/ENM/0035/R2

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PRS-ENM-0035/R2

Environmental Monitoring Plan
Fiscal Year 2010
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

Date Issued—May 2010

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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CONTENTS

FIGURES

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TABLES

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ACRONYMS

amsl	above mean sea level
ACO	Administrative Consent Order
AIP	Agreement in Principle
ASER	Annual Site Environmental Report
CAP-88	Clean Air Act Assessment Package-88
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
DQO	data quality objective
EDE	effective dose equivalent
EM	Environmental Monitoring
EMP	EM Plan
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
FFA	Federal Facility Agreement
ft	feet
GWPP	Groundwater Protection Program
HU	hydrogeologic units
ISMS	Integrated Safety Management System
KAR	Kentucky Administrative Regulations
KDOW	Kentucky Division of Water
KDWM	Kentucky Division of Waste Management
KOW	Kentucky Ordnance Works
KPDES	Kentucky Pollutant Discharge Elimination System
km	kilometers
m	meter
mrem	millirem
MW	monitoring wells
NESHAP	National Emission Standards for Hazardous Air Pollutants
^{237}Np	neptunium-237
NPDES	National Pollutant Discharge Elimination System
OECD	Office of Environmental Compliance and Documentation
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
pH	hydrogen-ion concentration
ppb	parts per billion
^{239}Pu	plutonium-239
RADCON	Radiological Control Organization
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
RI	remedial investigation
SWMU	solid waste management unit
SPCC	spill prevention control and countermeasure
SARA	Superfund Amendments Reauthorization Act
^{99}Tc	technetium-99
TCE	trichloroethene

TLD	thermoluminescent dosimeter
UF_6	uranium hexafluoride
UCRS	Upper Continental Recharge System
USEC	United States Enrichment Corporation
Water Policy	The Action Memorandum for the Water Policy at PGDP
WKWMA	West Kentucky Wildlife Management Area
WMP	Watershed Monitoring Program

EXECUTIVE SUMMARY

The Environmental Monitoring (EM) Program is intended to govern routine compliance and surveillance monitoring at the Paducah site. The Environmental Monitoring Program ensures that compliance is maintained with U.S. Department of Energy (DOE) Order 231.1-1A, *Environmental, Safety and Health Reporting*; DOE Order 450.1, *Environmental Protection Program*; and DOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

The Paducah Environmental Monitoring Program also supplements the Paducah Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigations. Currently, there are five defined CERCLA operable units (i.e., surface water, groundwater, surface soils, burial grounds, and decontamination and decommissioning) that have been or will be investigated under the Paducah Federal Facility Agreement (FFA). Upon completion of response action activities for these five operable units, a Comprehensive Site Operable Unit will be implemented in accordance with the Paducah FFA. The routine EM Plan (EMP) is integrated with each operable unit investigation to provide collection of optimal data sets. For example, where appropriate, existing routine EM data is reviewed and utilized prior to an operable unit investigation. Furthermore, if additional routine data are determined to be needed as a result of an operable unit investigation, it will be addressed in future EMPs.

In the past, the EMP described the program for the upcoming calendar year. This EMP is based on the fiscal year and will become effective at the beginning of the fiscal year 2010, which begins on October 1, 2009.

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1. INTRODUCTION

1.1 PURPOSE

The Environmental Monitoring (EM) Plan (EMP) for the Paducah site is a document providing a single point of reference for effluent monitoring and environmental surveillance programs required by the following:

- U.S. Department of Energy (DOE) Order 231.1-1A, *Environmental, Safety and Health Reporting,* dated August 19, 2003;
- DOE Order 450.1 Administrative Change 1, *Environmental Protection Program,* dated January 15, 2003; and
- DOE Order 5400.5, Change 2, *Radiation Protection of the Public and the Environment,* dated January 7, 1993.

The purpose of this EMP is to define and document the requirements for EMPs at the Paducah site so that it conforms with the Orders cited and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (hereafter referred to as the *Regulatory Guide*), which also provides the framework for EMP requirements.

DOE Order 231.1-1A requires reporting of the EM results in an Annual Site Environmental Report (ASER) in accordance with the supplemental detailed requirements in DOE Manual 231.1-1A, dated March 19, 2004. The ASER is to summarize the yearly data in order to:

(1) Characterize site environmental management performance. Include data on effluent releases, environmental monitoring, and estimated radiological doses to the public from releases of radioactive material at DOE sites.
(2) Summarize environmental occurrences and responses reported during the calendar year.
(3) Confirm compliance with environmental standards and requirements.
(4) Highlight significant programs and efforts. Include environmental performance indicators and/or performance measures programs.

DOE Order 450.1 requires that Environmental Management Systems (EMSs) be implemented at all sites, and the objective is stated as follows:

> To implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations and by which DOE cost effectively meets or exceeds compliance with applicable environmental; public health; and resource protection laws, regulations, and DOE requirements. This objective must be accomplished by implementing EMSs at DOE sites. An EMS is a continuing cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental goals. These EMSs must be part of Integrated Safety Management Systems (ISMSs) established pursuant to DOE P 450.4, *Safety Management System Policy,* dated 10-15-96.

DOE Order 5400.5 requires that a program be in place that will limit the effective dose equivalent (EDE) to members of the public to a level that is less than 100 millirem (mrem) in a year. The order also requires

that a program be developed to ensure that radiological releases to the public are maintained at as low as reasonably achievable levels.

1.2 SCOPE

Environmental sampling at the Paducah site is a multimedia (e.g., air, water, soil, sediment, direct radiation, and biota) program of chemical, radiological, and ecological monitoring, and EM that consists of two activities: effluent monitoring and environmental surveillance. Although the evaluation and assessment of unplanned releases are addressed in this plan, emergency monitoring and responsibilities for this activity are not included. As part of the ongoing environmental restoration activities, solid waste management units (SWMUs) and areas of concern, both on and off DOE property, have been identified. Characterization and/or remediation of these sites will continue pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and Hazardous and Solid Waste Amendments corrective action conditions of the Resource Conservation and Recovery Act (RCRA) Permit. RCRA and CERCLA requirements are coordinated by DOE, U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky through the Federal Facility Agreement (FFA), which DOE, EPA, and the Commonwealth of Kentucky signed in 1998. The prior requirements of the Administrative Consent Order (ACO) were superseded by the execution of the FFA. This EMP is revised annually. These revisions incorporate any newly released and/or newly discovered contaminants detected during a site investigation as part of environmental remediation or other studies. In addition, existing EM data are utilized, as appropriate, prior to implementing remedial investigation (RI) activities.

1.3 GENERAL CONSIDERATIONS

1.3.1 Facility Description

The Paducah site, which contains the Paducah Gaseous Diffusion Plant (PGDP), is a government-owned facility within the DOE complex. The Paducah Site is located in a generally rural area of McCracken County, Kentucky (population approximately 67,000). PGDP is a uranium enrichment facility consisting of a diffusion cascade and extensive support facilities. The plant is located on a reservation consisting of approximately 3,500 acres in western McCracken County, 10 miles west of Paducah, Kentucky, (population approximately 26,000), and 3.5 miles south of the Ohio River (Figure 1.1) . The facility is on approximately 1,350 acres with controlled access. Roughly, 650 acres of the reservation are enclosed within a fenced security area. An uninhabited buffer zone of at least 400 yards surrounds the entire fenced area. Three small communities are located within three miles of the DOE property boundary at PGDP: Heath and Grahamville to the east and Kevil to the southwest. The closest commercial airport is Barkley Regional Airport, approximately 5 miles to the southeast.

Construction of the plant began in 1951, and, by 1952, operations were underway. Recycled uranium from nuclear reactors was introduced into the PGDP enrichment process in 1953 and continued through 1964. In 1964, feed material was switched solely to virgin-mined uranium. Use of recycled uranium was resumed in 1969 and continued through 1976. In 1976, the practice of recycling uranium feed material from nuclear reactors was halted and never resumed. During the recycling time periods, Paducah received approximately 100,000 tons (90,000 metric tons) of recycled uranium containing an estimated 328 grams of plutonium-239, 18,400 grams of neptunium-237, and 661,000 grams of technetium-99 (^{99}Tc). The majority of the plutonium-239 and neptunium-237 was separated out as waste during the initial chemical conversion to UF_6; however, some of the transuranics (e.g., ^{239}Pu and ^{237}Np) and ^{99}Tc were deposited on internal surfaces of process equipment.

As of July 1, 1993, responsibility for EM was split between DOE and United States Enrichment Corporation (USEC). DOE is the site owner and operator of waste management and environmental remediation projects, and manager of the DOE depleted uranium hexafluoride (UF_6) cylinder inventory at the Paducah site. USEC, which leases and operates the uranium enrichment facilities of PGDP, was a government-owned corporation from July 1993 to July 1998. At that time, it became a privately owned corporation. This EMP addresses only DOE monitoring and surveillance activities at the Paducah site.

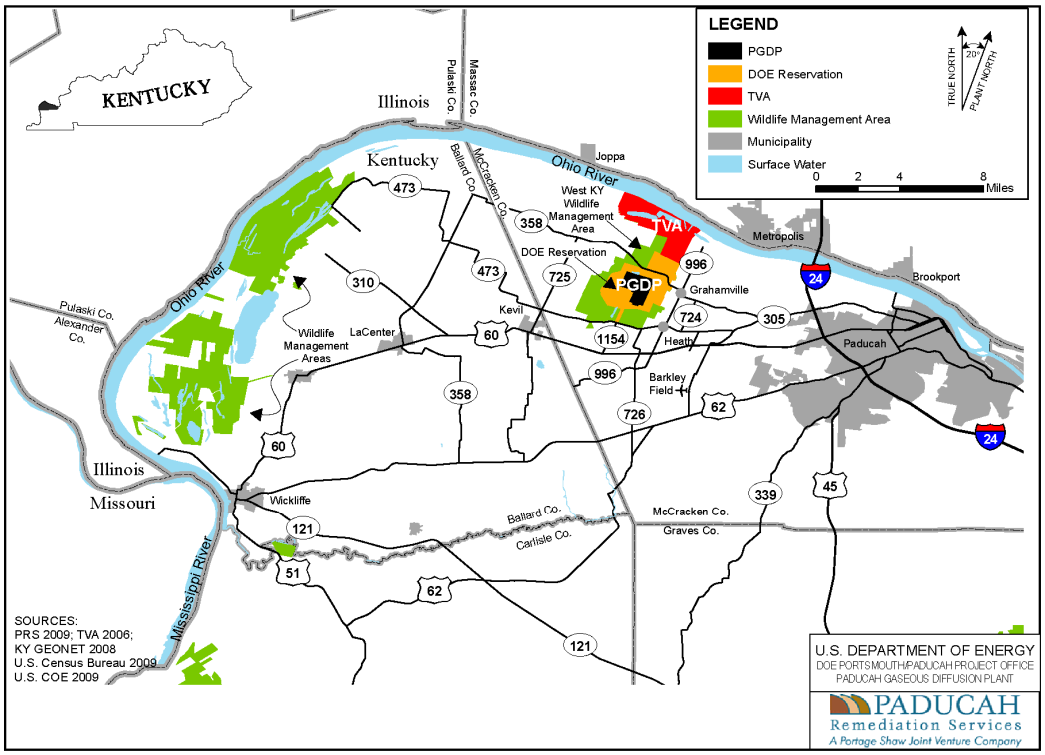

Figure 1.1. Location of the Paducah Site

1.3.2 Measuring Facility Impact

The *Regulatory Guide* requires comparisons of contaminants measured in the EMP to "background" concentrations. For the purposes of this report, a "background" location is called a reference location and is defined as an area unaffected by releases from or operation of DOE or USEC facilities. The area could, however, be impacted by the operation of other industrial or commercial facilities. When no standards or criteria exist for contaminants that may have an impact on human health or the environment, comparisons to concentrations at reference locations can be made to determine if concentrations are significantly higher near the DOE boundary.

1.4 PROGRAM OBJECTIVES

The EMP accomplishes the following.

- Provides for the systematic planning, integrated execution, and evaluation of programs for these:
  - — Public health and environmental protection,
  - — Pollution prevention, and
  - — Compliance with applicable environmental protection requirements.
- Includes policies, procedures, and training to identify activities with significant environmental impacts; to manage, control, and mitigate the impacts of these activities; and to assess performance and implement corrective actions where needed.
- Includes measurable environmental goals, objectives, and targets that are reviewed annually and updated when appropriate.

The EMP is integrated with ISMS/EMS to do the following.

- Evaluate, as applicable all of the following:
  - — Conformity of DOE proposed actions with state implementation plans to attain and maintain national ambient air quality standards;
  - — Data collection to be utilized in decision-making documents in the areas of surface water proection, groundwater protection and protection of other natural resources, including biota.
- Promote the long-term stewardship of a site's natural and cultural resources throughout its operational, closure, and post closure life cycle by evaluating actions for impact on natural and cultural resources through the ISMS/EMS process, including compliance with procedures and the work control process.
- Ensure the early identification of and appropriate response to potential adverse environmental impacts associated with DOE operations, including preoperational characterization and assessment and effluent and surveillance monitoring.

The EMP supports the following requirements of DOE Order 450.1.

- Conduct EM, as appropriate, to support the site's ISMS/EMS to detect and characterize releases from DOE activities; assess impacts; estimate the dispersal patterns in the environment; characterize the pathways of exposure to members of the public; characterize the exposures and doses to individuals, and to the population; and to evaluate the potential impacts to the biota in the vicinity of the DOE activity.
- Ensure the analytical work supporting EM is implemented using the following:
  - — A consistent system for collecting, assessing, and documenting environmental data of known and documented quality;

— A validated and consistent approach for sampling and analysis of radionuclide samples to ensure laboratory data meet program-specific needs and requirements within the framework of a performance-based approach for analytical laboratory work; and

— An integrated sampling approach to avoid duplicative data collection.

Outputs from the EMP Program will do these things.

- Provide information to the public on the releases from and potential impacts of DOE operations to the public and the environment;
- Identify DOE operations' pollutant contributions;
- Provide ancillary data that may be required to assess the consequences of a spill or release;
- Identify significant changes in sample analytical results;
- Supplement other Remedial Investigation (RI) data;
- Support data needs for CERCLA actions; and
- Provide a mechanism for long-term data collection needs under the FFA, when applicable.

1.5 OVERVIEW

The preceding section describes the general objectives contained in DOE Orders 450.1, 5400.5, and the *Regulatory Guide* for environmental monitoring programs.

The DOE prime contractor is responsible for implementing the EMP for DOE programs. Section 2 of this document describes the effluent (compliance) monitoring programs for environmental media. Section 3 addresses the Meteorological Monitoring System, which is collected from the National Weather Service. Section 4 addresses, by individual media, environmental surveillance activities undertaken to monitor the effects of DOE operations on the on-site and off-site environment. Section 5 describes the dose calculation methods for the site, and Section 6 provides various reporting requirements. Section 7 provides references for this plan.

The appendices provide detailed information regarding site permits, groundwater well information, sampling program details, quality assurance, and data management.

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2. EFFLUENT MONITORING

For the purposes of this document, monitoring is defined to include both sampling and the measurement of a parameter (e.g., pH, temperature) without the physical collection of a sample. Sampling refers to the actual collection of a representative portion of the medium for subsequent analysis for chemical/radiological species.

Effluent monitoring is the collection and analysis of samples or measurements of liquid and gaseous effluents to quantify and officially report chemical and radiological contaminants; assess radiation exposures of the public; provide a means to control effluents at or near the point of discharge; and demonstrate compliance with applicable standards and permit requirements. Effluent monitoring is initiated to demonstrate compliance with one or more federal or state regulations; permit conditions; or environmental commitments made in environmental impact statements, environmental assessments, DOE Orders and guides, or other official documents. Table 2.1 lists the various routine effluent monitoring activities performed at the Paducah site. A summary of permits and compliance agreements is listed in Appendix A.

Table 2.1. Routine Effluent Monitoring

Program	Number of Locations	Sampling Frequency	Parameters
Surface Water			
C-746-S&T Landfill	3[1]	Quarterly	See Appendix C
C-746-U Landfill	3[1]	Quarterly	
KPDES			
Chemical	1	Weekly	See Appendix C
	3	Monthly	
Chemical/Toxicity	4	Quarterly	
Leachate			
C-746-S&T Landfill	1	As required and annually	See Appendix C
C-746-U Landfill	1	As required and annually	
C-404 Landfill	1	As required	
* *C-637 Cooling Tower*	1	Monthly	N/A

[1]One location, L154, is permitted for both the C-746-S&T Landfill, as well as for C-746-U Landfill. Totals represent this location for each landfill.
*Sample collected by Northeast Plume Operations personnel; parameter information provided in the Northwest and Northeast Plumes Operations and Maintenance Plans.
KPDES = Kentucky Pollutant Discharge Elimination System
N/A = Not Applicable

The primary statute governing the monitoring of effluents to surface water is the Clean Water Act, which requires the issuance of a National Pollutant Discharge Elimination System (NPDES) permit. EPA has delegated the administration of the NPDES Program to the Kentucky Division of Water (KDOW) Kentucky Pollutant Discharge Elimination System (KPDES) Program. Sampling and analytical methods meet the requirements described in 40 *CFR (Code of Federal Regulations)* § 136. In addition, DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* and the *Regulatory Guide* provide general and detailed guidance regarding the establishment of effluent monitoring programs for both chemical and radiological parameters.

Rationale and Design Objectives. The objectives of the Effluent Monitoring Program include these:

- Verifying compliance with applicable federal, state, and local effluent regulations and DOE Orders;
- Determining compliance with commitments made in environmental impact statements, environmental assessments, or other official documents;
- Evaluating the effectiveness of treatment processes and pollution control;
- Identifying potential environmental problems and evaluating the need for remedial actions or mitigating measures;
- Supporting permit revision and/or reissuance;
- Detecting, characterizing, and reporting unplanned releases; and
- Measuring trends in effluents.

In addition, the *Regulatory Guide* requires this plan to document the following:

- Effluent monitoring (sampling or *in situ* measurement) extraction locations used for providing quantitative effluent release data for each outfall;
- Procedures and equipment used to perform the extraction and measurement;
- Frequency and analyses by analyte required for each extraction (continuous monitoring and/or sampling) location;
- Minimum detection level and accuracy by analyte;
- Quality assurance components; and
- Effluent outfall alarm settings and bases.

The preceding requirements are addressed as follow:

- Appendix C of this document lists all effluent monitoring locations. This appendix specifies sampling and field measurements.
- Appendix D of this document lists all associated procedures associated with sample extraction, as well as field measurements.
- Appendix C of this document lists the sampling frequency at each location, as well as the required analytical parameters by each method type (i.e., volatile, radionuclides, etc.).
- Each contracted laboratory receives a statement of work for all sampling activities. In cases where reporting limits are specified under a given permit, the statement of work specifies these reporting limits as a requirement for the bid for work. In cases where there are no regulatory drivers, laboratories are directed to use the lowest achievable reporting limit.

- Appendix D of this document is the EM Quality Assurance Plan. All quality assurance components are outlined within this plan.

- Effluent monitoring results from the KPDES outfalls is summarized in the daily monitoring reports, which are submitted on a monthly basis to the KDOW. Surface water monitoring results at the landfills are summarized in quarterly reports and submitted to Kentucky Division of Waste Management on a quarterly basis. Notifications of nonconformance are submitted per the specifications within the permits.

Evaluation of Effluents. Effluents, whether or not they contain radiological contaminants from new or modified facilities, are to be evaluated by the environmental compliance organization to determine the appropriate response.

Physical/Chemical/KPDES. KPDES is the regulatory program administered by KDOW for discharge of wastewater to the waters of the Commonwealth of Kentucky. The DOE Paducah site KPDES Permit (KY0004049, effective November 1, 2006) established monitoring requirements for the discharge of wastewater. Following the issuance of the permit, several parties petitioned KDOW for a hearing on the permit. These parties involved with KDOW on the hearings included DOE, USEC, Paducah Remediation Services, LLC, Uranium Disposition Services, LLC, and the Kentucky Resource Council (now called the Energy and Environment Cabinet). An Order to Mediate was issued by the Kentucky Environmental and Public Protection Cabinet (now called the Kentucky Energy and Environment Cabinet). Negotiations on an Agreed Order to settle all parties' disputes with the permit were completed on December 7, 2007. All new permit limitations were stayed with discharge limitations reverting to the April 1, 1998, permit. All monitoring requirements of the new permit were continued.

The permit defines limits on the concentration and amounts of specific chemicals that can be discharged and on the physical impact of those discharges (e.g., temperature or biological harm) to surface waters. The permit limits for radiological parameters have been stayed for an, as yet, undetermined time.

Processes for DOE operations have been evaluated to determine the chemicals, radiological species, and physical parameters (e.g., temperature) likely to affect the KPDES-permitted effluents. Effluents from state-permitted landfills are evaluated during the reporting and permit renewal processes.

Radiological. Based on the evaluation of emissions and the results of radiological monitoring reported in the ASER for 2004, neither continuous monitoring nor continuous sampling with frequent analyses are required by DOE Order 5400.5. This is because the weighted sum of radiological constituents is less than "one" and does not exceed the Derived Concentration Guide (DCG) at all the KPDES discharge points, DOE-owned and USEC-leased. Radiological analyses are performed on grab samples from rain runoff locations (i.e., outfalls, landfills, etc.) and from several stream locations (Bayou Creek and Little Bayou Creek).

Program Implementation Procedures. The EM/Environmental Restoration (ER) Director (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the EM/ER Director reports through a line organization to the site manager and provides centralized coordination responsibilities.

2.1 Liquid

2.1.1 Surface Water

Surface water leaving DOE-owned outfalls includes rainfall runoff from cylinder yards and landfills, C-612 Northwest Plume Groundwater Treatment System, as well as effluent from the C-616 USEC

Wastewater Treatment Facility. The intent of monitoring is to assess compliance with state and federal regulations, permits, and DOE Orders and to assess the impact of DOE operations on the local environment. In addition, DOE has responsibility for "legacy" contaminants such as polychlorinated biphenyls (PCBs) and trichloroethene (TCE) in outfalls.

C-746-S&T and C-746-U Surface Water. Rainfall runoff from three locations at C-746-U and three locations at C-746-S&T Landfills are to be sampled quarterly for parameters listed in Appendix C. Although three locations are cited for each, there are only five unique locations. As part of the November 20, 2008, permit modification, the locations were revised and one location is listed for both the C-746-U Landfill and the C-746-S&T Landfill.

KPDES Monitoring. Four DOE-owned effluent sampling points covered by the KPDES permit (Outfalls 001, 015, 017, and 019) are illustrated in Appendix C. Sampling is conducted weekly at Outfall 001 and monthly at Outfalls 015, 017, and 019, when water is flowing.

2.1.2 Leachate

C-746-S&T and C-746-U Leachate. Leachate from the solid waste landfills is sampled annually and as needed and is analyzed for the parameters listed in Appendix C in accordance with permit requirements.

C-404 Leachate. Leachate samples are collected from the C-404 Landfill Leachate Collection System when leachate is removed and analyzed for the parameters listed in Appendix C in accordance with permit requirements.

2.1.3 C-637 Cooling Tower

Northeast Plume Cooling Tower. C-637-2A basin (previously called L-234) is sampled monthly for TCE. Samples also are collected at the Riser (RISR6) and sometimes at C-637-2B and RISR1, when those areas receive water from the Northeast Plume Containment System.

2.2 AIRBORNE

Industrial operations that emit airborne pollutants considered potentially harmful to the environment are regulated through operating permits. The DOE operations at the Paducah site currently have no major sources of emissions and currently no air permits.

3. METEOROLOGICAL MONITORING

DOE operations may have airborne radionuclide and chemical emissions from various sources such as CERCLA remedial actions, as well as fugitive emissions. Data used for chemical emission modeling purposes are available from the National Weather Service including information from the station located at the Barkley Airport approximately 6.4 kilometers (km) (4 miles) southeast of the Paducah site. Meteorological data utilized for the Clean Air Act Assessment Package-88 (CAP-88) radionuclide emission modeling is compiled from historical data from a former on-site meteorological tower.

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4. ENVIRONMENTAL SURVEILLANCE

DOE Order 450.1 requires that the Paducah site perform environmental surveillance monitoring. Environmental surveillance is the collection and analysis of samples or direct measurements of air, water, soil, biota, and other media from DOE sites and their environment for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposures of members of the public, and assessing the effects, if any, on the local environment.

DOE Order 5400.5 has established a radiation protection standard of 100 mrem per year from all exposure pathways to members of the public. This standard requires that exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an EDE or greater than, 100 mrem (Chapter II, 1). Any one air emission source is limited to 10 mrem dose to the maximum exposed member of the public, 40 *CFR* § 61 Subpart H. The maximum dose the public may receive from drinking water, as specified by the Safe Drinking Water Act, is 4 mrem per year.

DOE Order 5400.5 defines "public dose" as the dose received by member(s) of the public from exposure to radiation and to radioactive material released by a DOE facility or operation, whether the exposure is within a DOE site boundary or off-site. It does not include doses received from occupational exposures, doses received from naturally occurring "reference" radiation, doses received by a patient from medical procedures, or doses received from consumer products. The determination of the public dose, as established by EPA regulation 40 *CFR* § 61, differs in that the 10 mrem per year limit applies to dose received where the members of the public reside.

The *Regulatory Guide* further requires that DOE facilities perform routine surveillance if an annual dose of site origin at the site boundary exceeds either 5 mrem effective dose equivalent (EDE) to an individual or 100-person rem collective EDE within a radius of 80 km (49.7 miles) of a central point on the site. Historically, as reported in previous ASERs, the annual dose due to DOE operations at the Paducah site has been less than 5 mrem (individual) or 100-person rem; therefore, no routine surveillance is required. To verify compliance, routine surveillances are conducted at the Paducah site. An overview of routine environmental surveillance is provided in Table 4.1. The table lists, for each program, the number of sampling locations, sampling frequency, sample type, and parameters for which analysis is performed.

Table 4.1. Routine Environmental Surveillance

Program	Number of Locations	Sampling Frequency	Sample Type	Parameters
Groundwater				
Surveillance Quarterly	13	Quarterly	Grab	See Appendix C
Surveillance Semiannual	150	Semiannually	Grab	See Appendix C
Surveillance Geochemical	44	Annually	Grab	See Appendix C
C-746 S&T Landfills	25[1]	Quarterly	Grab	See Appendix C
C-746-U Landfill	21[1]	Quarterly	Grab	See Appendix C
C-404 Landfill	9	Semiannually	Grab	See Appendix C
C-746-K Landfill	4	Semiannually	Grab	See Appendix C
Northeast Plume	11	Quarterly/Semiannually	Grab	See Appendix C
Northwest Plume	12	Semiannually/Annually	Grab	See Appendix C
C-400	8	Quarterly	Grab	See Appendix C
Residential Annually	15	Annually	Grab	See Appendix C
Residential Monthly	2	Monthly	Grab	See Appendix C
Residential Carbon Filter System	1	Semiannually	Grab	See Appendix C
Water Levels Quarterly	79[2]	Quarterly	Grab	See Appendix C
Water Levels Annually	108	Annually	Grab	See Appendix C
Watershed Biological Monitoring Benthic Macroinvertebrates	8	Annually	Grab	See Appendix C
Surface Water and Seeps	22	Quarterly	Grab	See Appendix C
Sediment	14	Semiannually	Grab	See Appendix C
Terrestrial - Deer	5[3]	Annually	Species	See Appendix C
Ambient Air[4]	N/A	N/A	N/A	N/A
Meterologic[5]	N/A	N/A	N/A	N/A
Environmental TLDs	46	Quarterly	Continuous	External Gamma

TLD = thermoluminescent dosimeter

[1]Four of the same wells are sited in both C-746-U and C-746-S&T Landfill permits. For these totals, the wells are counted for both programs. Also, for the C-746-S&T Landfills locations, the count of 25 wells includes two wells that are only measured for water level. The number of locations sampled for analytical laboratory parameters is 23 locations.
[2]Quarterly water levels are divided into 4 different suites: 3 of the suites are collected at the C-404, C-746-S&T, and C-746-U Landfills; the fourth suite of wells is collected from various locations around the Paducah site.
[3]Five deer are harvested.
[4]Operated by Commonwealth of Kentucky personnel.
[5]Information is taken from the National Weather Service.

4.1 GROUNDWATER

4.1.1 Introduction

The Paducah site, located in the Jackson Purchase region of Western Kentucky, lies within the northern tip of the Mississippi Embayment portion of the Gulf Coastal Plain Province. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediment unconformably overlying Paleozoic bedrock. Figure 4.1 presents a schematic cross section that illustrates regional stratigraphic relationships. The *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III* (Clausen 1992) discusses geology and hydrogeology of the Paducah site in detail. Additional information regarding the geology and hydrogeology at the Paducah site is covered in the *Groundwater Conceptual Model for the Paducah Gaseous Diffusion Plant* (Jacobs 1997). Following is a summary of the Paducah site geology and hydrogeology.

Geology. Several formations or geologic units of rocks and sediment underlie the Paducah site. The lower formations, which lie beneath the entire site consist of Mississippian limestone, a Rubble Zone, and the Upper Cretaceous McNairy Formation. In the southern part of the Paducah site, the Paleocene Porters Creek Clay, Eocene Sands, and a Pliocene Terrace Gravel (an older member of the Continental Deposits) comprise the geologic units over the McNairy Formation. Beneath the Paducah site industrial complex and the remainder of the site to the north, Pleistocene Continental Deposits and loess overlie the McNairy Formation. Holocene alluvial deposits, in turn, cover (and replace) the Continental Deposits in the Ohio River Floodplain.

The Paleozoic bedrock located below the Paducah site consists of Mississippian-age limestone. In some areas of the Paducah site, a Rubble Zone, consisting of angular to subangular, silicified limestone fragments, is present at the top of the Mississippian limestone. The Upper Cretaceous McNairy Formation, which consists of 40% to 50% sand interbedded and with silt and clay, overlies the bedrock and the Rubble Zone. This is, in turn, overlaid by the Paleocene-age Porters Creek Clay in the southern portions of the Paducah site. It consists of dark-gray-to-black silt with varying amounts of clay and fine-grained, micaceous, commonly glauconitic sand. Eocene Sands, consisting of interbedded sand, silt, and clay, occur in the extreme southern portion of the site.

Pliocene and Pleistocene Continental Deposits unconformably overlie Cretaceous through Eocene strata at the Paducah site on a series of steps or terraces. The Continental Deposits are commonly divided into a basal gravel facies (lower Continental Deposits) and an upper, fine-grained clastic facies (upper Continental Deposits).

The lower Continental Deposits consist of chert gravel in a matrix of poorly sorted sand and silt. A Pliocene facies, ranging in thickness from 0 to 9.1 m (0 to 30 ft) and averaging less than 3.1 m (10 ft), exists in the southern portions of the site, occurring on the upper surfaces of a buried terrace at elevations greater than 106.7 m (350 ft) above mean sea level (amsl). A second Pliocene gravel facies, ranging in thickness from 4.6 to 6.1 m (15 to 20 ft), exists in southeastern and eastern portions of the site, occurring on an erosional surface at approximately 97.5 to 105.2 m (320 to 345 ft) amsl elevation. The third and most prominent of the three gravel facies, which underlies the Paducah site industrial complex and lands to the north, consists of Pleistocene fill deposits of the buried valley of the ancestral Tennessee River. The elevation of the base of the buried valley varies from approximately 74.7 to 86.9 m (245 to 285 ft) amsl. The upper surface of these gravel deposits occurs at an average elevation of 94.5 m (310 ft) amsl with an average thickness of approximately 9.1 m (30 ft). Thicker deposits, up to 15.2 m (50 ft), exist in deeper scoured channels, which trend east-west across the site and pinch out against the terrace slope at the southern end of the site.

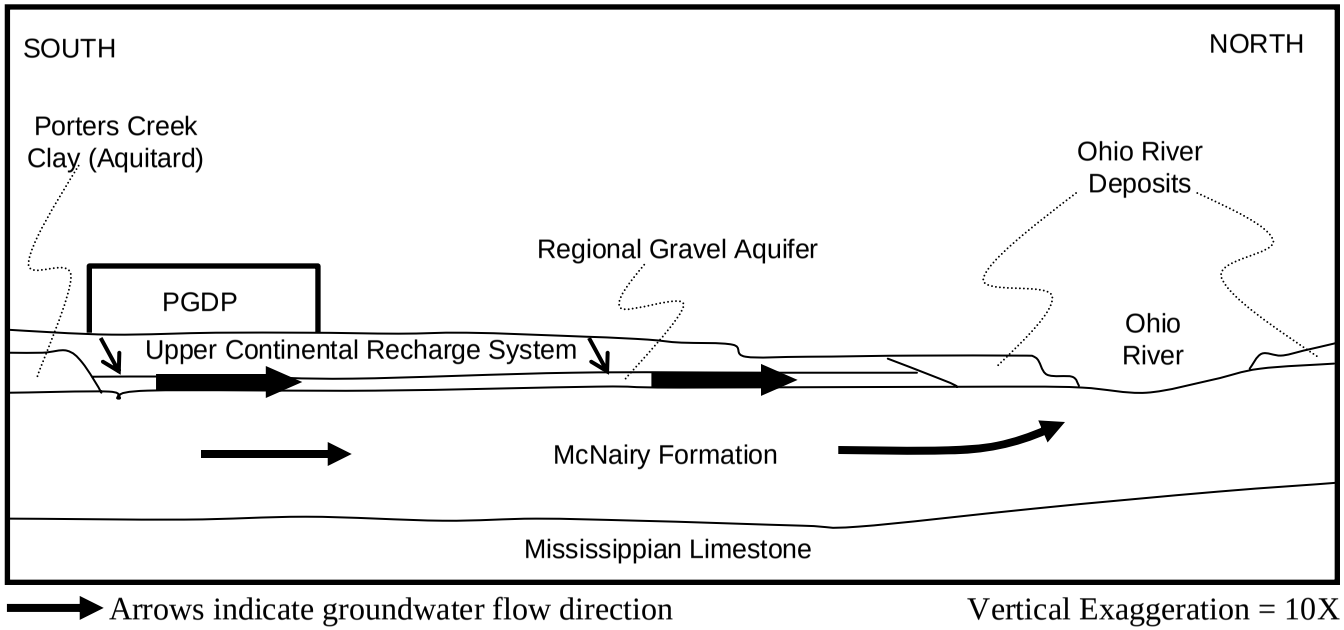


Figure 4.1. Schematic of Stratigraphic and Structural Relationships Near PGDP

The upper Continental Deposits primarily consist of clayey silt, with thin zones of sand and occasional gravel, and vary in thickness from approximately 15 to 55 ft. These deposits have been differentiated into three general lithofacies based on grain size distributions: (1) clay and silt, (2) sand, and (3) gravel. Sand- and gravel-dominated lithofacies exist at different elevations throughout the upper Continental Deposits; however, most occur at consistent elevations.

Loess, consisting of yellowish-brown silt and clayey silt, overlies the Continental Deposits at the site and varies in thickness from approximately 1.5 to 7.6 m (5 to 25 ft), with an average of approximately 4.6 m (15 ft). Holocene alluvial deposits occur at lower elevations within the Ohio River floodplain north of the Paducah site.

Hydrogeology. The local groundwater flow system at the Paducah site occurs within four specific components: (1) the Terrace Gravel, (2) the Upper Continental Recharge System (UCRS), (3) the Regional Gravel Aquifer (RGA), and (4) the McNairy Flow System. The following components are defined:

(1) Terrace Gravel—This component consists of Pliocene-aged gravel deposits found in the southern portion of the Paducah site. These deposits usually lack sufficient thickness and saturation to constitute an aquifer. The Terrace Gravel provide groundwater underflow to the RGA to the east of the PGDP where the buried ancestral Tennessee River valley intersects lower terrace Pliocene gravel deposits.

(2) UCRS—This component consists of three distinct hydrogeologic units (HUs): HU1, HU2, and HU3. The uppermost unit, HU1, is the overlying loess that blankets the entire site. HU2, the second unit, consists of a horizon of common sand and gravel lenses. The most prevalent sand and gravel lenses occur at an elevation of approximately 105.2 to 107 m (345 to 351 ft) amsl, with less prevalent lenses occurring at an elevation of 102.7 to 104 m (337 to 341 ft) amsl. Clay, silt, and clayey silt comprise the lowermost unit, HU3. This relatively low hydraulic conductivity unit forms the upper confining layer to the underlying RGA.

(3) RGA—This component consists primarily of the Pleistocene lower Continental Deposits gravels (HU5), but also includes a basal sand layer of the Upper Continental Deposits, HU4; coarse-grained upper McNairy sediment in direct contact with the lower Continental Deposits; and Holocene alluvium found adjacent to the Ohio River. These combined deposits are commonly thicker than the Pliocene terrace gravel deposits, with an average thickness of 9.1 m (30 ft) and range up to 15.2 m (50 ft) along an axis that trends east-west through the site. The RGA is the primary aquifer used locally.

(4) McNairy Flow System—This component consists of the interbedded and interlensing sand, silt, and clay of the McNairy Formation. Sand facies account for 40% to 50% of the total formation thickness of approximately 68.6 m (225 ft).

Topographically controlled recharge and discharge areas to the south and north, respectively, bound the local groundwater flow systems. Recharge to the Terrace Gravel and Eocene Sands results in a groundwater divide southwest of the Paducah site. Northward flowing groundwater within the Terrace Gravel either discharges to local streams or recharges the RGA.

The primary source of recharge to the RGA is infiltration from the UCRS. Some horizontal flow likely occurs in the UCRS near the Paducah site, but the discontinuous nature of sand and gravel lenses in the UCRS and the large vertical gradient require groundwater in the UCRS to flow downward. The major pathway of groundwater flow is within the RGA, which dominates the flow regime. Groundwater flow in the RGA is to the north to discharge into the Ohio River.

Differences in permeability and aquifer thickness affect the hydraulic gradient at the Paducah site. High hydraulic gradient exists in the southern part of the site, where the Terrace Gravel and RGA gravels thin and truncate against the Porters Creek Clay. Lower gradients in the north central portion of the site are the result of the thickened RGA interval containing high fractions of coarse sand and gravel. Northward, near the Ohio River, the hydraulic gradient increases as a result of the thinner section of the RGA and the lower permeability of the bottom sediment of the Ohio River.

4.1.2 Rationale and Design Criteria

The groundwater monitoring program consists of routine compliance monitoring designed to accomplish the following:

- Obtain data to determine baseline conditions of groundwater quality and quantity;
- Demonstrate compliance with and implementation of all applicable regulations and DOE Orders;
- Provide data to permit early detection of groundwater pollution or contamination;
- Identify existing and potential groundwater contamination sources and maintain surveillance of these sources; and
- Provide data for making decisions about waste disposal on land-based units and the management and protection of groundwater resources.

The following addresses specific laws, regulations, and orders.

DOE Orders. DOE Order 450.1 does not require specific groundwater sampling frequencies or parameters; however, "Sample collection programs shall reflect specific facility needs. Type and frequency of sampling shall be adequate to characterize effluent streams." The order requires that DOE identify existing and potential groundwater contamination sources and maintain surveillance of these sources via groundwater monitoring. DOE Orders 231.1 and 450.1 outline requirements for groundwater monitoring at all DOE facilities. The EMP was written to include effluent monitoring and environmental surveillance at the Paducah site. Background wells are monitored annually for several parameters, including organics, inorganics, and radionuclides.

Commonwealth of Kentucky Regulation. 401 *KAR* § 5:037 requires preparation of a Groundwater Protection Plan that addresses requirements to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution. This requirement was addressed by DOE, by writing and implementing a Groundwater Protection Plan, according to 401 *KAR* § 5:037, prior to the deadline of August 24, 1995. This document last was revised in 2007. It will be revised on a three-year basis.

Agreement in Principle Sampling. The Agreement in Principle (AIP) supports groundwater program activities by providing oversight of the groundwater program. The oversight includes location of wells, sample analysis, statistical analysis of sample results, and data quality. AIP personnel conduct independent groundwater sampling and obtain DOE sample splits.

AIP personnel also respond to questions and concerns from the public, including sampling of residential wells. The AIP personnel participate in public meetings to provide an independent view of the effect of the Paducah site on the local environment and health of the public.

AIP funds research and special projects to assist in understanding groundwater contamination movement and its effects.

