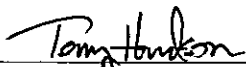


**Environmental Monitoring Plan  
Fiscal Year 2011  
Paducah Gaseous Diffusion Plant,  
Paducah, Kentucky**

This document is approved for public release per review by:

  
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LATA Kentucky Classification Support

12-20-2010  
Date



**Environmental Monitoring Plan  
Fiscal Year 2011  
Paducah Gaseous Diffusion Plant,  
Paducah, Kentucky**

Date Issued—December 2010

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

LATA ENVIRONMENTAL SERVICES OF KENTUCKY, LLC  
managing the  
Environmental Remediation Activities at the  
Paducah Gaseous Diffusion Plant  
under contract DE-AC30-10CC40020

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## ACRONYMS

AEC	Atomic Energy Commission
AIP	Agreement in Principle
AO	Agreed Order
ASER	Annual Site Environmental Report
CAP-88	Clean Air Act Assessment Package-88
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
<i>CFR</i>	<i>Code of Federal Regulations</i>
DCG	Derived Concentration Guide
DOE	U.S. Department of Defense
DOE	U.S. Department of Energy
DQO	data quality objective
EDE	effective dose equivalent
EM	environmental monitoring
EMP	Environmental Monitoring Plan
EMS	Environmental Management System
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FY	fiscal year
GSA	General Services Administration
GWPP	Groundwater Protection Program
ISMS	Integrated Safety Management System
<i>KAR</i>	Kentucky Administrative Regulation
KDOW	Kentucky Division of Water
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
LATA Kentucky	LATA Environmental Services of Kentucky, LLC
MW	monitoring well
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
OU	operable unit
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
QA	quality assurance
RADCON	radiological control
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SPCC	spill prevention control and countermeasure
SARA	Superfund Amendments Reauthorization Act
TLD	thermoluminescent dosimeter
UE	uranium enrichment
USEC	United States Enrichment Corporation
Water Policy	Action Memorandum for the Water Policy at PGDP
WKWMA	West Kentucky Wildlife Management Area
WMP	Watershed Monitoring Program

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## **EXECUTIVE SUMMARY**

This Paducah Site Environmental Monitoring Plan (EMP) for fiscal year (FY) 2011 is intended to document the rationale, sampling frequency, parameters, and analytical methods for environmental monitoring (EM) activities at the Paducah Site and provides information on site characteristics, environmental pathways, dose assessment methodologies, and quality assurance management.

EM at the Paducah Site consists of effluent monitoring and environmental surveillance activities and supports the evaluation and assessment of unplanned releases. Monitoring is conducted for a variety of media including air, surface water, groundwater, soil, and sediment.

Based on an evaluation of long-term groundwater data trends for nonregulatory-required monitoring activities, the sampling frequency for certain wells in this program has been reduced in FY 2011.

Sampling frequencies and sampling parameters that were modified for a sampling program that was permit-driven or collected as a result of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Resource Conservation and Recovery Act (RCRA) decision document were changed only if the permit allowed the change.

Data collected under existing permits and under CERCLA or RCRA decision documents will continue to be evaluated in FY 2011. If changes are deemed appropriate based on trending analyses, they will be proposed via a permit modification or decision document change and implemented immediately after approval by the regulatory agencies.

A summary of significant differences in this EMP compared to the EMP for FY 2010 is located in Section 1.3.

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# 1. INTRODUCTION

## 1.1 PURPOSE

This Paducah Site Environmental Monitoring Plan (EMP) for fiscal year (FY) 2011 is intended to document the rationale, sampling frequency, parameters, and analytical methods for environmental monitoring (EM) activities at the Paducah Site and provides information on site characteristics, environmental pathways, dose assessment methodologies, and quality assurance (QA) management. Guidance for EM is included in U.S. Department of Energy (DOE) Order (O) 450.1A, *Environmental Protection Program* (DOE 2008a); DOE O 5400.5, *Radiation Protection of the Public and the Environment* (DOE 1993a); and DOE/E--0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), hereinafter identified as the Radiological Guide; and state and federal regulations that implement federal environmental laws. This EMP was prepared by LATA Environmental Services of Kentucky, LLC, (LATA Kentucky) on behalf of DOE.

The purpose of DOE O 450.1A is to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations, through which DOE cost effectively meets or exceeds compliance with applicable environmental, public health, and resource protection requirements. DOE O 5400.5 establishes standards and requirements for DOE operations with respect to protection of the public and the environment against undue risk from radiation.

The Radiological Guide establishes the “elements of a radiological effluent monitoring and environmental surveillance program considered acceptable to DOE, in support of DOE 5400.5 (Radiation Protection of the Public and the Environment) and DOE 5400.1 (General Environmental Protection Program),” which was replaced by DOE O 450.1A, described above. This EMP is written to comply with “*should*” statements in the Radiological Guide, unless noted otherwise as an allowable exception.

This EMP also supports permit requirements and supplements the ongoing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigations (RIs) being conducted at the Paducah Site. In accordance with the Paducah Site Federal Facility Agreement (FFA), there are five defined CERCLA operable units (OUs)—surface water, groundwater, soils, burial grounds, and decontamination and decommissioning—that require investigation. This EMP is integrated with each OU investigation and/or remedial action to help provide collection of optimal data sets.

## 1.2 SCOPE

EM at the Paducah Site consists of effluent monitoring and environmental surveillance activities and supports the evaluation and assessment of unplanned releases. Monitoring is conducted routinely for a variety of media including air, surface water, groundwater, soil, and sediment. Effluent monitoring is the direct measurement or the collection and analysis of liquid and gaseous discharges to the environment. Environmental surveillance is the direct measurement or the collection and analysis of ambient air, surface water, groundwater, sediment, soil, biota, and other media.

The United States Enrichment Corporation (USEC) leases and operates the Paducah Gaseous Diffusion Plant (PGDP) uranium enrichment facility at the Paducah Site and conducts its own EM activities. This EMP does not address EM activities conducted by USEC.

In order for DOE and its primary remediation contractor to meet or exceed compliance with applicable environmental, public health, and resource protection requirements cost effectively, the EMP is evaluated and modified as appropriate. These modifications may include adjusting the number of monitoring wells, changing sampling frequency of certain activities, or eliminating parameters to avoid duplication of data. As the prime contractor for DOE at the Paducah Site, LATA Kentucky currently is evaluating the existing site permits to determine whether changes in sampling frequency or parameters are appropriate and acceptable to the regulatory agencies. Optimization of permit-required sampling will be implemented following approval by the regulatory agencies.

The Paducah Site EMP is prepared annually for implementation on an FY basis (i.e., October 1 through September 30). The DOE prime contractor is responsible for implementing the EMP.

### **1.3 RATIONALE**

The rationale for EM activities at the Paducah Site for FY 2011 is premised by the understanding that sampling frequency, sampling parameters, and analytical methods must be sufficient to meet regulatory and contractual requirements and support appropriate DOE Orders and Guidance cost effectively.

An evaluation of nonregulatory-required monitoring activities for groundwater resulted in reduced sampling frequency for certain wells for FY 2011. Information that was used in this determination includes the following:

- An updated understanding of contaminant migration pathways and contaminants present,
- Review of historical monitoring well (MW) results and trends,
- Analyses to determine MW compatibility with current and future objectives described in the Groundwater Protection Program (GWPP), and
- Addition of new MWs that may eliminate the need for sampling of older MWs.

Sampling frequencies and sampling parameters that were modified for a sampling program that was permit-driven or collected as a result of a CERCLA or Resource Conservation and Recover Act (RCRA) decision document were changed only if the permit allowed the change. Data collected under these programs will continue to be evaluated in FY 2011. If changes are deemed appropriate based on trending analyses, they will be proposed via a permit modification or decision document change and reflected in the EMP for FY 2012.

Accordingly, listed below are some of the significant differences in this EMP compared to the EMP for FY 2010.

- One outfall (Outfall 020) was added per the Kentucky Pollutant Discharge Elimination System (KPDES) permit that was modified December 1, 2009.
- In accordance with the revised KPDES permit, analysis requirements have been updated.
- The Environmental Monitoring Data Management Implementation Plan, previously included as Appendix E (although not required), was deleted and will be generated as a stand-alone plan.
- Groundwater MWs installed in FY 2010 have been added to the environmental surveillance program.

- Sampling frequencies for certain groundwater MWs have been revised to reflect current needs.
- The number of MWs sampled for the Northwest Plume has increased from 12 in FY 2010 to 32 in FY 2011. This is due to the completion of the Northwest Plume Optimization project in August 2010. This increase is consistent with the sampling proposed in the revised Operations and Maintenance Plan for this project.
- The sampling frequency for the surveillance and maintenance wells has been modified. In FY 2010, the frequency of sampling was quarterly and semiannually. Evaluation of data collected to date shows no significant changes in analytical results that would merit the need for continued sampling at this frequency level. For FY 2011, 21 wells were selected for annual monitoring. These were selected based on their location within the plumes. Some are key for early detection of plume migration; others are key for ongoing CERCLA work. Nineteen wells from this program were transferred to the Northwest Plume Program. The remaining wells will be sampled biennially.
- Thirty-five of the 44 wells sampled under the geochemical sampling program were sampled in FY 2010. The remaining nine are new wells that were being installed at the time the sampling event took place will be sampled in FY 2011. Analytical results from these 9 wells will complete the information needed to establish a baseline for the geochemistry data. The next sampling event under this program is projected for FY 2013 and will include all 44 wells.
- Real Estate License No. REEMCBC DOE-03-06-0710 requires that a deer sampling program be established and analytical results be provided to the West Kentucky Wildlife Management Area (WKWMA) manager prior to the first scheduled deer hunt that occurs each year. The harvests conducted to date have not indicated unaccepted levels of contamination. Based on these annual deer sample analyses, no restrictions have been placed on deer hunting activities at the reservation. Further evaluation of deer sampling data collected over the years is underway. It is anticipated that the evaluation will result in this sampling program being discontinued. In anticipation of this change, the number of deer harvested has been changed from five deer in FY 2010, to two deer in FY 2011. Sampling parameters also have been modified, with sampling limited to radiological analysis, as it is more indicative of plant processes.
- The sampling frequency or sampling locations for the Watershed Monitoring Program were not modified for FY 2011; however, the sampling parameters were changed based on the revised KPDES permit. The permit requires that in-stream surface water be sampled quarterly for polychlorinated biphenyls (PCBs) and trichloroethene (TCE) in Little Bayou Creek, Bayou Creek, and the Ohio River. Parameters have been adjusted accordingly.
- The sampling frequency or sampling locations for the Sediment Monitoring Program were not modified in FY 2011; however, the sampling parameters were changed based on the revised KPDES Permit. The permit now requires that sediments be monitored for PCBs semiannually at 14 locations in Little Bayou Creek and Bayou Creek. Parameters have been adjusted accordingly.

## 1.4 GENERAL CONSIDERATIONS

### 1.4.1 Site Description

The Paducah Site, comprised of PGDP and surrounding acreage, is located in a generally rural area of McCracken County, Kentucky (population approximately 67,000). The site is comprised 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). The plant is on approximately 1,350 acres with controlled access. Roughly, 650 acres of the site are enclosed within a fenced security area. An uninhabited buffer zone of at least 400 yd surrounds the entire fenced area. PGDP is an active uranium enrichment facility consisting of a diffusion cascade and extensive support facilities. The cascade, including product and tails withdrawal, is housed in six large process buildings within the fenced security area.

### 1.4.2 Site Background Information

Before World War II, the area now occupied by PGDP was used for agricultural purposes. Numerous small farms produced various grain crops, provided pasture for livestock, and included large fruit orchards.

During World War II, a 16,126-acre tract was assembled for construction of Kentucky Ordnance Works, which subsequently was operated by the Atlas Powder Company until the end of the war. At that time, it was turned over to the Federal Farm Mortgage Corporation and then to the General Services Administration (GSA).

In 1950, the U.S. Department of Defense (DOD) and DOE's predecessor, the Atomic Energy Commission (AEC), began efforts to expand fissionable material production capacity. As part of this effort, the National Security Resources Board was instructed to designate power areas within a strategically safe area of the United States. Eight government-owned sites initially were selected as candidate areas. In October 1950, as a result of joint recommendations from DOD, U.S. Department of State, and AEC, President Harry S. Truman directed AEC to expand further production of atomic weapons. One of the principal facets of this expansion program was the provision for a new gaseous diffusion plant. On October 18, 1950, AEC approved the Paducah Site for uranium enrichment (UE) operations and formally requested the Department of the Army to transfer the site from GSA to AEC. Of the 7,566 acres acquired by the AEC, 1,361 acres subsequently were transferred to the Tennessee Valley Authority (Shawnee Fossil Plant Site), and approximately, 2,700 acres were conveyed to the Commonwealth of Kentucky for wildlife conservation and for recreational purposes (WKWMA).