CERCLA Actions. The FFA among DOE, EPA, and the Commonwealth of Kentucky states that sampling of residential wells is required for those wells potentially affected by migration of the Northeast and Northwest Plumes. Another requirement of the FFA is to determine the nature and extent of off-site contamination. This requirement is addressed through the RI process for operable units at the Paducah site.

The *Action Memorandum for the Water Policy at Paducah Gaseous Diffusion Plant* (Water Policy) (DOE 1994) also requires groundwater sampling of residential wells affected by off-site contamination (Jacobs 1994; SAIC 1993). Nineteen residential wells currently are sampled for the parameters listed in Appendix C. Fourteen of the nineteen wells are utilized only for sampling purposes, as the residents have been supplied an alternate water source in accordance with the Water Policy. The remaining five wells (R90, R114, R384, R387, and R392) are outside the Water Policy boundary and are sampled routinely and monitored for the presence of groundwater contamination. The Water Policy was established in accordance with the ACO, following an Engineering Evaluation/Cost Analysis, and was written to document the preferred alternative addressing the need for protection of human health due to the presence of groundwater contamination originating from the Paducah site. As soon as possible after contamination was found in local residential water supply wells, the affected households were supplied with bottled water. Construction of water mains allowed the access to water lines to be provided to homes in the affected area. This was accomplished as a non-time-critical removal action under CERCLA.

The EMP also supplements the Paducah CERCLA RIs. Currently, there are five defined CERCLA operable units (i.e., surface water, groundwater, soils, burial grounds, and decontamination and decommissioning) that have been, or will be, investigated under the Paducah FFA. Upon completion of response action activities for these five operable units, a Comprehensive Site Operable Unit will be implemented in accordance with the Paducah FFA. The routine EMP is integrated with each operable unit investigation to provide collection of optimal data sets.

FFA Requirement and Operational and Maintenance Plan for the Northwest and Northeast Plume Programs. In order to monitor the nature and extent of groundwater contamination and to evaluate any cyclic trends in water quality that may affect contaminant migration, 12 additional wells are required to be sampled for the Northwest Plume and 11 for the Northeast Plume, according to their respective Operation and Maintenance Plans.

Landfill Groundwater Monitoring Program

C-746-S and C-746-T Landfills. DOE currently has Commonwealth of Kentucky-permitted (SW07300014 and 07300015) closed, solid waste landfills (C-746-S and C-746-T). The groundwater is monitored utilizing 23 monitoring wells (MWs) near the two landfills for collection of samples to analyze organic, inorganic, and radiological parameters identified in Appendix C. Two additional wells are permitted for water level measurements only; therefore, 25 total MWs are permitted.

C-746-U Landfill. The C-746-U Solid Waste Landfill is an operating landfill owned and managed by DOE. This landfill currently is being operated as a permitted, contained landfill, and 21 MWs are monitored quarterly for organic, inorganic, and radiological parameters, as listed in Appendix C.

C-404 Landfill. The C-404 Hazardous Waste Landfill is closed and monitored under EPA Hazardous Waste Permit KY8-890-008-982. The C-404 Hazardous Waste Landfill currently is being monitored under detection monitoring (semiannual sampling) according to permit requirements. The groundwater is monitored utilizing nine MWs. There are six downgradient and three upgradient compliance point wells. Parameters specified to be analyzed are provided in Appendix C.

C-746-K Landfill. Sampling of four MWs is conducted to evaluate the potential impact of historical waste disposal activities at the C-746-K Landfill on the groundwater quality parameters, which are analyzed semiannually, as identified in Appendix C. Requirements to sample these four MWs are outlined in the Record of Decision for Waste Area Groups 1 and 7. Sampling of these wells is not required by a permit, but is conducted in support of the FFA CERCLA Investigation and RCRA Facility Investigations, as well as DOE Order 450.1, according to the Paducah FFA.

Surveillance Monitoring Program

Environmental Surveillance (Quarterly and Semiannual Monitoring) Program. In order to monitor the nature and extent of groundwater contamination and to monitor groundwater quality, 144 non-background wells are sampled semiannually and 13 are monitored quarterly, as shown in Appendix C. Sampling of these wells is not driven by a permitted process, but is conducted in support of the FFA CERCLA investigations and RCRA Facility Investigations, as well as DOE Order 450.1. Seven of these wells are sampled/monitored in an additional sampling event, which is in conjunction with groundwater sampling activities associated with the C-404 Landfill.

Background Monitoring Program. Five background wells are sampled semiannually to monitor the background water chemistry of wells located upgradient of the plant to compare with MWs potentially impacted from plant activities.

Environmental Surveillance (Geochemical Monitoring) Program. In order to monitor the effects of natural attenuation of groundwater contamination and to monitor groundwater quality, 44 MWs are sampled annually. Sampling of these wells is not driven by a permitted process, but is conducted in support of the FFA CERCLA investigations and RCRA Facility Investigations, as well as DOE Order 450.1.

4.1.3 Extent and Frequency of Monitoring

Appendix B provides information for all wells used at the Paducah site, as well as residential wells located off-site. The groundwater sampling frequency and parameters, which are identified in Appendix C, are reviewed annually. The information detailed in Appendix C is the planning document for all monitoring and lists sites to be monitored, the governing program(s), wells, parameters, and the frequency.

An effort has been made to reduce the amount of sampling conducted at certain wells. The criteria used to determine less frequent sampling of a well include the following:

- New understanding of contaminant migration pathways and contaminants present,
- Review of historical MW results,
- Analyses to determine if the MW meets the current and future objective of the Groundwater Protection Program (GWPP), and

- Addition of new MWs that may eliminate the need for sampling of older MWs.

4.1.4 Program Implementation Procedures

Organization. The EM/ER director is responsible for implementing all relevant aspects of the EMP. In that role, the EM Director (or designee) provides centralized coordination of the GWPP matrix organization.

Plans. The *Groundwater Protection Plan*, last issued in September 2007, addresses the following specific requirements listed in Section 3(3) of 401 *KAR* 5:037: 1) general information regarding the facility and its operation; 2) identification of activities associated with the facility, as identified in Section 2 of the regulation; 3) identification of all practices chosen for the plan to protect groundwater from pollution; 4) implementation schedules for the protection practices; 5) description of and implementation schedule for employee training necessary to ensure implementation of the plan; 6) schedule of required inspections, as applicable; and 7) certification of the plan by the appropriate PGDP representative. These plans and the EMP provide the framework of the Groundwater Monitoring Program.

4.2 SURFACE WATER/SEDIMENT ENVIRONMENT

The Environmental Surveillance Watershed Monitoring Program at the Paducah site for surface water, sediment, and aquatic biota has evolved over a number of years in response to regulatory and community concerns. The program is described in the following sections. Frequencies of monitoring and chemical parameters are provided in Appendix C.

Surface Water. Measurement of water quality parameters in surface water samples provides a general guide to the environmental health of the system. Certain contaminants (e.g., volatile organic compounds) that are not particularly concentrated in other media are more efficiently analyzed in water samples.

Sediment. A single sediment sample can represent information that would require a large number of water samples, spaced over a period of time, to reconstruct. Sediment acts to collect, concentrate, and store specific kinds of contaminants at specific locations. Concentrations of contaminants in sediments represent integrated measures of aqueous contaminant concentrations over some preceding period of time.

4.2.1 Rationale and Design Criteria

The surface water and sediment sampling sites included in this EMP are located on selected receiving streams downstream from primary contaminant sources and reference streams, either off-site or upstream of the Paducah site. Contaminant sources include both point sources (e.g., effluent outfalls) and nonpoint sources, such as waste disposal areas or burial grounds. More than one downstream site on a receiving stream was included in the program design if there was a substantial distance [>3 km (1.9 miles)] between major contaminant sources. In these cases, two sites ensure that adverse impacts and ecological recovery can be detected before additional dilution occurs downstream, thus providing a suitable database for documenting the effectiveness of remedial actions. Reference streams were determined to be minimally impacted, using site-specific data on the species composition of the benthic macroinvertebrate (benthos) community. These data were obtained from either qualitative sampling conducted as part of the reference site selection process or previous Biological Monitoring Programs.

4.2.2 Extent and Frequency of Monitoring

4.2.2.1 Surface Water Program

Surface water is sampled at 22 locations (including 2 seeps) upstream and downstream from the Paducah site operations. Samples collected at upstream locations are considered background locations. Grab samples are collected quarterly. Samples also are taken from a location at the Paducah site water intake on the Ohio River to evaluate the role of feed water in affecting water quality of discharges. Frequency, field measurements parameters, and analytical parameters are listed in Appendix C.

4.2.2.2 Sediment Program

Sediment samples are collected semiannually from 14 locations, two of which are considered background locations. Sediment is sampled near the surface water and biological stations at locations downstream from plant operations and in reference streams. Station locations coincide with those for surface water in Bayou Creek and Little Bayou Creek. Sediment samples also are taken from a site in Little Bayou Creek upstream of plant inputs where the stream does not have permanent flow. Sampling frequency, field measurement parameters, and analytical parameters are listed in Appendix C.

4.2.3 Program Implementation Procedures

The EM/ER director (or designee) is responsible for implementing all aspects of the Surveillance Program. In that role, the EM director reports through the line organization to the site manager.

4.3 TERRESTRIAL ENVIRONMENT

The terrestrial environment around the DOE reservation is predominantly rural with residences and farms surrounding the site. Immediately adjacent to the DOE Reservation is West Kentucky Wildlife Management Area (WKWMA), which is used by a considerable number of hunters, trappers, and fishermen each year. Hunting activities may include such wildlife as rabbits, deer, quails, raccoons, squirrels, doves, turkeys, waterfowl, and other game. Trapping of beavers also is included. Additionally, the WKWMA sponsors annual field hunting trials for dogs.

This section discusses the terrestrial environment near the Paducah site that could become contaminated as a result of releases of materials from current or past DOE operations. Farm-raised animal products, as well as local wildlife in the area, may be contaminated through water releases. Wildlife and animal products, including meat, eggs, and milk, become contaminated through animal ingestion of contaminated water, sediment, other animals, or through direct contact with contaminated areas. The subsequent ingestion of these products can lead to a dose to man and is discussed in subsequent sections. Concentrations of both radionuclide and chemical contaminants are evaluated in the terrestrial environment. The *Regulatory Guide* suggests that if wild game, such as deer or game birds, is available locally, these should be considered for sampling purposes.

4.3.1 Rationale and Design Criteria

4.3.1.1 Milk

Because a predicted effective dose from the airborne pathway is insignificant from a risk perspective, and ^{99}Tc and uranium do not bioaccumulate in milk, the surveillance of milk is not required or recommended by the *Regulatory Guide* and is not performed by the Paducah site.

4.3.1.2 Food crops

Food crops are not pathways since no significant [i.e., exceeding National Emission Standards for Hazardous Air Pollutants (NESHAP) regulatory levels] airborne sources of contaminants have been identified for DOE operations utilizing the EPA data quality objectives (DQOs).

4.3.1.3 Wildlife

Under an agreement between the Kentucky Department of Fish and Wildlife and DOE, the Paducah site, in conjunction with WKWMA personnel, conducts the Annual Deer Sampling Program to obtain samples for analysis of potential contaminants. Sufficient deer are collected by WKWMA personnel to ensure that samples representative of the deer population living near the site are obtained. Five deer are expected to meet collection criteria. Historical data from reference deer are utilized for background comparisons. Appendix C provides a list of the parameters required for the various tissue samples.

Special studies also may be initiated for specific evaluations as needed. Additional game species may be harvested and sampled for target analytes or compounds per procedures approved by DOE's contractor and DOE.

4.3.2 Extent and Frequency of Monitoring

Deer are sampled annually (prior to hunting season) following approved procedures. Rabbit sample results were benign in calendar year 1999 and were discontinued in calendar year 2000. Opportunistic sampling occurs for other wildlife species as determined by DOE.

4.4 EXTERNAL GAMMA RADIATION

Due to past releases of radionuclides and current operations involving radioactive sources [e.g., depleted uranium hexafluoride cylinder management], the Paducah site conducts routine surveillance of external gamma radiation exposure. Historical monitoring has shown that the external gamma radiation dose from routine DOE operations at the Paducah site boundary is well under 5 mrem (individual) and 100-person rem. Routine surveillance of external gamma radiation with thermoluminescent dosimeter (TLD) monitors is conducted as a conservative measure, although it is not required to comply with DOE Order 5400.5 or other regulations or requirements.

4.4.1 Objectives

A primary objective of external exposure monitoring is to establish the potential radiation dose to a member of the public from direct exposure to DOE operations at the boundary of the DOE perimeter fence.

A second objective is to establish the potential dose that a member of the public may receive while visiting or passing through the accessible portion of the reservation. Public traffic is allowed on the main reservation roads outside of the active plant area as a courtesy to the public, and some members of the public "visit" the DOE Reservation for various reasons, including hunting.

A third objective is to calculate the dose equivalent of the maximally exposed individual member of the public.

4.4.2 Rationale and Design Criteria

Both theoretical calculations and historical monitoring indicate that any plausible DOE contribution to ambient gamma radiation levels is negligible. Higher radiation levels in the cylinder yards are due to protactinium, a decay product of uranium-238. Past liquid releases to Little Bayou Creek have resulted in contamination of the sediment, which also contribute to the elevated gamma readings (Energy Systems 1989).

The External Gamma Radiation Monitoring Program is designed to provide exposure data on direct radiation from DOE operations to members of the public. The primary factor in selecting the monitoring locations is the potential for a member of the public to be exposed to direct radiation. The highest potential radiation exposure to the public is at the plant perimeter.

The monitoring program conducts area gamma radiation dose monitoring using calcium sulfate-type TLDs. Devices of this type are capable of measuring exposure resulting from gamma radiation and are used throughout the industry to perform EM.

The primary source for radiation exposure to areas outside the PGDP security fence is the UF_6 cylinder storage yards, which are located within the secured area, but in close proximity to the perimeter of the fence. Studies conducted within the cylinder storage yards have shown that the cylinders are sources of both gamma and neutron radiation. The neutrons are produced at moderate energy levels by the alpha-fluorine reaction taking place within the residual UF_6 material. Further studies have indicated that the range of the neutrons is such that the neutron dose rate falls off rapidly with distance. For residual contamination, neutron producing radionuclides have not been detected in sufficient quantity to create a significant source for neutron radiation.

The Radiological Control Organization (RADCON) performs area dose rate monitoring within the security fence at PGDP. This monitoring includes devices for measuring both gamma and neutron radiation. Neutrons are included in the area RADCON monitoring due to the reduced source to receptor distance for workers within the confines of the PGDP fenced security area. The RADCON area dose rate monitoring program is described in BJC/PAD-225, *Technical Basis for the Area Dosimeter Program at the Paducah Gaseous Diffusion Plant* (BJC 2000). Results from this program are included in the ASER.

4.4.3 Extent and Frequency of Monitoring

The extent and frequency of monitoring for external gamma radiation are determined based on the assumptions that the exposure levels decrease with distance from the sources and that the levels are relatively constant over time.

Public access assumptions are that (1) the security fence provides a physical boundary beyond which the public has no access, (2) public access to the reservation is controlled administratively and limited, (3) the locations of residences and communities outside the reservation are known, and (4) individual exposure scenarios may vary.

Environmental gamma detection TLDs are located at 46 locations including the PGDP perimeter, outfalls, ditches, and background locations. TLDs also have been placed in areas that historically have received the highest radiation exposure.

The RADCON area monitoring TLDs are located at 27 locations within the PGDP fenced security area. The areas monitored by this program include routinely occupied break areas, cylinder yards, storage

facilities, and areas with elevated dose rate. These locations are provided in *Technical Basis for the Area Dosimeter Program at the Paducah Gaseous Diffusion Plant* (BJC 2000).

Re-evaluation of the TLD placement locations was conducted to assess safety concerns associated with the TLD locations. As a result, two location changes were made for CY 2010 due to safety concerns.

Yearly, data comparisons are made between the current year and the prior year's radiation monitoring and the results are presented in the Annual Report for External Gamma Radiation Monitoring. Because the new locations are close in proximity to the previous location, the data comparisons will be made between the two years.

4.5 AMBIENT AIR

DOE complies with 40 *CFR* § 61, Subpart H, to control airborne emissions of radionuclides. This compliance includes evaluation of activities that have potential radionuclide emissions. For any activities that meet the definition of construction under 40 *CFR* § 61, Subpart A, or any activities such as fabrication, erection, or installation of a new building or structure within a facility that emits radionuclides, the potential emissions must be evaluated against the NESHAP requirements. If the EDE caused by all emissions from the new construction or modification within an existing facility is less than 1% of the standard prescribed in Section 61.92, then an application for approval under Section 61.07 or notification of startup under Section 61.09 does not need to be filed, per Section 61.96. The EDE shall be calculated in accordance with 40 *CFR* § 61, Subpart H.

DOE has identified several areas as potential fugitive and diffuse sources. Based on prior health physics data and historical ambient air monitoring, it is unlikely that any of these potential sources are significant; however, in accordance with methods utilized at other DOE facilities, DOE utilized ambient air monitoring data to verify insignificant levels of radionuclides in off-site ambient air. Ambient air data collected at sites surrounding the plant capture radionuclides from all sources, including fugitive and diffuse. The Radiation/EM Section of the Radiation Health and Toxic Agents Branch of the Department for Public Health of the Kentucky Cabinet for Health Services conducts ambient air monitoring for the Paducah site. The air monitoring network is comprised of ten ambient air monitoring stations, including one background station. Commonwealth of Kentucky ambient air monitoring data are reviewed and included in the NESHAP and ASER reports.

4.6 VEGETATION/SOIL

Vegetation and soil are not pathways because no significant airborne sources of contaminants (i.e., exceeding NESHAP regulatory levels) have been identified for DOE operations utilizing the DQO process.

4.7 WATERSHED BIOLOGICAL MONITORING

Biological monitoring of receiving streams at the Paducah site was initiated in 1987 and revised according to the requirements of the 2006 KPDES permit. This Watershed Monitoring Program (WMP) includes quantitative surveys of benthic macroinvertebrate communities in Bayou Creek and Little Bayou Creek and two off-site reference streams, Massac Creek and West Fork Massac. Sampling the benthic macroinvertebrates provides a direct measure of the ecological health of streams and the condition of the biotic resources at risk. These sampling locations are identified in Appendix C.

4.7.1 Rationale and Design Objectives

The design of the sampling program for surface water and aquatic biota is intended to comply with the goals of environmental surveillance monitoring outlined in DOE Order 450.1 and the *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan* (PRS 2006b). The objectives of the watershed monitoring program are as follows:

(1) Determine whether discharges from PGDP and SWMUs associated with PGDP are adversely affecting instream fauna;

(2) Assess the ecological health of Bayou and Little Bayou Creeks;

(3) Assess the degree to which abatement actions ecologically benefit Bayou and Little Bayou Creeks;

(4) Provide guidance for remediation; and

(5) Provide an evaluation of changes in potential human health concerns.

As described in the KPDES permit, the goal of the WMP is to ensure that the site cleanup will result in the Bayou Creek and Little Bayou Creek watersheds, achieving compliance with the applicable water quality criteria.

4.7.2 Extent and Frequency of Monitoring

The sampling for the WMP is described in *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (PRS 2006b).

4.7.3 Program Implementation Procedures

The EM/ER director (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the EM/ER director (or designee) reports through a line organization to the site manager and provides centralized coordination responsibilities.

5. DOSE CALCULATIONS

Operations at the Paducah site may emit waterborne radionuclides and chemicals. After release, these substances disperse throughout the environment by applicable transport mechanisms where they eventually some may reach and affect humans. This section describes the methodologies used to model the dispersion of radionuclides and chemicals and to estimate human exposure resulting from the intake of the dispersed substances. Human exposures to radionuclides are characterized in terms of total EDEs to maximally exposed off-site individuals and to the entire population residing within 80 km (49.7 miles) of the site. Exposures to chemicals are characterized in terms of percent allowable daily intake or reference dose.

5.1 CONFORMANCE WITH STANDARDS FOR PUBLIC DOSE CALCULATIONS

Models selected to assess environmental transport of and human exposures to substances released from DOE operations are appropriate for the physical and environmental situation encountered and for the data available to characterize the situation. Input data, including default values, are documented and evaluated for applicability to the situation being modeled.

A complete set of potential human exposure pathways are considered in the assessments of radiological and chemical exposures. Those pathways that represent the potential exposures to the most exposed individual and to the entire population residing within 80 km (49.7 miles) of the site are evaluated. The pathways that are evaluated are discussed in Sections 5.3 and 5.4.

Descriptions of the models and computer codes may consist of references to published descriptions or of actual mathematical formulations developed for special calculations. Surface water and groundwater modeling are conducted, as necessary, to conform to applicable requirements of the Commonwealth of Kentucky and of the regional EPA office.

5.2 MAJOR CONSIDERATIONS

Members of the public may receive radiation and chemical doses from the Paducah site from materials released to ground and surface waters. In addition, some members of the public may receive minor radiation doses through direct external irradiation by radiation emanating from the cylinder yards located within plant. Doses are estimated for all potentially important exposure pathways relevant to the above exposure modes. Table 5.1 lists environmental release and transport mechanisms that apply to emissions from DOE operations. Estimation of the consequences of radionuclide or chemical releases from DOE operations must consider all potential pathways by which these materials may reach the surrounding population. To aid in selecting potentially important pathways, a land use census was performed in 1990. This census recorded and mapped the locations of all residences, dairy and meat animals, and vegetable gardens within a 5-km (3-mile) radius of the site. All identified locations were plotted on a map divided into 16 equal sectors corresponding to the 16 cardinal compass points. This information was compared to modeling results to identify the maximally exposed individual. The census also verified the accumulated data with flyover photographs and by consulting the McCracken County Cooperative Extension Service. Information kept on file by DOE was used to verify residences. Demographic data were obtained from the Bureau of the Census to document characteristics of the people who live near the site.

Table 5.1. Environmental Transport Mechanisms Applicable to Releases from DOE Operations

Releases to surface water	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Deposit in sediment Infiltrate to groundwater
Releases to groundwater	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Flow into surface water
Radionuclides in objects	Remain in fixed sources

As part of a CERCLA Site Investigation, a survey was taken of users of surface and groundwater in the vicinity of the Paducah site to determine the number of residents using water wells within a 6.4-km (4-mile) radius of the site and to determine the number of surface water intakes on the Ohio River up to 24.2 km (15 mile) downstream from the site.

No resident or business responding to the survey reported using a private intake on the Ohio River or on Bayou Creek or Little Bayou Creek for any part of their water supply. On the Ohio River, the nearest downstream water-intake point used for drinking water is at Cairo, Illinois. A surface water sample is collected immediately downstream of all PGDP effluents. Cairo is within 50 miles of the Paducah site, and drinking water concentrations at that location are considered in the dose assessment (see Section 5.4.2). Figures 5.1 and 5.2 list potential environmental pathways to humans and associated human exposure modes for the release mechanisms given in Table 5.1. Sections 5.3 and 5.4 discuss the environmental transport, food chain, and dosimetric models used to evaluate human exposures due to current or past DOE operations at the site. Input data to the models are evaluated using site-specific (collected under the EM and surveillance activities described earlier in this plan) and generic (default) values.

Models and computer codes for evaluating public exposures to released radionuclides and chemicals are selected based on (1) the applicability of the model to the situation being evaluated, (2) the degree to which the model has been documented and verified, and (3) the availability of the data needed to implement the model.

5.3 TRANSPORT MODELS

This section describes the methodologies that are used to characterize environmental concentrations of materials released from current or past DOE operations. In some cases, transport models are used to predict concentrations; in other cases, measured concentrations are available. When both predicted

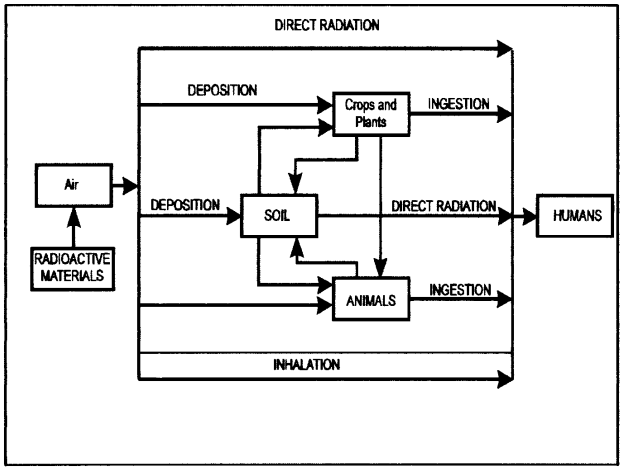


Figure 5.1. Possible Pathways Between Radioactive Materials Released to the Atmosphere and Individuals

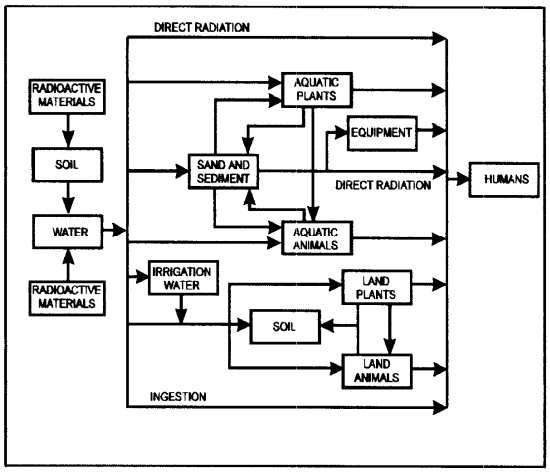


Figure 5.2. Possible Pathways Between Radioactive Materials Released to the Ground or to Surface Waters and Individuals

and measured concentrations are available, the measured concentrations are used to verify modeling predictions.

5.3.1 Atmospheric Transport

Contaminants released to air may be inhaled by individuals or deposit on vegetation that may be consumed by farm animals or humans.

Dose calculations on atmospheric releases are described in Section 5.4.1.

5.3.2 Surface Water Transport

Contaminants released to surface water may remain dissolved or suspended in water, deposit in sediment, deposit on ground or vegetation by irrigation, or infiltrate to infiltrate to the groundwater.

Quantities of radionuclides and chemicals released to surface waters are determined by sampling upstream and downstream of site outfalls in each of the local receiving streams, including Little Bayou Creek, Bayou Creek, and the Ohio River. Concentrations of these substances in surface waters accessible to the public are quantified by sampling.

5.3.3 Groundwater Transport

Contaminants released into groundwater may remain dissolved or suspended in the water and may be deposited by irrigation onto the ground surface and vegetation. Residences north of the plant between the site and the Ohio River historically have used groundwater. Contamination of private wells with both ^{99}Tc and TCE due to releases from historical DOE operations led to a response action in 1988. DOE supplied potable water to affected residents and installed an interim water supply for each resident whose water had TCE above the laboratory reporting limit of 1 ppb. For a long-term water supply, a community water line was extended to the residents with contaminated wells. Irrigation of gardens and watering of livestock using contaminated well water has ceased. Presently, groundwater transport is not modeled, but such modeling is initiated if off-site samples indicate a need for risk assessment purposes.

5.4 ENVIRONMENTAL PATHWAY MODELS

This section describes the methodologies that are used to characterize mechanisms for human uptake and exposure to the contaminant concentrations described in Section 5.3. As in Section 5.3, both modeling and sampling are used to obtain contaminant concentrations in media and foods to which humans may be exposed. In addition, environmental gamma radiation exposure is measured through a TLD program. *Regulatory Guide* 1.109 models (NRC 1977) are used.

5.4.1 Contaminants in Air

The ambient air surrounding the Paducah site is monitored by the Kentucky Cabinet for Health Services to evaluate public exposure to airborne radionuclides. The results of this ambient air monitoring also is used by DOE to demonstrate compliance with state and federal regulations as well as with DOE directives. Figure 5.3 illustrates current air monitoring locations. The DOE contribution to airborne radioactivity from operations at the Paducah site normally is too low to be detected in the presence of natural background radiation in the environment; therefore, as required under 40 *CFR* § 61, Subpart H, potential doses to the public from point sources also are calculated with a dispersion model. This model calculates how measured quantities of released radionuclides mix with the atmosphere, where they travel, how they are mixed in the atmosphere, and where they could deposit. Once the dispersion is calculated, population data and concentration/dose conversion factors are used to calculate individual and population doses. These doses include exposure from all the pathways represented in Figure 5.1, although the primary pathway of exposure is inhalation. The ambient air monitoring data collected from the ambient air monitoring network are used to assess the impact of emissions of all point and fugitive sources.

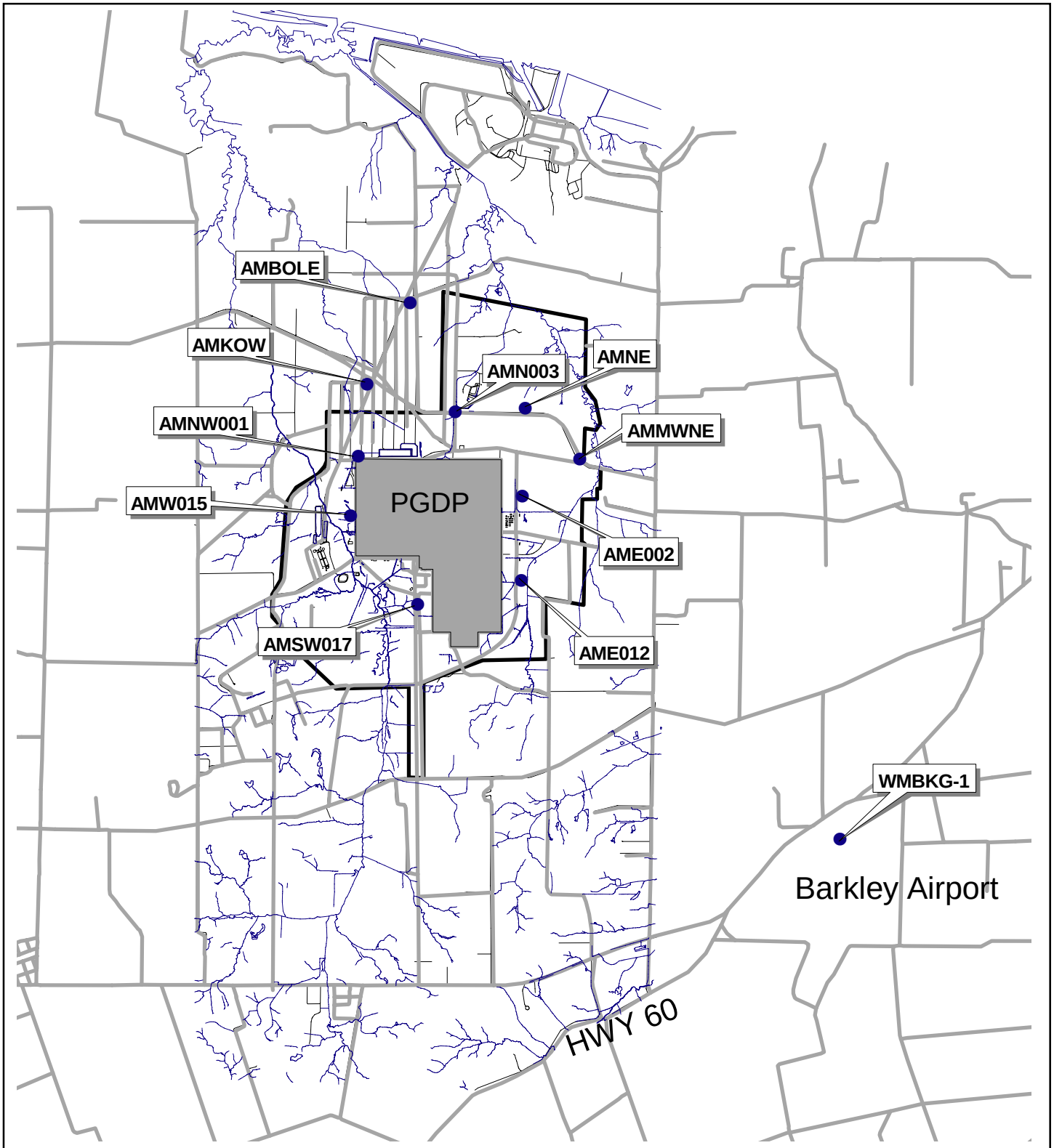
The radiation dose calculations were performed using the CAP-88 computer codes. This package contains EPA's most recent version of the AIRDOS-EPA computer code. The code uses a steady-state, Gaussian plume, atmospheric dispersion model to calculate environmental concentrations of released radionuclides. The code also uses *Regulatory Guide* 1.109 for food chain models to calculate human exposures, both internal and external, to radionuclides deposited in the environment. EPA's latest version of the DARTAB computer code then uses the human exposure values to calculate radiation doses to the public from radionuclides released during the year. The dose calculations use dose conversion factors from the latest version of the RADRISK data file, which EPA provides with CAP-88.

5.4.2 Contaminants in Surface Water

Potential direct pathways of human exposure to contaminants in surface waters include ingestion (drinking water), immersion (swimming, wading, showering), direct irradiation (boating, skiing, shoreline use), and inhalation (breathing water vapor while showering). Indirect pathways involve deposition on soil and crops by irrigation (Section 5.3.2); deposition in sediment (Section 5.3.2); uptake by fish (Section 5.4.7), and ingestion by terrestrial animals (Section 5.4.7). While surface water is not used for drinking or irrigation near the plant, Cairo, Illinois, less than 80.5 km (50 miles) downstream on the Ohio River, has the nearest drinking water intake to the plant. The dose to a Cairo, Illinois, resident from drinking water ingestion (730 liter/year from the Ohio River) is estimated based on samples from Bayou Creek and Little Bayou Creek with the appropriate dilution factors.

5.4.3 Contaminants in Sediment

Discharges from DOE operations to surface waters may result in accumulations in sediment of radionuclides or contaminants of concern. Potential pathways of human exposure from sediment are direct irradiation and ingestion. An example of an indirect pathway involves fish ingesting contaminated sediment and subsequent human ingestion of the fish.



LEGEND:
- Ambient Air Stations
- Streams
- Roads

3000 0 3000 Feet

TRUE NORTH 20° PLANT NORTH

U.S. DEPARTMENT OF ENERGY
DOE PORTSMOUTH/PADUCAH PROJECT OFFICE
PADUCAH GASEOUS DIFFUSION PLANT

PADUCAH Remediation Services
A Portage Shaw Joint Venture Company

Figure 5.3 Paducah Site Ambient Air Monitoring Stations

FIGURE No. emp2009.apr
DATE 1/14/09

External irradiation from contaminated sediment in Little Bayou Creek is a pathway of potential importance. Sediment is known to contain uranium isotopes, neptunium-237, and plutonium-239. Radionuclides deposited on the shores of rivers or creeks may accumulate over a period of time, leading to external irradiation of persons standing on contaminated surfaces. The amount of the nuclides built up on the shoreline depends on the concentration in the water, the depth of deposit, and the length of the period of buildup. The dose to persons depends on the time the contaminants remain on the skin surfaces.

Incidental ingestion of contaminated sediment may result from exposure during fishing, hunting, or other recreational activities. To determine a scenario for exposure time for the Little Bayou Creek area, several assumptions are made. During 1990, WKWMA allowed hunting and dog trials in this area for a period ranging from September 1 to March 30 (213 days). For both the direct irradiation and incidental ingestion pathways, an individual was assumed to hunt every other day (106 days) during this period and spend a total of one-half hour in the Little Bayou Creek bed. This exposure time probably is unrealistically long because signs are posted in this area stating that prolonged exposure could result in a dose above background. The ingestion rate of 50 mg/day incidental soil/sediment intake for adults is based on EPA *Exposure Factors Handbook*, EPA/600/P-95/002Fa (EPA 1997).

5.4.4 Contaminants in Groundwater

Potential direct pathways of human exposure to contaminants in groundwater include ingestion (drinking water), immersion (showering), and inhalation (breathing water vapor while showering). Indirect pathways involve deposition on soil and crops by irrigation (Section 5.4.5) and ingestion by terrestrial animals (Section 5.4.7).

Dose calculations are made for the drinking water pathway if measurable concentrations of radionuclides are found in water samples collected from private drinking water systems. A maximally exposed individual is assumed to ingest 730 liters of water per year containing the measured concentrations of radionuclides per year. These calculations continue to be performed as dictated by the findings of the sampling program. The primary use of the sampling data is to verify that significant quantities of radionuclides and chemicals from DOE operations are not seeping into off-site water supplies. Verification is based on comparison of measured concentrations with federal and state standards and with historical concentrations for each contaminant found.

5.4.5 Contaminants in Soil

DOE operations do not have any potential sources since no significant (i.e., exceeding NESHAP regulatory levels) airborne sources of contaminants have been identified for DOE operations.

5.4.6 Contaminants in or on Vegetation

DOE operations do not have any potential sources since no significant (i.e., exceeding NESHAP regulatory levels) airborne sources of contaminants have been identified for DOE operations.

5.4.7 Contaminants in Terrestrial Animals and Fish

Contaminants may accumulate in terrestrial animals from eating contaminated feed, drinking contaminated water (not modeled), and breathing contaminated air (not modeled). Contaminants may accumulate in fish when they eat contaminated foods and equilibrate with surrounding waters. Potential direct pathways for human exposure to contaminants in terrestrial animals and fish are eating meat, eggs and fish, and in drinking milk. Because bioconcentration factors associated with radionuclides of concern

at the Paducah site in fish, milk, and eggs are low, assessments of these pathways are not performed based on measured concentrations.

A dose assessment from the ingestion of deer meat is performed using measured concentrations of contaminants. For ingestion of deer, the average weight of deer was obtained from the WKWMA manager. The assessment assumes that an individual kills two average-weight deer and consumes the edible portions of these deer during the year.

5.4.8 Radionuclides in Objects

The only identified source of potential exposure to the public from radiation emanating from radionuclides contained in structures and other objects is gamma radiation from the uranium cylinder storage yards.

5.4.9 Waterborne Radionuclides

In 1990, a survey of surface water and groundwater users in the vicinity of the Paducah site was conducted to determine the number of residents using water wells within a 6.4-km (4-mile) radius of the plant site and to determine the number of surface water intakes on the Ohio River within 24.1 km (15 miles) downstream of the plant. No residents or businesses that responded to the survey questionnaire reported using a private surface water intake on the Ohio River, Bayou Creek, or Little Bayou Creek for any part of their water supply. Private groundwater wells were the major water supply for residents surrounding the Paducah site. Most residents reported using water from their residential wells for drinking, irrigation, and domestic uses.

In September 1988, following the discovery of contamination in residential drinking water wells, water was supplied to all wells with contamination. In 1992, a Water Policy was developed, which specified that residents in the Water Policy box were to receive supplied water either through bottled water or municipal water. That effort was completed May 31, 1994.

Under conditions of continuous exposure, members of the public are assumed to ingest 730 liters of drinking water per year. Based on this criterion, the dose of the maximally exposed individual was calculated from drinking well water contaminated with ^{99}Tc at the Safe Drinking Water Act Level is 900 pCi/L. This dose would be 0.85 millirem per year (mrem/year). A risk estimation was prepared for the Phase I Site Investigation to assess the potential risk to individuals who previously might have been exposed to contaminated groundwater based on this dose calculation.

5.5 INTERNAL DOSIMETRY MODELS

The results of all dose calculations are reported in terms of total EDE, the sum of EDEs received during the year from external exposures, plus the 50-year committed EDEs from intake of radionuclides during the year. Dose conversion factors used in the calculations are obtained from the following sources and any revisions to them. Factors that are used in the calculations are given in DOE/EH-0070, *External Dose-Rate Conversion Factors for Calculation of Dose to the Public;* DOE/EH-0071, *Internal Dose Conversion Factors for Calculation of Dose to the Public;* and EPA-520/l-88-020, Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion.* Although not used in specific dose calculations, the DCGs given in DOE Order 5400.5 may be used to infer the acceptability or magnitude of doses associated with measured concentrations of radionuclides in environmental media.

5.6 RADIATION DOSE TO NATIVE AQUATIC ORGANISMS

Compliance to DOE Order 5400.5 with the 1-rad/day absorbed dose rate limit to native aquatic organisms (e.g., invertebrates, fish, and muskrats) is demonstrated using generally accepted methods of dose calculation. Current practice estimates absorbed doses by multiplying measured radionuclide concentrations in surface waters by internationally recognized, organism-specific dose rate factors for external and internal exposures (NRCC 1983) and summing the external and internal contributions. Results from this study are included in the ASER.