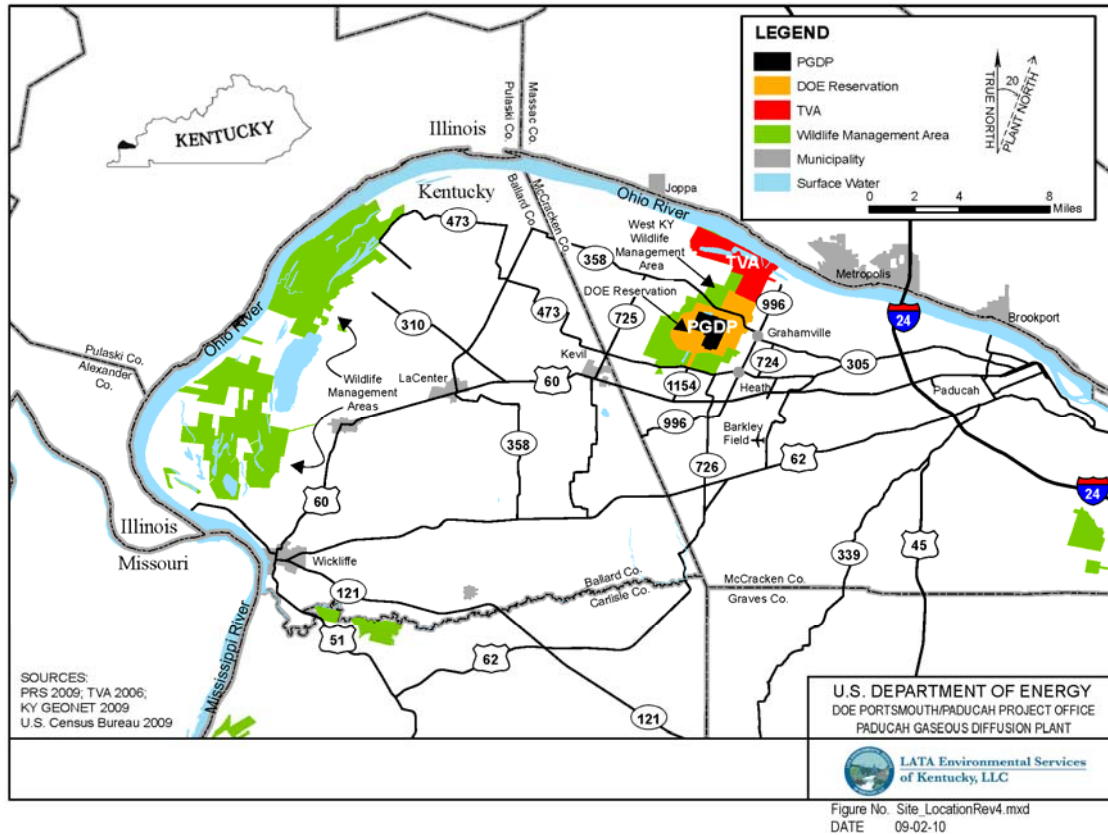
Although construction of PGDP was not complete until 1954, production of enriched uranium began in 1952. Recycled uranium from nuclear reactors was introduced into the PGDP enrichment "cascade" in 1953 and continued through 1964. In 1964, cascade feed material was switched solely to virgin-mined uranium. Use of recycled uranium 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 of recycled uranium containing an estimated 328 grams of plutonium-239 ( $^{239}\text{Pu}$ ), 18,400 grams of neptunium-237 ( $^{237}\text{Np}$ ), and 661,000 grams of technetium-99 ( $^{99}\text{Tc}$ ). The majority of the  $^{239}\text{Pu}$  and  $^{237}\text{Np}$  was separated out during the initial chemical conversion to uranium hexafluoride ( $\text{UF}_6$ ). Concentrations of transuranics (e.g.,  $^{239}\text{Pu}$  and  $^{237}\text{Np}$ ) and  $^{99}\text{Tc}$  are believed to have been deposited on internal surfaces of process equipment and in waste products.



In October 1992, congressional passage of the 1992 National Energy Policy Act established USEC.

Effective July 1, 1993, DOE leased the plant UE operation facilities to USEC. Under the terms of the lease, USEC assumed responsibility for environmental compliance activities directly associated with UE operations. The plant's mission of UE has continued unchanged since 1950, and the original facilities still are in operation, albeit with substantial upgrading and refurbishment.



**Figure 1. Location of the Paducah Site**

The PGDP was placed on the U.S. Environmental Protection Agency (EPA) National Priorities List on May 3, 1994, with an effective date of June 30, 1994. Environmental restoration is being addressed under an FFA with EPA and the Commonwealth of Kentucky. The FFA became effective February 13, 1998.

### 1.5 PLAN OBJECTIVES

The main objectives of this EMP are as follows:

- Ensure the early identification and appropriate response to potential adverse environmental impacts associated with DOE operations through effluent monitoring and environmental surveillance.
- Ensure that 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; and
- An integrated sampling approach to avoid duplicative data collection.
- Support the “fully implemented status” of the Paducah Site Environmental Management System (EMS).
- Support the implementation of the Paducah Site Integrated Safety Management System (ISMS).
- Support the integration of EMS into the site’s ISMS.

Outputs from implementation of the EMP may be used to do the following:

- Provide data for use in the Annual Site Environmental Report (ASER), which informs the public about releases and potential impacts from DOE operations to human health 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;
- Support or supplement data needs for CERCLA actions; and
- Provide a mechanism for long-term data collection needs under the FFA, when applicable.

## **1.6 PLAN OVERVIEW**

Relevant background and current information were provided in Section 1. Section 2 of this document describes effluent monitoring for liquid and airborne radiological constituents. Section 3 addresses meteorological monitoring, which is collected from the National Weather Service. Section 4 addresses, by media, environmental surveillance activities undertaken to monitor the radiological impacts of DOE operations. Section 5 describes the dose calculation methods used for the site. Section 6 provides various reporting requirements. Section 7 lists references utilized in the preparation of this plan.

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

### **1.6.1 Measuring Facility Impact**

The Radiological Guide requires comparisons of the measured concentrations against “background” concentrations. For the purposes of this EMP, a “background” location is called a reference location and is defined as an area unaffected by releases from PGDP. 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 Paducah Site boundary.

## 2. EFFLUENT MONITORING

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 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 1. Routine Effluent Monitoring**

Program	Number of Locations	Sampling Frequency	Parameters
<b>Surface Water</b>			
C-746-S&T Landfill	3 <sup>1</sup>	Quarterly	See Appendix C
C-746-U Landfill	3 <sup>1</sup>	Quarterly	
<b>KPDES</b>			
Chemical	1	Weekly	See Appendix C
	4	Monthly	
Chemical/Toxicity	5	Quarterly	
<b>Leachate</b>			
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

<sup>1</sup> 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) KPDES Program. Sampling and analytical methods meet the requirements described in 40 *CFR* § 136. In addition, DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and the Radiological Guide provide general and detailed guidance regarding the establishment of effluent monitoring programs for radiological parameters.

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

- 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 Radiological Guide recommends this plan 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 (Appendix B provides the monitoring well inventory);
- Minimum detection level and accuracy by analyte; and
- QA components.

The preceding requirements are addressed as follows:

- Appendix C of this document lists all effluent monitoring locations. This appendix specifies sampling and field measurements. Appendix C also lists the sampling frequency at each location, as well as the required analytical parameters by each method type (i.e., volatiles, radionuclides, etc.).
- Appendix D of this document is the Environmental Management QA Plan. All QA components are outlined within this plan. Appendix D lists all associated procedures associated with sample extraction, as well as field measurements.
- 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 routinely achievable reporting limit.
- Effluent monitoring results from the KPDES outfalls are summarized in the discharge monitoring reports, which are submitted on a monthly basis to KDOW.
- Surface water monitoring results at the landfills are summarized in quarterly reports and submitted to Kentucky Division of Waste Management (KDWM) on a quarterly basis. Notifications of nonconformance are submitted per the specifications within the permits.

**Evaluation of Effluents.** Effluents, regardless of whether 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 wastewaters to the waters of the Commonwealth of Kentucky. The DOE Paducah Site KPDES permit

(KY0004049, effective November 1, 2006) establishes monitoring requirements for the discharge of wastewater. Following the issuance of the permit, several parties petitioned KDOW for a hearing on the permit. An Order to Mediate was issued by the Kentucky Environmental and Public Protection Cabinet (now named the Kentucky Energy and Environment Cabinet).

An Agreed Order (AO) to settle all parties' disputes with the permit was signed on December 7, 2007. A revised KPDES permit, reflecting the changes set forth in the AO, was effective December 1, 2009. This modified permit added an additional outfall (020) to the monitoring locations for separate tracking and monitoring for treated leachate discharges from the C-746-U and C-746-S Landfills.

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. LATA Kentucky is in the process of evaluating the permit required analytes in preparation for the upcoming permit renewal process in 2011.

**Radiological.** Based on the evaluation of emissions and the results of radiological monitoring reported in the ASER for 2009, 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. Therefore, radiological analyses performed on grab samples from rain runoff locations (i.e., outfalls, landfills, etc.) and from several stream locations (Bayou Creek and Little Bayou Creek) are discontinued in the FY 11 EMP.

**Program Implementation Procedures.** The environmental monitoring and reporting manager (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the environmental monitoring and reporting manager reports through a line organization to the Paducah Environmental Remediation Project manager and provides centralized coordination responsibilities.

## 2.1 LIQUID

### 2.1.1 Surface Water

Surface water leaving DOE-owned outfalls (Outfalls 001, 015, 017, 019, and 020) includes rainfall runoff from cylinder yards and landfills and effluent from site processes (e.g., the C-612 Northwest Plume Groundwater Treatment System and 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 PCBs and 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 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.** Five DOE-owned effluent sampling points covered by the KPDES permit (Outfalls 001, 015, 017, 019, and 20) are illustrated in Appendix C. Sampling is conducted weekly at Outfall 001 and monthly at Outfalls 015, 017, 019, and 20, when water is flowing.

### **2.1.2 Leachate**

**C-746-S and C-746-U Leachate.** Leachate from the solid waste landfills is sampled annually 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 are not considered to be a major source of pollutants and consequently have no air permits.

Actions conducted under CERCLA have the potential to emit airborne pollutants. The C-400 project monitors air emissions as specified in the approved CERCLA documents.

### **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 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

In support of DOE Order 450.1A, the Paducah Site performs environmental surveillance. 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 effective dose equivalent (EDE) 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 per 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 Radiological Guide recommends that DOE facilities perform routine surveillance if an annual dose of site origin at the site boundary exceeds either 5 mrem 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 radiological surveillance is required. As a result, it has been removed from the surface and sediment monitoring programs in the FY 11 EMP.

An overview of routine environmental surveillance is provided in Table 2, which lists for each program the number of sampling locations, sampling frequency, sample type, and parameters for the analysis performed.

### 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. The *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III* (Clausen *et al.* 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* (PRS 2010).

**Table 2. Routine Environmental Surveillance**

<b>Program</b>	<b>Number of Locations</b>	<b>Sampling Frequency</b>	<b>Sample Type</b>	<b>Parameters</b>
<b><i>Groundwater</i></b>				
Surveillance	21	Annually	Grab	See Appendix C
Surveillance	129	Biennially	Grab	See Appendix C
Surveillance Geochemical	44	Every 3 years	Grab	See Appendix C
C-746 S&T Landfills	25 <sup>1</sup>	Quarterly	Grab	See Appendix C
C-746-U Landfill	21 <sup>1</sup>	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	22	Quarterly/Semiannually	Grab	See Appendix C
Northwest Plume	10	Semiannually	Grab	See Appendix C
C-400	8	Quarterly	Grab	See Appendix C
Residential Annually	14	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	98	Quarterly	Grab	N/A
Water Levels Semiannually	6	Semiannually	Grab	N/A
Water Levels Annually	265	Annually	Grab	N/A
<b><i>Watershed Biological Monitoring</i></b>				
Benthic Macroinvertebrates	8	Annually	Grab	See Appendix C
<b><i>Surface Water and Seeps</i></b>				
	22	Quarterly	Grab	See Appendix C
<b><i>Sediment</i></b>				
	14	Semiannually	Grab	See Appendix C
<b><i>Terrestrial—Deer</i></b>				
	2 <sup>3</sup>	Annually	Species	See Appendix C
<b><i>Ambient Air</i></b> <sup>3</sup>				
	N/A	N/A	N/A	N/A
<b><i>Meteorologic</i></b> <sup>4</sup>				
	N/A	N/A	N/A	N/A
<b><i>Environmental TLDs</i></b>	46	Quarterly	Continuous	External Gamma

TLD = thermoluminescent dosimeter

<sup>1</sup> Four of the same wells are cited 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.

<sup>2</sup> Two deer will be harvested in FY 11. Program projected to be discontinued starting in FY 12.

<sup>3</sup> Operated by Commonwealth of Kentucky personnel.

<sup>4</sup> Information is taken from the National Weather Service.

#### **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 450.1A 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 Order 450.1A outlines 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 biennially for several parameters, including organics, inorganics, and radionuclides.

**Commonwealth of Kentucky Regulation.** 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 is required by 401 KAR § 5:037. 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 was revised in August 2010. 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. KDWM 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.

**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 and ongoing remedial actions 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 (DOE 1995; DOE 1993b). Seventeen residential wells currently are sampled for the parameters listed in Appendix C. Thirteen of the seventeen 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 Administrative Consent Order, 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 access to water lines for 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 and ongoing remedial actions. Currently, there are five defined CERCLA OUs (i.e., surface water, groundwater, soils, burial grounds, and decontamination and decommissioning) that have been, or will be, investigated under the Paducah FFA. The EMP is integrated with each operable unit investigation to provide collection of optimal data sets.

**FFA Requirement and Operation 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, 32 wells are required to be sampled for the Northwest Plume and 11 for the Northeast Plume, according to their respective Operation and Maintenance Plans.

The number of MWs sampled for the NW Plume increased due to completion of the NW Plume Optimization project in August 2010. This will aid in determining the effectiveness of the new extraction wells installed as part of this optimization.

#### **Landfill Groundwater Monitoring Program**

**C-746-S and C-746-T Landfills.** DOE currently has Commonwealth of Kentucky-permitted (SW07300014 and SW07300015) closed, solid waste landfills (C-746-S and C-746-T). The groundwater is monitored utilizing a total of 25 MWs near the two landfills. Of these 25, 23 are used for collection of samples to analyze organic, inorganic, and radiological parameters identified in Appendix C. The remaining two are used for water level measurements.

**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 (SW0730045), 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 450.1A, according to the Paducah FFA.

The FY 11 EMP does not include any changes for the Landfill Groundwater Monitoring Program because the sampling frequency and the parameters to be sampled are permit driven. Data collected under this program will be evaluated in FY 11 and, if changes are deemed appropriate based on trending results, they will be proposed via a permit modification and reflected in FY 12 EMP.

## **Surveillance Monitoring Program**

**Environmental Surveillance (Annual and Biennial Monitoring) Program.** In order to monitor the nature and extent of groundwater contamination and to monitor groundwater quality, 124 non-background wells are sampled biennially and 21 are monitored annually, 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, as well as DOE Order 450.1A. 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.

The sampling frequency for this program has been modified in FY 11. In FY 10, the frequency of sampling was quarterly and semiannually. Evaluation of the data collected over the last ten years shows that there have not been significant changes that will merit the need for sampling as frequently. Twenty-one wells were selected to be monitored annually. These were selected based on their location within the plumes. Some are key for early detection of plume migration; others are key for ongoing CERCLA work.

**Background Monitoring Program.** Four background wells are sampled biennially and one annually 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 to be sampled every three years. Sampling of these wells is not driven by a permitted process, but is conducted in support of the FFA CERCLA investigations, as well as DOE Order 450.1A.

Thirty-five of the 44 wells sampled under this program were sampled in FY 10. The remaining 9 are new wells that were being installed at the time the sampling event took place in FY 10. These 9 new wells will be sampled in FY 11. This will complete the information needed to establish a baseline for the geochemistry data. The next sampling event under this program is projected for FY 13 and will include all 44 wells.

### **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.

### **4.1.4 Program Implementation Procedures**

**Organization.** The environmental monitoring and reporting manager is responsible for implementing all relevant aspects of the EMP.