5.7 QUALITY ASSURANCE/DATA MANAGEMENT

The DOE prime contractor has responsibility for summarizing EM data and submitting these and background data (e.g., population density, land use, and geographical information) to the Oak Ridge National Laboratory's Office of Environmental Compliance and Documentation (OECD). This office has primary responsibility for performing both radiation and chemical dose calculations. The OECD is responsible for retaining records on input parameters, assumptions, and results of model calculations. The doses are submitted to the DOE contractor for review and inclusion in the ASER. The use of standard EPA or DOE DCGs or analytical models for calculations of doses to the public from exposures resulting from activities from DOE operations ensures comparability and representativeness of the results. If an alternative model or approach is used, approval is obtained from EPA and DOE prior to its use. To verify the concentrations of radionuclides or chemicals in water, measured concentrations are compared to calculated concentrations derived by dividing the total emissions by the total flow.

5.8 REPORTS AND RECORDS

Doses to the maximally exposed individual and to the population are published in the ASER. In addition, if the dose to the maximally exposed individual exceeds 10 mrem in a year, the Paducah site notifies DOE Headquarters. All input data used in dose calculations are considered as records requiring "permanent retention." Chemical doses and doses to aquatic biota are published in the ASER. Doses are compared to applicable standards.

6. REPORTS

6.1 INTRODUCTION

This section provides an overview of the reporting requirements that are followed by the Paducah site for the EMP. These requirements have been established in regulations, statutes, and orders issued by regulatory agencies and by DOE and are addressed specifically in the individual sections of this plan.

It is the policy of DOE to comply with all applicable environmental requirements, and those listed here are subject to supersession and/or amendment as well as being variable in applicability to individual DOE sites or facilities.

6.2 REPORTING REQUIREMENTS

The preparation and disposition of reports relevant to EM are shown in Table 6.1, Applicable Reporting Requirements. The ASER contains a summary for the effluent monitoring and environmental surveillance data for a calendar year. Data that are collected less frequently than annually are contained in each year's reports until new data are available. The ASER includes comparisons of values of contaminants at sampling locations to average reference values or to environmental standards, criteria, or permit limits. All permit activities, such as mitigation action plans, new requirements, or emission sources are described.

The ASER also includes the information from the Superfund Amendments Reauthorization Act (SARA) Title III, Section 313, *Toxic Chemical Release Inventory Report,* on quantities of nonradiological chemical emissions to the environment from unplanned releases. The summary includes additional "large quantity" chemicals used or stored for DOE operations that are not required to be reported by SARA Title III, but are known to be emitted from the facilities.

Table 6.1. Applicable Reporting Requirements

Reporting	Due Date	Source of Requirement	Requirement
Annual Site Environmental Report	October 1	DOE Order 231.1	All DOE facilities that conduct significant environmental protection programs shall prepare an ASER for DOE/OR. The report must provide a comprehensive review of the Environmental Surveillance Programs, status of environmental compliance, and effluent data for nonradioactive pollutants.
Annual NESHAP Compliance Report	June 30	NESHAP 40 *CFR* §61 Subpart H	Reporting shall include results from monitoring of radionuclide emissions to the ambient air, as well as, required dose calculations. Ambient air monitoring data are included in the NESHAP and ASER reports for assessment of fugitive and diffuse emission sources.
Discharge Monitoring Reports	Monthly and Quarterly	Clean Water Act	Discharge Monitoring Reports are required for compliance with the KPDES Permit, KY0004049.
Annual PCB Document	July 1	40 *CFR* § 761.180	The Annual PCB Document is required for PCBs in use and PCB wastes.

Table 6.1. Applicable Reporting Requirements (Continued)

Reporting	Due Date	Source of Requirement	Requirement
SARA Section 313	March 1	SARA Title III	Covered facilities (see above) shall report to EPA and the state, all environmental releases of specified toxic chemicals that are manufactured, processed, or otherwise used in excess of specified thresholds.
C-746-U Landfill Compliance Monitoring Report	Quarterly	401 *KAR* § 47:130	This report is required in accordance with the Landfill Solid Waste Permit, SW07300045.
C-746-U Landfill Waste Quantity and Operations Report	Quarterly	401 *KAR* § 47:130	This report is required in accordance with the Landfill Solid Waste Permit, SW07300045.
C-746-S&T Landfills Compliance Monitoring Report	Quarterly	401 *KAR* § 47:130	This report is required in accordance with the Landfill Solid Waste Permits, SW07300014 and SW07300015.
C-746-S&T Landfills Operations Report	Quarterly	401 *KAR* § 47:130	This report is required in accordance with the Landfill Solid Waste Permits, SW07300014 and SW07300015.
Semiannual C-404 Landfill Groundwater Monitoring Report	May, November	401 *KAR* § 34:060	This report is required in accordance with the Paducah Hazardous Waste Permit, KY8-890-008-982.
C-404 Operating Report	Quarterly	401 *KAR* § 34:060	This report is required in accordance with the Paducah Hazardous Waste Permit, KY8-890-008-982.
Watershed Monitoring Report	April 28 Annually	Clean Water Act	Watershed Monitoring is required by the KPDES Permit, KY0004049.
EM Plan	October 1 Annually	DOE Order 450.1	Conduct EM, as appropriate, to support the site's ISMS; to detect, characterize, and respond to releases from DOE activities; assess impacts; estimate dispersal patterns in the environment; characterize the pathways of exposure to members of the public; characterize the exposures and doses to individuals and to the population; and to evaluate the potential impacts to the biota in the vicinity of the DOE activity.
Groundwater Protection Plan	Three Years August 2010	401 *KAR* § 5:037	This regulation establishes the requirement to prepare and to implement groundwater protection plans to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution.
Contingency Plan for Hazardous Waste Storage	Reviewed Annually, Updated as Needed		A review of the document is required on an annual basis by the Hazardous Waste Permit, KY8-890-008-982.
Best Management Practices Plan	Reviewed Annually, Updated as Needed		This plan is required by the KPDES Permit, KY0004049.

Table 6.1. Applicable Reporting Requirements (Continued)

Reporting	Due Date	Source of Requirement	Requirement
Spill Prevention Control and Countermeasure (SPCC) Plan	Five Years February 2013	40 *CFR* § 112	Requires regulated facilities to prepare and implement a SPCC. The purpose of a SPCC Plan is to form a comprehensive spill prevention program that minimizes the potential for discharges.
Annual External Gamma Monitoring Report	March 15	DOE Order 5400.5	This report estimates the external gamma dose on an annual basis; it also is included in the ASER.

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7. REFERENCES

BJC 2000. *Technical Basis for the Area Dosimeter Program at the Paducah Gaseous Diffusion Plant*, BJC/PAD-225, Bechtel Jacobs Company LLC, Kevil, KY, November.

Clausen, J. L., *et al.* 1992. *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III*, KY/E-150, Martin Marietta Energy Systems, Inc., Paducah Gaseous Diffusion Plant, Paducah, KY, August.

DOE 1994. *Action Memorandum for the Water Policy at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR06-1201&D2, U.S. Department of Energy, June.

EPA 1980. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition, U.S. Environmental Protection Agency, Washington, DC, November.

EPA 1997. *EPA Exposure Factors Handbook,* EPA/600/P-25/002Fa, U.S. Environmental Protection Agency, Washington, DC, August.

Jacobs 1994. *Technical Memorandum for Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, Jacobs Engineering Group, Kevil, KY, March.

Jacobs 1997. *Groundwater Conceptual Model for the Paducah Gaseous Diffusion Plant,* DOE/OR/06-1628&D0, Jacobs Engineering Group, Inc., Kevil, KY, August.

Energy Systems (Martin Marietta Energy Systems, Inc.) 1989. *Paducah Gaseous Diffusion Plant Site Environmental Report for 1988*, Martin Marietta Energy Systems, Paducah Gaseous Diffusion Plant, Paducah, KY, May.

NRC (U.S. Nuclear Regulatory Commission) 1977. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50,* Appendix I, Regulatory Guide 1.109, Revision 1, USNRC, Office of Standards Development, Washington, DC.

NRCC (National Research Council of Canada) 1983. *Radioactivity in the Canadian Aquatic Environment*, Publication No. NRCC 19250, ISSN 0316-0114.

PRS 2006a. *Groundwater Protection Program Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PRS/PROG/0013/R1, Paducah Remediation Services, LLC, June.

PRS 2006b. *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan, Paducah Gaseous Diffusion Plant,* PRS-PROJ-0003, Paducah Remediation Services, LLC, November.

PRS 2007. *C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PRS/ENM/0031/R2, Paducah Remediation Services, LLC, July.

SAIC (Science Applications International Corporation) 1993. *Record of Decision for Interim Remedial Action of the Northwest Plume at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/06-1143&D4, Science Applications International Corporation, Oak Ridge, TN, July.

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APPENDIX A

PADUCAH PERMIT SUMMARY

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DOE PERMIT SUMMARY
FOR THE
PADUCAH GASEOUS DIFFUSION PLANT

Permit Type	Issuer	Expiration Date	Permit Number	Permittee
WATER				
Kentucky Pollutant Discharge Elimination System	Kentucky Division of Water (KDOW)	10/31/2011	KY0004049	Department of Energy (DOE), Paducah Remediation Services, LLC, and Uranium Disposition Services, LLC
Permit to Withdraw Public Water	KDOW	NA	1345	DOE
SOLID WASTE				
C-746-S Residential Landfill (Closure)	Kentucky Division of Waste Management (KDWM)	11/04/2016	SW07300014	DOE/Paducah Remediation Services, LLC
C-746-T Inert Landfill (Closure)	KDWM	11/04/2016	SW07300015	DOE/Paducah Remediation Services, LLC
C-746-U Solid Waste Landfill	KDWM	11/04/2016	SW07300045	DOE/Paducah Remediation Services, LLC
RCRA				
Hazardous Waste Facility Operating Permit	KDWM	10/31/2014	KY8-890-008-982	DOE/Paducah Remediation Services, LLC

DOE COMPLIANCE AGREEMENTS SUMMARY
FOR THE
PADUCAH GASEOUS DIFFUSION PLANT

Agreement	Effective Date	Expiration Date	Entities
TSCA FFCA (Toxic Substances Control Act Federal Facility Compliance Agreement)	03/92	To be determined	EPA and DOE
Federal Facilities Compliance Act Agreed Order / Site Treatment Plan	10/95	2015	KDWM and DOE
Federal Facility Agreement	02/98	Ongoing	KDWM, EPA, and DOE
Agreed Order for Waste, Air, and Water Violations	10/2003	Ongoing	Commonwealth of Kentucky and DOE
Agreed Order for DUF_6 Management	10/2003	Ongoing	KDWM and DOE

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APPENDIX B

MONITORING WELL PROGRAM INVENTORY

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ACRONYMS

404G	C-404 Landfill groundwater well
A	annual inspection
AB	abandoned
AB-IP	abandoned in place
A-TS	inspect only, transducer in well
CARB	residential well sampled under the Carbon Filter Treatment System
CM	construction monitoring well
EW	extraction well
GC	geochemical surveillance well
GWESSA	groundwater environmental surveillance semiannual well
GWNESA	groundwater Northeast Plume semiannual well
GWNWSA	groundwater Northwest Plume semiannual well
GWRESM	groundwater residential monthly well
GWRESA	groundwater residential annual well
KG	C-746-K Landfill groundwater well
LRGA	Lower Regional Gravel Aquifer
MW	monitoring well
NA	not applicable; monitoring well or piezometer abandoned; EW-not sampled under EMP Program
NR	not required
NS	not sampled
PTZ	PTZ Project multiport well
PZ	piezometer
Q	In the Water Level column, "Q" indicates water levels are collected in a suite at the C-746-U Landfill, the C-746-S&T Landfills, or the C-404 Landfill. In the Inspection column, "Q" indicates a quarterly inspection is required.
R	residential well
RGA	Regional Gravel Aquifer
SG	C-746-S & -T Landfill groundwater well
UCRS	Upper Continental Recharge System
UG	C-746-U Landfill groundwater well
Unknown	information is unknown, cannot be confirmed, or is unavailable
URGA	Upper Regional Gravel Aquifer
W	A well with physical characteristics not considered typical of a monitoring well
WLA	water level collected annually
WLQ	water level collected quarterly

.

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW1	RGA	AB 94	NA	NA	NA
MW2	Unknown	AB 88	NA	NA	NA
MW3	Unknown	AB 88	NA	NA	NA
MW4	Unknown	AB 88	NA	NA	NA
MW5	Unknown	AB 88	NA	NA	NA
MW6	Unknown	AB 88	NA	NA	NA
MW7	UCRS	AB 94	NA	NA	NA
MW8	RGA	AB 94	NA	NA	NA
MW9	RGA	AB 94	NA	NA	NA
MW10	RGA	AB	NA	NA	NA
MW11	UCRS	AB 94	NA	NA	NA
MW12	RGA	AB 94	NA	NA	NA
MW13	UCRS	AB 94	NA	NA	NA
MW14	UCRS	AB 94	NA	NA	NA
MW15	RGA	AB 94	NA	NA	NA
MW16	UCRS	AB 94	NA	NA	NA
MW17	RGA	AB 94	NA	NA	NA
MW18	UCRS	AB 94	NA	NA	NA
MW19	RGA	AB 94	NA	NA	NA
MW20	RGA	Current	GC	NS	A
MW21	RGA	AB 94	NA	NA	NA
MW22	RGA	AB 94	NA	NA	NA
MW23	Porters Creek Clay Well	AB 94	NA	NA	NA
MW24	Porters Creek Clay Well	AB 94	NA	NA	NA
MW25	Porters Creek Clay Well	AB 94	NA	NA	NA
MW26	Porters Creek Clay Well	AB 94	NA	NA	NA
MW27	Porters Creek Clay Well	AB 94	NA	NA	NA
MW28	UCRS	AB 94	NA	NA	NA
MW29	UCRS	AB 94	NA	NA	NA
MW30	UCRS	AB 94	NA	NA	NA
MW31	UCRS	AB 94	NA	NA	NA
MW32	UCRS	AB 94	NA	NA	NA
MW33	UCRS	AB	NA	NA	NA
MW34	UCRS	AB 94	NA	NA	NA
MW35	UCRS	AB 94	NA	NA	NA
MW36	UCRS	AB 94	NA	NA	NA

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW37	UCRS	AB 94	NA	NA	NA
MW38	RGA	AB 94	NA	NA	NA
MW39	RGA	AB 94	NA	NA	NA
MW40	RGA	AB 94	NA	NA	NA
MW41	RGA	AB 94	NA	NA	NA
MW42	RGA	AB 94	NA	NA	NA
MW43	RGA	AB 94	NA	NA	NA
MW44	RGA	AB 94	NA	NA	NA
MW45	RGA	AB 87	NA	NA	NA
MW46	RGA	AB 94	NA	NA	NA
MW47	UCRS	AB 94	NA	NA	NA
MW48	RGA	AB 94	NA	NA	NA
MW49	UCRS	AB 94	NA	NA	NA
MW50	RGA	AB 94	NA	NA	NA
MW51	RGA	AB 94	NA	NA	NA
MW52	RGA	AB 94	NA	NA	NA
MW53	RGA	AB 94	NA	NA	NA
MW54	RGA	AB 94	NA	NA	NA
MW55	RGA	AB 87	NA	NA	NA
MW56	UCRS	AB 87	NA	NA	NA
MW57	UCRS	AB 94	NA	NA	NA
MW58	UCRS	AB 90	NA	NA	NA
MW59	RGA	AB	NA	NA	NA
MW60	UCRS	AB	NA	NA	NA
MW61	RGA	AB	NA	NA	NA
MW62	RGA	AB	NA	NA	NA
MW63	RGA	Current	GWESSA	WLQ	A
MW64	UCRS	Current	NS	WLA	A
MW65	RGA	Current	NS	WLA	A
MW66	RGA	Current	GWESSA	WLQ	A
MW67	RGA	Current	GWESSA	Q	A
MW68	RGA	Current	NS	WLA	A
MW69	UCRS	Current	NS	WLA	A
MW70	RGA	AB 94	NA	NA	NA
MW71	RGA	Current	NS	WLQ	A
MW72	RGA	Current	NS	WLA	A
MW73	RGA	Current	NS	WLA	A
PZ74	UCRS	Current	NS	WLA	A
MW75	UCRS	Current	NS	WLA	A
MW76	RGA	Current	GWESSA	Q	A
MW77	RGA	Current	NS	WLA	A
MW78	RGA	Current	NS	WLA	A
MW79	RGA	Current	NS	WLA	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW80	RGA	Current	NS	WLA	A
MW81	RGA	Current	NS	WLA	A
MW82	UCRS	Current	NS	WLA	A
MW83	UCRS	Current	NS	WLA	A
MW84	RGA	Current	404G	Q	A
MW85	UCRS	Current	404G	Q	A
MW86	RGA	Current	GWESSA	Q	A
MW87	RGA	Current	404G	Q	A
MW88	UCRS	Current	404G	Q	A
MW89	RGA	Current	GWESSA	Q	A
MW90	RGA	AB 2001	NA	NA	NA
MW90A	RGA	Current	404G	Q	A
MW91	UCRS	Current	404G	Q	A
MW92	RGA	Current	GWESSA	Q	A
MW93	RGA	Current	404G	Q	A
MW94	UCRS	Current	404G	Q	A
MW95	RGA	AB 2001	NA	NA	NA
MW95A	RGA	Current	GWESSA	Q	A
MW96	UCRS	Current	NS	WLA	A
MW97	RGA	AB 97	NA	NA	NA
MW98	RGA	Current	GWESSA	Q	A
MW99	RGA	Current	GWESSA, GC	WLQ	A
MW100	RGA	Current	GWESSA, GC	Q	A
PZ101	RGA	Current	NS	WLQ	A
MW102	McNairy	Current	NS	WLQ	A
MW103	RGA	Current	GWESSA	WLQ	A
MW104	UCRS	AB 96	NA	NA	NA
MW105	RGA	AB	NA	NA	NA
MW106	RGA	Current	GWESSA	WLQ	A
PZ107	RGA	Current	NS	WLQ	A
W108	RGA	Current	NS	WLA	A
PZ109	RGA	Current	NS	WLA	A
PZ110	RGA	Current	NS	WLA	A
PZ111	UCRS	Current	NS	WLA	A
PZ112	RGA	Current	NS	WLA	A
PZ113	RGA	Current	NS	WLA	A-TS
PZ114	McNairy	Current	NS	WLA	A
PZ115	McNairy	Current	NS	WLQ	A
PZ116	RGA	Current	NS	WLA	A
PZ117	RGA	Current	NS	WLQ	A
PZ118	RGA	Current	NS	WLQ	A
MW119	RGA	AB	NA	NA	NA
MW120	McNairy	Current	NS	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW121	McNairy	Current	NS	WLQ	A
MW122	McNairy	Current	NS	WLQ	A
MW123	RGA	Current	NS	WLQ	A
MW124	RGA	Current	GWNESA	NS	A
MW125	RGA	Current	GWESSA, GC	Q	A
MW126	RGA	Current	GWNESA	WLQ	A
MW127	UCRS	AB-IP	NA	NA	NA
MW128	UCRS	AB-IP	NA	NA	NA
MW129	Terrace Gravels	AB-IP	NA	NA	NA
MW130	Terrace Gravels	AB-IP	NA	NA	NA
MW131	Terrace Gravels	AB-IP	NA	NA	NA
MW132	RGA	Current	NS	WLA	A
MW133	McNairy	Current	NS	WLQ	A
MW134	RGA	Current	GWESSA, GC	WLQ	A
MW135	RGA	Current	GWESSA	NS	A
MW136	UCRS	AB	NA	NA	NA
MW137	RGA	Current	NS	WLQ	A
MW138	UCRS	Current	NS	WLA	A
MW139	RGA	Current	GWESSA	Q	A
MW140	McNairy	AB	NA	NA	NA
MW141	RGA	AB 98	NA	NA	NA
MW142	RGA	AB 98	NA	NA	NA
MW143	UCRS	AB 98	NA	NA	NA
MW144	RGA	Current	NS	WLA	A
MW145	RGA	Current	GWNESA, GC	NS	A
MW146	RGA	Current	GWESSA	WLQ	A
MW147	RGA	Current	NS	WLA	A
MW148	RGA	Current	GWESSA	WLA	A
MW149	UCRS	Current	GWESSA	WLA	A
MW150	RGA	Current	GWESSA	WLQ	A
MW151	Terrace Gravels	Current	NS	WLQ	A
MW152	RGA	Current	GWESSA, GC	WLQ	A
MW153	UCRS	Current	NS	WLA	A
MW154	UCRS	Current	NS	WLA	A
MW155	RGA	Current	GWESSA	NS	A
MW156	RGA	Current	GWESSA	WLQ	A
MW157	UCRS	Current	NS	WLA	A
MW158	RGA	AB 99	NA	NA	NA
MW159	RGA	AB 99	NA	NA	NA
MW160	UCRS	AB 99	NA	NA	NA
MW161	RGA	Current	GWESSA, GC	WLQ	A
MW162	UCRS	Current	NS	WLA	A
MW163	RGA	Current	GWESSA, GC	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW164	UCRS	Current	NS	WLA	A
MW165	RGA	Current	GWESSA	Q	A
MW166	UCRS	Current	NS	WLA	A
MW167	UCRS	Current	NS	WLA	A
MW168	RGA	Current	GWESSA	WLQ	A
MW169	RGA	Current	GWESSA	WLQ	A
MW170	UCRS	Current	NS	WLA	A
MW171	UCRS	Current	NS	WLA	A
MW172	UCRS	Current	NS	WLA	A
MW173	RGA	Current	GWESSA	Q	A
MW174	UCRS	Current	GWESSA	NS	A
MW175	RGA	Current	400	WLQ	A
MW176	UCRS	Current	NS	WLA	A
MW177	UCRS	Current	NS	WLA	A
MW178	RGA	Current	NS	WLQ	A
MW179	RGA	AB 2003	NA	NA	NA
MW180	UCRS	Current	NS	WLA	A
MW181	RGA	AB 2000	NA	NA	NA
MW182	UCRS	Current	GWESSA	NS	A
183, Not Installed	NA	NA	NA	NA	NA
MW184	UCRS	AB 98	NA	NA	NA
MW185	RGA	Current	NS	WLQ	A
MW186	UCRS	Current	GWESSA	NS	A
MW187	UCRS	Current	GWESSA	NS	A
MW188	RGA	Current	GC	WLQ	A
MW189	UCRS	Current	NS	WLA	A
MW190	UCRS	Current	NS	WLA	A
MW191	RGA	Current	GWESSA	WLQ	A
MW192	UCRS	Current	NS	WLA	A
MW193	RGA	Current	GWESSA, GC	Q	A
MW194	RGA	Current	GWESSA	WLQ	A
MW195	UCRS	AB 94	NA	NA	NA
MW196	Terrace Gravels	Current	NS	WLQ	A
MW197	RGA	Current	GWESSA	Q	A
MW198	UCRS	Current	NS	WLA	A
MW199	RGA	Current	GWESSA	WLQ	A
MW200	RGA	Current	GWESSA	Q	A
MW201	RGA	Current	GWESSA, GC	WLQ	A
MW202	RGA	Current	GWESSA	WLQ	A
MW203	RGA	Current	GWESSA	WLQ	A
MW204	UCRS	Current	NS	WLA	A
MW205	RGA	Current	GWESSA	WLQ	A
MW206	RGA	Current	GWESSA, GC	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW207	UCRS	Current	NS	WLA	A
MW208	UCRS	Current	NS	WLA	A
MW209	UCRS	Current	NS	WLA	A
MW210	UCRS	Current	NS	WLA	A
MW211	UCRS	Current	NS	WLA	A
MW212	UCRS	Current	NS	WLA	A
MW213	UCRS	Current	NS	WLA	A
MW214	UCRS	Current	NS	WLA	A
MW215	UCRS	Current	NS	WLA	A
MW216	UCRS	Current	NS	WLA	A
MW217	UCRS	Current	NS	WLA	A
MW218	UCRS	Current	NS	WLA	A
MW219	UCRS	Current	NS	WLA	A
MW220	RGA	Current	SG	Q	A
MW221	RGA	Current	SG	Q	A
MW222	RGA	Current	SG	Q	A
MW223	RGA	Current	SG	Q	A
MW224	RGA	Current	SG	Q	A
MW225	RGA	Current	NS	Q	A
MW226	RGA	Current	GWESSA	Q	A
MW227	RGA	Current	GWESSA	Q	A
EW228	RGA	NA	NS	NS	NR
EW229	RGA	NA	NS	NS	NR
EW230	RGA	NA	NS	NS	NR
EW231	RGA	NA	NS	NS	NR
232, Not Installed	NA	NA	NA	NA	NA
MW233	RGA	Current	GWNWSA	WLQ	A
MW234	RGA	AB 2002	NA	NA	NA
MW235	RGA	AB 2002	NA	NA	NA
MW236	RGA	Current	GWNWSA	WLQ	A
MW237	UCRS	Current	NS	WLQ	A
MW238	RGA	Current	GWNWSA	WLQ	A
MW239	McNairy	Current	NS	WLQ	A
MW240	RGA	Current	GWNWSA	WLQ	A
MW241	RGA	AB 2003	NA	NA	NA
MW241A	RGA	Current	NS	WLQ	A
MW242	RGA	Current	GWNWSA, GC	WLQ	A
MW243	RGA	Current	GWNWSA, GC	WLQ	A
MW244	RGA	Current	GWNWSA	WLQ	A
MW245	RGA	Current	GWNWSA	WLQ	A
MW246	UCRS	Current	NS	WLQ	A
MW247	McNairy	Current	NS	WLQ	A
MW248	RGA	Current	GWNWSA	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW249	RGA	Current	NS	WLQ	A
MW250	RGA	Current	GWNWSA	WLQ	A
PZ251	UCRS	Current	NS	WLA	A
MW252	RGA	Current	GWESSA	WLA	A
MW253	RGA	Current	GWESSA	WLA	A
254, Not Installed	NA	NA	NA	NA	NA
MW255	RGA	Current	GWNESA, GC	NS	A
MW256	RGA	Current	GWNESA, GC	NS	A
MW257	RGA	Current	GC	WLQ	A
MW258	RGA	Current	GWNESA, GC	NS	A
259, Not Installed	NA	NA	NA	NA	NA
MW260	RGA	Current	GWESSA, GC	NS	A
MW261	RGA	Current	GWESSA, GC	NS	A
MW262	RGA	Current	GWESSA	NS	A
MW263	RGA	AB 2003	NA	NA	NA
MW264	RGA	AB 2003	NA	NA	NA
MW265	RGA	AB 2000	NA	NA	NA
MW266	RGA	AB 2003	NA	NA	NA
MW267	RGA	AB 2003	NA	NA	NA
MW268	RGA	AB 2002	NA	NA	NA
MW269	RGA	AB 2002	NA	NA	NA
MW270	RGA	AB 2000	NA	NA	NA
MW271	RGA	AB 2002	NA	NA	NA
MW272	RGA	AB 2002	NA	NA	NA
MW273	RGA	AB 2002	NA	NA	NA
MW274	RGA	AB 2002	NA	NA	NA
MW275	RGA	AB 2002	NA	NA	NA
MW276	RGA	AB 2002	NA	NA	NA
MW277	RGA	AB 2000	NA	NA	NA
PZ278	UCRS	AB 97	NA	NA	NA
PZ279	UCRS	AB 97	NA	NA	NA
PZ280	UCRS	AB 97	NA	NA	NA
PZ281	UCRS	AB 97	NA	NA	NA
PZ282	UCRS	AB 97	NA	NA	NA
MW283	RGA	Current	GWNESA	NS	A
MW284	RGA	Current	NS	WLA	A
285, Not Installed	NA	NA	NA	NA	NA
286, Not Installed	NA	NA	NA	NA	NA
PZ287	RGA	Current	NS	WLA	A
MW288	RGA	Current	GWNESA, GC	NS	A
PZ289	RGA	Current	NS	WLA	A
PZ290	RGA	Current	NS	WLA	A
MW291	RGA	Current	GWNESA, GC	NS	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW292	RGA	Current	GWNESA, GC	NS	A
MW293	RGA	AB 2003	NA	NA	NA
MW293A	RGA	Current	GWNESA	NS	A
MW294	RGA	AB 2003	NA	NA	NA
MW294A	RGA	Current	NS	WLA	A
295, Not Installed	NA	NA	NA	NA	NA
296, Not Installed	NA	NA	NA	NA	NA
297, Not Installed	NA	NA	NA	NA	NA
298, Not Installed	NA	NA	NA	NA	NA
299, Not Installed	NA	NA	NA	NA	NA
MW300	Terrace Gravels	Current	KG	WLQ	A
MW301	Terrace Gravels	Current	KG	WLQ	A
MW302	Terrace Gravels	Current	KG	WLQ	A
MW303	Terrace Gravels	AB 94	NA	NA	NA
MW304	Terrace Gravels	Current	NS	WLA	A
MW305	Eocene	Current	GWESSA	WLQ	A
MW306	Eocene	Current	NS	WLA	A
MW307	Eocene	Current	NS	WLA	A
MW308	Eocene	Current	NS	WLA	A
MW309	Terrace Gravels	Current	NS	WLA	A
MW310	Terrace Gravels	Current	NS	WLA	A
MW311	Terrace Gravels	Current	NS	WLQ	A
MW312	UCRS	Current	NS	WLA	A
MW313	UCRS	Current	NS	WLA	A
MW314	UCRS	Current	NS	WLA	A
MW315	UCRS	Current	NS	WLA	A
MW316	UCRS	Current	NS	WLA	A
MW317	Terrace Gravels	Current	NS	WLA	A
MW318	Terrace Gravels	Current	NS	WLA	A
319, Not Installed	NA	NA	NA	NA	NA
320, Not Installed	NA	NA	NA	NA	NA
321, Not Installed	NA	NA	NA	NA	NA
322, Not Installed	NA	NA	NA	NA	NA
323, Not Installed	NA	NA	NA	NA	NA
324, Not Installed	NA	NA	NA	NA	NA
MW325	RGA	Current	NS	WLQ	A
MW326	RGA	Current	NS	WLA	A
MW327	RGA	Current	NS	WLQ	A
MW328	RGA	Current	GWESSA, GC	NS	A
MW329	RGA	Current	GWESSA, GC	NS	A
MW330	RGA	Current	NS	WLA	A
EW331	RGA	NA	NS	NS	NR
EW332	RGA	NA	NS	NS	NR

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW333	RGA	Current	GWESSA	Q	A
PZ334	UCRS	Current	NS	WLA	A
PZ335	UCRS	Current	NS	WLA	A
PZ336	UCRS	Current	NS	WLA	A
MW337	RGA	Current	GWESSA	Q	A
MW338	RGA	Current	GWESSA	Q	A
MW339	RGA	Current	GWESSA, GC	NS	A
MW340	RGA	Current	GWESSA	NS	A
MW341	RGA	Current	GWESSA	WLQ	A
MW342	RGA	Current	400	WLQ	A
MW343	RGA	Current	400	WLQ	A
MW344	Terrace Gravels	Current	KG	WLQ	A
MW345	Rubble Zone	Current	GWESSA	NS	A
MW346	Rubble Zone	Current	NS	WLA	A
MW347	Rubble Zone	Current	NS	WLA	A
PZ348	UCRS	Current	NS	WLA	A
PZ349	RGA	Current	NS	WLA	A
PZ350	UCRS	Current	NS	WLA	A
PZ351	RGA	Current	NS	WLA	A
MW352	RGA	AB 2002	NA	NA	NA
MW353	RGA	Current	NS	Q	A
MW354	RGA	Current	GWESSA	NS	A
MW355	RGA	Current	GWESSA	NS	A
MW356	McNairy	Current	GWESSA	NS	A
MW357	URGA	Current	UG	Q	A
MW358	LRGA	Current	UG	Q	A
MW359	UCRS	Current	UG	Q	A
MW360	URGA	Current	UG	Q	A
MW361	LRGA	Current	UG	Q	A
MW362	UCRS	Current	UG	Q	A
MW363	URGA	Current	UG	Q	A
MW364	LRGA	Current	UG	Q	A
MW365	UCRS	Current	UG	Q	A
MW366	URGA	Current	UG	Q	A
MW367	LRGA	Current	UG	Q	A
MW368	UCRS	Current	UG	Q	A
MW369	URGA	Current	UG/SG	Q	A
MW370	LRGA	Current	UG/SG	Q	A
MW371	UCRS	Current	UG	Q	A
MW372	URGA	Current	UG/SG	Q	A
MW373	LRGA	Current	UG/SG	Q	A
MW374	UCRS	Current	UG	Q	A
MW375	URGA	Current	UG	Q	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW376	LRGA	Current	UG	Q	A
MW377	UCRS	Current	UG	Q	A
378, Not Installed	NA	NA	NA	NA	NA
379, Not Installed	NA	NA	NA	NA	NA
MW380	RGA	Current	GWNWSA	WLQ	A
MW381	RGA	Current	GWNWSA, GC	WLQ	A
382, Not Installed	NA	NA	NA	NA	NA
383, Not Installed	NA	NA	NA	NA	NA
MW384	URGA	Current	SG	Q	A
MW385	LRGA	Current	SG	Q	A
MW386	UCRS	Current	SG	Q	A
MW387	URGA	Current	SG	Q	A
MW388	LRGA	Current	SG	Q	A
MW389	UCRS	Current	SG	Q	A
MW390	UCRS	Current	SG	Q	A
MW391	URGA	Current	SG	Q	A
MW392	LRGA	Current	SG	Q	A
MW393	UCRS	Current	SG	Q	A
MW394	URGA	Current	SG	Q	A
MW395	LRGA	Current	SG	Q	A
MW396	UCRS	Current	SG	Q	A
MW397	LRGA	Current	SG	Q	A
398, Not Installed	NA	NA	NA	NA	NA
399, Not Installed	NA	NA	NA	NA	NA
400, Not Installed	NA	NA	NA	NA	NA
MW401	RGA	Current	NS	WLA	A
MW402	RGA	Current	NS	WLA	A
MW403	RGA	Current	GWESSA, GC	NS	A
MW404	RGA	Current	GWESSA, GC	NS	A
MW405	RGA	Current	GWESSA	NS	A
MW406	RGA	Current	GWESSA	NS	A
MW407	RGA	Current	GWESSA	NS	A
MW408	RGA	Current	GWESSA	NS	A
MW409	RGA	Current	GWESSA, GC	WLQ	A
MW410	RGA	Current	GWESSA	WLQ	A
MW411	RGA	Current	GWESSA	WLQ	A
412, Not Installed	NA	NA	NA	NA	NA
413, Not Installed	NA	NA	NA	NA	NA
MW414	RGA	Current	GWESSA, GC	Q	A
MW415	RGA	Current	GWESSA	WLQ	A
MW416	RGA	Current	GWESSA	Q	A
MW417	RGA	Current	GWESSA	WLQ	A
MW418	RGA	Current	GWESSA	Q	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW419	RGA	Current	GWESSA	Q	A
MW420	URGA	Current	404G	Q	A
MW421	RGA	Current	400	WLA	A
MW422	RGA	Current	400	WLA	A
MW423	RGA	Current	400	WLA	A
MW424	RGA	Current	400	WLA	A
MW425	RGA	Current	400	WLA	A
MW426	RGA	Current	GWESSA, GC	WLQ	A
MW427	RGA	Current	GWESSA, GC	WLQ	A
MW428	RGA	Current	GWESSA	WLQ	A
MW429	RGA	Current	GWESSA	WLQ	A
MW430	RGA	Current	GWESSA	WLQ	A
MW431	RGA	Current	GWESSA	WLQ	A
MW432	RGA	Current	GWESSA	WLQ	A
MW433	RGA	Current	GWESSA	WLQ	A
MW434	RGA	Current	GWESSA	WLQ	A
MW435	RGA	Current	GWESSA	WLQ	A
MW436	RGA	Current	GWESSA	WLQ	A
MW437	RGA	Current	GWESSA	WLQ	A
MW438	RGA	Current	GWESSA	WLQ	A
MW439	RGA	Current	GWESSA, GC	WLQ	A
MW440	RGA	Current	GWESSA	WLQ	A
MW441	RGA	Current	GWESSA, GC	WLQ	A
MW442	RGA	Current	GWESSA	WLQ	A
MW443	RGA	Current	GWESSA	WLQ	A
MW444	RGA	Current	GWESSA	WLQ	A
MW445	RGA	Current	GWESSA	WLQ	A
MW446	RGA	Current	GWESSA	WLQ	A
MW447	RGA	Current	GWESSA, GC	WLQ	A
MW448	RGA	Current	GWESSA	WLQ	A
MW449	RGA	Current	GWESSA	WLQ	A
MW450	RGA	Current	GWESSA	WLQ	A
MW451	RGA	Current	GWESSA	WLQ	A
MW452	RGA	Current	GWESSA	WLQ	A
MW453	RGA	Current	GWESSA	WLQ	A
MW454	RGA	Current	GWESSA	WLQ	A
MW455	RGA	Current	GWESSA	WLQ	A
MW456	RGA	Current	GWESSA	WLQ	A
MW457	RGA	Current	GWESSA	WLQ	A
MW458	RGA	Current	GWESSA	WLQ	A
MW459	RGA	Current	GWESSA	WLQ	A
MW460	RGA	Current	GWESSA	WLQ	A
MW461	RGA	Current	GWESSA	WLQ	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
MW462	RGA	Current	GWESSA	WLQ	A
MW463	RGA	Current	GWESSA	WLQ	A
MW464	RGA	Current	GWESSA	WLQ	A
MW465	RGA	Current	GWESSA	WLQ	A
MW466	RGA	Current	GWESSA	WLQ	A
MW467	RGA	Current	GWESSA	WLQ	A
MW468	RGA	Current	GWESSA, GC	WLQ	A
MW469	RGA	Current	GWESSA	WLQ	A
MW470	RGA	Current	GWESSA	WLQ	A
MW471	RGA	Current	GWESSA	WLQ	A
MW472	RGA	Current	GWESSA	WLQ	A
MW473	RGA	Current	GWESSA, GC	WLQ	A
MW474	RGA	Current	GWESSA, GC	WLQ	A
MW475	RGA	Current	GWESSA	WLQ	A
MW476	RGA	Current	GWESSA	WLQ	A
MW477	RGA	Current	GWESSA	WLQ	A
MW478	RGA	Current	GWESSA	WLQ	A
MW479	RGA	Current	GWESSA	WLQ	A
MW480	RGA	Current	GWESSA	WLQ	A
MW481	RGA	Current	GWESSA	WLQ	A
MW482	RGA	Current	GWESSA	WLQ	A
MW483	RGA	Current	GWESSA	WLQ	A
MW484	RGA	Current	GWESSA	WLQ	A
MW485	RGA	Current	GWESSA	WLQ	A
MW486	RGA	Current	GWESSA	WLQ	A
MW487	RGA	Current	GWESSA	WLQ	A
MW488	RGA	Current	GWESSA	WLQ	A
MW489	RGA	Current	GWESSA	WLQ	A
MW490	RGA	Current	GWESSA, GC	WLQ	A
MW491	RGA	Current	GWESSA	WLQ	A
MW492	RGA	Current	GWESSA	WLQ	A
MW493	RGA	Current	GWESSA	WLQ	A
MW494	RGA	Current	GWESSA	WLQ	A
PZ5G	Unknown	Current	NS	WLA	A
PZ5S	Unknown	Current	NS	WLA	A
Z12	Unknown	Current	NS	WLQ	A
Z16	Unknown	Current	NS	WLQ	A
CM01	PTZ Project	Current	NS	WLA	A
CM02	PTZ Project	Current	NS	WLA	A
CM03	PTZ Project	Current	NS	WLA	A
CM04	PTZ Project	Current	NS	WLA	A
CM05	PTZ Project	Current	NS	WLA	A
CM06	PTZ Project	Current	NS	WLA	A

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
CM07	PTZ Project	Current	NS	WLA	A
CM08	PTZ Project	Current	NS	WLA	A
CM09	PTZ Project	Current	NS	WLA	A
CM10	PTZ Project	Current	NS	WLA	A
CM11	PTZ Project	Current	NS	WLA	A
CM12	PTZ Project	Current	NS	WLA	A
R2	Unknown	Current	GWRESA	NS	A[2]
R5	Unknown	Current	NS	NS	A[2]
R9	Unknown	Current	GWRESA	NS	A[2]
R10	Unknown	Current	NS	NS	A[2]
R12	Unknown	Current	GWRESA	NS	A[2]
R13	Unknown	Current	GWRESA	NS	A[2]
R14	Unknown	Current	GWRESA	NS	A[2]
R16	Unknown	Current	NS	NS	A[2]
R17[1]	Unknown	Current	NS	NS	A[2]
R18[1]	Unknown	Current	NS	NS	A[2]
R19	Unknown	Current	GWRESA	NS	A[2]
R20	RGA	Current	GWRESA	NS	A[2]
R21	Unknown	Current	GWRESA	NS	A[2]
R22	Unknown	Current	NS	NS	A[2]
R23	Unknown	Current	GWRESA	NS	A[2]
R24[1]	Unknown	Current	NS	NS	A[2]
R25	Unknown	Current	NS	NS	A[2]
R27	Unknown	Current	NS	NS	A[2]
R28	Unknown	Current	NS	NS	A[2]
R31	Unknown	Current	NS	NS	A[2]
R39	Unknown	Current	NS	NS	A[2]
R40	Unknown	Current	NS	NS	A[2]
R53	Unknown	Current	NS	NS	A[2]
R65	Unknown	Current	NS	NS	A[2]
R68	Unknown	Current	NS	NS	A[2]
R69	Unknown	Current	NS	NS	A[2]
R72	Unknown	Current	NS	NS	A[2]
R82	Unknown	Current	NS	NS	A[2]
R83	Unknown	Current	GWRESA	NS	A[2]
R90	Unknown	Current	GWRESA	NS	A[2]
R113	Unknown	Current	NS	NS	A[2]
R114	Unknown	Current	GWRESA	NS	A[2]
R245	Unknown	Current	NS	NS	A[2]
R246[1]	Unknown	Current	NS	NS	A[2]
R278	Unknown	Current	NS	NS	A[2]
R293	Unknown	Current	NS	NS	A[2]
R294	RGA	Current	GWRESM	NS	A[2]

Monitoring Well Program Inventory					
Well Number	**Screened Zone**	**Status**	**Sampled**	**Water Level**	**Inspection**
R295	Unknown	Current	NS	NS	A[2]
R297	Unknown	Current	NS	NS	A[2]
R278	Unknown	Current	NS	NS	A[2]
R299	Unknown	Current	NS	NS	A[2]
R302	RGA	Current	GWRESM	NS	A[2]
R381	Unknown	Current	NS	NS	A[2]
R382	Unknown	Current	NS	NS	A[2]
R384	RGA	Current	GWRESA	NS	A[2]
R386	Unknown	Current	NS	NS	A[2]
R387	RGA	Current	GWRESA	NS	A[2]
R392	RGA	Current	GWRESA	NS	A[2]
R424	RGA	Current	CARB	NS	A[2]
R434	Unknown	Current	NS	NS	A[2]
R512[1]	Unknown	Current	NS	NS	A[2]
R517	Unknown	Current	NS	NS	A[2]
R518	Unknown	Current	NS	NS	A[2]
R519	Unknown	Current	NS	NS	A[2]
R520	Unknown	Current	NS	NS	A[2]
R521	Unknown	Current	NS	NS	A[2]
R522	Unknown	Current	NS	NS	A[2]
R523	Unknown	Current	NS	NS	A[2]
R524	Unknown	Current	NS	NS	A[2]
R525	Unknown	Current	NS	NS	A[2]
R527	Unknown	Current	NS	NS	A[2]
R528	Unknown	Current	NS	NS	A[2]
R529	Unknown	Current	NS	NS	A[2]
R530	Unknown	Current	NS	NS	A[2]
R531	Unknown	Current	NS	NS	A[2]
R532	Unknown	Current	NS	NS	A[2]
R533	Unknown	Current	NS	NS	A[2]
R534	Unknown	Current	NS	NS	A[2]
R537	Unknown	Current	NS	NS	A[2]
R540	Unknown	Current	NS	NS	A[2]
R541	Unknown	Current	NS	NS	A[2]

[1]No current License Agreement with resident; no access to property.