**Plans.** The *Groundwater Protection Plan*, last issued in August 2010, addresses the following specific requirements listed in Section 3(3) of 401 KAR 5:037:

- (a) General information regarding the facility and its operation;
- (b) Identification of activities associated with the facility, as identified in Section 2 of the regulation;

- (c) Identification of all practices chosen for the plan to protect groundwater from pollution;
- (d) Implementation schedules for the protection practices;
- (e) Description of and implementation schedule for employee training necessary to ensure implementation of the plan;
- (f) Schedule of required inspections, as applicable; and
- (g) 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, monitoring of two sites ensures that adverse impacts and ecological recovery can be detected before additional dilution occurs downstream, thus providing a suitable baseline 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 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 location 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 environmental monitoring and reporting manager (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the Environmental Monitoring and Reporting Manager reports through a line organization to the Paducah Environmental Remediation Project Manager and provides centralized coordination responsibilities.

### **4.3 TERRESTRIAL ENVIRONMENT**

Woodlands, meadows, and cultivated fields dominate the rural landscape around the DOE reservation. Immediately adjacent to the DOE Reservation is WKWMA, which is used by a considerable number of hunters, trappers, and anglers each year. Hunting and trapping activities may include such wildlife as rabbit, deer, quail, raccoon, squirrel, dove, turkey, waterfowl, and beaver. 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, may 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 Radiological Guide suggests that if wild game, such as deer or game birds, is available locally, these species should be considered for radiological 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 <sup>99</sup>Tc and uranium do not bioaccumulate in milk, the surveillance of milk is not required or recommended by the Radiological Guide and is not performed by the Paducah Site.

##### **4.3.1.2 Food crops**

Food crops are not pathways because 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 radiological analysis. Historical data from reference deer are utilized for background comparisons. Appendix C provides a list of the parameters 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. Opportunistic sampling may occur 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  $^{238}\text{U}$ . Past liquid releases to Little Bayou Creek have resulted in contamination of the sediment, which also contributes to the elevated gamma readings (DOE 2010).

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<sub>6</sub> 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<sub>6</sub> material. Further studies have indicated that the range of the neutrons is such that the neutron dose rate falls off rapidly with distance. Past monitoring has demonstrated that neutron producing radionuclides have not been detected in sufficient quantity to create a significant source for neutron radiation.

The radiological control (RADCON) organization 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. Results from area dose rate monitoring 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 principle 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.

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).

Data comparisons are made yearly 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 Health Branch of the Department for Public Health of the Kentucky Cabinet for Health and Family 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 considered completed 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 450.1A and the *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan* (LATA Kentucky 2010). The objectives of the watershed monitoring program are as follows:

- (1) Determine whether discharges from PGDP and solid waste management units 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 potential human health concerns.

As described in the KPDES permit, the goal of the WMP is to ensure that Bayou Creek and Little Bayou Creek watersheds meet 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* (LATA Kentucky 2010).

#### **4.7.3 Program Implementation Procedures**

The environmental monitoring and reporting manager (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the environmental monitoring and reporting manager reports through a line organization to the Paducah Environmental Remediation Project Manager and provides centralized coordination responsibilities.

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## **5. DOSE CALCULATIONS**

Operations at the Paducah Site may emit waterborne radionuclides and chemicals. After release, these substances disperse through the environment by transport mechanisms where they eventually 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 is 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 3 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 survey was performed in 1990. This survey 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 survey also verified the accumulated data with flyover photographs and through consultation with 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 3. Environmental Transport Mechanisms Applicable to Releases from DOE Operations**

<b>Releases to surface water</b>	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Deposit in sediment Infiltrate to groundwater
<b>Releases to groundwater</b>	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Flow into surface water
<b>Radionuclides in objects</b>	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 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. Cairo is within 50 miles of the Paducah Site, and drinking water concentrations to the population at that location are considered in the dose assessment. Figures 2 and 3 list potential environmental pathways to humans and associated human exposure modes for the release mechanisms given in Table 3. 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. Input data to the models are evaluated using site-specific (collected under the EM and surveillance activities described earlier in this plan), historical data, 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 used to characterize environmental concentrations of radiological 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 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.

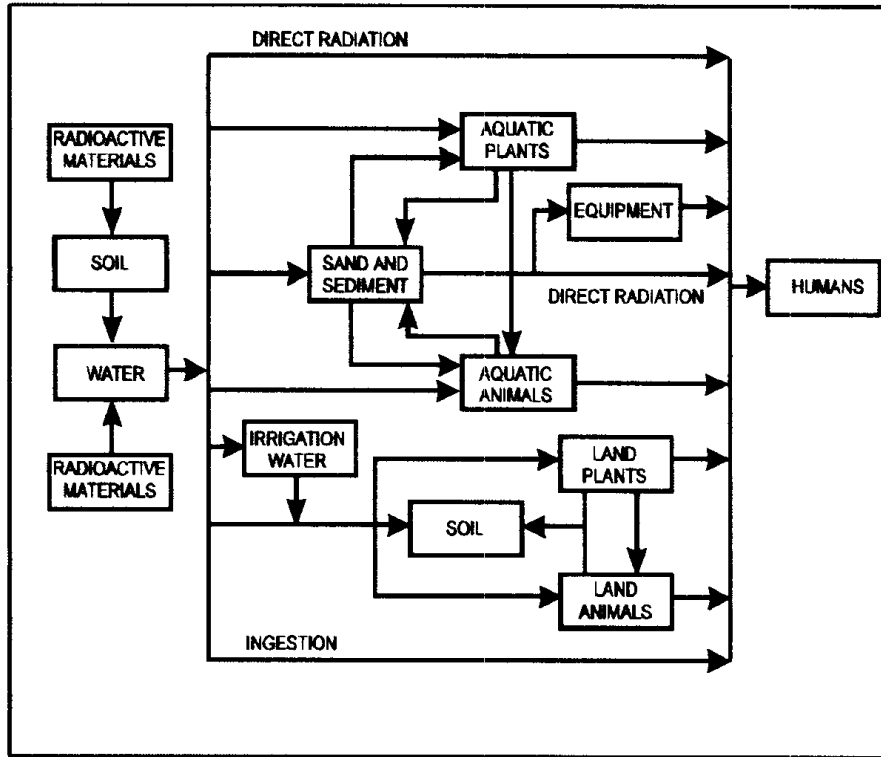


Figure 2. Possible Pathways Between Radioactive Material Released to the Atmosphere and Humans

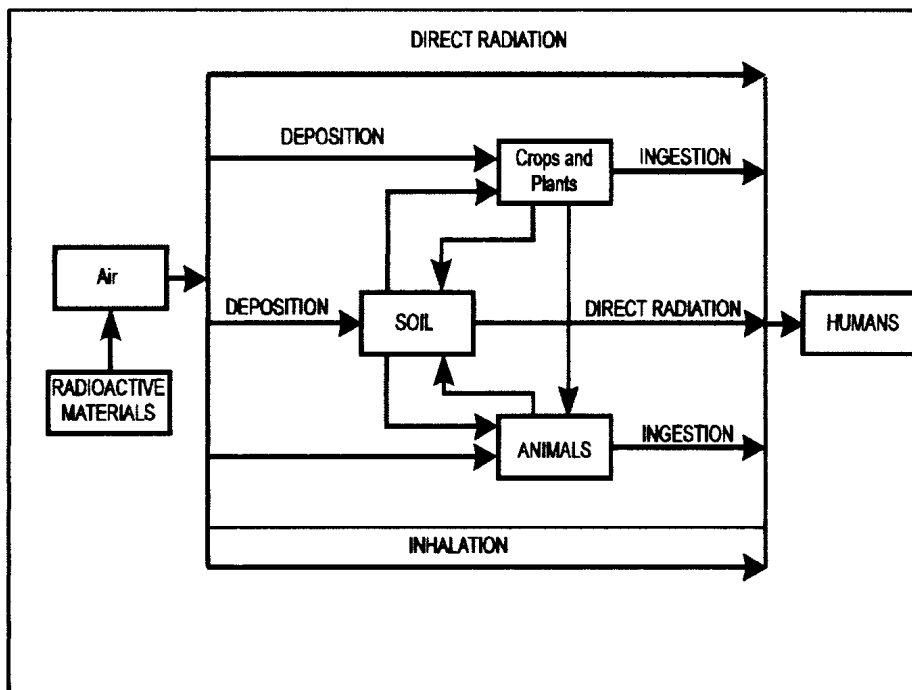


Figure 3. Possible Pathways Between Radioactive Materials Released to the Ground or to Surface Waters and Humans

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, deposited in sediment, deposited on ground or vegetation by irrigation, or may infiltrate to the groundwater.