[2]Annual inspection required for capping and locking only.

QUARTERLY WATER LEVEL SUITES AT LANDFILLS

Quarterly water levels are collected in support of the quarterly landfill groundwater monitoring program for reporting groundwater flow rate and direction. Wells at the following landfills are sampled in a suite within as short a time period as possible. Non-commitment wells are those wells which are also measured within that time period but, the data is for information purposes only.

C-404 Landfill[1] Quarterly Water Levels (9) Permitted Wells
MW84
MW87
MW90A
MW85
MW88
MW91
MW93
MW420
MW94
Commitment Wells (7)
MW 67
MW76
MW227
MW333
MW337
MW414
MW416
Non-Commitment Wells (6)
MW86
MW89
MW92
MW95A
MW226
MW338

C-746-U Landfill Quarterly Water Levels (21) Permitted Wells	
MW357	MW368
MW358	MW369[2]
MW359	MW370[2]
MW360	MW371
MW361	MW372[2]
MW362	MW373[2]
MW363	MW374
MW364	MW375
MW365	MW376
MW366	MW377
MW367	
Non-Commitment Wells (9)	
MW 98	MW173
MW100	MW193
MW125	MW197
MW139	MW200
MW165	

C-746-S&T Landfill Quarterly Water Levels (25) Permitted Wells
MW220
MW221
MW222
MW223
MW224
MW225[3]
MW353[3]
MW384
MW385
MW386
MW387
MW388
MW389
MW390
MW391
MW392
MW393
MW394
MW395
MW396
MW397
MW369[2]
MW370[2]
MW372[2]
MW373[2]
Non-Commitment Wells (2)
MW418
MW419

[1] Per a DOE commitment (pertaining to C-404 Landfill permitting process), quarterly water level measurements will be taken for seven additional wells, that were not cited within the permit, within a 24 hour window of when water level measurements are collected on the C-404 permitted wells. Although these wells are not identified in the permit, the obtained data will be reported in the landfill report.

[2]Wells are cited in both the C-746-U Landfill permit, as well as the C-746-S&T Landfill permit.

[3]Based on the approved permit on November 20, 2008 for the C-746-S&T Landfill, these two wells are permitted wells; however, only for water level measurements.

OTHER WATER LEVELS COLLECTED QUARTERLY AND ANNUALLY

Additional quarterly and annual water levels are collected at the site in support of the plume maps.

Quarterly Water Levels (148)							
MW63	MW137	MW202	MW250	MW417	MW444	MW463	MW482
MW66	MW146	MW203	MW257	MW426	MW445	MW464	MW483
MW71	MW150	MW205	MW300	MW427	MW446	MW465	MW484
MW99	MW151	MW206	MW301	MW428	MW447	MW466	MW485
PZ101	MW152	MW233	MW302	MW429	WM448	MW467	MW486
MW102	MW156	MW236	MW305	MW430	MW449	MW468	MW487
MW103	MW161	MW237	MW311	MW431	MW450	MW469	MW488
MW106	MW163	MW238	MW325	MW432	MW451	MW470	MW489
PZ107	MW168	MW239	MW327	MW433	MW452	MW471	MW490
PZ115	MW169	MW240	MW341	MW434	MW453	MW472	MW491
PZ117	MW175	MW241A	MW342	MW435	MW454	MW473	MW492
PZ118	MW178	MW242	MW343	MW436	MW455	MW474	MW493
MW120	MW185	MW243	MW344	MW437	MW456	MW475	MW494
MW121	MW188	MW244	MW380	MW438	MW457	MW476	Z12
MW122	MW191	MW245	MW381	MW439	MW458	MW477	Z16
MW123	MW194	MW246	MW409	MW440	MW459	MW478	
MW126	MW196	MW247	MW410	MW441	MW460	MW479	
MW133	MW199	MW248	MW411	MW442	MW461	MW480	
MW134	MW201	MW249	MW415	MW443	MW462	MW481	

Annual Water Levels (114)							
MW64	W108	MW157	MW207	MW284	MW317	MW422	CM11
MW65	PZ109	MW162	MW208	PZ287	MW318	MW423	CM12
MW68	PZ110	MW164	MW209	PZ289	MW326	MW424	
MW69	PZ111	MW166	MW210	PZ290	MW330	MW425	
MW72	PZ112	MW167	MW211	MW294A	PZ334	PZ5G	
MW73	PZ113	MW170	MW212	MW304	PZ335	PZ5S	
PZ74	PZ114	MW171	MW213	MW306	PZ336	CM01	
MW75	PZ116	MW172	MW214	MW307	MW346	CM02	
MW77	MW132	MW176	MW215	MW308	MW347	CM03	
MW78	MW138	MW177	MW216	MW309	PZ348	CM04	
MW79	MW144	MW180	MW217	MW310	PZ349	CM05	
MW80	MW147	MW189	MW218	MW312	PZ350	CM06	
MW81	MW148	MW190	MW219	MW313	PZ351	CM07	
MW82	MW149	MW192	PZ251	MW314	MW401	CM08	
MW83	MW153	MW198	MW252	MW315	MW402	CM09	
MW96	MW154	MW204	MW253	MW316	MW421	CM10	

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APPENDIX C

ENVIRONMENTAL SAMPLING FREQUENCY AND PARAMETERS

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CONTENTS

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TABLES

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FIGURES

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ACRONYMS

ANOVA	Analysis of Variance
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EM	environmental monitoring
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FY	fiscal year
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
MCL	maximum contaminant level
MW	monitoring well
PGDP	Paducah Gaseous Diffusion Plant
RFI	Resource Conservation and Recovery Act Facility Investigation
ROD	Record of Decision
^{99}Tc	technetium-99
TCE	trichlorethene
TLD	thermoluminescent dosimeter
WAG	waste area group
WKWMA	West Kentucky Wildlife Management Area

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C.1. INTRODUCTION

This appendix provides a summary of the environmental sampling frequencies and parameters for the effluent monitoring and environmental surveillance activities at the Paducah Site.

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C.2. GROUNDWATER MONITORING

The Paducah Site samples individual monitoring and residential wells on a routine basis. Additionally, monitoring wells (MWs) are monitored for water levels on a routine basis. The environmental monitoring (EM) project director is responsible for accepting any new MWs installed and assuring that the wells meet the following standards:

(1) Construction requirements as outlined in either the Statement of Work, Field Sampling Plan, or Work Plan for the project;

(2) Acceptance criteria for well development, as outlined in the U.S. Department of Energy's (DOE) prime contractor procedures;

(3) Requirements for pump and packer placement; and

(4) The well is functioning properly and has no deficiencies.

MWs that do not meet these requirements will not be accepted by the EM project director until all deficiencies have been corrected.

New MWs to be installed during fiscal year (FY) 2009, which do not have specific regulatory sampling requirements and are not included in this plan, will be monitored according to the Semiannual Environmental Surveillance Program. When the FY 2010 Environmental Monitoring Plan is issued, these new MWs will be incorporated into the appropriate program and documented.

All MWs are inspected, at a minimum, on an annual basis. *The Monitoring Well Maintenance Implementation Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PRS/PROJ/0025, outlines the MW evaluation and rehabilitation methods. Maintenance activities are documented and maintained by EM.

C.2.1 GROUNDWATER MONITORING PROGRAM FOR LANDFILL OPERATIONS

C-746-S, C-746-T, and C-746-U Landfills (Solid Waste Landfill Monitoring)

Frequency: Quarterly

Driver: Sampling requirements are outlined in the Solid Waste Landfill permits issued by the Kentucky Division of Waste Management (KDWM).

Reported: Quarterly Compliance Monitoring Reports, as required by the applicable Solid Waste Landfill permits.

Rationale: To evaluate the potential impact of historical waste disposal activities at the C-746-S&T Landfills, as well as historical and current waste disposal activities at the C-746-U Landfill on groundwater quality and to comply with compliance monitoring requirements, as set forth in the Solid Waste Landfill permits.

Rule: For the C-746-U Landfill: Solid Waste Permit SW07300045, GSTR0001, Standard Requirement 8, "If the analysis of the groundwater sample results indicates contamination [i.e., a statistical or maximum contaminant level (MCL) exceedance] as specified in 401 *KAR* 48:300 Section 8(1), the owner or operator shall notify the cabinet within (forty-eight) 48 hours of receiving the results and shall arrange to split sample no later than ten (10) days from the receipt of the results."

For C-746-S&T Landfills: Solid Waste Permits SW07300014 and SW07300015, GSTR0003, Standard Requirement 8, "If the analysis of the groundwater sample results indicates contamination (i.e., a statistical or MCL exceedance) as specified in 401 *KAR* 48:300 Section 8(1), the owner or operator shall notify the cabinet within (forty-eight) 48 hours of receiving the results and shall arrange to split samples no later than ten (10) days from the receipt of the results."

Comments: The current Solid Waste Landfill permits were received on November 20, 2008, for the C-746-S&T and C-746-U Landfills. Tables C.1 and C.2 list monitoring wells for the C-746-S, C-746-T, and C-746-U Landfills and Table C.3 lists the quarterly analytical parameters for these landfills. Locations are shown on Figure C.1.

Table C.1. C-746-S and C-746-T Landfill Wells (23)[1]

MW220	MW386
MW221	MW387
MW222	MW388
MW223	MW389
MW224	MW390
MW369*	MW391
MW370*	MW392
MW372*	MW393
MW373*	MW394
MW384	MW395
MW385	MW396
	MW397

Table C.2. C-746-U Landfill Wells (21)

MW357	MW367
MW358	MW368
MW359	MW369*
MW360	MW370*
MW361	MW371
MW362	MW372*
MW363	MW373*
MW364	MW374
MW365	MW375
MW366	MW376
	MW377

*Wells are sampled with the C-746-U Landfill; these four wells are not counted in the totals for the C-746-S&T Landfills, but are reported in both the compliance Monitoring Reports for the C-746-U and C-746-S&T Landfills. These wells are upgradient wells for the C-746-U Landfill and are downgradient wells for the C-746-S&T Landfills.

[1]The total number of permitted wells associated with the C-746-S&T Landfill is 25; however, two of these wells are permitted only for water level measurement. The total number of analytically measured wells, therefore, is 23.

Table C.3. C-746-S, C-746-T, C-746-U
Quarterly Analytical Parameters

Volatiles	**Anions**	**Field Parameters**
1,1,1,2-Tetrachloroethane	Bromide	Barometric Pressure
1,1,1-Trichloroethane	Chloride	Conductivity
1,1,2,2-Tetrachloroethane	Fluoride	Depth to Water
1,1,2-Trichloroethane	Nitrate as Nitrogen	Dissolved Oxygen
1,1-Dichloroethane	Sulfate	Eh
1,1-Dichloroethene		pH
1,2,3-Trichloropropane	**Metals**	Temperature
1,2-Dibromo-3-chloropropane	Aluminum	Turbidity
1,2-Dibromoethane	Antimony	
1,2-Dichlorobenzene	Arsenic	**PCBs****
1,2-Dichloroethane	Barium	PCB, Total
1,2-Dichloropropane	Beryllium	PCB-1016
1,4-Dichlorobenzene	Boron	PCB-1221
2-Butanone	Cadmium	PCB-1232
2-Hexanone	Calcium	PCB-1242
4-Methyl-2-pentanone	Chromium	PCB-1248
Acetone	Cobalt	PCB-1254
Acrolein	Copper	PCB-1260
Acrylonitrile	Iodide	PCB-1268
Benzene	Iron	
Bromochloromethane	Lead	**Radionuclides**
Bromodichloromethane	Magnesium	Alpha Activity
Bromoform	Manganese	Beta activity
Bromomethane	Mercury	Iodine-131
Carbon Disulfide	Molybdenum	Radium-226
Carbon Tetrachloride	Nickel	Radium-228***
Chlorobenzene	Potassium	Strontium-90
Chloroethane	Rhodium	Technetium-99
Chloroform	Selenium	Thorium-230
Chloromethane	Silver	Thorium-232***
cis-1,2-Dichloroethene	Sodium	Tritium
cis-1,3-Dichloropropene	Tantalum	
Dibromochloromethane	Thallium	
Dibromomethane	Uranium	
Dimethylbenzene, Total*	Vanadium	
Ethylbenzene	Zinc	
Iodomethane	Barium, Dissolved	
Methylene Chloride	Chromium, Dissolved	
Styrene	Uranium, Dissolved	
Tetrachloroethene		
Toluene	**Miscellaneous**	
trans-1,2-Dichloroethene	Chemical Oxygen Demand	
trans-1,3-Dichloropropene	Cyanide	
trans-1,4-Dichloro-2-Butene	Total Organic Carbon	
Trichloroethene	Total Organic Halides	
Trichlorofluoromethane	Total Dissolved Solids	
Vinyl Acetate	Total Suspended Solids	
Vinyl Chloride		

* Xylenes

** PCBs are required under the Solid Waste Permits to be monitored quarterly for the C-746-U Landfill and annually for the C-746-S&T Landfills; however, based on the data quality objectives determined for the landfills, PCBs were added to the C-746-S&T Landfills quarterly.

*** Permit does not require analysis of radium-228 and thorium-232. These parameters are analyzed for information purposes only in support of the C-746-U Landfill assessment.

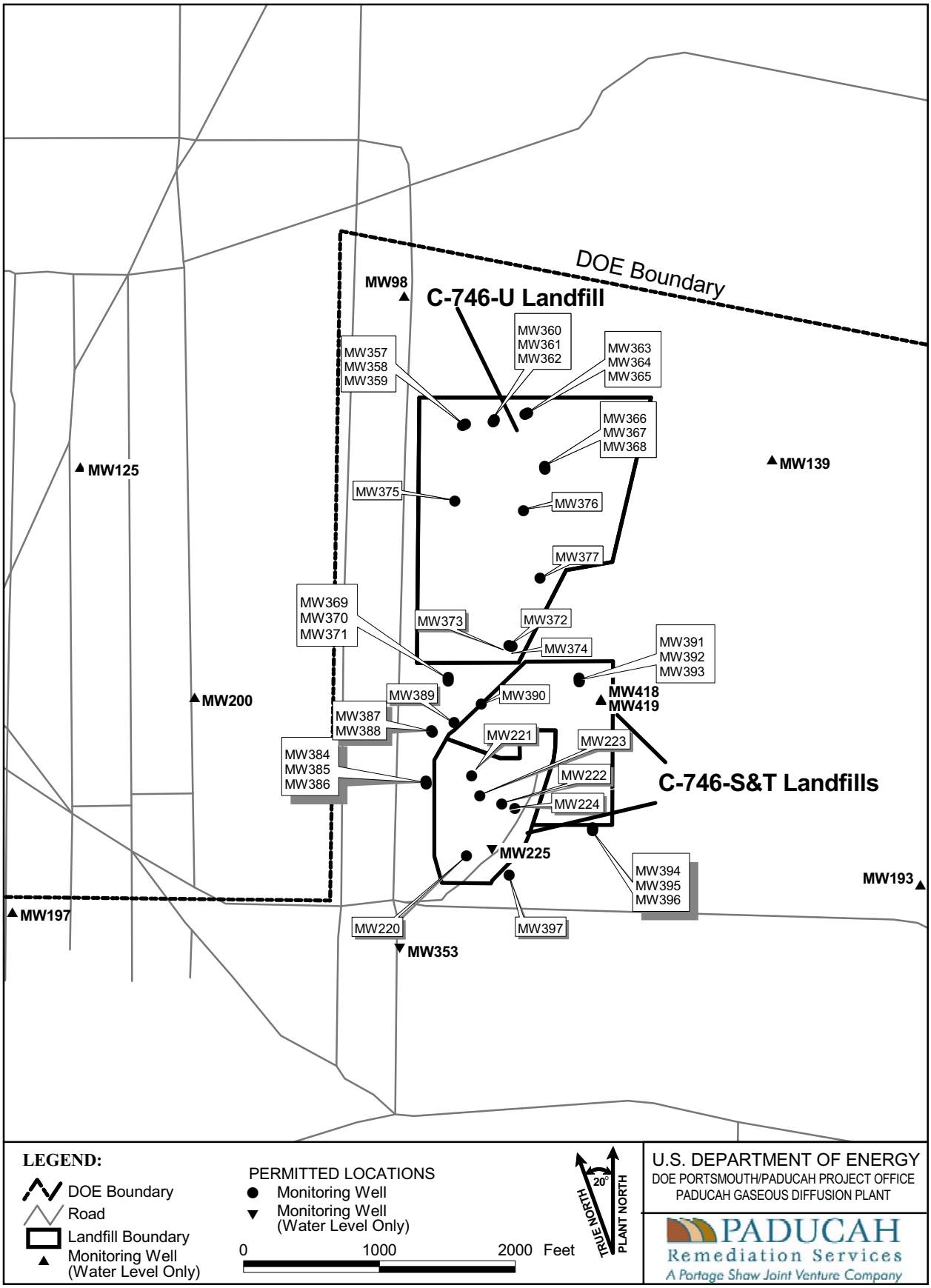

Figure C.1. Groundwater Monitoring Wells Near the C-746-S, T, and U Landfills

C-404 Low-level Radioactive Waste Burial Ground (RCRA Detection Status Monitoring)

Frequency: Semiannually

Driver: The semiannual parameters are required to be sampled per the U.S. Environmental Protection Agency (EPA) Hazardous Waste Permit, KY8-890-008-982.

Reported: Semiannual C-404 Groundwater Monitoring Report required by the permit.

Rationale: To monitor the C-404 Low-level Radioactive Waste Burial Ground under detection monitoring program regulations.

Rule: Determine, within 30 days of the completion of data validation, if there is a statistical increase over background for permit parameters using the Analysis of Variance (ANOVA) method. If there is an increase, then evaluate if the contamination is from the C-404 Landfill or another source. If another source is the cause of the contamination, then a notification must be submitted to KDWM within 7 days.

Comments: MW90 and MW95 were replaced in 2002 with MW90A and MW95A, respectively. Prior to the replacement activities, evaluations of these wells were conducted and results were presented to KDWM. Although initial evaluation indicated that the well maintained the integrity required for use in groundwater monitoring, the KDWM's view was that because leaky casing joints were identified, the wells must be abandoned.

In the event that only a partial sample can be obtained, the following priority will be followed: field parameters, TCE, metals. The dissolved metal samples (arsenic, cadmium, chromium, lead, mercury, selenium, and uranium) are filtered in the laboratory. A listing of monitoring wells for C-404 Landfill and the analytical parameters are presented in Table C.5. Locations are shown on Figure C.2.

Table C.4. C-404 Landfill Wells (9)[1]

MW84
MW85
MW87
MW88
MW90A
MW91
MW93
MW94
MW420

Table C.5. C-404 Landfill Semiannual Analytical Parameters

Volatiles	**Field Parameters**
Trichloroethene	Barometric Pressure
	Conductivity
Metals	Depth to water
Arsenic	Dissolved Oxygen
Cadmium	Eh
Chromium	pH
Iron	Temperature
Lead	Turbidity
Manganese	
Mercury	**Radionuclides**
Selenium	Technetium-99
Uranium	Uranium-234
Arsenic, Dissolved	Uranium-235
Cadmium, Dissolved	Uranium-238
Chromium, Dissolved	
Lead, Dissolved	**Other**
Mercury, Dissolved	Sulfide
Selenium, Dissolved	Sulfite
Uranium, Dissolved	Sulfate
	Total Organic Carbon

[1]MW67, MW76, MW86, MW89, MW92, MW95A, MW226, MW227, MW333, MW337, and MW338 are also sampled for TCE, ^{99}Tc, and depth to water under a sampling event that coincides within a 24 hour time frame of the sampling MWs at the C-404 Landfill. MWs 414 and 416 are also part of this special sampling event; however, only depth to water measurements are collected for these two wells.

C-746-K Landfill Monitoring

Frequency: Semiannually

Driver: Requirements to sample four monitoring wells are outlined in the Record of Decision (ROD) for Waste Area Groups (WAGs) 1 and 7. In addition, the parameters to be analyzed originally were documented in the Sampling and Analysis Plan Addendum, KY/ER-2. The ROD allows for annual evaluation of parameters. The Sampling and Analysis Plan Addendum, KY/ER-2, was superseded previously by the Environmental Monitoring Plan.

Reported: Semiannual Federal Facility Agreement (FFA) Progress Report

Rationale: To evaluate the potential impact of historical waste disposal activities at the C-746-K Landfill on groundwater quality.

Comments: In the event a well becomes dry while purging, no sample will be taken; however, it should be recorded that no sample was collected because the well was dry. The Interim Corrective Measures Work Plan specified the addition of metals analysis to the sampling plan. Dissolved metals only are analyzed if there are detections in the total metals analysis. Starting in 2005, the frequency was reduced from quarterly to semiannually. Tables C.6 and C.7 provide a listing of landfill wells and analytical parameters, respectively. Locations are shown on Figure C.2.

Table C.6. C-746-K Landfill Wells (4)

MW300
MW301
MW302
MW344

Table C.7. C-746-K Landfill Semiannual Analytical Parameters

Volatiles	**Metals**
1,1,1-Trichloroethane	Barium, Dissolved
1,1,2-Trichloroethane	Beryllium, Dissolved
1,1-Dichloroethane	Cadmium, Dissolved
1,1-Dichloroethene	Lead, Dissolved
1,2-Dichloroethane	Arsenic, Dissolved
Benzene	Uranium, Dissolved
Bromodichloromethane	Aluminum
Carbon Tetrachloride	Arsenic
Chloroform	Barium
cis-1,2-Dichloroethene	Beryllium
Dimethylbenzene, Total*	Cadmium
Ethylbenzene	Calcium
Tetrachloroethene	Iron
Toluene	Lead
trans-1,2-Dichloroethene	Magnesium
Trichloroethene	Manganese
Vinyl Chloride	Nickel
	Potassium
Field Parameters	Sodium
Conductivity	Uranium
Barometric Pressure	
Depth to water	**Radionuclides**
Dissolved Oxygen	Alpha Activity
pH	Beta Activity
Temperature	Technetium-99
Turbidity	
Eh	**Anions**
	Chloride
Other	Sulfate
Alkalinity	Nitrate
Ferrous Iron (Fe^{+2})	

*Xylenes

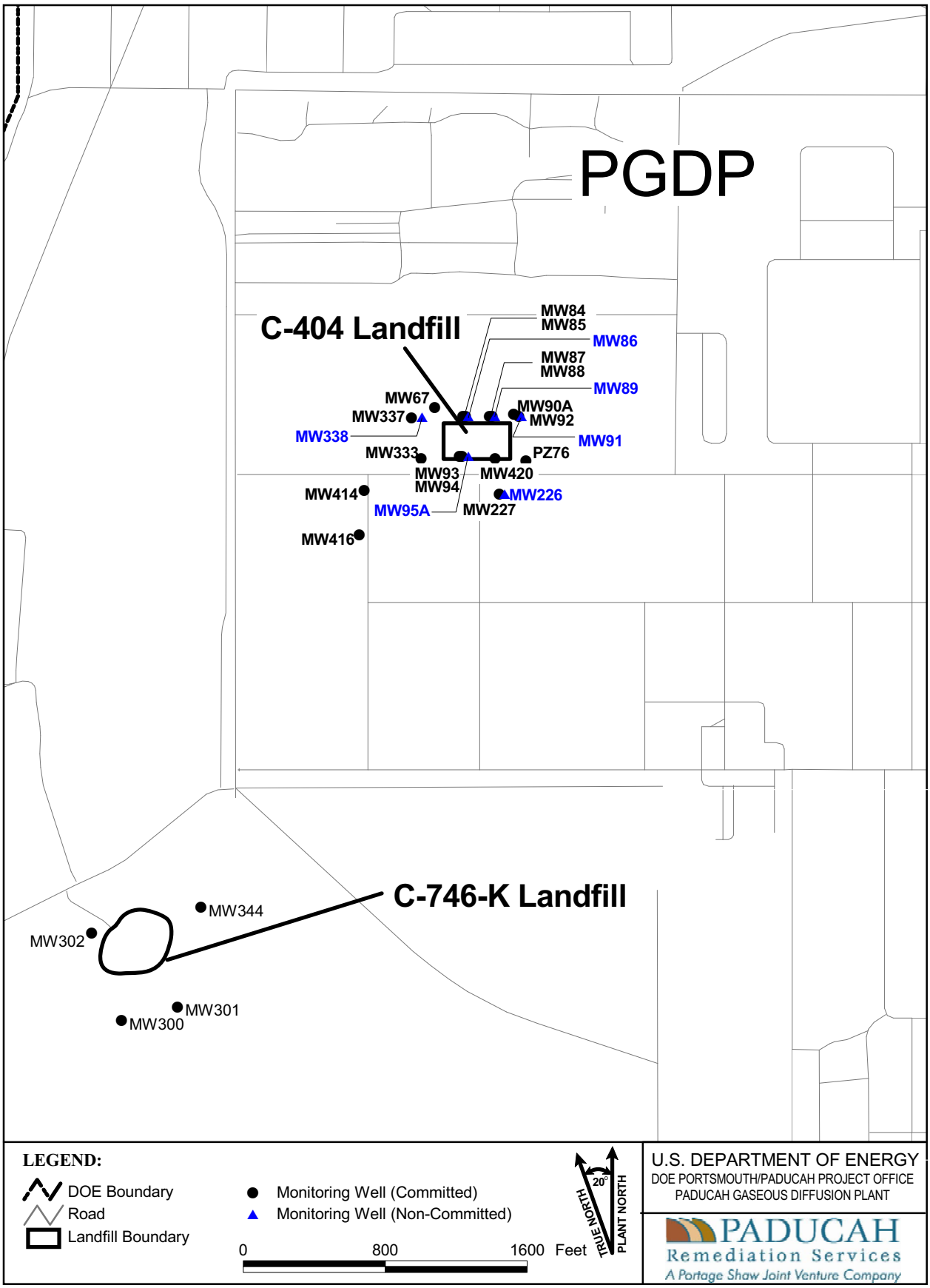

Figure C.2. Groundwater Monitoring Wells Near C-404 and C-746-K Landfills

C.2.2 NORTHEAST PLUME OPERATIONS AND MAINTENANCE PROGRAM

Northeast Plume Monitoring

Frequency: Semiannually and Quarterly

Driver: The MWs are required to be sampled according to the Operations and Maintenance Plan for the Northeast Plume.

Reported: Semiannual FFA Progress Report

Rationale: To monitor the nature and extent of groundwater contamination and to evaluate any cyclic trends in water quality that may affect contaminant migration.

Comments: The extraction wells are not sampled under the groundwater program, but rather are sampled under the Operations and Maintenance Plan for the Northeast Plume. In FY 2006, MW284 and MW294A were moved to the groundwater surveillance program. Tables C.8 and C.9 provide Northeast Plume semiannual and quarterly wells and parameters. Locations are shown on Figure C.3.

Table C.8. Northeast Plume Semiannual Wells and Parameters

Semiannual Wells (11)	Semiannual Analytical Parameters	
MW124	**Volatiles**	**Radionuclides**
MW126	1,1,1-Trichloroethane	Alpha Activity
MW145	1,1,2-Trichloroethane	Beta Activity
MW255	1,1-Dichloroethane	Technetium-99
MW256	1,1-Dichloroethene	
MW258	1,2-Dichloroethane	**Field Parameters**
MW283	Benzene	Barometric Pressure
MW288	Bromodichloromethane	Conductivity
MW291	Carbon Tetrachloride	Depth to water
MW292	Chloroform	Dissolved Oxygen
MW293A	*cis*-1,2-Dichloroethene	pH
	Dimethylbenzene, Total*	Temperature
	Ethylbenzene	Turbidity
	Tetrachloroethene	Eh
	Toluene	
	trans-1,2-Dichloroethene	
	Trichloroethene	
	Vinyl Chloride	

*Xylenes

Table C.9. Northeast Plume Quarterly Wells and Parameters

Quarterly Wells (5)	Quarterly Analytical Parameters
MW255	**Radionuclides**
MW256	Technetium-99
MW258	
MW288	**Field Parameters**
MW292	Barometric Pressure
	Conductivity
	Depth to water
	Dissolved Oxygen
	pH
	Temperature
	Turbidity

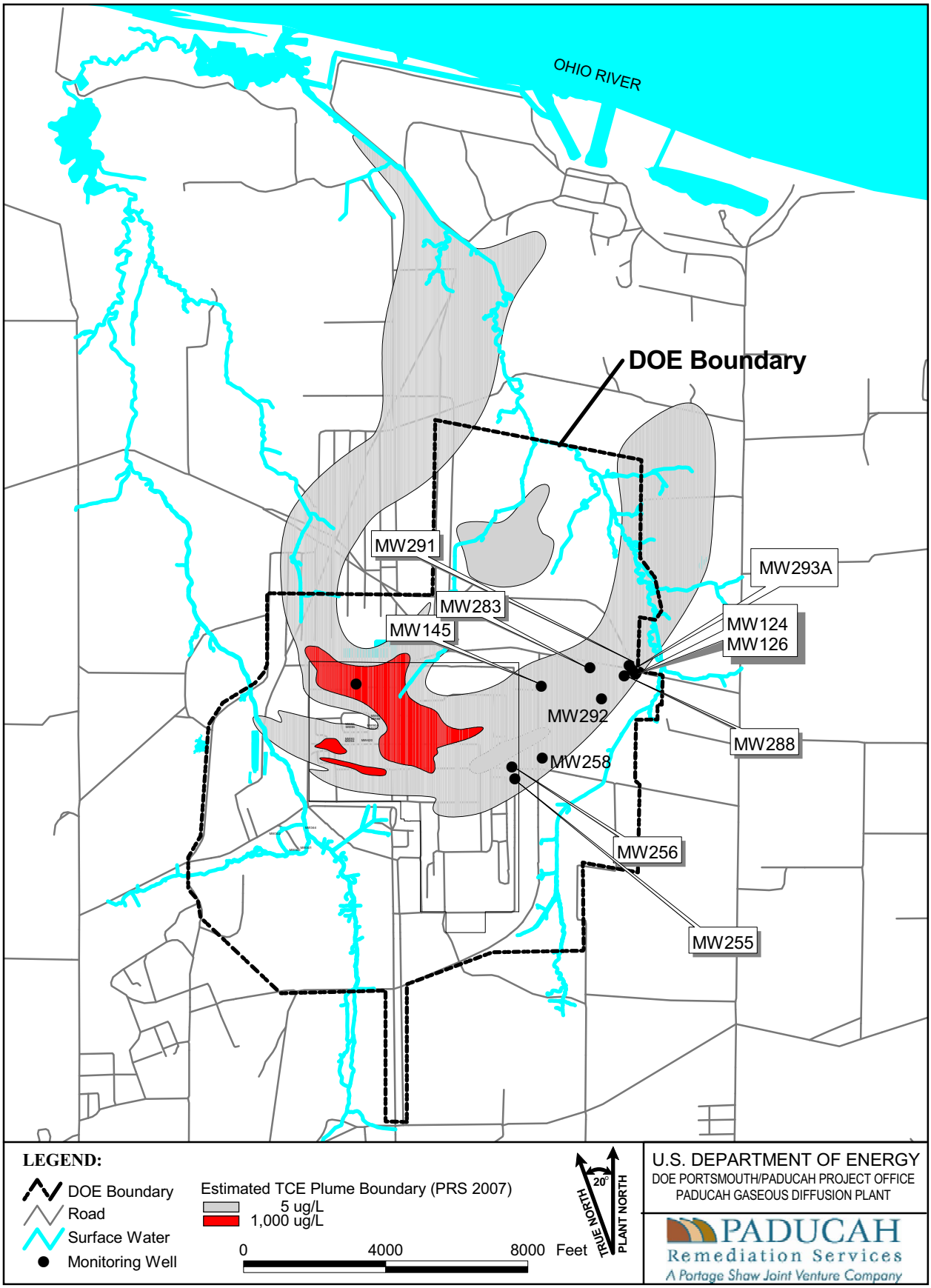

Figure C.3. Northeast Plume Monitoring Wells

C.2.3 NORTHWEST PLUME OPERATIONS AND MAINTENANCE PROGRAM

Northwest Plume Monitoring

Frequency: Semiannually and Annually

Driver: The MWs are required to be sampled according to the Operations and Maintenance Plan for the Northwest Plume.

Reported: Semiannual FFA Progress Report

Rationale: To monitor the nature and extent of groundwater contamination and to evaluate any cyclic trends in water quality that may affect contaminant migration.

Comments: The extraction wells are not sampled under the groundwater program, but rather are sampled under the Operations and Maintenance Plan for the Northwest Plume. Tables C.10, C.11, and C.12 show semiannual wells, semiannual analytical parameters, and annual analytical parameters; Locations are shown on Figure C.4. The semiannual analytical parameters are analyzed on both the north and south wells, while the annual analytical parameters only are analyzed on the south wells.

Table C.10. Northwest Plume Semiannual Wells (12)

North Wells (6)
MW233
MW236
MW238
MW240
MW380
MW381
South Wells (6)
MW242
MW243
MW244
MW245
MW248
MW250

Table C.11. Northwest Plume Semiannual Analytical Parameters - North and South Wells

Volatiles	Field Parameters
1,1,1-Trichloroethane	Barometric Pressure
1,1,2-Trichloroethane	Conductivity
1,1-Dichloroethane	Depth to water
1,1-Dichloroethene	Dissolved Oxygen
1,2-Dichloroethane	pH
Benzene	Temperature
Bromodichloromethane	Turbidity
Carbon Tetrachloride	Eh
Chloroform	
cis-1,2-Dichloroethene	**Radionuclides**
Dimethylbenzene, Total*	Alpha Activity
Ethylbenzene	Beta Activity
Tetrachloroethene	Technetium-99
Toluene	
trans-1,2-Dichloroethene	
Trichloroethene	
Vinyl Chloride	

*Xylenes

Table C.12. Northwest Plume Annual Analytical Parameters – South Wells

Radionuclides	Field Parameters
Neptunium-237	Barometric Pressure
Plutonium-239	Conductivity
Radium-226	Depth to water
Radon-222	Dissolved Oxygen
Thorium-230	pH
	Temperature
	Turbidity

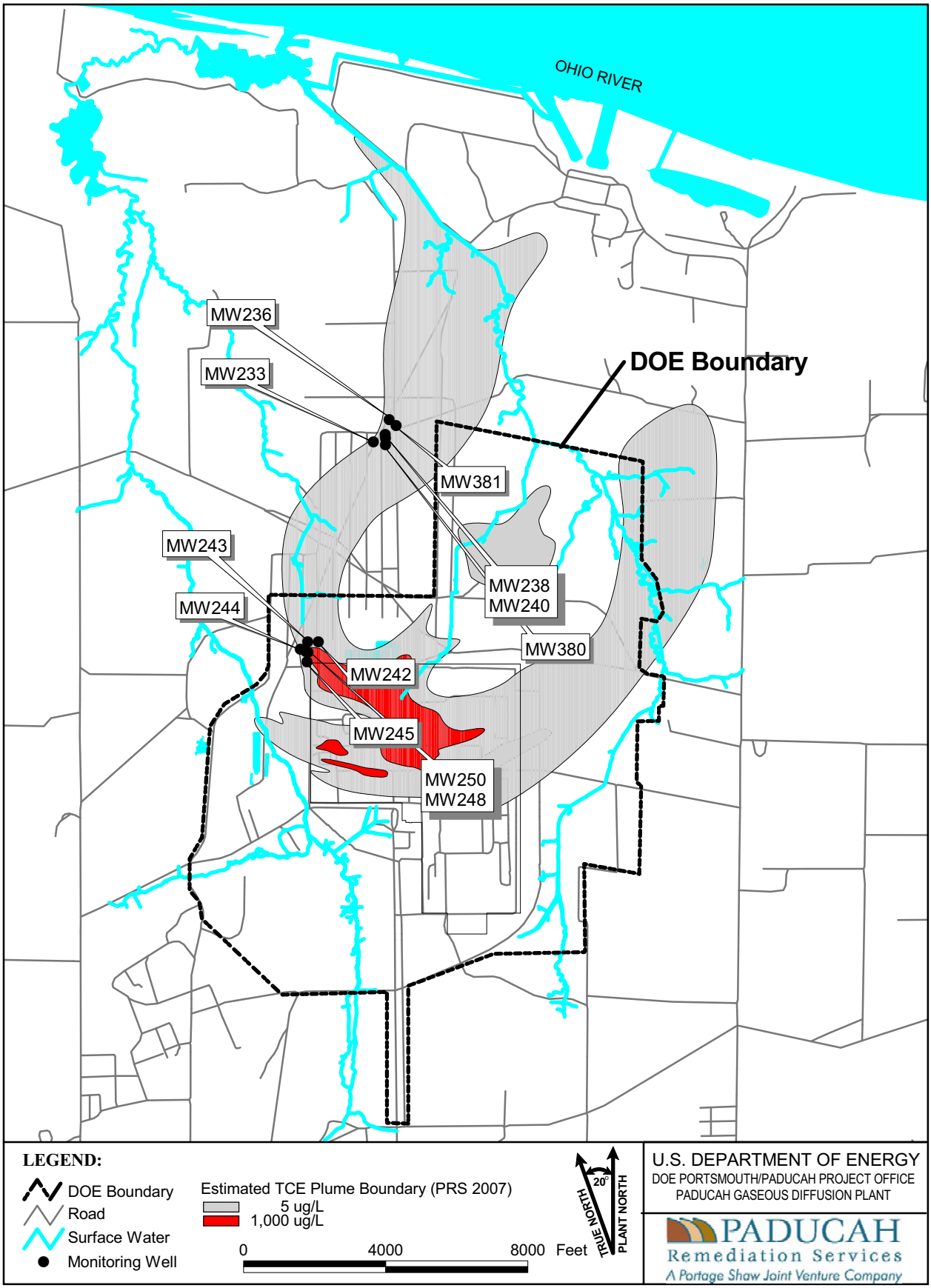

Figure C.4. Northwest Plume Monitoring Wells

C.2.4 C-400 Monitoring Wells

C-400 Wells

Frequency: Quarterly

Driver: The MWs are required to be sampled by the *Remedial Action Work Plan for the Interim Remedial Action for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0004&D2/R2.

Reported: Semiannual FFA Progress Report

Rationale: These wells will provide a meaningful tool for evaluating the downgradient dissolved-phase contamination in the Northwest Plume and the efficacy of the C-400 Interim Remedial Action. Long-term assessment of the C-400 IRA impact on the groundwater plumes will be provided by sampling of existing wells and installation and sampling of new wells. RGA wells MW175 (screened 75-80 ft bgs), MW342 (screened 75-85 ft bgs), and MW343 (screened 75-85 ft bgs) monitor the lower RGA along the west side of C-400 and existing north of C-400. RGA Wells MW421, MW422, MW423, MW424, and MW425 (all with ports centered at 72 ft, 80 ft, and 84 ft bgs) monitor the middle and lower RGA in the northwest corner of C-400.

Comments: Table C.13 provides a listing of the C-400 monitoring wells and Table C.14 provides the quarterly analytical parameters for these wells.

Table C.13. C-400 Monitoring Wells (8)

MW175
MW342
MW343
MW421
MW422
MW423
MW424
MW425

Table C.14. C-400 Monitoring Well Quarterly Analytical Parameters

Volatiles	**Metals**
1,1-Dichloroethene	Uranium
cis-1,2-Dichloroethene	
trans-1,2-Dichloroethene	**Anions**
Trichloroethene	Chloride
Vinyl Chloride	
	Radionuclides
PCBs	Technetium-99
Aroclor-1236	Alpha Activity
PCB, Total	Beta Activity
PCB-1016	
PCB-1221	**Field Parameters**
PCB-1242	Barometric Pressure
PCB-1248	Conductivity
PCB-1254	Depth to Water
PCB-1260	Dissolved Oxygen
	Eh
	pH
	Temperature
	Turbidity

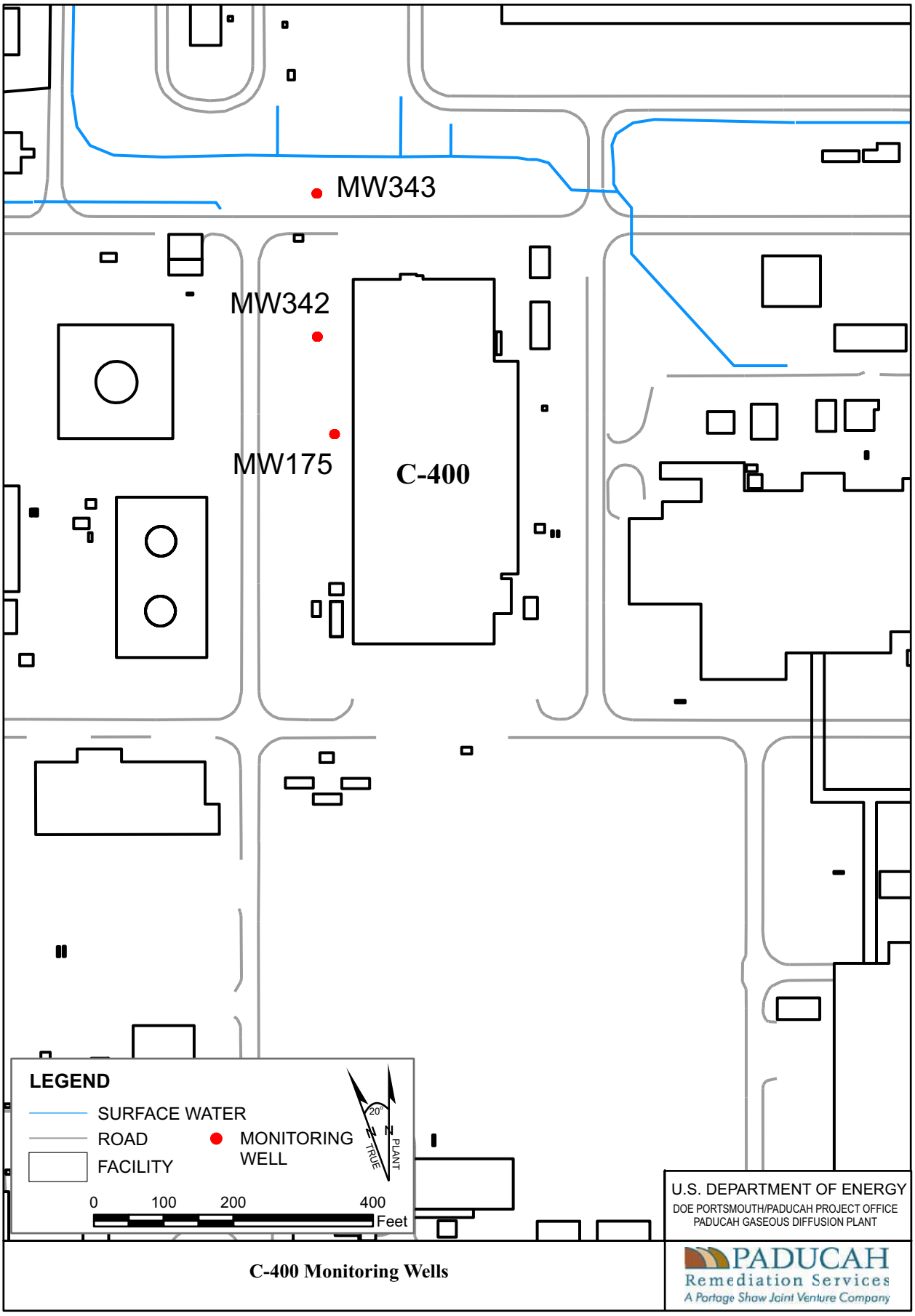

Figure C.5. C-400 Monitoring Wells

C.2.5 C-613 NORTHWEST STORM WATER CONTROL FACILITY

C-613 Sed Basin – Storm Water

Frequency: Quarterly

Driver: DOE/OR/07-2044&D1/R3 and the Paducah FFA

Rationale: To monitor water collected in the C-613 Sed Basin to ensure that discharges to KPDES Outfall 001 will not cause the effluent at Kentucky Pollutant Discharge Elimination System (KPDES) Outfall 001 to exceed regulatory limits.

Reported: Reported to KDWM via electronic mail.

Comments: Table C.15 provides a listing of the C-613 Sed Basin quarterly water parameters.

C-613 Sed Basin Third Quarter Split Sample – Water

Frequency: Annually, during the third quarter.

Driver: Availability of data to compare to KDWM sample results.

Rationale: Sampling will be conducted during normal operations of the C-613 Sed Basin as decided by KDWM.

Reported: Not applicable.

Comments: Table C.16 provides a listing of the C-613 Sed Basin third quarter analytical parameters.

C-613 Sed Basin – Sediments

Frequency: One-time sampling event scheduled for CY 2010.

Driver: Availability of data to compare to KDWM sample results, as well as to characterize waste as the sediment is removed as part of maintenance activities.

Rationale: Sampling will be conducted during prolonged, dry periods, and as decided by KDWM.

Reported: Not applicable. Data will be used for profile development/profile confirmation.

Comments: Table C.17 provides a listing of the C-613 Sed Basin annual sediment parameters.

Table C.15. C-613 Sed Basin Quarterly Water Parameters

Other
pH
Total Suspended Solids
Turbidity
Field Parameters
pH
Turbidity

Table C.16. C-613 Sed Basin Third Quarter Water Analytical Parameters

Metals	Other
Antimony	Total Suspended Solids
Arsenic	
Beryllium	**Radionuclides**
Cadmium	Gross alpha
Chromium	Gross beta
Copper	Isotopic Uranium
Iron	
Lead	**Field Parameters**
Nickel	pH
Selenium	Turbidity
Silver	
Thallium	
Uranium	
Zinc	
Mercury	

Table C.17. C-613 Sed Basin
Annual Sediment Parameters

Volatiles
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichlorethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethane
1,2-Dichloropropane
1,2-Dimethylbenzene
2-Butanone
2-Hexanone
4-Methyl-2-pentanone
Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
Dibromochloromethane
Ethylbenzene
Methylene chloride
Styrene
Tetrachloroethene
Toluene
Trichloroethene
Vinyl Chloride
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
m,p-Xylene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene

PCBs
PCB, Total
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
PCB-1268

Semivolatiles		
1,2,4-Trichlorobenzene	2-Methylnaphthalene	Benzo(ghi)perylene
1,2-Dichlorobenzene	2-Methylphenol	Benzo(k)fluoranthene
1,3-Dichlorobenzene	2-Nitrobenzenamine	Bis(2-chloroethoxy)methane
1,4-Dichlorobenzene	2-Nitrophenol	Bis(2-chloroethyl) ether
2,4,5-Trichlorophenol	3,3-Dichlorobenzidine	Bis(2-chloroisopropyl) ether
2,4,6-Trichlorophenol	3-Nitrobenzenamine	Bis(2-ethylhexyl)phthalate
2,4-Dichlorophenol	4-Bromophenyl phenyl ether	Butyl benzyl phthalate
2,4-Dimethylphenol	4-Chloro-3-methylphenol	Chrysene
2,4-Dinitrophenol	4-Chlorobenzenamine	Di-n-butyl phthalate
2,4-Dinitrotoluene	4-Chlorophenyl phenyl ether	Di-n-octylphthalate
2,6-Dinitrotoluene	4-Nitrobenzenamine	Dibenz(a,h)anthracene
2-Chloronaphthalene	4-Nitrophenol	Dibenzofuran
2-Chlorophenol	Acenaphthene	Diethyl phthalate
2-Methyl-4,6-dinitrophenol	Acenaphthylene	Dimethyl phthalate
	Anthracene	Fluoranthene
	Benz(a)anthracene	Fluorene
	Benzo(a)pyrene	Hexachlorobenzene
	Benzo(b)fluoranthene	Hexachlorobutadiene
		Hexachlorocyclopentadiene
		Hexachloroethane
		Indeno(1,2,3-cd)pyrene
		Isophorone
		N-Nitroso-di-n-propylamine
		N-Nitrosodiphenylamine
		Naphthalene
		Pentachlorophenol
		Phenanthrene
		Phenol
		Pyrene
		Pyridine
		m,p-Cresol

Metals	
Aluminum	Magnesium
Antimony	Manganese
Arsenic	Mercury
Barium	Nickel
Beryllium	Potassium
Cadmium	Selenium
Calcium	Silver
Chromium	Sodium
Cobalt	Thallium
Copper	Uranium
Iron	Vanadium
Lead	Zinc

Radionuclides
Activity of U-235
Americium-241
Cesium-134
Cesium-137
Cobalt-60
Neptunium-237
Plutonium-238
Plutonium-239/240
Technetium-99
Thorium-228
Thorium-230
Thorium-232
Thorium-234
Uranium-234
Uranium-235
Uranium-238

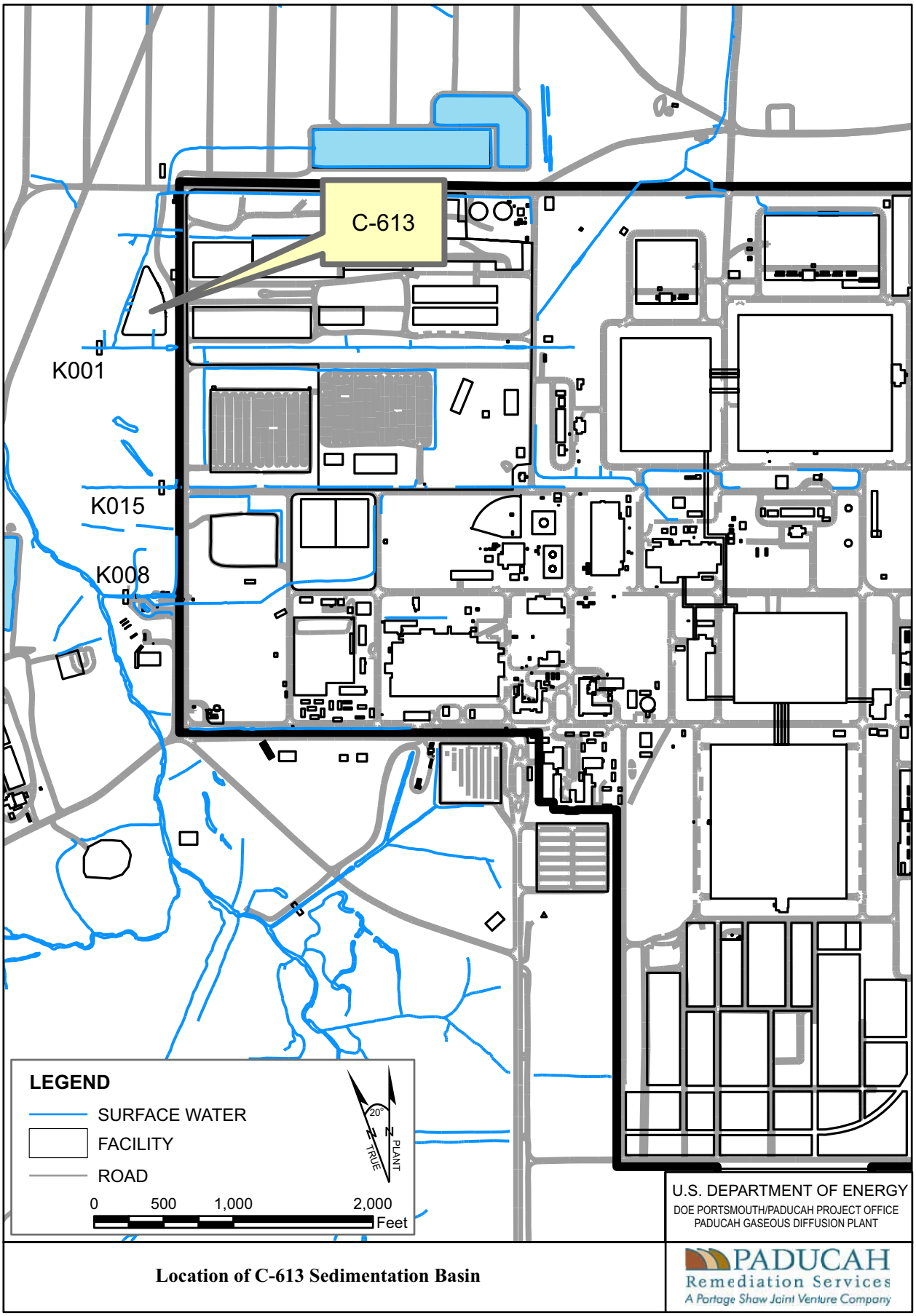

Figure C.6. C-613 Sed Basin

C.2.6 RESIDENTIAL GROUNDWATER MONITORING PROGRAM

Monthly Residential Monitoring

Driver: As required by the DOE Water Policy, per the Action Memorandum outlined in DOE/OR/06-1142&D3, among DOE, Commonwealth of Kentucky, and the EPA.

Reported: Quarterly letter to each resident summarizing the monthly data and the Annual Site Environmental Report.

Decision Rule: If a residential well outside the current water box contains TCE or technetium-99 (^{99}Tc) and is confirmed, based on resampling and analysis to have originated from the plant, as determined by a review of MW data, historical data, or existing information at plant action levels (TCE greater than 1 ppb and ^{99}Tc greater than 25 pCi/L), then provide drinking water to the resident, revise the contaminant boundary, provide water to those residents within the new contaminant boundary, and reevaluate the existing Water Policy.

Comments: In FY 2006, well R2 was changed from monthly sampling to annual monitoring. Tables C.18 and C.19 identify residential wells and residential analytical parameters, respectively. Locations are shown on Figure C.7.

Annual Residential Monitoring

Driver: As required per the Action Memorandum outlined in DOE/0R106-1142&D3 among the DOE, the Commonwealth of Kentucky, and EPA.

Reported: Letters to residents and Annual Site Environmental Report

Rule: If a residential well outside the current water box contains TCE or ^{99}Tc above the action levels (TCE greater than 1 ppb and ^{99}Tc greater than 25 pCi/L) and the contamination is determined to have originated from the plant, then provide drinking water to the resident. The contaminant boundary must be revised and additional residents provided water, if necessary.

Comments: In FY 2006, the frequency for all wells that had been sampled on a semiannual basis was changed to an annual basis. Locations are shown on Figure C.7. At the onset of FY 2010, no Water Policy license agreement with DOE was in place with the residents who own the property where wells R72 and R82 are located; therefore, these wells were removed from the sampling schedule..

Carbon Filter Treatment System

Frequency: Semiannually

Driver: DOE decision

Reported: Letters to residents and Annual Site Environmental Report

Comments: DOE is maintaining a treatment system for one resident who is outside the Water Policy box; however, the source of contamination has been determined by DOE and the Commonwealth of Kentucky to have not originated at the Paducah Site. Location is shown on Figure C.7.

Table C.18. Residential Wells (18)

Monthly (2)
R294 (P)
R302 (P)
Annually (15)
R2 (P)
R114 (H)
R12 (P)
R13 (P)
R14 (P)
R19 (P)
R20 (P)
R21(P)
R23 (H)
R384 (H)
R387 (H)
R392 (H)
R83 (P)
R9 (H)
R90 (H)
Carbon Filter (1)
R424 Port 1 direct groundwater
R424 Port 2 after carbon filter
R424 Port 3 after ultraviolet light

H – Hose–depth to water not collected
P – Pump

Table C.19. Residential Analytical Parameters

Monthly
Conductivity
Depth to water
Dissolved Oxygen
pH
Temperature
Barometric Pressure
Alpha Activity
Beta Activity
Technetium-99
Trichloroethene
Annual
Conductivity
Depth to water*
Dissolved Oxygen
pH
Temperature
Technetium-99
Trichloroethene
Carbon Filter
Conductivity
Dissolved Oxygen
pH
Temperature
Technetium-99
Total Coliform
Trichloroethene
Barometric Pressure

*- not available at all locations

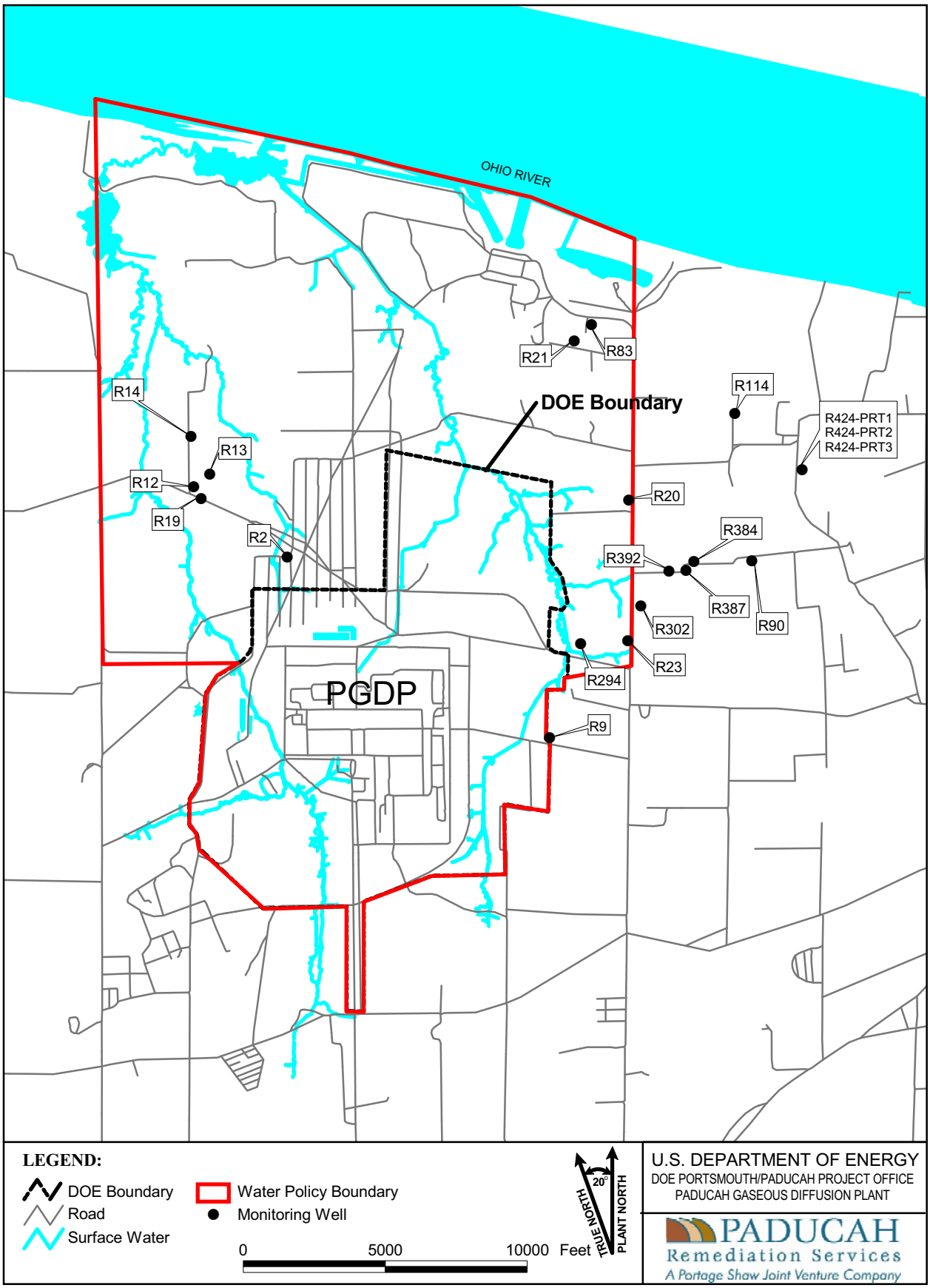

Figure C.7. Residential Wells

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C.2.7 ENVIRONMENTAL SURVEILLANCE GROUNDWATER MONITORING PROGRAM

Quarterly and Semiannual Environmental Surveillance Monitoring

Driver: DOE Order 450.1 and the Paducah FFA

Reported: Annual Site Environmental Report and Plume Maps

Rationale: To monitor the nature and extent of groundwater contamination and to monitor groundwater quality. Sampling of these wells is conducted in support of the Paducah FFA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Investigation; Resource Conservation and Recovery Act Facility Investigations (RFIs); and DOE Order 450.1. All of these wells lie on the plant perimeter or DOE boundary and any detection of contaminants will allow for a potential increase in sample frequency of downgradient MWs.

Rule: If a MW outside the current water box contains confirmed TCE and ^{99}Tc originating from the plant, as determined by a review of MW data, historical data, or existing information at the plant action levels (TCE greater than 1 ppb and ^{99}Tc greater than 25 pCi/L), then sample other residential wells in the vicinity. Table C.20 and C.21 identify surveillance wells and environmental surveillance analytical parameters, respectively. Tables C.22 and C.23 show surveillance geochemical wells and surveillance geochemical annual analytical parameters, respectively. Locations are shown on Figure C.8.

Table C.20. Surveillance Wells (150)

Semiannual (145)			
MW63	MW253	MW426**	MW464**
MW66	MW260	MW427**	MW465**
MW67*	MW261	MW428**	MW466**
MW76*	MW262	MW429**	MW467**
MW98	MW328	MW430**	MW468**
MW99	MW329	MW431**	MW469**
MW100	MW333*	MW432**	MW470**
MW106	MW337*	MW433**	MW471**
MW125	MW338*	MW434**	MW472**
MW134	MW339	MW435**	MW473**
MW135	MW340	MW436**	MW474**
MW139	MW341	MW437**	MW475**
MW146	MW343	MW438**	MW476**
MW148	MW345	MW439**	MW477**
MW149	MW354	MW440**	MW478**
MW152	MW355	MW441**	MW479**
MW155	MW356	MW442**	MW480**
MW156	MW403 Port 3	MW443**	MW481**
MW161	MW404 Port 4	MW444**	MW482**
MW163	MW405 Port 5	MW445**	MW483**
MW165	MW406 Port 5	MW446**	MW484**
MW168	MW407 Port 4	MW447**	MW485**
MW169	MW408 Port 5	MW448**	MW486**
MW173	MW409	MW449**	MW487**
MW174	MW410	MW450**	MW488**
MW182	MW411	MW451**	MW489**
MW186	MW414*	MW452**	MW490**
MW187	MW415	MW453**	MW491**
MW191	MW416*	MW454**	MW492**
MW193	MW417	MW455**	MW493**
MW197	MW418	MW456**	MW494**
MW200	MW419	MW457**	
MW201	MW86*	MW458**	**Background (5)**
MW202	MW89*	MW459**	MW103
MW203	MW92*	MW460**	MW150
MW205	MW95A*	MW461**	MW194
MW206	MW226*	MW462**	MW199
MW252	MW227*	MW463**	MW305

Quarterly (12)	
MW182 (PCBs)	MW95A (TCE and ^{99}Tc)
MW418 (PCBs)	MW226 (TCE and ^{99}Tc)
MW419 (PCBs)	MW227 (TCE and ^{99}Tc)
MW86 (TCE, ^{99} Tc,)	MW409 (TCE and ^{99}Tc)
MW89 (TCE and ^{99} Tc)	MW410 (TCE and ^{99}Tc)
MW92 (TCE and ^{99}Tc)	MW411 (TCE and ^{99}Tc)

* MWs 67, 76, 333, 337, and 338 are also sampled for TCE, ^{99}Tc, and depth to water under a sampling event that coincides within a 24 hour time frame of the sampling MWs at the C-404 Landfill. MWs 414 and 416 are also part of this special sampling event; however, only depth to water measurements are collected for these two wells.

**These are new monitoring wells. The first semiannual sampling event is scheduled to begin in March 2010.

Table C.21. Environmental Surveillance Analytical Parameters

Semiannual Field Parameters	Quarterly Field Parameters
Barometric Pressure	Barometric Pressure
Conductivity	Conductivity
Depth to water	Depth to water
Dissolved Oxygen	Dissolved Oxygen
pH	pH
Temperature	Temperature
Turbidity	Turbidity
	Eh
Radionuclides	
Alpha Activity	**PCBs, Total and Dissolved**
Beta Activity	PCB, Total
Technetium-99	PCB-1016
Uranium	PCB-1221
	PCB-1232
Volatiles	PCB-1242
1,1,1-Trichloroethane	PCB-1248
1,1,2-Trichloroethane	PCB-1254
1,1-Dichloroethane	PCB-1260
1,1-Dichloroethene	PCB-1268
1,2-Dichloroethane	
Benzene	**Radionuclides**
Bromodichloromethane	^{99}Tc
Carbon Tetrachloride	
Chloroform	**Volatiles**
cis-1,2-Dichloroethene	Trichloroethene
Dimethylbenzene, Total**	
Ethylbenzene	
Tetrachloroethene	
Toluene	
trans-1,2-Dichloroethene	
Trichloroethene	
Vinyl Chloride	

**Xylenes

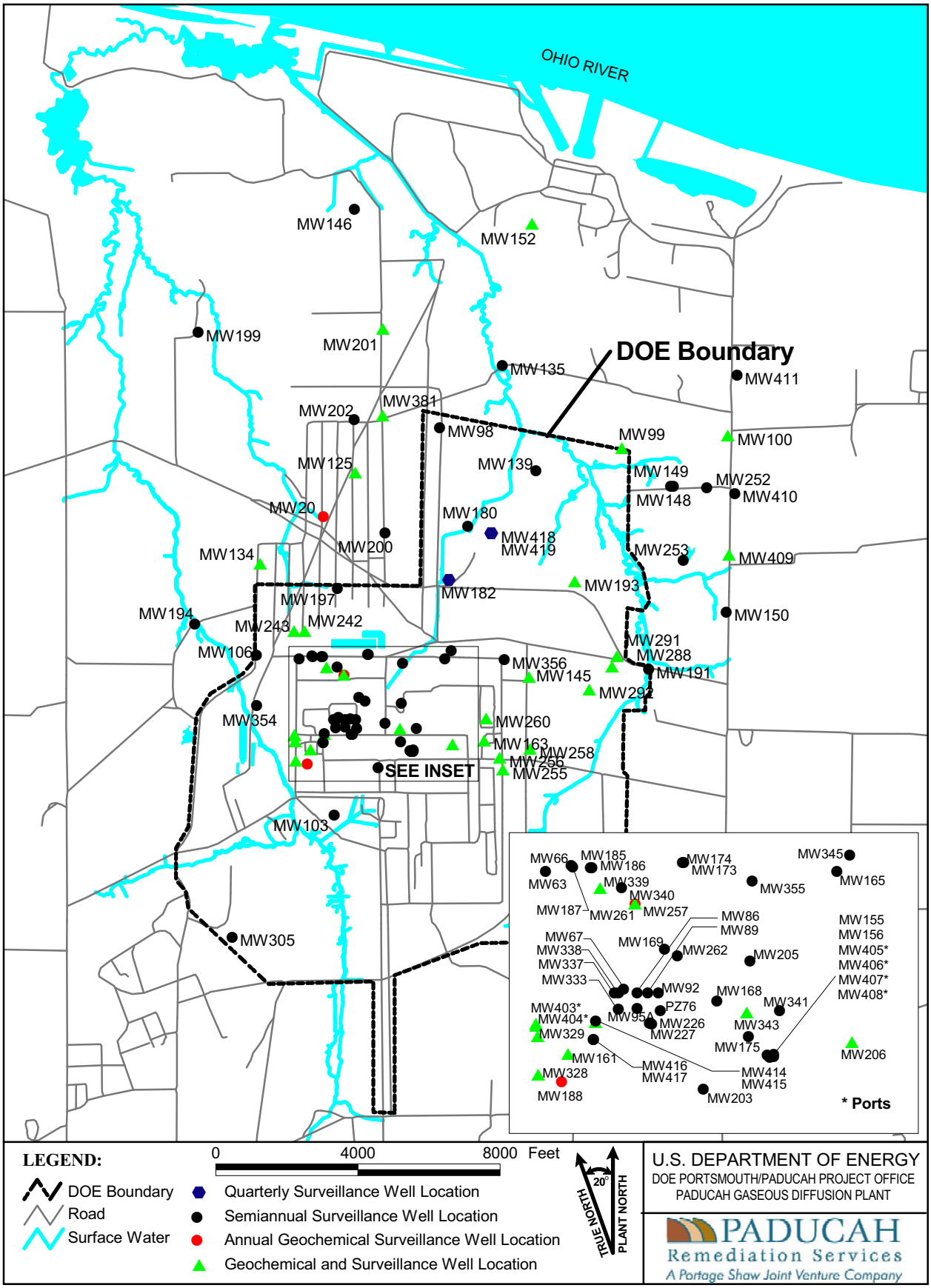

Figure C.8. Groundwater Surveillance Wells - RGA

Geochemical Environmental Surveillance Monitoring

Frequency: Annually

Driver: DOE Order 450.1 and the Paducah FFA

Rationale: To monitor the nature and extent of groundwater contamination and to monitor groundwater quality and support contaminant attenuation. Sampling of these wells is conducted in support of the Paducah FFA CERCLA Investigation, RFIs, and DOE Order 450.1. Tables C.22 and C.23 show surveillance geochemical wells and surveillance geochemical annual analytical parameters, respectively. Locations are shown on Figure C.8.

Reported: Annual Site Environmental Report

Table C.22. Surveillance Geochemical Wells (44)

MW20	MW291
MW99	MW292
MW100	MW328
MW125	MW329
MW134	MW339
MW145	MW343
MW152	MW381
MW161	MW403 Port 3
MW163	MW404 Port 3
MW188	MW404 Port 4
MW193	MW404 Port 5
MW206	MW409
MW201	MW414
MW242	MW426**
MW243	MW427**
MW255	MW439**
MW256	MW441**
MW257	MW447**
MW258	MW468**
MW260	MW473**
MW261	MW474**
MW288	MW490**

Table C.23. Surveillance Geochemical Annual Analytical Parameters

Other	**Metals (total and dissolved*)**
Sulfate	Aluminum
Nitrate	Antimony
Total Organic Carbon	Barium
Chloride	Beryllium
Total Dissolved Solids	Cadmium
Silica	Calcium
Fluoride	Chromium
Phosphate	Cobalt
Alkalinity	Copper
Ferrous Iren (Fe^{+2})	Iron
	Lead
Field Parameters	Magnesium
Barometric Pressure	Manganese
Conductivity	Molybdenum
Depth to water	Nickel
Dissolved Oxygen	Potassium
Eh	Silver
pH	Sodium
Temperature	Zinc
Turbidity	Arsenic
	Mercury
Volatiles	Selenium
Ethene	Uranium
Ethane	
Methane	

*Dissolved metals are analyzed only if there is detection in the total metals analysis.

These are **new surveillance geochemical wells. The first sampling event is scheduled for June 2010.

C.3. SURFACE WATER, SEDIMENT, AND WATERSHED BIOLOGICAL MONITORING

C.3.1 EFFLUENT WATERSHED MONITORING PROGRAM

C-746-S & -T Landfills and C-746-U Landfill Surface Water

Frequency: Quarterly

Driver: Landfill permits issued by KDWM.

Rationale: Monitor rain runoff from the C-746-S&-T and C-746-U Landfills.

Reported: Quarterly Compliance Monitoring Reports and Surface Landfill Reports required by the landfill permits. Tables C.24 and C.25 show landfill surface water locations and landfill surface water parameters, respectively. Locations are shown on Figure C.9.

Table C.24. Landfill Surface Water Locations (6)

C-746-S&T	C-746-U
L135	L150
L136	L154*
L154*	L351

*L154 is listed on both the C-746-S&T, as well as the C-746-U Landfill permits.

Table C.25. Landfill Surface Water Parameters

Anions
Chloride
Sulfate
Field Measurements
Conductivity
Dissolved Oxygen
Flow Rate
pH
Temperature
Metals
Iron
Sodium
Uranium
Other
Total Dissolved Solids
Total Suspended Solids
Total Solids
Chemical Oxygen Demand
Total Organic Carbon
Radionuclides
Alpha Activity
Beta Activity

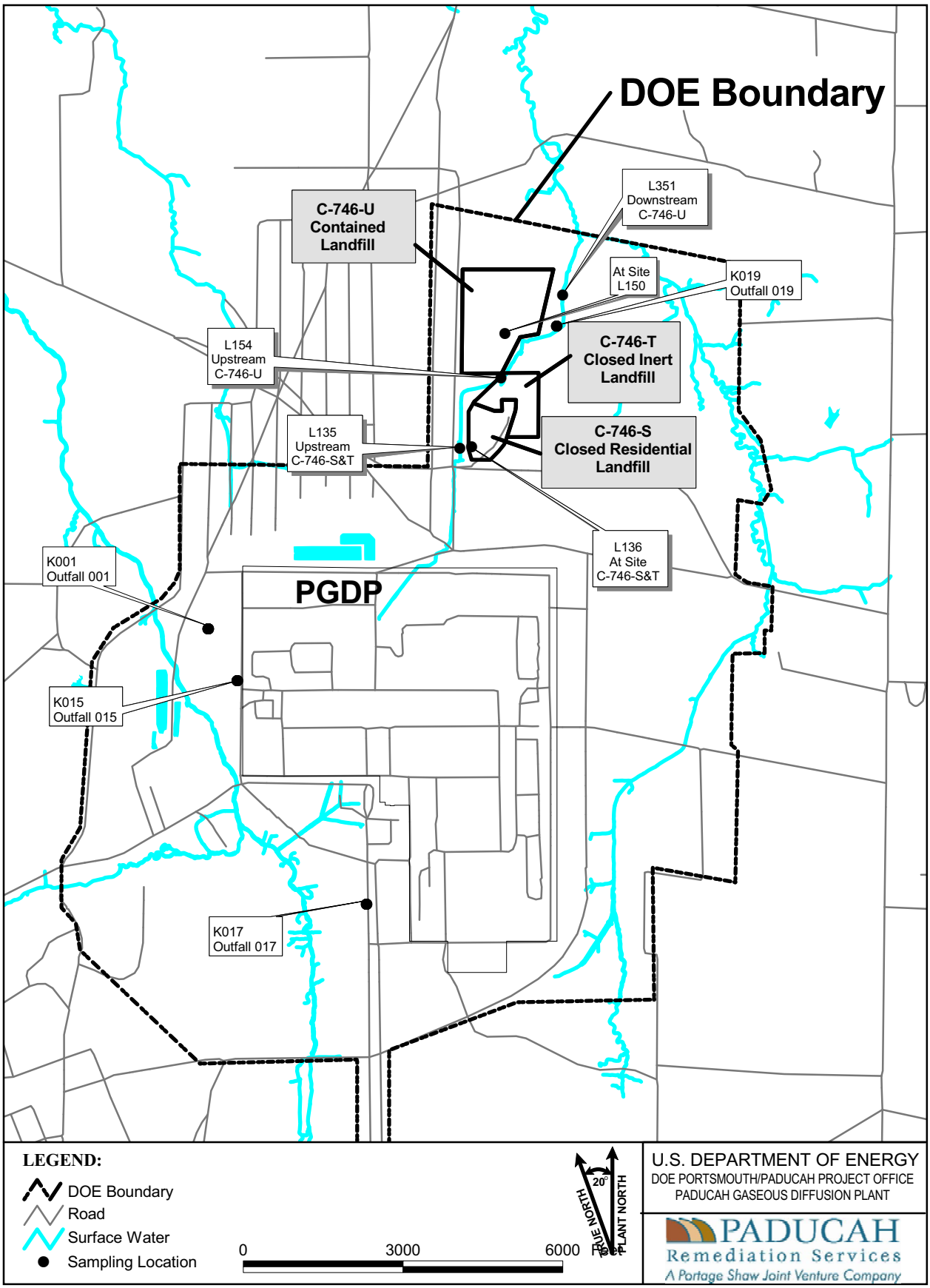

Figure C.9. KPDES and Landfill Surface Water Locations

KPDES Outfall Sampling

Driver: DOE Kentucky Pollutant Discharge Elimination System (KPDES) Permit for the Paducah Gaseous Diffusion Plant (PGDP), Permit Number KY0004049, McCracken County, Kentucky.

Reported: Monthly and Quarterly Discharge Monitoring Reports

Comments: A new KPDES permit was effective on November 1, 2006; however, upon petitioning by the co-permittees an Agreed Order was established between the petitioning parties and the Kentucky Division of Water. The shaded rows in Table C.26 indicate 45 parameters under Agreed Order that may be removed once the sampling requirements of Agreed Order Section III, paragraphs 11 and 12, are met.