Quantities of radionuclides and chemicals released to surface waters are determined by sampling upstream and downstream of permitted outfalls in each of the local receiving streams. 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 boundary and the Ohio River historically have used groundwater. Contamination of private wells with both <sup>99</sup>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**

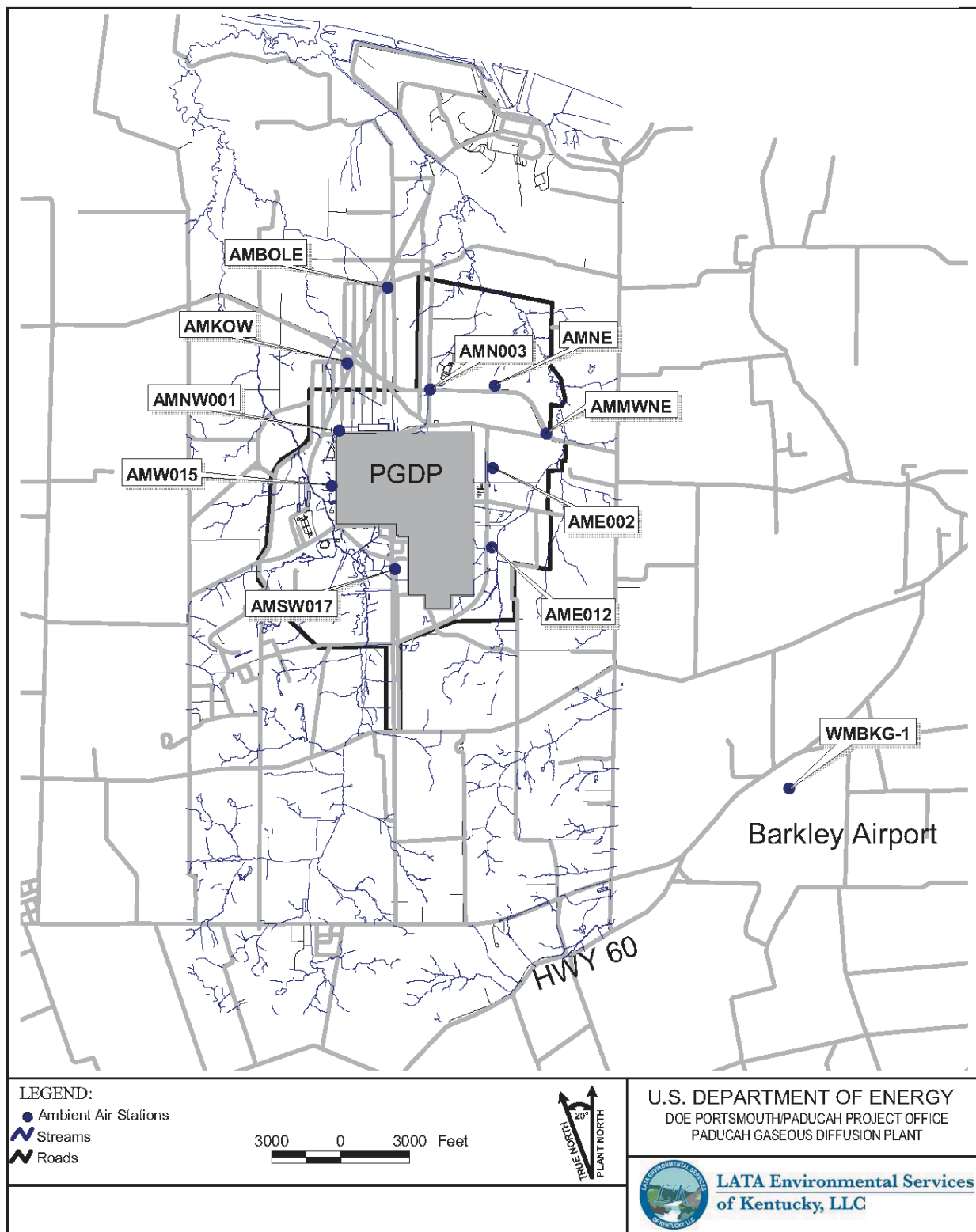
This section describes the methodologies that are used to characterize mechanisms for human uptake and exposure to the radiological contaminant concentrations described in Section 5.3. As in Section 5.3, both modeling and sampling are used to obtain contaminant concentrations in media and foods to which 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 and Family Services to evaluate public exposure to airborne radionuclides. The results of this ambient air monitoring also are used by DOE to demonstrate compliance with state and federal regulations as well as with DOE directives. Figure 4 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 3, 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 are 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





**Figure 4. Paducah Site Ambient Air Monitoring Stations**

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 historical data 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. 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.

External irradiation from contaminated sediment in Little Bayou Creek is a pathway of potential importance. Sediment is known to contain uranium isotopes,  $^{237}\text{Np}$ , and  $^{239}\text{Pu}$ . 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 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 <sup>99</sup>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 estimate 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 1988a); DOE/EH-0071, *Internal Dose Conversion Factors for Calculation of Dose to the Public* (DOE 1988b); and EPA-520/1-88-020, Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion* (EPA 1988). 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 with DOE Order 5400.5 regarding 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 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.” 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 4, 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 ASER also includes the chemicals reported in the Emergency Planning and Right-to-Know Act, Section 312, Hazardous Chemical Inventory.

**Table 4. Applicable Reporting Requirements**

Reporting	Due Date	Source of Requirement	Requirement
Annual Site Environmental Report	October 1	DOE Order 231.1A	All DOE facilities that conduct significant environmental protection programs shall prepare an ASER for DOE. 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 <i>CFR</i> §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 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 KPDES Permit KY0004049.
Annual PCB Document	July 1	40 <i>CFR</i> § 761.180	The Annual PCB Document is required for PCBs in use and PCB wastes.

**Table 4. Applicable Reporting Requirements (Continued)**

<b>Reporting</b>	<b>Due Date</b>	<b>Source of Requirement</b>	<b>Requirement</b>
SARA Section 313	June 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.
SARA Section 312	March 1	SARA Title III	Annual Hazardous Chemical Inventory Report.
C-746-U Landfill Compliance Monitoring Report	Quarterly	401 KAR § 47:130	This report is required in accordance with 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 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 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 Paducah Hazardous Waste Permit KY8-890-008-982.
Watershed Monitoring Report	April 28 Annually	Clean Water Act	Watershed Monitoring is required by KPDES Permit KY0004049.
Environmental Monitoring Plan	October 1 Annually	DOE Order 450.1A	Conduct monitoring as appropriate to support the site's ISMS; 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 evaluate the potential impacts to the biota in the vicinity of DOE activity.
Groundwater Protection Plan	Three Years  August 2013	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 Hazardous Waste Permit KY8-890-008-982.
Best Management Practices Plan	Reviewed Annually, Updated as Needed		This plan is required by KPDES Permit KY0004049.
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.