Table C.26. KPDES Outfall Sampling Locations, Frequency, and Parameters

Analysis	Frequency of Sampling at KPDES Locations D – Daily; W – Weekly; M – Monthly; Q – Quarterly								
	D	W	M	M	M	Q	Q	Q	Q
	K001	K001	K015	K017	K019	K001	K015	K017	K019
Flow (MGD)	X		X	X	X				
Total Suspended Solids (mg/L)		X	X	X	X				
Oil & Grease (mg/L)		X	X	X	X				
Total Residual Chlorine (mg/L)		X							
Temperature (°F)†		X							
PCBs (mg/L)		X	X	X	X				
Trichloroethene (mg/L)		X							
Total Phosphorus (mg/L)		X							
Total Alpha (pCi/L)		X	X	X	X				
Total Beta (pCi/L)		X	X	X	X				
Uranium (µg/L)		X	X	X	X				
Total Recoverable Zinc (µg/L)				X	X				
BOD_5 (mg/L)					X				
Ammonia					X				
a-Terpineol (mg/L)					X				
Benzoic Acid (mg/L)					X				
p-Cresol (mg/L)					X				
Phenol (mg/L)					X				
Acute Toxicity (TU_A)*							X	X	X
Chronic Toxicity (TU_c)** †						X			
Technetium-99 (pCi/L)						X	X	X	X
Hardness (as mg/L $CaCO_3$)						X	X	X	X
Total Recoverable Iron (µg/L)							X		X
1,1,2,2-Tetrachloroethane (µg/L)						X	X	X	X
1,1-Dichloroethene (µg/L)						X	X	X	X
1,2-Diphenylhydrazine (µg/L)						X	X	X	X
2,4,6-Trichlorophenol (µg/L)						X	X	X	X
2,4-Dinitrotoluene (µg/L)						X	X	X	X
3,3-Dichlorobenzidine (µg/L)						X	X	X	X
4,4'-DDD (µg/L)						X	X	X	X
4,4'-DDE (µg/L)						X	X	X	X
4,4'-DDT (µg/L)						X	X	X	X
Acrylonitrile (µg/L)						X	X	X	X
Aldrin (µg/L)						X	X	X	X

Table C.26. KPDES Outfall Sampling Locations, Frequency, and Parameters (Continued)

Alpha-BHC (µg/L)						X	X	X	X
Alpha-Endosulfan (µg/L)						X	X	X	X
Benzidine (µg/L)						X	X	X	X
Benzo(a)anthracene (µg/L)						X	X	X	X
Benzo(a)pyrene (µg/L)						X	X	X	X
Benzo(k)fluoranthene (µg/L)						X	X	X	X
Beta-BHC (µg/L)						X	X	X	X
Beta-Endosulfan (µg/L)						X	X	X	X
Bis(2-ethylhexyl)phthalate (µg/L)						X	X	X	X
Carbon Tetrachloride (µg/L)						X	X	X	X
Chlordane (µg/L)						X	X	X	X
Chrysene (µg/L)						X	X	X	X
Dibenzo(a,h)anthracene (µg/L)						X	X	X	X
Dieldrin (µg/L)						X	X	X	X
Endrin (µg/L)						X	X	X	X
Free Cyanide (µg/L)						X	X	X	X
Gamma-BHC (Lindane) (µg/L)						X	X	X	X
Heptachlor (µg/L)						X	X	X	X
Heptachlor epoxide (µg/L)						X	X	X	X
Hexachlorobenzene (µg/L)						X	X	X	X
Hexachlorethane (µg/L)						X	X	X	X
Indeno(1,2,3-cd)pyrene (µg/L)						X	X	X	X
N-Nitrosodimethylamine (µg/L)						X	X	X	X
N-Nitrosodi-n-propylamine (µg/L)						X	X	X	X
N-Nitrosodiphenylamine (µg/L)						X	X	X	X
Pentachlorophenol (µg/L)						X	X	X	X
Tetrachloroethene (µg/L)						X	X	X	X
Total Recoverable Cadmium (µg/L)						X	X	X	X
Total Recoverable Copper (µg/L)						X	X	X	X
Total Recoverable Lead (µg/L)						X	X	X	X
Total Recoverable Mercury (µg/L)						X	X	X	X
Total Recoverable Selenium (µg/L)						X	X	X	X
Total Recoverable Silver (µg/L)						X	X	X	X
Total Recoverable Thallium (µg/L)						X	X	X	X

Shaded rows indicate 45 parameters under Agreed Order that may be removed once the sampling requirements of Agreed Order Section III, paragraphs 11 and 12, are met.

* Acute toxicity sampling requires two grab samples.
** Chronic toxicity sampling requires three 24-hour composite samples.

†**NOTE:** Temperature and chronic toxicity for Outfall 017 shall become effective upon completion and commencement of operation of the depleted uranium conversion facility which is expected in 2010.

Locations are shown on Figure C.9.

Watershed KPDES Permit Biological Sampling

Locations: Areas outside of the PGDP security fence and the West Kentucky Wildlife Management Area (WKWMA) and reference from a specified background location. (See field and analytical parameters in Table C.27 for location names and Figure C.10 for a map of the locations.)

Driver: DOE KPDES Permit for the PGDP, permit number KY0004049, McCracken County, Kentucky

Frequency: Benthic Macroinvertebrates—Annually

Reported: Annual Watershed Monitoring Report required by the KPDES Permit.

Comments: A new KPDES permit was issued in November 2006. Changes to the Watershed Monitoring Program included the elimination of bioaccumulation sampling or fish community ecological health.

Table C.27. Watershed Monitoring Locations and Analyses

Type of Monitoring	Analyses	Locations*
Benthic Macroinvertebrates Multi-habitat Assessment	Taxonomic Level Total Density Total Biomass	BM 4.6 BM 5.85 BM 6.2 LUM 2.7 LUM 4.5 LUM 6.6 MAM 8.6 WFM 0.5

*Locations are shown on Figure C.10.

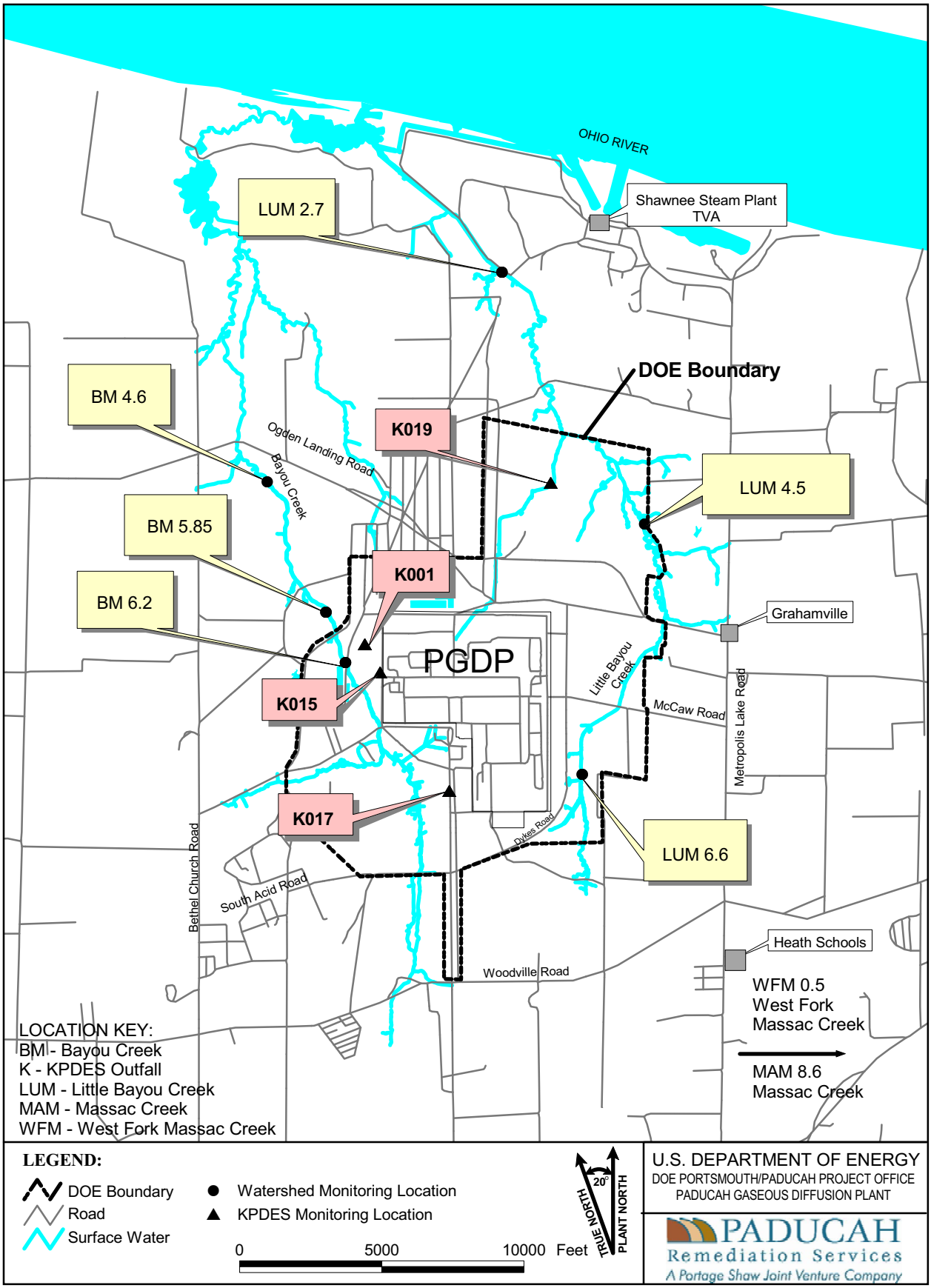

Figure C.10. Watershed Monitoring Locations

C.3.2 ENVIRONMENTAL SURVEILLANCE WATERSHED MONITORING PROGRAM

Surface Water Monitoring

Frequency: Quarterly

Driver: DOE Order 450.1

Rationale: To monitor potential contamination released into Bayou Creek and Little Bayou Creek surface water from historical plant operations. Tables C.28, C.29, and C.30 show surface water sampling locations, quarterly analytical parameters, and quarterly seep location analytical parameters, respectively. Locations are show on Figure C.11.

Reported: Annual Site Environmental Report

Table C.28. Surface Water and Seep Sampling Locations (22)

Surface Water (20)
C612 (SP)**
C616
C746K-5
C746KTB3
L1 (BG)
L10
L11
L194
L29A (BG/R)**
L291
L30 (R)**
L306 (R)**
L5
L12
L241
L6 (BG)
L64
S31
K001UP Composite Rad Only*
K015UP Grab Rad Only*
Seeps (2)
LBCSP5**
LBCSP7**

BG – Background locations
R – Ohio River locations
SP – Sampling port
* – Field measurements are to be collected in the stream.
** – Unable to obtain flow rates

Table C.29. Surface Water Quarterly Analytical Parameters		Table C.30. Quarterly Seep Location Analytical Parameters
Radiological	**Metals**	**Radionuclides**
Dissolved Alpha	Aluminum	Alpha Activity
Dissolved Beta	Antimony	Beta Activity
Suspended Alpha	Barium	Technetium-99
Suspended Beta	Beryllium	Uranium
Technetium-99	Cadmium	
Neptunium-237	Calcium	**Volatiles**
Plutonium-238	Chromium	1,1,1-Trichloroethane
Plutonium-239/240	Cobalt	1,1,2-Trichloroethane
Thorium-228	Copper	1,1-Dichloroethane
Thorium-230	Iron	1,1-Dichloroethene
Thorium-232	Lead	1,2-Dichloroethane
Thorium-234	Magnesium	Benzene
% Uranium-235	Manganese	Bromodichloromethane
Americium-241	Nickel	Carbon Tetrachloride
Cesium-134	Potassium	Chloroform
Cesium-137	Silver	*cis*-1,2-dichloroethene
Cobalt-60	Sodium	Dimethylbenzene, Total**
Potassium-40	Thallium	Ethylbenzene
Uranium	Uranium	Tetrachloroethene
Uranium-234	Vanadium	Toluene
Uranium-235	Zinc	*Trans*-1,2-Dichloroethene
Uranium-238	Arsenic	Trichloroethene
	Mercury	Vinyl Chloride
PCBs	Selenium	
PCB, Total		**Field Measurements**
PCB-1016	**Miscellaneous**	pH
PCB-1221	Hardness-Total as CaCO3	Dissolved Oxygen
PCB-1232	Total Suspended Solids	Temperature
PCB-1242	Chloride	Conductivity
PCB-1248	Ammonia as Nitrogen	
PCB-1254	Nitrogen as Nitrate/Nitrite	
PCB-1260	Phosphorous	**Metals**
PCB-1268	Cyanide	Sodium
		Potassium
		Calcium
Field Measurements	**Volatiles**	Magnesium
pH	Trichloroethene	Manganese
Flow*		
Dissolved Oxygen		
Temperature		**Other**
Conductivity		Chloride
Alkalinity		Sulfate
		Alkalinity

* See previous page for locations where flow rates are not collected.
**Xylenes

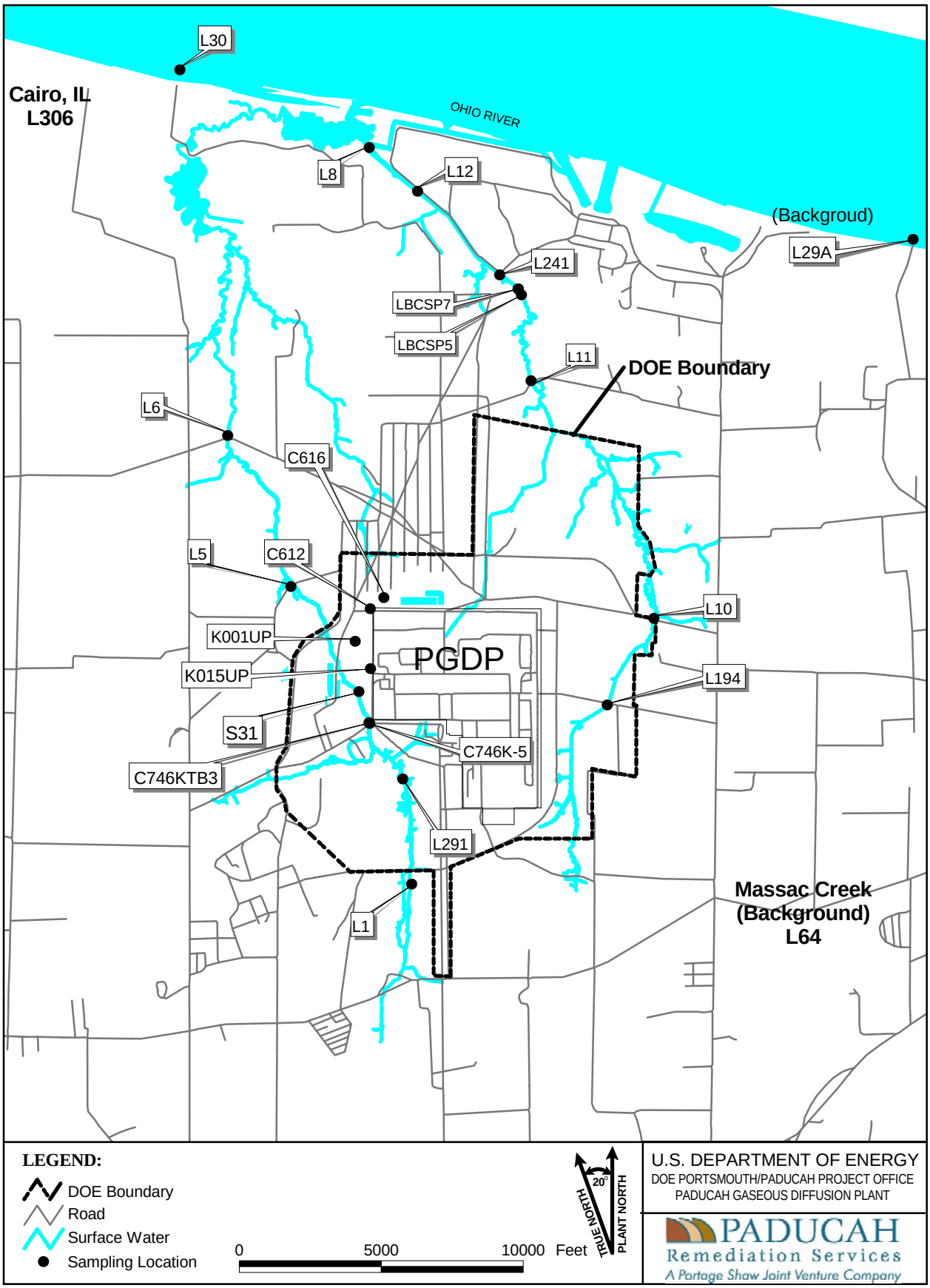

Figure C.11. Surface Water Monitoring Locations

Sediment Monitoring

Frequency: Semiannually

Driver: DOE Order 450.1

Rationale: Monitor potential contamination released into Bayou Creek and Little Bayou Creek sediments from historical plant operations. Tables C.31 and C.32 show sediment sampling locations and analytical parameters. Locations are shown on Figure C.12.

Reported: Annual Site Environmental Report

Table C.31. Sediment Sampling Locations (14)

C612
C616
C746KTB2
K001
L194
S1
S2
S20 (BG)
S27
S28 (BG)
S31
S32
S33
S34

BG = Background locations

Table C.32. Sediment Analytical Parameters

PCBs	**Metals**
PCB, Total	Aluminum
PCB-1016	Antimony
PCB-1221	Barium
PCB-1232	Beryllium
PCB-1242	Cadmium
PCB-1248	Calcium
PCB-1254	Chromium
PCB-1260	Cobalt
PCB-1268	Copper
	Iron
Radiological	Lead
Uranium	Magnesium
% Uranium-235	Manganese
Uranium-234	Nickel
Uranium-235	Potassium
Uranium-238	Silver
Alpha activity	Sodium
Beta activity	Thallium
Technetium-99	Uranium
Plutonium-239/240	Vanadium
Thorium-230	Zinc
Americium-241	Arsenic
Cesium-137	Mercury
Cobalt-60	Selenium
Neptunium-237	
Potassium-40	

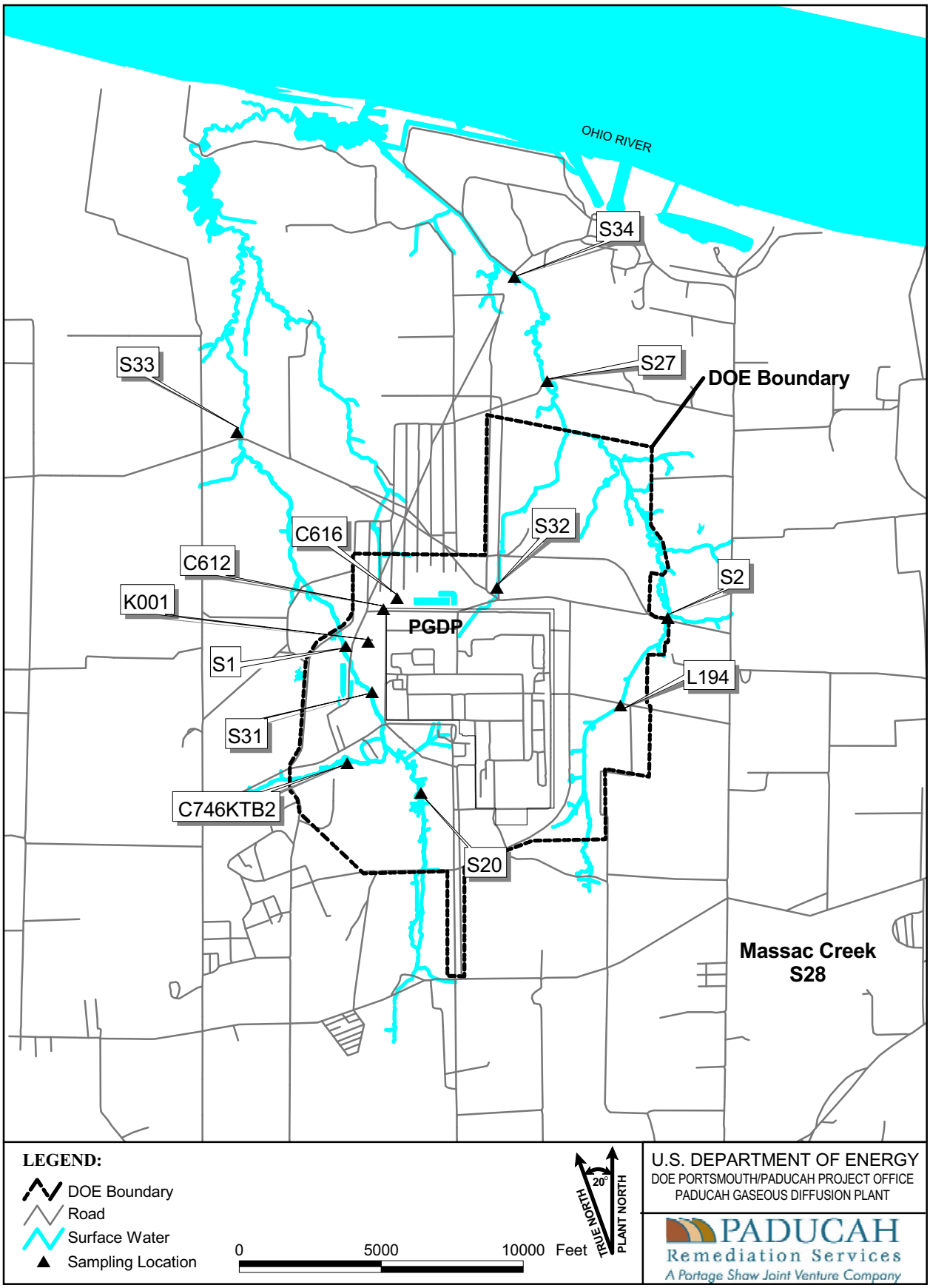

Figure C.12. Semiannual Sediment Locations

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C.4. ANNUAL DEER HARVESTING

Frequency: Annually

Locations: Areas outside of the PGDP security fence and the WKWMA and reference deer from a specified background location. Reference deer were last collected from Stewart Island in 2002.

Driver: DOE Order 450.1

Rationale: Evaluate data for risk assessment each year to determine if human health would be impacted from the consumption of two deer harvested from the WKWMA during the hunting season. If risk is elevated above thresholds, then notify the WKWMA personnel to take appropriate action. Table C.33 provides annual deer sampling parameters.

Reported: Annual Site Environmental Report and to WKWMA personnel

Table C.33. Annual Deer Sampling Parameters (Five Site Deer)

Liver and Muscle	Fat (Rump and Abdominal) and Liver	Kidney	Bone	Thyroid
Metals	**PCBs**	**Metals**	**Radionuclides**	**Radionuclides**
Aluminum	PCB, Total	Aluminum	Technetium-99	Technetium-99
Antimony	PCB-1016	Antimony	Neptunium-237	
Barium	PCB-1221	Barium	Plutonium-239	
Beryllium	PCB-1232	Beryllium	Uranium-233/234	
Cadmium	PCB-1242	Cadmium	Uranium-235	
Chromium	PCB-1248	Chromium	Uranium-238	
Cobalt	PCB-1254	Cobalt	Thorium-230	
Copper	PCB-1260	Copper		
Iron	PCB-1268	Iron		
Lead		Lead		
Manganese		Manganese		
Nickel	**Other**	Nickel		
Silver	Percent Lipids	Silver		
Thallium		Thallium		
Vanadium		Vanadium		
Zinc		Zinc		
Arsenic		Arsenic		
Mercury		Mercury		
Selenium		Selenium		
Radionuclides				
Technetium-99				
Neptunium-237				
Plutonium-239				
Uranium-234				
Uranium-235				
Uranium-238				
Thorium-230				

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C.5. LANDFILL LEACHATE SAMPLING

C-746-S&T and C-746-U Landfills Leachate Monitoring

Frequency: Annually

Driver: C-746-S, T and U Landfill permits issued by KDWM, Permit Numbers, SW07300014, SW07300015, and SW07300045, respectively. Annual leachate parameters for C-746-S&T and C-746-U Landfills are presented in Table C.34.

Reported: Annual Environmental Compliance Report required by landfill permits

Table C.34. C-746-S&T and C-746-U Annual Leachate Parameters

Volatiles	PCBs	Metals	Anions
1,1,1,2-Tetrachloroethane	PCB, Total	Aluminum	Bromide
1,1,1-Trichloroethane	PCB-1016	Antimony	Chloride
1,1,2,2-Tetrachloroethane	PCB-1221	Arsenic	Fluoride
1,1,2-Trichloroethane	PCB-1232	Barium	Nitrate as Nitrogen
1,1-Dichloroethane	PCB-1242	Beryllium	Sulfate
1,1-Dichloroethene	PCB-1248	Boron	
1,2,3-Trichloropropane	PCB-1254	Cadmium	**Field Parameters**
1,2-Dibromo-3-chloropropane	PCB-1260	Calcium	Conductivity
1,2-Dibromoethane	PCB-1268	Chromium	Dissolved Oxygen
1,2-Dichlorobenzene		Cobalt	Eh
1,2-Dichloroethane	**Radionuclides**	Copper	Temperature
1,2-Dichloropropane	Alpha Activity	Iodide	pH
1,4-Dichlorobenzene	Beta activity	Iron	
2-Butanone	Iodine-131	Lead	**Miscellaneous**
2-Hexanone	Radium-226	Magnesium	Total Dissolved Solids
4-Methyl-2-pentanone	Strontium-90	Manganese	Chemical Oxygen Demand
Acetone	Technetium-99	Mercury	Cyanide
Acrolein	Thorium-230	Molybdenum	Total Organic Halides
Acrylonitrile	Tritium	Nickel	Total Organic Carbon
Benzene	Cesium-137[1]	Potassium	Oil and Grease[1]
Bromochloromethane	Cobalt-60[1]	Rhodium	Phosphorus[1]
Bromodichloromethane	Thorium-234[1]	Selenium	Hardness - Total as $CaCO_3$[1]
Bromoform	Americium-241[1]	Silver	Carbonaceous Biochemical Oxygen Demand[1]
Bromomethane	Neptunium-237[1]	Sodium	Total Suspended Solids[1]
Carbon Disulfide	Plutonium-239/240[1]	Tantalum	
Carbon Tetrachloride	Activity of Uranium-235[1]	Thallium	
Chlorobenzene	Uranium-234[1]	Uranium	
Chloroethane	Uranium-238[1]	Vanadium	
Chloroform	Dissolved Alpha[1]	Zinc	
Chloromethane	Dissolved Beta[1]	Barium, Dissolved[1]	
cis-1,2-Dichloroethene	Technetium-99, Dissolved[1]	Chromium, Dissolved[1]	
cis-1,3-Dichloropropene	Cesium-137, Dissolved[1]	Uranium, Dissolved[1]	
Dibromochloromethane	Cobalt-60, Dissolved[1]	Antimony, Dissolved[1]	
Dibromomethane	Thorium-234, Dissolved[1]	Arsenic, Dissolved[1]	
Dimethylbenzene, Total*	Americium-241, Dissolved[1]	Cadmium, Dissolved[1]	
Ethylbenzene	Neptunium-237, Dissolved[1]	Cobalt, Dissolved[1]	
Iodomethane	Plutonium-239/240, Dissolved[1]	Copper, Dissolved[1]	
Methylene Chloride	Thorium-230, Dissolved	Lead, Dissolved[1]	
Styrene	Activity of Uranium-235, Dissolved[1]	Manganese, Dissolved[1]	
Tetrachloroethene	Uranium-234, Dissolved[1]	Nickel, Dissolved[1]	
Toluene	Uranium-238, Dissolved[1]	Selenium, Dissolved[1]	
trans-1,2-Dichloroethene	Uranium	Silver, Dissolved[1]	
trans-1,3-Dichloropropene	Uranium, Dissolved	Tin[1]	
trans-1,4-Dichloro-2-Butene		Tin, Dissolved[1]	
Trichloroethene		Titanium[1]	
Trichlorofluoromethane		Titanium, Dissolved[1]	
Vinyl Acetate		Uranium, Dissolved[1]	
Vinyl Chloride		Vanadium, Dissolved[1]	
		Zinc, Dissolved [1]	

* Xylenes

[1] Additional parameters that are not listed in the C-746 S&T and C-746-U Landfill permits, SW07300014, SW07300015, and SW07300045.

C-404 Low-level Radioactive Waste Burial Ground Leachate Monitoring

Frequency: As needed

Driver: The leachate parameters are required to be sampled per the EPA Hazardous Waste Permit, number KY8-890-008-982.

Reported: C-404 Quarterly Operations and Maintenance Report. Leachate analytical parameters for C-404 Landfill are presented in Table C.35.

Table C.35. C-404 Landfill Leachate Analytical Parameters

Volatiles	Metals
Trichloroethene	Barium
	Cadmium
Radionuclides	Chromium
Technetium-99	Copper
Uranium-234	Iron
Uranium-235	Lead
Uranium-238	Nickel
Plutonium-239/240	Silver
Thorium-230	Zinc
Cesium-137[1]	Arsenic
Neptunium-237	Mercury
	Selenium
PCBs	Uranium[1]
PCB, Total[1]	
PCB-1016[1]	**Other**
PCB-1221[1]	Fluoride
PCB-1232[1]	Ammonia as Nitrogen[2]
PCB-1242[1]	
PCB-1248[1]	
PCB-1254[1]	**Field Parameters**
PCB-1260[1]	pH[1]
PCB-1268[1]	Conductivity[1]
	Dissolved Oxygen[1]
	Eh[1]
	Temperature[1]

[1] Additional operation parameters that are not listed in the C-404 Landfill Permit, KY8-890-008-982.
[2] Permit specifies ammonia nitrate; however, ammonia as nitrogen is the parameter required by the KDWM. This change will be incorporated in the next permit modification.

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C.6. EXTERNAL GAMMA RADIOLOGICAL MONITORING

Frequency: Collected continuously and analyzed quarterly; thermoluminescent dosimeters (TLDs) at 46 monitoring locations are changed quarterly for gamma radiation monitoring. Figure C.13 shows TLD monitoring locations.

Driver: DOE Order 450.1

Reported: Annual Site Environmental Report and Annual Report for External Gamma Radiation Monitoring

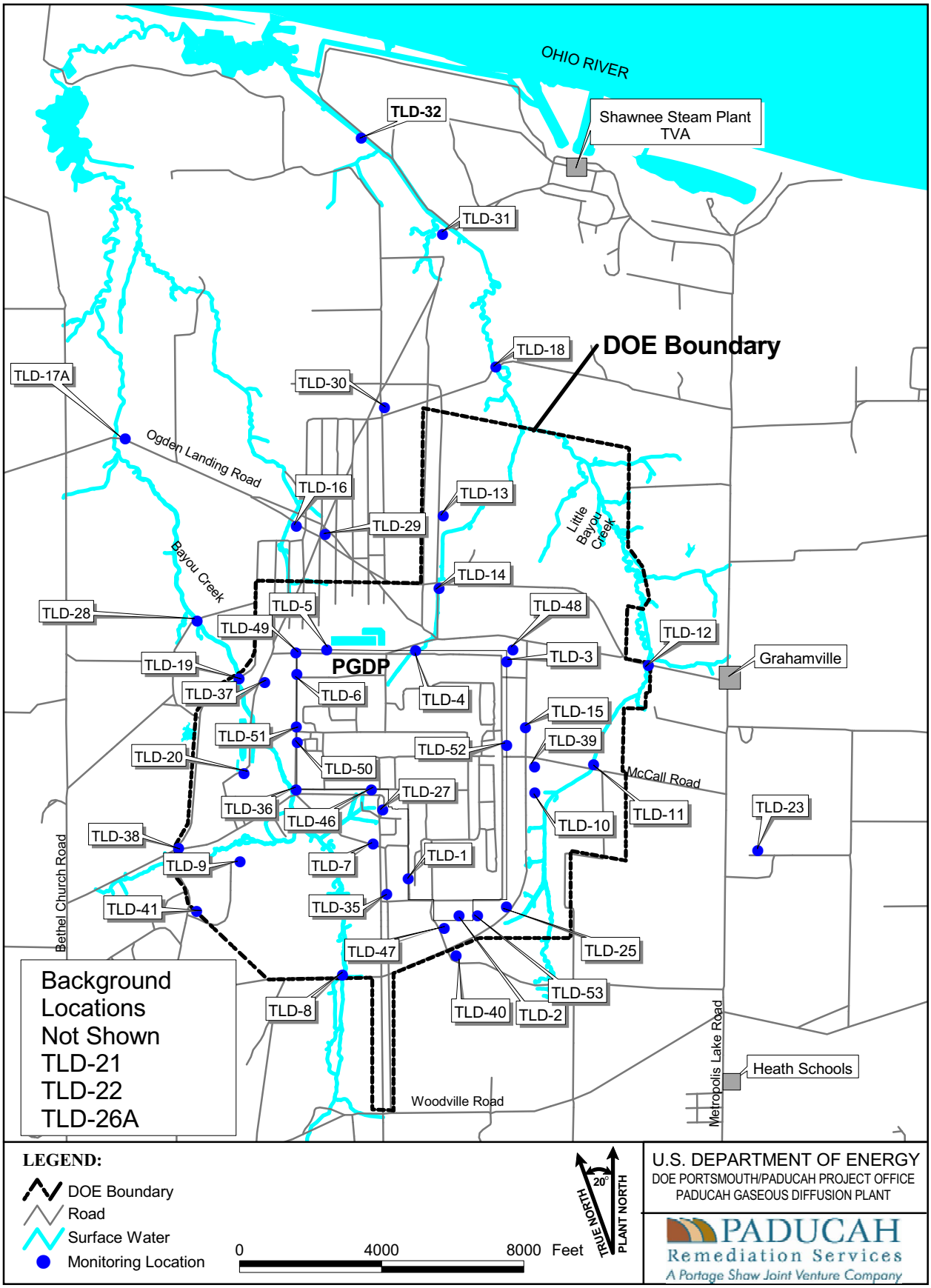

Figure C.13. TLD Monitoring Locations

APPENDIX D

ENVIRONMENTAL MONITORING QUALITY ASSURANCE PROJECT PLAN

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Environmental Monitoring
Quality Assurance Project Plan
at the
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

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Environmental Monitoring Quality Assurance Project Plan at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—May 2010

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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TABLE OF CONTENTS

TABLES

ACRONYMS

ACO	Administrative Consent Order
AOC	Areas of Concern
BC	Bayou Creek
CFR	*Code of Federal Regulations*
COC	chain-of-custody
DCC	Document Control Center
DMC	Document Management Center
DMR-QA	Discharge Monitoring Report – Quality Assurance
DOE	U.S. Department of Energy
DQO	data quality objective
EDD	electronic data deliverable
EM	Environmental Monitoring
EM QAPP	Environmental Monitoring Quality Assurance Project Plan
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
ER	Environmental Restoration
ES	environmental services
FFA	Federal Facility Agreement
HSWA	Hazardous Solid Waste Amendment
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
LBC	Little Bayou Creek
MCL	maximum contaminant limit
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NTU	nephelometric turbidity unit
OREIS	Oak Ridge Environmental Information System
OSHA	Occupational Safety and Health Administration
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
PRS	Paducah Remediation Services, LLC
PRS QAPP	DOE Prime Contractor Quality Assurance Program Plan
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RGA	Regional Gravel Aquifer
RPD	relative percent difference
RSD	relative standard deviation
SMO	Sample Management Organization
SOW	statement of work
SWMU	solid waste management unit
^{99}Tc	technetium-99
TCE	trichloroethene
TCL	Target Compound List
USEC	United States Enrichment Corporation
VOC	volatile organic compound

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1. INTRODUCTION TO THE QUALITY PROGRAM

The Environmental Monitoring (EM) Program, managed by Paducah Remediation Services, LLC, (PRS) and its subcontractors, performs environmental monitoring, effluent monitoring, environmental surveillance, and compliance reporting. The EM Quality Assurance Project Plan (QAPP) describes the responsibilities and activities that affect the quality of the operations, maintenance, and scientific and technical information collected. This EM QAPP is a stand-alone project plan that supports and is included as an attachment to the *Environmental Monitoring Plan* (EMP), PRS-ENM-0035, Rev. 2. The EMP provides overall direction for EM activities.

The DOE Prime Contractor Quality Assurance Program Plan (PRS QAPP) (PRS-CDL-0058) implements the Quality Assurance requirements established in 10 *CFR* § 830.120 and DOE Order 414.1C, and flows those requirements down into all DOE Prime Contractor activities and functions. The EM program is focused on obtaining environmental data and measurements; therefore, the EM QAPP follows the format established in the U.S. Environmental Protection Agency (EPA), *Requirements for Quality Assurance Project Plans* (QA/R-5). This EPA document applies specifically to environmental data collected and used in decision making and provides the structure, content, and guidance for QAPPs associated with environmental data collection.

This plan will be updated through an annual review and revised as necessary. All revisions to the EM QAPP will be subject to the DOE Prime Contractor internal review process.

Reference Documents

- PRS-ENM-0035/R2, *Environmental Monitoring Plan*
- Kentucky Pollutant Discharge Elimination System (KPDES) Permit, KY0004049, November 1, 2006
- KY8-890-008-982, Hazardous Solid Waste Amendments (HSWA) Permit, April 24, 2006
- 10 *CFR* § 830.120, *Quality Assurance Requirements*
- DOE Order 414.1C, *Quality Assurance*
- EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans*
- SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*
- PRS-CDL-0058, *PRS Quality Assurance Program Plan for the Paducah Environmental Remediation Project, Paducah, Kentucky*

2. PROJECT/TASK ORGANIZATION AND RESPONSIBILITY

2.1 PROJECT PERSONNEL

The Organizational Chart for EM is shown in Attachment 1. The organization is designed to provide a clear line of functional and program responsibility and authority supported by a management control structure. Overall responsibilities for this project include the following:

- Establishing clearly defined lines of communication and coordination;
- Monitoring project budget and schedule;
- Providing progress reports;
- Establishing quality assurance and control;
- Ensuring health and safety;
- Ensuring project coordination; and
- Maintaining project database.

2.2 RESPONSIBILITIES

2.2.1 Environmental Restoration and Environmental Monitoring Director

The Environmental Restoration (ER) and Environmental Monitoring (EM) Director reports to the Site Manager and is responsible for implementation of all activities associated with EM such as maintaining budgets, schedules, and milestones. The EREM Director has direct responsibility for project oversight, issuing technical reports, and ensuring the project is on schedule and within budget. The EREM Director ensures that implementation of the QA and Health and Safety Programs are consistent with DOE guidelines. The EREM Director responds to QA/quality control (QC) deficiencies, initiates and completes corrective actions, and ensures data management requirements are followed.

2.2.2 Environmental Sampling Manager

The Environmental Sampling Manager is responsible for providing technical support to the EM project by generating required reports and making decisions regarding technical issues (i.e., sample locations, analytical methods, etc.). The Environmental Sampling Manager also is responsible for ensuring that the monitoring activities are consistent with the sitewide groundwater program and other EM policies and procedures. The Environmental Sampling Manager also is responsible for managing and administering projects; planning activities; and procuring services, as necessary.

2.2.3 Sample Handler

The Sample Handler reports to the Environmental Sampling Manager and is responsible for overseeing routine monitoring/sampling activities; maintaining and inspecting monitoring equipment; coordinating split sampling activities with the Commonwealth of Kentucky; overseeing procedures; and ensuring visitor and worker safety and health on the project site.

2.2.4 Field Samplers

The Field Samplers report to the Sample Handler and are responsible for all groundwater monitoring, KPDES, surface water, and sediment sampling activities, which include the following: maintaining logbook entries; calibrating monitoring equipment; performing field analyses; maintaining sampling

equipment; performing well inspections; conducting all routine monthly, quarterly, semiannual, and annual sampling, as well as special, residential, and Commonwealth of Kentucky split sampling; preserving samples; and maintaining quality records of sampling events in written format. The Field Samplers are responsible for overseeing the performance of necessary calibrations; decontaminating sampling equipment; performing laboratory inspections; maintaining an inventory list of reagents and chemicals; managing and reviewing records and logbooks; and working in accordance with applicable Chemical Hygiene Plans.