## 7. REFERENCES

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- DOE (U.S. Department of Energy) 1988a. *External Dose-Rate Conversion Factors for Calculation of Dose to the Public*, DOE/EH-0070, July.
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- 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.
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- DOE 2010. *Paducah Site Annual Environmental Report 2009*, PRS-ENM-0053, 2 Volumes, U.S. Department of Energy, Paducah, KY, October.
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- EPA 1997. *EPA Exposure Factors Handbook*, EPA/600/P-25/002Fa, U.S. Environmental Protection Agency, Washington, DC, August.

- LATA Kentucky (LATA Environmental Services of Kentucky, LLC) 2010. *Bayou Creek and Little Bayou Creek Revised Watershed Monitoring Plan, Paducah Gaseous Diffusion Plant, PAD-PROJ-0003*, LATA Environmental Services of Kentucky, LLC, Kevil, KY, September.
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- NRCC (National Research Council of Canada) 1983. *Radioactivity in the Canadian Aquatic Environment*, Publication No. NRCC 19250, ISSN, 0316-0114.
- PRS (Paducah Remediation Services, LLC) 2010. *Update of the Paducah Gaseous Diffusion Plant Sitewide Groundwater Flow Model*, PRS-ENR-0028, Paducah Gaseous Diffusion Plant Site, Groundwater Modeling Working Group, February.



**APPENDIX A**  
**PADUCAH PERMIT SUMMARY**

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**U.S. DEPARTMENT OF ENERGY PERMIT SUMMARY  
FOR THE  
PADUCAH GASEOUS DIFFUSION PLANT**

Permit Type	Issuer	Expiration Date	Permit Number	Permittee
<b>WATER</b>				
Kentucky Pollutant Discharge Elimination System	Kentucky Division of Water (KDOW)	10/31/2011	KY0004049	Department of Energy (DOE), LATA Environmental Services of Kentucky, LLC, and Uranium Disposition Services, LLC
Permit to Withdraw Public Water	KDOW	NA	1345	DOE <sup>1</sup>
<b>SOLID WASTE</b>				
C-746-S Residential Landfill (Closure)	Kentucky Division of Waste Management (KDWM)	11/04/2016	SW07300014	DOE/LATA Environmental Services of Kentucky, LLC
C-746-T Inert Landfill (Closure)	KDWM	11/04/2016	SW07300015	DOE/LATA Environmental Services of Kentucky, LLC
C-746-U Solid Waste Landfill	KDWM	11/04/2016	SW07300045	DOE/LATA Environmental Services of Kentucky, LLC
<b>RCRA</b>				
Hazardous Waste Facility Operating Permit	KDWM	10/31/2014	KY8-890-008-982	DOE/LATA Environmental Services of Kentucky, LLC

<sup>1</sup> LATA Kentucky has requested inactivation of this permit due to substantive requirements already being addressed by CERCLA action.

**U.S. DEPARTMENT OF ENERGY 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 <sub>6</sub> Management	10/2003	Ongoing	KDWM and DOE

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**APPENDIX B**

**MONITORING WELL PROGRAM INVENTORY**

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## ACRONYMS

400G	C-400 groundwater well
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
GWESA	environmental surveillance annual sampling
GWESBA	environmental surveillance biennial sampling
GWNEQ	groundwater Northeast quarterly
GWNESA	groundwater Northeast Plume semiannual well
GWNWQ	groundwater Northwest Plume O&M Quarterly
GWNWSA	groundwater Northwest Plume O&M semiannually
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
NI	not inspected
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 quarterly, 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
WLSA	water level collected semiannually

<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
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	Q	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



<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
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	NWA
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	GWNWSA	Q	A
MW64	UCRS	Current	NS	Q	A
MW65	RGA	Current	NS	Q	A
MW66	RGA	Current	GWNWSA	Q	A
MW67	RGA	Current	GWESBA, 404G	Q	A
MW68	RGA	Current	NS	Q	A
MW69	UCRS	Current	NS	Q	A
MW70	RGA	AB 94	NA	NA	NA
MW71	RGA	Current	NS	Q	A
MW72	RGA	Current	NS	Q	A
MW73	RGA	Current	NS	Q	A
PZ74	UCRS	Current	NS	Q	A
MW75	UCRS	Current	NS	Q	A
MW76	RGA	Current	GWESBA, 404G	Q	A
MW77	RGA	Current	NS	Q	A
MW78	RGA	Current	NS	Q	A
MW79	RGA	Current	NS	Q	A

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

Monitoring Well Program Inventory					
Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW121	McNairy	Current	NS	Q	A
MW122	McNairy	Current	NS	Q	A
MW123	RGA	Current	NS	Q	A
MW124	RGA	Current	GWNESEA	NS	A
MW125	RGA	Current	GWESBA, GC	Q	A
MW126	RGA	Current	GWNESEA	Q	A
MW127	UCRS	AB-IP	NA	NA	NA
MW128	UCRS	AB-IP	NA	NA	NA
MW129	Terrace	AB-IP	NA	NA	NA
MW130	Terrace	AB-IP	NA	NA	NA
MW131	Terrace	AB-IP	NA	NA	NA
MW132	RGA	Current	NS	Q	A
MW133	McNairy	Current	NS	Q	A
MW134	RGA	Current	GWESBA, GC	Q	A
MW135	RGA	Current	GWESBA	Q	A
MW136	UCRS	AB	NA	NA	NA
MW137	RGA	Current	NS	Q	A
MW138	UCRS	Current	NS	Q	A
MW139	RGA	Current	GWESBA	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	Q	A
MW145	RGA	Current	GWNESEA, GC	Q	A
MW146	RGA	Current	GWESBA	Q	A
MW147	RGA	Current	NS	Q	A
MW148	RGA	Current	GWESBA	Q	A
MW149	UCRS	Current	GWESBA	Q	A
MW150	RGA	Current	GWESA	Q	A
MW151	Terrace	Current	NS	Q	A
MW152	RGA	Current	GWESA, GC	Q	A
MW153	UCRS	Current	NS	Q	A
MW154	UCRS	Current	NS	Q	A
MW155	RGA	Current	GWESBA	NS	A
MW156	RGA	Current	GWESBA	Q	A
MW157	UCRS	Current	NS	Q	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	GWESA, GC	Q	A
MW162	UCRS	Current	NS	Q	A
MW163	RGA	Current	GWESBA, GC	Q	A