2.2.5 Data Coordinator

The Data Coordinator enters the data into ES PEMS, including COC information, field data, validation qualifiers, and any pertinent sampling information. After receiving a notification that a fixed base lab EDD is available to download, the Data Coordinator loads the EDD to ES PEMS, performs electronic verification of the data, and then compiles the data assessment package. The Data Coordinator also prepares data for transfer from ES PEMS to the Paducah OREIS.

2.2.6 QA Specialist

The project QA Specialist is responsible for QA oversight associated with EM activities. The QA Specialist is part of the project team and is responsible for QA review of data packages generated by monitoring and sampling activities and other information to determine if the project team followed all applicable procedures. The QA Specialist is responsible for assessing the EM program and providing oversight to ensure that nonconformances and conditions adverse to quality are properly documented, reported to the DOE Prime Contractor Issues Management Program, and corrected.

2.2.7 Environmental Monitoring Project Manager

The EM Project Manager is responsible for coordinating the EM documents and reports and maintaining working copies. The EM Project Manager also is responsible for EM monitoring and maintenance activities for MWs, as well as all sampling activities described in the EMP.

2.2.8 Environmental Compliance Support Personnel

The Environmental Compliance support personnel are responsible for establishing regulatory compliance requirements; assisting in implementation, planning, and oversight of regulatory compliance; and providing assistance when needed.

2.2.9 Sample/Data Manager

The Sample/Data Manager is responsible for long-term storage of project data and for transmitting data to external agencies according to the Paducah Site Data Management Plan, DOE/OR/07-1595&D1, and the Paducah Data Management Policy. The Sample/Data Manager ensures compliance with policies and procedures relating to data management with respect to the project and that the requirements of PRS-ENM-5003 are followed.

2.2.10 Lab Coordinator

The Lab Coordinator reports to the Sample/Data Manager and is responsible for contracting any fixed-base laboratory utilized during the sampling activities. The Lab Coordinator also provides coordination for sample shipment to the laboratory, contractual screening of data packages, and transmittal of data packages to the Document Management Center.

2.2.13 Subcontractors

Subcontractors provide sampling support to EM for all sampling activities up to biological monitoring activities (including deer and watershed monitoring sampling).

3. PROBLEM DEFINITION/BACKGROUND

3.1 PROBLEM STATEMENT

The EM program performs effluent monitoring and surveillance activities to do the following:

- Achieve compliance with federal or state regulations, permit conditions, or environmental commitments both on and off-site;
- Better understand the effects of DOE operations on the quality of the regional environment;
- Address public concern about off-site contamination; and
- Meet DOE requirements.

3.2 BACKGROUND

The Paducah Gaseous Diffusion Plant (PGDP) located in Paducah, Kentucky, is an operating uranium enrichment facility owned by DOE. Effective July 1, 1993, DOE leased the plant production facilities at Paducah to the United States Enrichment Corporation (USEC) to provide operations and maintenance services. DOE contracted with PRS effective April 24, 2006, to manage and integrate the Environmental Management activities for DOE.

During past operations of PGDP, hazardous substances generated as byproducts from the enrichment process were released into the environment. The source areas where releases originally occurred are often referred to as solid waste management units (SWMUs) and areas of concern (AOC). In general, SWMUs and AOC are typically areas such as burial grounds, spill sites, landfarms, surface impoundments, and underground storage tanks. The releases from these source areas can migrate into the surrounding soils, aquatic and terrestrial biota, and in some cases, the underlying groundwater and adjacent surface waters. In July 1988, groundwater samples collected from residential wells north of PGDP led to the discovery of trichloroethene (TCE) and technetium-99 (^{99}Tc) contamination in the regional gravel aquifer (RGA). With the participation of the Commonwealth of Kentucky, EPA, and DOE, the Administrative Consent Order (ACO) was entered effective November 23, 1988. The ACO was a legally binding agreement for the participating parties that initiated the investigation into the nature and extent of the contamination in these wells. On May 31, 1994, the PGDP was put on the National Priorities List (NPL) and a Federal Facility Agreement (FFA) was negotiated among DOE, the Commonwealth of Kentucky, and EPA that became effective in February 1998. The ACO was superseded by the FFA. Additionally, a Resource Conservation and Recovery Act (RCRA) HSWA permit is held jointly between DOE and the DOE Prime Contractor with the Commonwealth of Kentucky. This permit defines actions consistent with the FFA for the investigation and remediation of the SWMUs and AOCs identified at Paducah. Investigations

performed by the ACO/FFA revealed that environmental releases from certain SWMUs and AOCs have migrated to the groundwater and surface waters resulting in off-site contamination of the RGA.

4. PROJECT/TASK DESCRIPTION

4.1 PURPOSE

The purpose of this plan is to describe the practices used by EM and to ensure the quality of the data collection, analytical data generation, handling, and reporting of the environmental monitoring data. It is further intended to prevent significant quality failures prior to data generation and to minimize the impact of such failures. This plan also describes actions that are intended to ensure a high degree of confidence in the results of the EM projects for the Kentucky Department for Environmental Protection (KDEP), EPA Region 4, and the public.

4.2 SCOPE

EM performs effluent monitoring and environmental surveillance activities. Table 4-1 provides a listing of the different tasks under EM.

Effluent monitoring is initiated to achieve compliance with one or more federal or state regulations, permit conditions, or environmental commitments. This consists of KPDES monitoring of DOE Outfalls (analytical and aquatic environment toxicity testing); groundwater monitoring at permitted RCRA or solid waste landfill units, such as C-404, C-746-K, C-746-S, C-746-T, and C-746-U; and groundwater monitoring in response to administrative orders.

Table 4-1. Summary of EM Activities

Effluent Monitoring	Groundwater Surface Water—C-746-S & -T Landfill Runoff, KPDES Outfalls, and Watershed Monitoring (benthic macroinvertebrate testing)
Environmental Surveillance	Groundwater Surface Water Sediment External Gamma Radiation Terrestrial Wildlife Aquatic Biological Monitoring

Environmental surveillance, which excludes the effluent monitoring previously described, is defined as perimeter and off-site monitoring. Environmental surveillance activities are performed to better understand the effects of DOE operations on the quality of the regional environment, to better address public concern about off-site contamination, and to meet DOE requirements. Environmental surveillance activities consist of groundwater surveillance monitoring wells, surface water and sediment sampling, external gamma radiation monitoring, terrestrial wildlife sampling, and benthic macroinvertebrate sampling.

Other specific activities performed for both effluent monitoring and environmental surveillance include, but are not limited to, collection of groundwater, surface water, terrestrial wildlife, aquatic organisms, and sediment; storing, analyzing, and shipping samples; and data evaluation, verification, validation, assessment, and reporting.

Requirements and responsibilities described in this plan apply to all routine activities conducted by EM personnel for effluent monitoring and environmental surveillance. Polychlorinated biphenyl (PCB) spills, asbestos events, and environmental spills are not within the scope of this QAPP.

4.3 REQUIREMENTS

The EM QAPP is written to meet requirements identified in EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans*; SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*; and DOE Order 414.1C, *Quality Assurance*. This document is supplemented by several DOE Prime Contractor procedures; and other contractors' applicable plans and procedures (including a fixed-base laboratory QA plan).

5. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

This EMP is implemented so that the objectives of the EM program, as outlined in *Environmental Monitoring Plan,* PRS-ENM-0035/R1, are met. The QA objectives of EM are to generate quality assured data which ensures that data reported to EPA, KDEP, and the public is legally and scientifically defensible. The intended use of the acquired data is to provide regulatory reports and an annual site environmental report which discuss the solid and hazardous waste monitoring and the impact of PGDP operations on the environment. The primary users of the data are the EM team members for decision making or for routine monitoring according to regulations or DOE Orders.

Analytical data consists primarily of definitive data (formerly QC Level III and formerly QC Level IV) based on the data needs determined in the above-mentioned project objectives. Procedures used to assess precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters for data generated by EM activities are discussed below.

5.1 DATA QUALITY REQUIREMENTS AND PARCCS EVALUATION

This section defines the goals of PARCCS parameters for the data. Appropriate procedures and QC checks, as specified in the analytical method, are employed to assess the level of acceptance of these parameters. All sample results are reported for the data when the analytical sample set is completed. QC data generated are reported upon request. Acceptance criteria and evaluation of laboratory analytical results for the PARCCS parameters are determined according to the following outline, and the appropriate analytical method.

Once data has been reviewed, verified, and/or validated, data assessment personnel will evaluate the finalized sample data assessment packages against the EM program objectives. The evaluation will be used to determine whether the data meets the program objectives. The following text presents the methods used to evaluate the PARCCS parameters.

5.1.1 Accuracy, Precision, and Sensitivity of Analysis

The objective of the analytical QC requirements is to ensure adequate accuracy, precision and sensitivity of analysis. Samples collected for groundwater analysis during the project will be analyzed using EPA SW-846 analytical methods, for which QA/QC procedures have been established. Samples collected for KPDES will be analyzed using the EPA analytical methods, *Methods for Chemical Analysis of Water and Wastes,* EPA/600/4-79-020. Toxicity samples are analyzed in accordance with protocol published in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms,* EPA/600/4-89/001 (Second Edition). The precision and accuracy for each parameter/method is also provided in SW-846.

- **Accuracy**

  Accuracy is defined as the nearness of a measurement to its true value. Accuracy measures the average or systematic error of a method. Accuracy of chemical test results is assessed by spiking samples with known standards and establishing the percent recovery. For organic analyses, two types of recoveries are measured: matrix spike and surrogate spike. For a matrix spike, known amounts of standard compounds identical to the compounds present in the sample of interest are added to the sample. For a surrogate spike, the standards are chemically similar but not identical to the compounds being analyzed in the fraction. The purpose of the surrogate spike is to provide quality control on every sample by constantly monitoring for unusual matrix effects and gross sample processing errors. For inorganic analyses, only matrix spikes are measured in general. Since accuracy is often determined from spiked samples, laboratories commonly report accuracy in this form. Percent recovery is defined as

  $$\% \text{ Recovery} = \frac{R-U}{S} \times 100$$

  where S = concentration of spike added
  U = measured concentration in unspiked aliquot
  R = measured concentration in spiked aliquot

- **Precision**

  Precision is the agreement between a set of replicate or duplicate measurements without assumption of knowledge of the true value. Precision is assessed by means of duplicate/replicate sample analysis. Precision can usually be expressed as relative percent difference (RPD) or relative standard deviation (RSD). The quantities are defined as follows:

  $$RPD = 100 \times 2 |X_1 - X_2| / (X_1 + X_2)$$

  where X_1 and X_2 are the reported concentrations for each duplicate or replicate

  $$RSD = \frac{S}{X} \times 100$$

  where S is the standard deviation of the series of individual measurements and X is the mean of the series of individual measurements.

- **Sensitivity**

  The sensitivity of analysis (or the detection limit) is determined by the SW-846 analytical method and the laboratory analyst and instrumentation. During the development of DQOs, the required detection limit is determined based on regulatory restrictions such as maximum contaminant levels (MCLs) for drinking water standards. The analytical laboratory is requested to meet these requirements.

5.1.2 Field Representativeness, Completeness, and Comparability

The following discussion covers the DQOs of representativeness, completeness, and comparability and how these DQOs may be achievable through the field sampling operations and the analytical process.

- Representativeness

  Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. See Table 7-1 for a list of field procedures that contribute to representativeness of the sampled media. The documentation required in this QAP will enable checking that sampling protocols have been followed and sample identification and integrity have been assured. Field planning meetings, field assessments, and oversight by the Field Services Manager will provide opportunities to check that field procedures are being correctly implemented.

  To ensure the representativeness of sampled media, demonstrated analyte-free water will be used in various field operations and during the preparation of trip blanks and field blanks. Samples will be preserved and maintained at specified temperatures in accordance with analytical requirements. Disposable gloves will be worn by field personnel and changed between sampling locations. The use of dedicated, decontaminated sampling equipment constructed with required material such as Teflon and stainless steel also contributes to the sample's representativeness.

  For the low-flow groundwater purging and sampling method, representativeness will be achieved by performing the sampling operation within the required criteria for water quality measurements, minimal drawdown, and low flow rate. The pump intake will be placed within the targeted horizon of the screened interval of the well. The water will be evacuated until water quality parameters have stabilized. Care will be taken to maintain sufficient pressure so as not to introduce air into the pump tubing. Samples will be collected with minimal turbulence directly from dedicated tubing constructed of appropriate material. The use of this sampling method should produce samples with less suspended solids than other groundwater sampling methods. Sampling methods and locations provide good representation of site characteristics.

- Completeness

  Completeness is defined as the percentage of all measurements made whose results are judged to be valid. Invalid data will be the data that have been rejected during data validation. It is expected that the laboratory will provide valid data meeting acceptance criteria for 90 percent of the samples analyzed. If the data provided is less than 90 percent complete, an evaluation will be made to determine whether additional samples should be collected.

  The completeness objective for this project is 90 percent.

  Percent of completeness is defined as

$$\% \text{ Completeness} = \frac{V}{n} \times 100$$

where V= number of measurements judged valid
n = total number of measurements made

- Comparability

  Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data will be comparable with other measurement data for similar samples and sample conditions. Use of consistent and standardized methods and units of measurement will maintain comparability of the data. Actual detection limits will depend on the sample matrix (necessary dilutions, etc.) and will be reported as defined for the specific samples.

6. SPECIAL TRAINING REQUIREMENTS/CERTIFICATIONS

Personnel are trained in the safe and appropriate performance of their assigned duties in accordance with the requirements as outlined in the project training matrix. The training matrix is divided into training related to health and safety requirements, and project-specific or job-specific training, identified as required or beneficial to perform an assigned duty or function. Based upon assigned duties, the training matrix may include, but not be limited to, the following:

Health and Safety-Related Training

- Hazwoper training, such as 40-hour Occupational Safety and Health Administration (OSHA), 8-hour OSHA refresher, medical monitoring, and respirator training
- Plant-specific training, such as lockout-tagout, firewatch, etc.

Project-Specific or Job-Specific Training

- Project-specific documents, such as required reading on QA/Data Management (DM) plans, Waste Management plans, Health & Safety plans, operating procedures, Chemical Hygiene Plans, and work instructions, etc.

Training files are maintained by the DOE Prime Contractor Training Organization. A training database is utilized to manage and track training. Personnel training records are maintained at the appropriate EM office. Subcontractors maintain copies of training records at the appropriate satellite DCC.

7. DOCUMENTATION AND RECORDS

7.1 DOCUMENTS, PLANS, PROCEDURES, WORK INSTRUCTIONS, AND OPERATOR AIDS

The applicable and appropriate documents and procedures utilized for EM activities are listed in Table 7-1. Documents, plans, procedures, work instructions, and operator aids utilized are identified in this section and may be referenced in the appropriate section discussing each project. Procedures are

managed by the DMC. The DMC ensures that the most current approved procedures and plans are available for personnel.

7.2 RECORDS MANAGEMENT

Records management is defined as the procedures and the process by which records will be maintained. The EM team will implement the records management requirements.

Table 7-1. DOE/DOE Prime Contractor Documents, Plans, Procedures, Work Instructions, and Operator Aids

Number	Title
PRS-ENM-0016	Maintenance and Use of ASTM Type II Water System
PRS-ENM-0014	Deer Sampling
DOE/OR/07-1707	Federal Facility Agreement for the Paducah Gaseous Diffusion Plant
PRS-ENM-0811	Pesticide and PCB Data Verification and Validation
PRS-ENM-5007	Data Management Coordination
PRS-ENM-0021	Temperature Control for Sample Storage
KY0004049	KPDES Permit
KY073-00014	C-746-S Residential Landfill Permit
KY073-00015	C-746-T Inert Landfill Permit
KY073-00045	C-746-U Residential Landfill Permit
KY8-890-008-982	Hazardous Solid Waste Amendments Permit
PRS-ENM-5102	Radiochemical Data Verification and Validation
PRS-ENM-5103	Polychlorinated Dibenzodioxins/ Polychlorinated Dibenzofurans Data Verification and Validation
PRS-ENM-5105	Volatile and Semivolatile Data Verification and Validation
PRS-ENM-5003	Quality Assured Data
PRS-ENM-5004	Sample Tracking, Laboratory Coordination, and Sample Handling Guidance
PRS-DOC-1009	Records Management, Administrative Record, and Document Control
PRS-ENM-0026	Wet Chemistry and Miscellaneous Analyses Data Verification and Validation
PRS-ENM-0035	Environmental Monitoring Plan
PRS-ENM-2100	Groundwater Level Measurement
PRS-ENM-2101	Groundwater Sampling
PRS-ENM-2203	Surface Water Sampling
PRS-ENM-2300	Collection of Soil Samples
PRS-ENM-2302	Collection of Sediment Samples Associated with Surface Water
PRS-ENM-2700	Logbooks and Data Forms
PRS-ENM-2702	Decontamination of Sampling Equipment and Devices
PRS-ENM-2704	Trip, Equipment, and Field Blank Preparation
PRS-ENM-2708	Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals
PRS-ENM-5107	Inorganic Data Verification and Validation
PRS-QAP-1210	Issues Management Program
PRS-QAP-1220	Occurrence Notification and Reporting
PRS-QAP-1420	Conduct of Assessment
PRS-ENM-0023	Composite Sampling
PRS-ENM-0018	Sampling Containerized Waste

7.2.1 Description of the Records Management System

The records management system is defined by PRS-DOC-1009, *Records Management, Administrative Record, and Document Control.* This procedure establishes the requirements to ensure consistent management of records maintained by DOE Prime Contractor. The EM records are maintained at the appropriate satellite records storage area; the record copy is located within the DMC at the DOE Prime Contractor Kevil building and records which are in-use are located at the field office (C-755-T-01).

7.2.2 Personnel Responsible for Records

The Project Manager has direct responsibility for ensuring the requirements are adhered to as stated in this plan. The DCC and Data Manager are responsible for the daily activities associated with records management and implementing the requirements stated in this plan.

7.2.3 Identification of EM Records

Information maintained by EM include, but are not limited to, documents, plans, procedures, logbooks, COC forms, personnel training records, and field forms. Records maintained by the DOE Prime Contractor include, but are not limited to, the following: training records, maintenance records, calibration records, assessment records, corrective action plans and evidence, procedures and work control documents, regulatory inspection records, field laboratory records, logbooks, waste inventory records, and chains of custody.

7.2.4 Storage of EM Records

EM files are maintained as field operating records and are considered the project record copy. File cabinets will be labeled with the appropriate project identification and with a list of individuals authorized to access the project records.

7.2.5 Transfer of Records to the DMC

Documents, plans, procedures, and records to be submitted to the DMC are provided as specified in Table 7-2.

Table 7-2. Transfer of Records to the DMC

Record Type	Storage Location	Frequency of Transfer	Comments
Training records	Kevil	As required	Submittal letter with a copy of training records will be submitted to the DMC.
Maintenance records	C-755-T-01	Annually	Copy of maintenance records will be submitted to the DMC.
Calibration records	C-755-T-01	Annually	Copy of calibration records will be submitted to the DMC.
Assessment records (i.e., audits, surveillances, and self assessment reports)	Kevil	Annually	Submittal letter with a copy of assessment records will be submitted to the DMC.
Corrective action plans and evidence	Kevil	As needed	Submittal letter with a copy of corrective action records will be submitted to the DMC or the Corrective Action Manager.

Table 7-2. Transfer of Records to the DMC (Continued)

Record Type	Storage Location	Frequency of Transfer	Comments
Procedures and work control documents	Kevil	Periodically	Procedures, work instructions and operator aids were initially submitted as required; changes will be submitted, as necessary, to the DMC.
Regulatory inspection records	Kevil	Annually	Submittal letter with a copy of regulatory inspection records will be submitted to the DMC.
Logbooks	C-755-T-01	Annually	Original logbooks will be submitted to the DMC.
Waste inventory records	C-755-T-01	Project completion	Copy of the waste inventory records will be submitted to the DMC.
Chains of custody	C-755-T-01	Monthly	Copy of chains of custody are sent to Sample/Data Management.

Electronic copies of deliverables are maintained in the project files and provided to the appropriate personnel, as required.

7.2.6 Retention of Records

Quality records will be maintained in the DMC for duration of the project. Upon submittal of records to the DMC, the record will be identified as a quality record or otherwise. At that time, the DMC will determine the time frame for the retention of the record.

8. SAMPLE PLANNING, MANAGEMENT, AND MEASUREMENT/DATA ACQUISITION

Many types of data are collected to measure and monitor effluents from DOE operations and to maintain surveillance on the effects of those operations on the environment and public health. Data types collected for EM are described in the following sections and consist of sample information, field measurements, and definitive data. Data are collected in accordance with requirements PRS-ENM-5003, *Quality Assured Data*.

9. DATA COLLECTION DESIGN

The EMP provides detailed information on sampling locations, the types of samples and sample parameters required at each location, and the frequency of collection for EM samples.

9.1 SAMPLE INFORMATION

Sample information is environmental data describing the sampling event and consists of the following: station (or location), date collected, time collected, and other sampling conditions collected for every sampling event. This information is recorded in logbooks and may be included on the COC or sample labels. This information is input directly into ES PEMS, as applicable.

9.2 FIELD MEASUREMENTS

Field measurements are measurements of a parameter that are collected real-time in the field. Field measurements for EM include water level measurements, pH, specific conductance (conductivity), flow rates, temperature, barometric pressure, residual chlorine, turbidity, reduction-oxidation potential (RedOx or Eh), dissolved oxygen, and depth to water.

Field measurements are taken and recorded on appropriate field forms or in logbooks and input into ES PEMS. If field forms are used, they are input and QC checked against the field logbook by appropriate data personnel. Criteria for field measurements are provided in Table 9-1.

For the collection of depth to water and quarterly/annual water level measurements, the tape measure must be checked against a surveyor's tape measure.

Table 9-1. Field Measurement Criteria

Sampling Activity	Field Screening Method	Criteria for Sample Selection
Low-Flow/ Minimal Drawdown Groundwater Sampling	Field Measurements performed consist of pH, specific conductance, turbidity, dissolved oxygen, temperature, and oxidation reduction potential (Eh)	• pH must read within the ± 0.2 range; • temperature must read within ± 0.2°C; • conductivity must read ± 1% of reading, ±1 count; • dissolved oxygen must read within ± ± 0.2 mg/L ≤ 20 mg/L, ± 0.6 mg/L > 20 mg/L; • turbidity must read within ± 5% of reading ± 1 nephelometric turbidity unit (NTU); • oxidation reduction potential must read within ± 25 mV
Surface Water Sampling	Field measurements for pH, specific conductance, temperature, dissolved oxygen, total residual chlorine, and flow rate.	• pH must read within the ±0.2 range; • temperature must read within ± 1°C; • conductivity must read ± 20 µmhos/cm; • dissolved oxygen must read within ± 0.5 mg/L; • total residual chlorine is performed using amperometric titrator; no particular range is required; • flow rate is determined by using the ISCO open channel flow flume located at the outfalls or by the Stream Discharge Calculation on open streams

9.3 DEFINITIVE DATA

Definitive data is defined as the analytical and biological monitoring data generated by the fixed-base laboratory. Analyses are specified in Appendix C of EMP Definitive data generated by the fixed-base

laboratory is required to undergo a laboratory data review for consistency and completeness in accordance with the fixed-base laboratory QA plan. The primary data outputs include data packages (i.e., hard copies) and EDDs.

All data packages received from the fixed-base laboratory are tracked, reviewed, and maintained in a secure environment. The primary individual responsible for these tasks is the Laboratory Coordinator. PRS-ENM-5007, *Data Management Coordination*, provides the process of evaluating the quality of laboratory EDDs.

10. SAMPLING METHODS REQUIREMENTS

10.1 SAMPLE PLANNING AND MANAGEMENT

The DQOs discussed in Section 5 are used to create Statements of Work (SOWs) for sampling and analyses to be performed. This information is input into ES PEMS for the purpose of sample planning, scheduling, and management. ES PEMS is used to plan sampling and manage data. ES PEMS performs the following functions:

- Generate COC records and sample labels.
- Track sample collection and shipment.
- Manage field-generated data.
- Import laboratory-generated data.
- Update field and laboratory data based on integrated data verification and validation.
- Report data for project use.
- Format data for transfer data to Paducah OREIS.

Requirements for addressing the day-to-day operations of ES PEMS include data entry, backups, security, and interface with the Sample Management Office (SMO). A QC check of the sample information and measurements data entry is made and involves comparing printouts of 100 percent of the data in ES PEMS to the original COC, field form, logbook, or instrument printout. Guidelines set forth in PRS-ENM-5007, *Data Management Coordination*, are followed. The QC check should be appropriately documented.

System backups are performed daily by the Network Administrator. Backups follow normal protocol maintained by the Network Administrator. Upon completion of the EM project, ES PEMS will be downloaded to an ASCII file, stored on a zip disk or other form of electronic media, and transferred to the DCC for archival. Security of the data within ES PEMS is essential for the success of EM. The security precautions and procedures implemented by the data management team are designed to minimize the vulnerability of the data to unauthorized access or corruption. ES PEMS users have network passwords and have installed password-protected screen savers.

11. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Samples are uniquely identified by a sample identification number. Sample identification numbers for EM are identified in ES PEMS and are assigned by the Data Manager or Data Coordinator according to the

project, sample type, and location. Examples of sample numbering schemes are found in the Data Management Implementation Plan, Appendix E of the EMP.

Sample Handling Procedures and Documentation. The samples are properly preserved, packaged, and delivered to the laboratory under proper COC. The following procedures are used for handling samples:

- PRS-ENM-5003, *Quality Assured Data*
- PRS-ENM-2700, *Logbooks and Data Forms*
- PRS-ENM-2708, *Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*
- PRS-ENM-5007, *Data Management Coordination*
- PRS-ENM-5004, *Sample Tracking, Laboratory Coordination, and Sample Handling Guidance*
- PRS-ENM-2704, *Trip, Equipment, and Field Blank Preparation*
- PRS-ENM-2702, *Decontamination of Sampling Equipment and Devices*

Documentation from the sample collection process is in the form of logbooks, COC forms, and other records. Prior to the shipment of samples to fixed-base laboratories, a copy of the COC is to be provided to the Laboratory Coordinator. The Sample Management Organization (SMO) assists with the coordination of sample shipments to a fixed-base laboratory.

12. ANALYTICAL METHOD REQUIREMENTS

When available and appropriate for the sample matrix, SW-846 methods or EPA methods are used. When not available, other nationally recognized methods such as those of DOE, EPA, and the American Society for Testing and Materials will be used. Analytical methods are specified in Appendix C of the EMP. Analytical methods, analytical parameters, and reporting limits also are identified in the analytical SOWs in ES PEMS.

13. QUALITY CONTROL REQUIREMENTS

13.1 FIELD QUALITY CONTROL SAMPLES

Table 13-1 provides a summary of the field QC samples that are taken for the EM samples. Field QC samples include field blanks, equipment blanks, field duplicates, and trip blanks. QC samples for EM activities are collected 1 per every 20 samples, as defined by SW-846, *Test Methods for Evaluating Solid Waste.* These samples will be analyzed in the same manner as the field samples.

- Field Duplicates (or Replicates)

  Field duplicate samples are collected and analyzed to assess the overall precision of the field and laboratory effort. Field duplicate samples, of a similar matrix, will be collected at a rate of five percent or one per 20 samples or less.

- Trip Blanks

  Trip blanks are used to determine whether on-site atmospheric contaminants are seeping into the sample vials, or if any cross-contamination of samples is occurring during shipment or storage of

sample containers. A trip blank consists of demonstrated analyte-free water (based on target compound list [TCL] analysis results falling below Contract Required Quantitation Limits) sealed in 40-mL Teflon septum vials with no headspace (or bubbles) in the vials. Trip blanks are to be kept in close proximity to the samples being collected and will be maintained at 4^{o} C and handled in the same manner as the other volatile organic compounds (VOCs) aqueous samples. Trip blanks are collected when VOCs are collected at a frequency of one per 20 environmental samples or one per day, whichever is more frequent. Trip blanks will be analyzed for volatile organics only.

- Field Blanks

  A field blank is a sample that serves as a check on environmental contamination at the sample site. Distilled, analyte-free water is transported to the site, opened in the field, transferred into each type of sample bottle, and returned to the laboratory for analysis of all parameters associated with that sampling event. It is also acceptable for field blanks to be filled in the lab, transported to the field, and then opened. Field blanks may be used as a reagent blank, as needed. One field blank will be collected per every 20 environmental samples.

- Equipment Blanks (or Rinseates)

  An equipment blank is a sample of analyte-free water passed through decontaminated sampling equipment. Equipment blanks are used as a measure of decontamination process effectiveness and are analyzed for the same parameters as the sample collected with the equipment. Equipment blanks may also be used as a reagent blank, as needed. Equipment blanks are required only when nondisposable, non-dedicated equipment is being used. Equipment blanks are collected at a frequency of one per 20 environmental samples.

Table 13-1. Field QC Samples

QC Samples	Frequency
Field Duplicates	One per 20 samples
Trip Blanks	One per cooler
Field Blanks	One per 20 samples
Equipment Blanks	One per 20 samples

13.2 INTERNAL QC CHECKS AND FREQUENCY FOR LABORATORY ANALYSIS

The fixed-base laboratory has an established internal QC program that is managed by the laboratory supervisors. QC samples are run in accordance with the applicable regulatory procedure or method. Where regulatory methods do not apply, QC is defined in the technical procedure.

13.2.1 Independent Quality Control

The fixed-base laboratories are directed by DOE and EPA regulators to participate in independent QC programs, such as Proficiency Evaluation Testing and Proficiency Acceptance Testing, etc. The site fixed-base laboratory participates in additional voluntary independent programs to improve analytical QC. These programs generate data that are readily recognizable as objective measures, allowing the participating laboratory and government agencies a periodic review of their performance. Results that exceed acceptable limits are investigated and documented according to formal procedures. Although participation in a certain program is mandated, the degree of participation is voluntary so that each

laboratory can select parameters of particular interest to that facility. These programs are conducted by EPA, DOE, and commercial laboratories.

The EPA has an additional quality assurance program known as the Discharge Monitoring Report–Quality Assurance (DMR-QA) study. This study applies to all major and selected minor permittees under the National Pollutant Discharge Elimination System (NPDES). The purpose is to evaluate the analytical and reporting ability of the laboratories routinely performing the inorganic chemical and whole-effluent toxicity self-monitoring analyses required in NPDES permits. These results are periodically reported in the DMR.

14. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Any equipment (an inclusive term for tools, gauges, instruments, and other items that have specific preventive maintenance) is serviced as specified by manufacturers recommended schedule. Maintenance activities are documented in the appropriate logbook. Out-of-service equipment is clearly tagged. Changing or removing status indicators is the responsibility of the Surveillance and Maintenance Manager. Spare parts are maintained for equipment as needed.

The laboratories are also responsible for implementing preventive maintenance procedures, schedules, and record keeping similar to those described previously for field equipment on instruments and equipment. For additional information, refer to the fixed-base laboratory QA Plan.

15. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

15.1 FIELD EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

Calibration of equipment is performed according to manufacturer's specifications. Field instrument calibrations are documented in field logbooks.

15.2 LABORATORY EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

Laboratory equipment calibration procedures and frequencies associated with samples collected in support of EM and submitted to fixed based laboratories will be in accordance with the associated analytical method with SMO Master Specifications.

16. INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES (PROCUREMENT)

Inspection/acceptance requirements for supplies and consumables are managed in accordance with the PRS QAPP and DOE Prime Contractor QA procedures.

17. DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENT)

All historical data used in support of EM is downloaded or directly accessed from Paducah OREIS, if available. If historical data required for EM is not available from Paducah OREIS, other databases, records, etc., may be used with the approval of the Data Manager.

18. DATA MANAGEMENT

Data management activities are managed according to Appendix E. EM utilizes ES PEMS for sample scheduling, collection, and tracking each sample and associated data from the point of collection through final data reporting. ES PEMS tracking includes field forms, COCs, hard copy data packages, and EDDs. Data is entered as the project progresses. All field measurement data, analytical data, sampling information, and other pertinent information are entered into ES PEMS.

Field measurement data and sampling information are entered into ES PEMS on a routine basis. Analytical EDDs are loaded to ES PEMS as they are provided by the laboratories. Project data sets are verified, validated (if applicable) and assessed. Once the assessment is complete, an ASCII file is prepared with the project data and associated QC samples for inclusion into Paducah OREIS and for official reporting.

19. ASSESSMENT/OVERSIGHT

19.1 ASSESSMENTS AND RESPONSE ACTIONS

Audits and surveillances are performed to review and evaluate adherence to requirements. Unscheduled and scheduled audits and surveillances may be performed to verify compliance with all aspects of the QA Program and determine the program's effectiveness. These audits and surveillances are conducted in accordance with written procedures and checklists and are performed by personnel who do not have direct responsibility for performing the activities being audited.

Independent assessment activities include reviewing documents and monitoring work activities to provide an effective real-time means of evaluating the adequacy and effectiveness of methods for achieving quality. Independent assessments are conducted bi-annually (twice per year).

Management assessments are conducted in accordance with a schedule prepared by the project manager.

Corrective actions of internal audit/surveillance findings and nonconformances are managed in accordance with the PRS QAPP and applicable procedures.

19.2 REPORTS TO MANAGEMENT

Reports providing a status update on the activities affecting quality are provided to management upon request.

20. DATA VALIDATION AND USABILITY

20.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

The data review process determines whether a set of environmental data satisfies the data requirements defined during DQOs. This process involves the integration and evaluation of all information associated with a result. Data review consists of an evaluation of the following: data authenticity, data integrity, data usability, and outliers. The data review process is conducted using the checklists from PRS-ENM-5003. This checklist provides a listing of the QC elements that may be applicable to each groundwater and EM program. Checklists are completed as required for reporting.

20.2 INITIAL DATA REVIEWS

Initial data reviews are conducted by a technical reviewer, prior to submitting documents, plans, data, etc., to the project manager for review and approval. Sampling information and field measurements data is routinely reviewed and approved by the Surveillance and Maintenance Manager.

20.3 FINAL DATA REVIEW AND DATA USAGE

Final data reviews are performed prior to release of data to external agencies to ensure accuracy in reported results. The final data review steps are performed by the Project Manager, Data Manager, QA Specialist, and other EM team members as appropriate. More detail on data review is described in the EM Data Management Implementation Plan (Appendix E).

20.4 VALIDATION AND VERIFICATION METHODS

Data verification and validation is performed according to PRS-ENM-5003, *Quality Assured Data* and the following procedures:

- PRS-ENM-5105 *Volatile and Semivolatile Data Verification and Validation*
- PRS-ENM-5107, *Inorganic Data Verification and Validation*
- PRS-ENM-5103, *Polychlorinated Dibenzodioxins/ Polychlorinated Dibenzofurans Verification and Validation*

- PRS-ENM-5102, *Radiochemical Data Verification and Validation*
- PRS-*ENM*-0026, *Wet Chemistry and Miscellaneous Analyses Data Verification and Validation*
- PRS-ENM-0811, *Pesticide and PCB Data Verification and Validation*

20.5 RECONCILIATION WITH USER REQUIREMENTS

The equations used for precision, accuracy, and completeness will be used to quantitatively compare sample data results with the required DQOs. Any DQO deviations and/or data outliers will be discussed with the appropriate personnel to determine possible causes for such conditions. Discussions, evaluations, and conclusions as a result of the above assessments will be consolidated into the data assessment report. The assessment qualifiers and supporting comments will note any limitations on the use of the data.

ATTACHMENT 1

EM ORGANIZATIONAL CHART

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Approvals:

Site Manager: Dan Ferguson

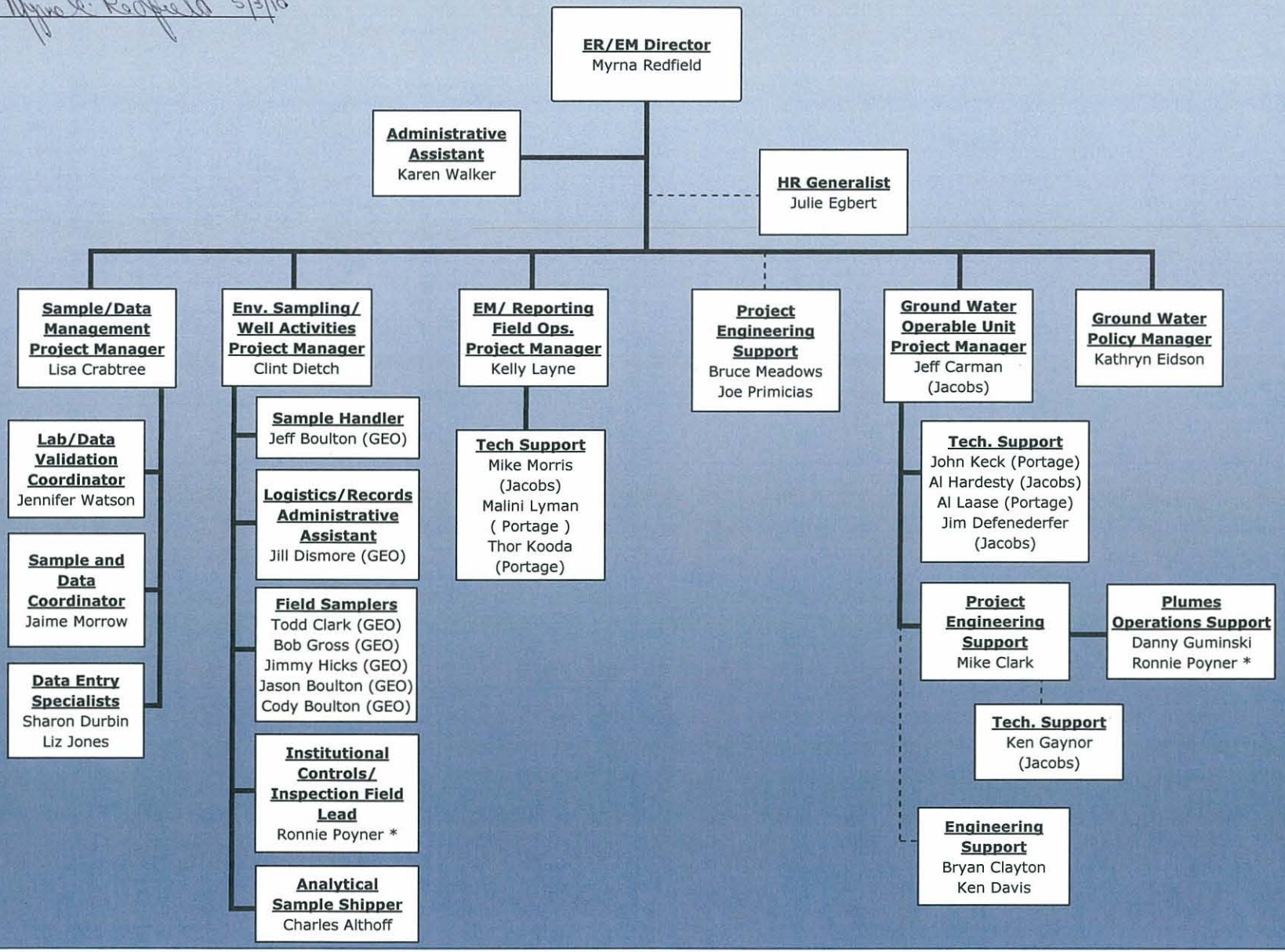
Deputy SM: K Poor

Business Manager: R. Jeffrey Hoyles

Org. Manager: Myrna L. Redfield 5/3/10

14 PRS
15 Subs

Environmental Restoration & Environmental Monitoring



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APPENDIX E

ENVIRONMENTAL MONITORING
DATA MANAGEMENT IMPLEMENTATION PLAN

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Environmental Monitoring
Data Management Implementation Plan
at the
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

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Environmental Monitoring
Data Management Implementation Plan
at the
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

Date Issued—January 2009

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
PADUCAH REMEDIATION SERVICES, LLC
managing the
Environmental Remediation Activities at the
Paducah Gaseous Diffusion Plant
under contract DE-AC30-06EW05001

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CONTENTS

ACRONYMS

COC	chain-of-custody
DMC	Document Management Center
DMIP	Data Management Implementation Plan
DOE	U.S. Department of Energy
EDD	electronic data deliverable
EM	Environmental Monitoring
EMP	Environmental Monitoring Plan
GIS	geographic information system
MW	monitoring well
Paducah OREIS	Paducah Oak Ridge Environmental Information System
Paducah PEMS	Paducah Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
PRS	Paducah Remediation Services LLC
QA	quality assurance
QC	quality control
RTL	ready-to-load
SMO	Sample Management Office
SOW	statement of work

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EXECUTIVE SUMMARY

This Data Management Implementation Plan identifies and documents data management requirements and applicable procedures, expected data types and information flow, and roles and responsibilities for data management activities associated with Environmental Monitoring (EM) at the Paducah Gaseous Diffusion Plant. This document supports the Environmental Monitoring Plan (EMP) and the EM Quality Assurance Project Plan (Appendix D of the EMP).

Data management for this project is implemented throughout the life cycle for environmental measurements data. This life cycle occurs from the planning of data for environmental and waste characterization, through the collection, review, and actual usage of the data for decision-making purposes, to the long-term storage of data.

Data types to be managed for the project include field data and analytical data. Historical data is downloaded from Paducah's Oak Ridge Environmental Information System (Paducah OREIS), if available. All historical data available in electronic format are stored in the project's Paducah Project Environmental Measurements System (Paducah PEMS). Field data are collected in field logbooks, or field data forms and are entered into Paducah PEMS, as appropriate, for storage. Analytical data are planned and managed through Paducah PEMS and transferred to Paducah OREIS for long-term storage and reporting.

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1. INTRODUCTION

The purpose of this Data Management Implementation Plan (DMIP) is to identify and document data management requirements and applicable procedures, expected data types and information flow, and roles and responsibilities for all data management activities associated with the Paducah Environmental Monitoring (EM) at the Paducah Gaseous Diffusion Plant (PGDP). This document supports the Environmental Monitoring Plan (EMP). Data management provides a system for efficiently generating and maintaining technically and legally defensible data that provide the basis for making sound decisions regarding the environmental and waste characterization at PGDP.

To meet current regulatory requirements for the U.S. Department of Energy's (DOE) environmental management projects, complete documentation of the information flow is established. Each phase of the data management process (planning, collecting, analyzing, managing, verifying, assessing, reporting, consolidating, and archiving) must be appropriately planned and documented. EM is responsible for data collection and data management for this project.

The scope of this DMIP is limited to environmental information generated under EM. This information includes electronic and/or hard copy records obtained by the project that describe environmental conditions. Information generated by the project (e.g., laboratory analytical results from samples collected) and obtained from sources outside the project (e.g., historical data) falls within the scope of this DMIP. Certain types of information, such as personnel or financial records, are outside the scope of this DMIP.

1.1 PROJECT MISSION

Requirements and responsibilities described in this plan apply to activities conducted by the project team in support of EM. Specific activities involving data include, but are not limited to, sampling of groundwater, surface water, sediment, soil and biota; storing, analyzing, and shipping samples, when applicable; and evaluation, verification, validation, assessment, and reporting of analytical results.

1.2 DATA MANAGEMENT ACTIVITIES

Data management is implemented throughout the life cycle of EM. This life cycle occurs from the planning of data for environmental and waste characterization, through the collection, review, and actual usage of the data for decision-making purposes, to the long-term storage of data. Data management activities include the following:

- Acquire existing data
- Plan data collection
- Prepare for sampling activities
- Collect field data
- Collect field samples
- Submit samples for analysis
- Process laboratory analytical data
- Verify data
- Validate data
- Assess data

- Consolidate, analyze, and use data and records
- Submit data to the Paducah Oak Ridge Environmental Information System (Paducah OREIS)

Section 6 contains a detailed discussion of the activities listed above.

1.3 DATA MANAGEMENT INTERACTIONS

The Data Manager interfaces with the Data Coordinator to oversee the use of Paducah's Project Environmental Measurements System (Paducah PEMS) and to ensure that data deliverables meet DOE's standards. The Data Coordinator enters information into Paducah PEMS related to the fixed-base laboratory data once the samples have been delivered and the Lab Coordinator has verified receipt of the samples. The fixed-base laboratory electronic data deliverables (EDDs) are loaded into Paducah PEMS by the Data Coordinator. EM is responsible for data verification, validation if applicable, assessment, and for preparing the data for transfer from Paducah PEMS to Paducah OREIS. The Data Manager is responsible for transferring the data from the ready-to-load (RTL) files to the Paducah OREIS database.

The Lab Coordinator develops the statement of work (SOW) to be performed by an analytical laboratory in the form of a project-specific laboratory SOW. Analytical methods, reporting limits, and deliverable requirements are specified in this SOW. For routine work, a laboratory SOW is developed annually, prior to the beginning of the fiscal year. Laboratory SOWs for non-routine or special sampling events will be developed as needed throughout the fiscal year.

The Lab Coordinator receives EDDs, performs contractual screenings, and distributes data packages. The Lab Coordinator interacts with the Data Manager to ensure that hard copy and electronic-deliverable formats are properly specified and interfaces with the contract laboratory to ensure that the requirements are understood and met.

2. DATA NEEDS AND SOURCES

Multiple data types are generated and/or assessed during this project. These data types include field data, analytical data (including environmental data), and geographic information system (GIS) data.

2.1 HISTORICAL DATA

Historical data consist of analytical data and lithologic descriptive data from borings and monitoring wells (MWs) previously installed in support of the project. Historical data that are available electronically are downloaded from Paducah OREIS as needed. Historical data available in electronic format are stored in the project's Paducah PEMS and is evaluated when necessary.

2.2 FIELD DATA

Field data for the project includes sample collection information, field measurement analyses, and monitoring well water levels.

2.3 ANALYTICAL DATA

Analytical data for the project consist of laboratory analyses for environmental and waste characterization.

2.4 GIS COVERAGE

The Paducah GIS network is used for preparing maps used in data analysis and reporting of both historical and newly generated data. Coverage for use during the project is as follows:

- Stations (station coordinates are downloaded from Paducah OREIS)
- Facilities
- Plumes
- Plant buildings
- Plant roads
- Plant fences
- Streams
- Topographic contours

3. DATA FORMS AND LOGBOOKS

Field logbooks, site logbooks, chain-of-custody (COC) forms, data packages with associated quality assurance/quality control (QA/QC) information, and field forms are maintained according to the requirements defined in procedure PRS-DOC-1009, *Records Management, Administrative Record, and Document Control.*

Duplicates of field records are maintained until the completion of the project. Logbooks and field documentation are copied periodically. The originals are forwarded to the DMC annually and copies are maintained in the field office. Electronic versions are stored in the project file; the originator of the diskette maintains back-up copies.

3.1 FIELD FORMS

Sample information is environmental data describing the sampling event and consists of the following: station (or location), date collected, time collected, and other sampling conditions. This information is recorded in logbooks, COC forms, or sample labels. This information is entered directly into Paducah PEMS by the Data Coordinator. The EMP provides detailed information on sampling locations, types of samples, sample parameters required at each location, and the frequency of collection for EM samples.

Sample COC forms contain sample-specific information recorded during collection of the sample. Any deviations from the sampling plan are noted on the sample COC form or logbook. The Sampling Group reviews each sample COC form for accuracy and completeness as soon as practical following sample collection.

Sample COC forms are generated from Paducah PEMS with the following information:

Information that is preprinted:	Information that is entered manually:
- Lab COC number	- Sample date and time
- Project name or number	- Sample comments (optional)
- Sample ID number	
- Sampling location	
- Sample type (e.g., REG = regular sample)	
- Sample matrix (e.g., WG = groundwater)	
- Analysis (e.g., TCE)	
- Sample container (volume, type, preservation)	

Sample identification numbers are identified in ES PEMS and are assigned by the Data Coordinator according to the project, sample type, and location. An example of the sample numbering schemes used for EM is provided below for each different type of media.

Groundwater Sampling Identification Numbers. Used for all groundwater, carbon-filtered, and quality control samples, such as duplicates, field blanks, trip blanks, and equipment rinseates (blanks) in the following format:

MW###LE-YY, where MW### is the sequential number of the monitoring well;
L is the location number such as C404 (for C-404), KG (for C-746-K), SG (for C-746-S and -T), or UG (for C-746-U); SA (for Semiannual Environmental Surveillance wells); AT (for Surveillance Attenuation Semiannual Monitoring of Environmental Surveillance wells); QN (for GWACO Northwest Plume north wells); QS (for GWACO Northwest Plume south wells)
E is the number of the event of when the samples were collected (1 through 4); and
YY is the fiscal year the sample was collected.

For example, sample identification number "MW226C4041-06" was collected at MW226, a monitoring well at a specific location near the C-404 landfill, during the first event in fiscal year 2006 (in calendar year, this would be October 2005). A field duplicate sample is identified by the addition of a "D" after the "MW###" in the numbering scheme. "MW226DC4041-06" is the duplicate sample of "MW226C4041-06." Adding "TB" (for a trip blank), a "FB" (for a field blank), or a "RI" (for an equipment rinseate) to the front of the numbering scheme identifies the trip blanks, field blanks, and equipment rinseates. For example, "TBC4041-06" is a trip blank ("TB") that was collected at C-404 during the first groundwater sampling event of the fiscal year 2006.

Residential Groundwater Sampling Identification Numbers. Used for all groundwater residential, and associated quality control samples, such as duplicates, field blanks, trip blanks, and equipment rinseates (blanks) in the following format:

R###RESM-YY, where R### is the sequential number of the residential well;
RES indicates the sample ID is for the residential groundwater sampling program;
M is the month in which the samples were collected; and
YY is the calendar year the sample was collected.

For example, sample identification number "R302RES10-03" was collected at R302, a residential well during October 2003. An annual sample is identified by the addition of an "A" after the "R###" in the numbering scheme. A field duplicate sample is identified by the addition of a "D" after the "R###" in the numbering scheme. "R302DRES10-03" is the duplicate sample of "R302RES10-03." Adding a "TB" (for a trip blank), a "FB" (for a field blank), or a "RI" (for an equipment rinseate) to the front of the numbering scheme identifies the trip blanks, field blanks, and equipment rinseates. For example, "RIRES10-03" is an equipment rinseate blank ("RI") that was collected during the sampling event of October 2003.

Carbon Filter Treatment Sampling Identification Numbers. Used for sampling of the carbon filter treatment system in the following format:

LPXTM-YY, where L indicates the location of the carbon filters (in this instance, L is station R424);
PX indicates the Port to be sampled, X is 1, 2, or 3;
T is the time of the sampling, before (B) or after (A) the filter has been changed;
M is the month of the year in which the samples were collected; and
YY is the calendar year the sample was collected.

For example, sample identification number "R424P3B2-06" was collected from R424, Port 3 before the filter was changed out in February 2006. No field QC samples are collected for this sampling program.

DI Water Check Sampling Identification Numbers. Used for all DI water check samples in the following format:

GWDIM-YY, where GWDI indicates the sample is under the DI GW sampling program;
M is the month of the year in which the samples were collected; and
YY is the calendar year the sample was collected.

For example, sample identification number "GWDI10-03" was collected from the DI Water System during October 2003. Another example, GWDI1-06 was collected from the DI Water System during January 2006. No field QC samples are collected since this is considered a check on the DI water system.

Landfill Surface Water Sampling Identification Numbers. For surface water sampling associated with effluent monitoring at the landfills, a sample identification numbering system is made of a series of numbers in the following format:

LXE-YY, where L is the L series location number such as L150, L154, etc.;
X is the location/description such as SS (for C-746-S Landfill surface water) and US (for C-746-U Landfill surface water);
E is the number of the event of when the samples were collected; and
YY is the fiscal year the sample was collected.

For example, sample identification number "L150US3-06" was taken at L150; "US" denotes surface water samples were collected at C-746-U; "3" denotes the sample was collected in the third event for the fiscal year, and "06" denotes the fiscal year 2006, in which the sample was taken. A field duplicate sample is identified by the addition of a "D" after the "L" in the numbering scheme. For example, "L136DSS1-06" is a duplicate surface water sample collected at location L136 at the C-746-S Landfill during the first event of fiscal year 2006. Adding a "TB" (for a trip blank), a "FB" (for a field blank), or a "RI" (for an equipment rinseate) to the front of the numbering scheme identifies the trip blanks, field blanks, and equipment rinseates. For example, "TBL135SS1-06" is a trip blank ("TB") that was collected at location L135 at C-746-S during the first surface water sampling event of the fiscal year 2006.

Environmental Surveillance Surface Water Sampling Identification Numbers. For surface water sampling associated with environmental surveillance monitoring, a sample identification numbering system is made of a series of numbers in the following format:

LEMPN-YY, where L indicates the location number such as L1, L10, L29, C612, etc.;
EMP denotes the samples were collected for EM;

N is the month in which the samples were collected; and
YY is the calendar year the sample was collected.

For example, “L29EMP5-06” is a sample identification number where “L29” denotes the sample was taken at a specified location; “EMP” denotes the samples were collected for EM; “5” denotes the sample was collected in May and “06” denotes the year, 2006, in which the sample was taken. A field duplicate sample is identified by the addition of a “D” after the “L” in the numbering scheme. For example, “L10DEMP5-06” is a duplicate sample collected at location L10 during May 2006. Adding a “TB” (for a trip blank), a “FB” (for a field blank), or a “RI” (for an equipment rinseate) to the front of the numbering scheme identifies the trip blanks, field blanks, and equipment rinseates. For example, “TB1EMP8-06” is the first trip blank (“TB”) that was collected during the August 2006 sampling event.

KPDES Sampling Identification Numbers. Sample identification numbering system is made up of several different series of numbers in the following formats:

TLN-YY, where T is the timeframe of collection such as a weekly (W1, W2, W3, or W4), a monthly sample (M), or a quarterly sample (Q);
L is the outfall location such as K001, K015, K017, or K019;
N is the month in which the sample was collected; and
YY is the calendar year the sample was collected.

For example, “MK0174-06” is a sample identification number where “M” denotes a monthly sample was collected at outfall K017; “4” denotes the sample was collected in the fourth month, April, and “06” denotes the year, 2006, in which the sample was collected. A field duplicate sample is identified by the addition of a “D” after the “L” in the numbering scheme. For example, “MK015D7-06” is a duplicate sample collected at outfall K015 during July 2006. Adding a “TB” (for a trip blank), a “FB” (for a field blank), or a “RI” (for an equipment rinseate) to the front of the numbering scheme identifies the trip blanks, field blanks, and equipment rinseates. For example, “FBMK0018-06” is a field blank (“FB”) that was collected at outfall K001 during August 2006.

KPDES Toxicity Sampling Identification Numbers. The following sample identification numbering scheme for toxicity samples is as follows:

QZTXLN-YY, where Q is the timeframe of collection—in this case quarterly;
Z is the sequential sample collected for the toxicity sample, such as 1, 2, 3, and 4;
TX identifies this sample as one to be analyzed for toxicity;
L is the outfall location such as K001, K015, K017, or K019;
N is the month in which the sample was collected; and
YY is the year the sample was collected.

For example, “Q2TXK0017-06” is the second quarterly toxicity sample that was collected at Outfall K001during July 2006.

Sediment Sampling Identification Numbers. Sample identification numbering system is made of a series of numbers in the following format:

LSEMPN-YY, where L is the location number such as 746K, S1, S20, S21, S27, etc.;
SEMP denotes the samples were collected for EM sediment sampling program;
N is the month in which the samples were collected; and
YY is the calendar year the sample was collected.

A field duplicate sample is identified by the addition of a “D” after the “L” in the numbering scheme. For example, “S27DSEMP11-03” is a duplicate sample collected at location S27 for EM sediment sampling program during November 2003. Adding a “TB” (for a trip blank), a “FB” (for a field blank), or a “RI” (for an equipment rinseate) to the front of the numbering scheme identifies the trip blanks, field blanks,

and equipment rinseates. For example, FB1SEMP5-06, is the first field blank to be collected during the May 2006 sediment sampling event.

Terrestrial Biota Sampling Identification Numbers. For deer sampling, the sample identification number is made up of a series of numbers in the following format:

BNEMPYY-T, where B is the terrestrial biota which was sampled, such as deer (D);
N is the sequential number of the order in which terrestrial biota were collected, noting that a number with one digit is denoted for that digit only (e.g., the first deer collected is denoted by "D1");
EMP denotes the samples were collected for EM;
YY is the year the terrestrial biota were collected; and
T is the type of tissue matrix collected, such as abdominal fat (AF), bone (B), kidney (K), muscle (M), rump fat (RF), liver (L), or thyroid (T).

For example, "D1EMP06-B" denotes that a bone ("B") sample was collected from the first deer ("D1") sampled in 2006 ("06") for EM ("EMP"). A duplicate sample is denoted by the words "DUP" appearing after the "B" in the numbering scheme. For example, "DDUPEMP06-T" denotes that a duplicate sample of the thyroid was collected in 2006. Equipment rinseates are identified by the addition of "RI1," "RI2," and "RI3" at the end of the numbering scheme. For example, DEMP06-RI1.

Annual Leachate Sampling Identification Numbers. For annual leachate sampling at C-746-S&T and C-746-U, the sample identification number is made up of a series of numbers in the following format:

PPPPP-PP-NN, where PPPPP-PP is the project identification number;
NN denotes a sequential sample that was collected (if needed);

For example, "ULS07-01-01" denotes an annual leachate sample from C-746-U landfill for the 2007 project id. Adding TB (for a trip blank), a "FB" (for a field blank), or a "RI" (for an equipment rinseate) to the front of the project identification number (ULS07-01) identifies the trip blanks, field blanks, and equipment rinseates. For example, "TBULS07-01" is a trip blank ("TB") that was collected during the annual leachate sampling event from C-746-U Landfill in 2007.

Special Request Sampling (Non-Routine) Identification Numbers. Used for non-routine or special request sampling in the following format:

LTM-YY, where L indicates the location of the sampling;
T is the type of media or a description of the sampling event;
M is the month of the year in which the samples were collected; and
YY is the calendar year the sample was collected.

Sample Coding for Waste Minimization. Samples are properly coded during collection by labeling the COC form and the sample label with the appropriate hazard codes (F001, F002, and U228). Data from the previous year is evaluated and the sampling locations needing hazard codes are added to the program. The following wells were determined to need hazard codes for FY 2009: ACO Well MW66, Northeast Plume Wells: MW243 and MW248; Northwest Plume Well: MW381; Environmental Surveillance Wells: MW155, MW156, MW161, MW187, MW257, MW261, MW262, MW333, MW339, MW340, MW341, MW343, MW405, MW406, MW407, MW408, MW414, MW415, MW416, and MW67; C-404 Well MW93. Samples collected from these wells are segregated from non-hazardous samples and are properly disposed.

3.2 LITHOLOGIC DESCRIPTION FORMS

Lithologic description forms are not necessary for use during routine activities under EM.

3.3 WELL CONSTRUCTION DETAIL FORMS

Well logs and construction diagrams contain information recorded by the engineer or geologist during construction of the MWs and EWs. These forms are not necessary for use during routine activities under EM.

3.4 LOGBOOK SAMPLE COLLECTION SHEETS

Sample collection sheets are utilized for recording sampling information during groundwater, surface water, and sediment sampling, as well as special sampling events. Logbooks are maintained according to PRS-ENM-2700, *Logbooks and Data Forms*.

4. DATA AND DATA RECORDS TRANSMITTALS

4.1 PADUCAH OREIS DATA TRANSMITTALS

Data to be stored in Paducah OREIS is submitted to the Data Manager prior to reporting. Official data reporting will be generated from data stored in Paducah OREIS.

4.2 DATA RECORDS TRANSMITTALS

EM personnel will make record transfers to the Document Management Center (DMC).

5. DATA MANAGEMENT SYSTEMS

5.1 PADUCAH PEMS

Paducah PEMS is the data management system that supports the project's sampling and measurement collection activities and generates Paducah OREIS RTL files. Appropriate project staff access Paducah PEMS throughout the life cycle of the project. The project uses Paducah PEMS to support the following functions:

- Initiate the project
- Plan for sampling
- Record sample collection and field measurements
- Record the dates of sample shipments to the laboratory (if applicable)
- Receive and process analytical results
- Verify data
- Access and analyze data
- Transfer project data (in RTL format) to Paducah OREIS

Paducah PEMS is used to generate sample COC forms, import laboratory-generated data, update field and laboratory data based on data verification, data validation if applicable, data assessment and transfer data to Paducah OREIS. Requirements for addressing the day-to-day operations of Paducah PEMS include backups, security, and interfacing with the Sample Management Office (SMO).

The Network Administrator performs system backups daily. The security precautions and procedures implemented by the data management team are designed to minimize the vulnerability of the data to unauthorized access or corruption. Only members of the data management team have access to the project's Paducah PEMS and the hard-copy data files. Members of the data management team have installed password-protected screen savers.

5.2 PADUCAH OREIS

Paducah OREIS is the centralized, standardized, quality assured, and configuration-controlled data management system that is the long-term repository of environmental data (measurements and geographic) for Paducah environmental management projects. Paducah OREIS is comprised of hardware, commercial software, customized integration software, an environmental measurements database, a geographic database, and associated documentation. EM uses Paducah OREIS for the following functions:

- Access to existing data
- Spatial analysis
- Report generation
- Long-term storage of project data (as applicable).

5.3 PADUCAH ANALYTICAL PROJECT TRACKING SYSTEM

The Paducah Analytical Project Tracking System is the business management information system that manages analytical sample analyses for Paducah environmental projects. The Paducah Analytical Project Tracking System provides cradle-to-grave tracking of sampling and analysis activities. The Paducah Analytical Project Tracking System generates the SOW, tracks collection and receipt of samples by the laboratory, flags availability of the analytical results, and allows invoice reconciliation. The Paducah Analytical Project Tracking System interfaces with Paducah PEMS (output from the Paducah Analytical Project Tracking System is automatically transferred to Paducah PEMS).

6. DATA MANAGEMENT TASKS AND ROLES AND RESPONSIBILITIES

6.1 DATA MANAGEMENT TASKS

The following data management tasks are numbered and grouped according to the activities summarized in Section 1.2. An explanation of the data review process is provided in the following sections and a summary of data reviews is shown in Table 6-1.

6.1.1 Acquire Existing Data

The primary background data for this project are historical analytical data and field information recorded in field logbooks, Paducah PEMS, and Paducah OREIS.

Table 6-1. Data Types, Reviews, and Frequencies[a]

Data Type	Data Review[b]			
Media	**Initial Data Review**	**Contractual Screening**	**Verification, Validation, and Assessment**	
EFFLUENT MONITORING				
Groundwater (MW Sampling at C-404, C-746-S, C-746-T, C-746-U, C-746-K, NE Plume, NW Plume, and Residential)				
Sample Information				
Field Measurements*	M**	Q**	Q**	N/A
Definitive Data	M**	Q**	Q**	See Attachment 1 for the validation strategy.
Surface Water (KPDES Sampling at 4 KPDES Outfalls, Surface Water Sampling at C-746-S, C-746-T, and C-746-U)				
Sample Information				
Field Measurements*	W	M***	M***	N/A
Definitive Data	W	M***	M***	See Attachment 1 for the validation strategy.
Leachate (C-404, C-746-S, C-746-T, and C-746-U)				
Sample Information				
Field Measurements*	A****	A****	A****	N/A
Definitive Data	A****	A****	A****	N/A
ENVIRONMENTAL SURVEILLANCE				
Groundwater (Env. Surv.-Q, S, Geochemical - A)				
Sample Information				
Field Measurements*	Q, A	Q, A	Q, A	N/A
Definitive Data	Q, A	Q, A	Q, A	See Attachment 1 for the validation strategy.
Surface Water (Locations on BC, LBC, and Massac Creek)				
Sample Information				
Field Measurements*	Q	Q	Q	N/A
Definitive Data	Q	Q	Q	See Attachment 1 for the validation strategy.
Sediment (Locations along BC, LBC, and Massac Creek)				
Sample Information				
Field Measurements*	S	S	S	N/A
Definitive Data	S	S	S	See Attachment 1 for the validation strategy.
External Gamma Radiation (46 TLDs on DOE property and surrounding area)				
Sample Information				
Field Measurements*	Q	N/A	A	N/A
Definitive Data	Q	N/A	A	N/A
Terrestrial Environment (Annual Deer Sampling)				
Sample Information				
Field Measurements*	A	A	A	N/A
Definitive Data	A	A	A	See Attachment 1 for the validation strategy.

W=Weekly; M=Monthly; Q=Quarterly; S=Semiannually; A=Annually; BC=Bayou Creek; LBC=Little Bayou Creek; Frequencies for each location varies. Refer to Appendix C for additional information.

a Parameters and additional locations are identified in Appendix C.

b Data review, by means of project surveillance, walkthroughs, self assessments, and audits, is not included in this table.

* Field Measurements consist of parameters identified in Section 9 of Appendix D.

** Verification, validation, and assessment performed semiannually for monitoring wells located at C-404 and C-746-K, and monthly for Residential MWs parameters.

*** Surface Water Sampling at C-746-S, C-746-T, and C-746-U is performed on a quarterly basis.

**** Leachate Sampling at C-404 is performed on an as-needed basis.

6.1.2 Plan Data Collection

Other documents for this project provide additional information for the tasks of project environmental data collection, including sampling and analysis planning, quality assurance, waste management, and health and safety. A laboratory SOW is developed annually, prior to the beginning of the fiscal year based on the requirements identified in the EMP. In addition, SOWs are developed for other sampling events, as needed.

6.1.3 Prepare for Sampling Activities

The data management tasks involved in sample preparation include identifying all sampling locations and preparing descriptions of these stations, developing sample and analysis summaries to be conducted at each sampling location, developing operational data collection sheets for routine operations and maintenance, and coordinating sample delivery to the laboratory. The Data Coordinator, working with the Lab Coordinator, conducts activities associated with the analytical laboratories. Coordinates for sample locations, which were surveyed during installation, are already established in Paducah OREIS. Coordinates for non-routine sampling events are obtained using a global positioning system.

The Sampling Group and Data Coordinator perform data management activities with field sampling in accordance with PRS-ENM-5007, *Data Management Coordination.*

The Data Coordinator reviews field forms and sampling information for completeness.

6.1.4 Collect Field Data

Paducah PEMS is used to identify, track, and monitor each sample and associated data from the point of collection through final data reporting. Project documentation includes field logbooks, COC records, and hard-copy analytical results.

Data management requirements for field logbooks and field forms specify that (1) sampling documentation must be controlled from initial preparation to completion, (2) sampling documentation generated must be maintained in a project file, and (3) modifications to planned activities and deviations from procedures shall be recorded.

The comprehensive sampling list in the EMP is used as the basis for finalizing the sample containers to be used for sample collection, and ordering a sufficient number of containers and other supplies. Before the start of routine sampling, the Lab Coordinator specifies the contents of sample kits, which includes sample containers provided by the laboratories, labels, preservatives, COC records, and instructions for collecting samples. Sample labels and COCs are completed according to PRS-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals.*

6.1.5 Collect Field Samples

The field team collects samples for the project. The field team records pertinent sampling information on the COC, along with maintaining a field logbook. The Data Coordinator enters the information from the COC forms into Paducah PEMS. A QC check of the sample information data entry is made and includes comparing printouts of 100% of the data in Paducah PEMS to the original COC. The QC check is appropriately documented and maintained in the project files.

6.1.6 Submit Samples for Analysis

Before the start of field sampling, the Project Manager coordinates the delivery of samples and receipt of results with the Lab Coordinator who, in turn, coordinates with the analytical laboratories. The Lab Coordinator presents a general sampling schedule to the analytical laboratories. The Lab Coordinator also coordinates the receipt of samples and containers with the laboratories. The Lab Coordinator ensures that hard-copy deliverables and EDDs from the laboratories contain the appropriate information and are in the correct format.

6.1.7 Process Laboratory Analytical Data

Data packages and EDDs received from the laboratory are tracked, reviewed, and maintained in a secure environment. Paducah PEMS is used for tracking project-generated data. The following information is tracked, as applicable: sample delivery group number, date received, number of samples, sample analyses, receipt of EDD, and comments. The Lab Coordinator compares the contents of the data package with the COC forms and identifies discrepancies. Discrepancies are reported to the laboratory.

To evaluate the quality of laboratory EDDs, the first two EDDs from each laboratory are 100% checked against hard-copy data packages (Form I's). Several EDDs were checked initially, now 10% of EDDs are checked. Depending on the information reported by the laboratory on the Form I's, checked items may include, but are not limited to, the result, lab qualifier, unit, client sample ID, lab sample ID, reporting limit, and validation qualifier. The Data Coordinator reports any discrepancies to the Lab Coordinator so that the analytical laboratory can be notified and the EDD corrected, if necessary.

6.1.8 Laboratory Contractual Screening

Laboratory contractual screening is the process of evaluating a set of data against the requirements specified in the analytical SOW to ensure that all requested information is received. The contractual screening includes, but is not limited to, the COC, analytes requested, method used, units, holding times, and reporting limits achieved. Contractual screening is performed for 100 percent of the data. The Lab Coordinator is primarily responsible for the contractual screening upon receipt of data from the analytical laboratory.

6.1.9 Data Verification

Data verification is the process for comparing a data set against a set standard or contractual requirement. Verification is performed by the Data Coordinator electronically, manually, or by a combination of both. Verification is performed for 100 percent of data. Data verification may include contractual screening and also criteria specific to EM. Data is flagged as necessary. Verification qualifiers are stored in ES PEMS and transferred with the data to Paducah OREIS.

6.1.10 Data Validation

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 for EM. Data validation evaluates the laboratory adherence to analytical-method requirements. Data validation is managed and coordinated with the Data Validator by the Validation Coordinator. The Data Validator performs data validation according to the procedures identified in Appendix D. Validation qualifiers are input and stored in ES PEMS and transferred to Paducah OREIS.

Definitive data is validated at a minimum of five percent of the total data packages from routine sampling events and is applied programmatically for each type of media. Data packages chosen for validation are

validated at 100 percent. Attachment 1 provides the validation strategy, which outlines data packages to be validated for environmental sampling activities.

6.1.11 Data Assessment

Data assessment is the process for assuring that the type, quality, and quantity of data are appropriate for their intended use. It allows for the determination that a decision (or estimate) can be made with the desired level of confidence, given the quality of the data set. Data assessment follows data verification and data validation (if applicable) and must be performed at a rate of 100 percent to ensure data is useable.

The data assessment is conducted by a technical reviewer or their designee in conjunction with project team members according to PRS-ENM-5003, *Quality Assured Data*. Assessment qualifiers are stored in ES PEMS and transferred with the data to Paducah OREIS. Data is made available for reporting upon completion of the data assessment, and associated documentation (Data Assessment Review Checklist) is filed with the project files. Any problems found during the review process are resolved and documented in the data assessment package.

6.1.12 Data Consolidation and Usage

The data consolidation process consists of the activities necessary to prepare the evaluated data for the users. The Data Coordinator prepares files of the assessed data from the ES PEMS to Paducah OREIS for future use. The Data Manager is responsible for transferring the data to Paducah OREIS. Data used in reports (e.g., the Quarterly Landfill Reports, the Annual Site Environmental Report, and the Report on Biological Monitoring Program) distributed to external agencies is obtained from data in Paducah OREIS and has been through the data review process. Data used for the Discharge Monitoring Report has been through the data review process, but due to the quick turnaround time, may not be loaded to Paducah OREIS at the time of reporting. All data reported has the approval of the Data Manager.

6.1.13 Submit Data to the Paducah OREIS

Upon completion of data assessment, the Data Coordinator uses Paducah PEMS to generate the RTL file upload to Paducah OREIS. The Data Manager is responsible for transferring the data to Paducah OREIS.

6.2 DATA MANAGEMENT ROLES AND RESPONSIBILITIES

The following project roles are defined, and the responsibilities are summarized for each data management task described in the previous subsection.

6.2.1 Project Manager

The Project Manager is responsible for the day-to-day operation of EM. The Project Manager ensures the requirements of policies and procedures are met, implements equipment maintenance and calibration requirements, and assesses operational data in accordance with PRS-ENM-5003. The Project Manager is responsible to flow down data management requirements to subcontractors as required.

6.2.2 Project Team

The project team consists of the technical staff and support staff (including the data management team) that conducts the various tasks required to successfully complete the project.

6.2.3 Data User

Data users are members of the project team who require access to project information to perform reviews, analyses, or ad hoc queries of the data. The data user determines project data usability by comparing the data against predefined acceptance criteria and assessing that the data are sufficient for the intended use.

6.2.4 Data Coordinator

The Data Coordinator enters the data into ES PEMS, including COC information, field data, validation qualifiers, and any pertinent sampling information. After receiving a notification that a fixed base lab EDD is available to download, the Data Coordinator loads the EDD to ES PEMS, performs electronic verification of the data, and then compiles the data assessment package. The Data Coordinator also prepares data for transfer from ES PEMS to the Paducah OREIS.

6.2.5 Document Center Manager

The Document Center Manager is responsible for the long-term storage of project records. The EM team interfaces with the Document Center Manager and transfers documents and records in accordance with DOE requirements.

6.2.6 QA Specialist

The QA Specialist is part of the project team and is responsible for reviewing project documentation to determine if the project team followed applicable procedures.

6.2.7 Data Manager

The Data Manager is responsible for long-term storage of project data and for transmitting data to external agencies according to the Paducah Site Data Management Plan, (DOE/OR/07-1595&D1), and the Paducah Data Management Policy. The Data Manager ensures compliance to procedures relating to data management with respect to the project and that the requirements of PRS-ENM-5003 are followed.

6.2.8 Lab Coordinator

The Lab Coordinator is responsible for contracting any fixed-base laboratory utilized during the sampling activities. The Lab Coordinator also provides coordination for sample shipment to the laboratory, contractual screening of data packages, and transmittal of data packages to the Paducah DMC.

6.2.9 Sampling Group

The Sampling Group is responsible for printing COCs and labels and preparing sample kits. This group records field information in logbooks and required field information on COCs. The Sampling Group coordinates sample delivery to the laboratories with the Lab Coordinator.

7. REFERENCES

PRS-ENM-2700, *Logbooks and Data Forms*.

PRS-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*.

PRS-ENM-5003, *Quality Assured Data*.

PRS-ENM-5007, *Data Management Coordination*.

DOE/OR/07-1595&D1, *Paducah Site Data Management Plan.*

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ATTACHMENT

ENVIRONMENTAL MONITORING DATA VALIDATION STRATEGY

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ATTACHMENT 1
Environmental Monitoring Data Validation Strategy

MEDIA—GROUNDWATER						
Sampling Location	**Analytical Parameters**	**Analytical Methods**	**Sample No. (Total for FY2009)[a]**	**Total By Media (5%)**	**Validation Package Selected for EM**	
					FY2009 (%)	**FY2010 (%)**
C-404 Semi-annual	TCE, Metals, Rad	SW-846 Methods	18	**FY2009** 454 [b] (23) [c] **FY2010** 612 [b] (30) [c]	1st Event–9 out of 9 (100%) 2nd Event–9 out of 9 (100%)	1st Event–9 out of 9 (100%) 2nd Event–9 out of 9 (100%)
C-746-S&-T	Metals, PCBs, Rad VOAs, Wet chemistry	SW-846 Methods	76		1st Qtr–19 out of 19 (100%) 2nd Qtr–19 out of 19 (100%) 3rd Qtr–19 out of 19 (100%) 4th Qtr–19 out of 19 (100%)	1st Qtr–19 out of 19 (100%) 2nd Qtr–19 out of 19 (100%) 3rd Qtr–19 out of 19 (100%) 4th Qtr–19 out of 19 (100%)
C-746-U	Metals, PCBs, Rad, VOAs, Wet chemistry	SW-846 Methods	84		1st Qtr–21 out of 21 (100%) 2nd Qtr–21 out of 21 (100%) 3rd Qtr–21out of 21 (100%) 4th Qtr–21 out of 21 (100%)	1st Qtr–21 out of 21 (100%) 2nd Qtr–21 out of 21 (100%) 3rd Qtr–21out of 21 (100%) 4th Qtr–21 out of 21 (100%)
C-746-K	Anions, Metals, Rad, VOAs	SW-846 Methods	8		1st Event –4 out of 4 (100%) 2nd Event –4 out of 4 (100%)	1st Event –4 out of 4 (100%) 2nd Event –4 out of 4 (100%)
Residential (Monthly)	TCE , ^{99}Tc, and gross alpha/beta	SW-846 Methods	24		None	None
Residential (Annually)	TCE , ^{99}Tc	SW-846 Methods	15		None	None
Residential (Carbon Filter)	TCE , ^{99}Tc, Wet chemistry	SW-846 Methods	12		None	None
C-400 Wells (Quarterly)	Anions, Metals, PCBs, Rad, VOAs	SW-846 Methods	12 (FY2009) 32 (FY2010)		None	None
Environmental Surveillance (Quarterly)	PCBs	SW-846 Methods	12		None	None
Environmental Surveillance (Quarterly)	TCE , ^{99}Tc	SW-846 Methods	12		None	None

Environmental Surveillance (Semiannually)	VOAs and Rad	SW-846 Methods	146		None	None
Environmental Surveillance (Semiannually) (New Monitoring Wells Starting in Feb 2010)	VOAs and Rad	SW-846 Methods	138 (FY2010)		None	None
Environmental Surveillance Geochemical (Annually)	VOAs, Metals, Wet chemistry	SW-846 Methods	35 (FY2009) 44 (FY2010)		1st Event–35 out of 35 (100%)	1st Event–44 out of 44 (100%)
Total Number of Samples Planned for Validation per FY					221 (49%)	230 (38%)

MEDIA—SURFACE WATER						
Sampling Location	**Analytical Parameters**	**Analytical Methods**	**Sample No. (Total for FY2009)**	**Total By Media (5%)**	**Validation Package Selected for EM**	
					FY2009 (%)	**FY2010 (%)**
C-746-U	Anions, Metals, Rad, Wet Chemistry	EPA Methods	12	104 (5)	1st Qtr – None 2nd Qtr – None 3rd Qtr – None 4th Qtr – None	1st Qtr – None 2nd Qtr – None 3rd Qtr – None 4th Qtr – None
C-746-S&-T	Anions, Metals, Rad, Wet Chemistry	EPA Methods	12		1st Qtr – None 2nd Qtr – None 3rd Qtr – None 4th Qtr – None	1st Qtr – None 2nd Qtr – None 3rd Qtr – None 4th Qtr – None
Quarterly SW[f]	Metals, PCBs, Rads, VOAs, Wet Chemistry	EPA Methods	80		3rd Event – 20 out of 20 (100%) All Other Events – None	3rd Event – 20 out of 20 (100%) All Other Events – None
Total Number of Samples Planned for Validation per FY					20 (19%)	20 (19%)
MEDIA—SEDIMENT						
Sediment (Semiannually)	Metals, PCBs, Rads,	EPA SW-846 Methods	28	28 (1)	2nd Event – 14 out of 14 (100%)	2nd Event – 14 out of 14 (100%)
Total Number of Samples Planned for Validation per FY					14 (50%)	14 (50%)

MEDIA—TISSUE						
Terrestrial Biota (Deer)	Metals, PCBs, Rads	EPA SW-846 Methods	5	5 (1)	5 out of 5 (100%)	5 out of 5 (100%)
Total Number of Samples Planned for Validation per FY					5 (100%)	5 (100%)

[a] The total number of samples to be collected for a particular sampling event.

[b] The total number of samples to be collected from all sampling events for a type of media (e.g., groundwater, surface water, sediment, tissue, and leachate).

[c] The total number of samples to be validated to meet a minimum of 5% of the total samples for data validation.

[d] "1st Qtr—14 out of 14 (100%)" is defined as the following:
1st Qtr –the description of the time frame during the fiscal year the sampling event takes places (e.g., "1st Qtr" is the First Quarter of the FY--October through December--of 2007);
14 out of 14—the number of samples targeted for validation and the number of samples collected,
(100%)—the percentage of data validation to be performed for a particular sampling event.

[e] "None" indicates the samples for this particular event and media was not targeted.

[e] Seep sampling not included in validation of Quarterly SW

NOTE 1: For information concerning the validation strategy used in CY 1999, CY 2000, CY 2001, CY2002, CY2003, CY2004, FY2005, FY2006, FY2007, and FY2008, please see a previous version of the EM QA and DM Plan.

NOTE2: For information concerning the validation strategy used for the Northeast and Northwest Plume monitoring, please see the Northeast and Northwest Plume QA Plan.