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

Monitoring Well Program Inventory					
Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW207	UCRS	Current	NS	Q	A
MW208	UCRS	Current	NS	Q	A
MW209	UCRS	Current	NS	Q	A
MW210	UCRS	Current	NS	Q	A
MW211	UCRS	Current	NS	Q	A
MW212	UCRS	Current	NS	Q	A
MW213	UCRS	Current	NS	Q	A
MW214	UCRS	Current	NS	Q	A
MW215	UCRS	Current	NS	Q	A
MW216	UCRS	Current	NS	Q	A
MW217	UCRS	Current	NS	Q	A
MW218	UCRS	Current	NS	Q	A
MW219	UCRS	Current	NS	Q	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	GWESBA, 404G	Q	A
MW227	RGA	Current	GWESBA, 404G	Q	A
EW228	RGA	NA	NA	Q	NR
EW229	RGA	NA	NA	Q	NR
EW230	RGA	NA	NA	Q	NR
EW231	RGA	NA	NA	NA	NR
EW 232	RGA	Current	NA	NA	NR
EW233	RGA	Current	NA	NA	NR
232, Not Installed	NA	NA	NA	NA	NA
MW233	RGA	Current	GWESA	Q	A
MW234	RGA	AB 2002	NA	NA	NA
MW235	RGA	AB 2002	NA	NA	NA
MW236	RGA	Current	GWESA	Q	A
MW237	UCRS	Current	NS	Q	A
MW238	RGA	Current	NS	Q	A
MW239	McNairy	Current	NS	Q	A
MW240	RGA	Current	GWESA	Q	A
MW241	RGA	AB 2003	NA	NA	NA
MW241A	RGA	Current	NS	Q	A
MW242	RGA	Current	GWNWQ, GC	Q	A
MW243	RGA	Current	GWNWQ, GC	Q	A
MW244	RGA	Current	GWNWQ	Q	A
MW245	RGA	Current	GWNWQ	Q	A
MW246	UCRS	Current	NS	Q	A

<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
MW247	McNairy	Current	NS	Q	A
MW248	RGA	Current	GWNWQ	Q/2*	A
MW249	RGA	Current	NS	Q	A
MW250	RGA	Current	GWNWQ	Q/2*	A
PZ251	UCRS	Current	NS	Q	A
MW252	RGA	Current	GWESA	Q	A
MW253	RGA	Current	GWESA	Q	A
254, Not Installed	NA	NA	NA	NA	NA
MW255	RGA	Current	GWNEQ GC	Q	A
MW256	RGA	Current	GWNEQ, GC	Q	A
MW257	RGA	Current	GC	Q	A
MW258	RGA	Current	GWNEQ, GC	Q	A
259, Not Installed	NA	NA	NA	NA	NA
MW260	RGA	Current	GWESBA, GC	Q	A
MW261	RGA	Current	GWESA, GC	Q	A
MW262	RGA	Current	GWESBA	Q	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	Q	A
285, Not Installed	NA	NA	NA	NA	NA
286, Not Installed	NA	NA	NA	NA	NA
PZ287	RGA	Current	NS	Q	A
MW288	RGA	Current	GWNEQ, GC	Q	A
PZ289	RGA	Current	NS	Q	A

<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
PZ290	RGA	Current	NS	Q	A
MW291	RGA	Current	GWNEQA, GC	Q	A
MW292	RGA	Current	GWNEQ, GC	Q	A
MW293	RGA	AB 2003	NA	NA	NA
MW293A	RGA	Current	GWNEQA	Q	A
MW294	RGA	AB 2003	NA	NA	NA
MW294A	RGA	Current	NS	Q	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	Current	KG	Q	A
MW301	Terrace	Current	KG	Q	A
MW302	Terrace	Current	KG	Q	A
MW303	Terrace	AB 94	NA	NA	NA
MW304	Terrace	Current	NS	Q	A
MW305	Eocene	Current	GWESBA	Q	A
MW306	Eocene	Current	NS	Q	A
MW307	Eocene	Current	NS	Q	A
MW308	Eocene	Current	NS	Q	A
MW309	Terrace	Current	NS	Q	A
MW310	Terrace	Current	NS	Q	A
MW311	Terrace	Current	NS	Q	A
MW312	UCRS	Current	NS	Q	A
MW313	UCRS	Current	NS	Q	A
MW314	UCRS	Current	NS	Q	A
MW315	UCRS	Current	NS	Q	A
MW316	UCRS	Current	NS	Q	A
MW317	Terrace	Current	NS	Q	A
MW318	Terrace Gravels	Current	NS	Q	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	Q	A
MW326	RGA	Current	NS	Q	A
MW327	RGA	Current	NS	Q	A
MW328	RGA	Current	GWESBA, GC	Q	A
MW329	RGA	Current	GWESBA, GC	Q	A

<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
MW330	RGA	Current	NS	Q	A
EW331	RGA	NA	NA	NA	NR
EW332	RGA	NA	NA	NA	NR
MW333	RGA	Current	GWESBA, 404G, GC	Q	A
PZ334	UCRS	Current	NS	Q	A
PZ335	UCRS	Current	NS	Q	A
PZ336	UCRS	Current	NS	Q	A
MW337	RGA	Current	GWESBA, 404G	Q	A
MW338	RGA	Current	GWESBA, 404G	Q	A
MW339	RGA	Current	GWNWSA, GC	Q	A
MW340	RGA	Current	GWNWSA	Q	A
MW341	RGA	Current	GWESBA	Q	A
MW342	RGA	Current	400G	Q	A
MW343	RGA	Current	GWESBA,400G, GC	Q	A
MW344	Terrace	Current	KG	Q	A
MW345	Rubble Zone	Current	GWESA	Q	A
MW346	Rubble Zone	Current	NS	Q	A
MW347	Rubble Zone	Current	NS	Q	A
PZ348	UCRS	Current	NS	Q	A
PZ349	RGA	Current	NS	Q	A
PZ350	UCRS	Current	NS	Q	A
PZ351	RGA	Current	NS	Q	A
MW352	RGA	AB 2002	NA	NA	NA
MW353	RGA	Current	NS	Q	A
MW354	RGA	Current	GWESBA	Q	A
MW355	RGA	Current	GWNWSA	Q	A
MW356	RGA	Current	GWESBA	Q	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



<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
MW373	LRGA	Current	UG/SG	Q	A
MW374	UCRS	Current	UG	Q	A
MW375	URGA	Current	UG	Q	A
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	NS	Q	A
MW381	RGA	Current	, GC	Q	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	Q	A
MW402	RGA	Current	NS	Q	A
MW403	RGA	Current	GWESBA, GC	Q	A
MW404	RGA	Current	GWESBA, GC	Q	A
MW405	RGA	Current	GWESBA	Q	A
MW406	RGA	Current	GWESBA	Q	A
MW407	RGA	Current	GWESBA	Q	A
MW408	RGA	Current	GWESBA	Q	A
MW409	RGA	Current	GWESA, GC	Q	A
MW410	RGA	Current	GWESA	Q	A
MW411	RGA	Current	GWESA	Q	A
412, Not Installed	NA	NA	NA	NA	NA
413, Not Installed	NA	NA	NA	NA	NA
MW414	RGA	Current	GWESBA, GC	Q	A
MW415	RGA	Current	GWESBA	Q	A

<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
MW416	RGA	Current	GWESBA	Q	A
MW417	RGA	Current	GWESBA	Q	A
MW418	RGA	Current	GWESA	Q	A
MW419	RGA	Current	GWESA	Q	A
MW420	URGA	Current	404G	Q	A
MW421	RGA	Current	400G	Q	A
MW422	RGA	Current	400G	Q	A
MW423	RGA	Current	400G	Q	A
MW424	RGA	Current	400G	Q	A
MW425	RGA	Current	400G	Q	A
MW426	RGA	Current	GWESBA, GC	Q	A
MW427	RGA	Current	GWESBA, GC	Q	A
MW428	RGA	Current	GWNWSA	Q	A
MW429	RGA	AB 2009	NA	NA	NA
MW429 A	RGA	Current	GWNWSA	Q	A
MW430	RGA	Current	GWNWSA	Q	A
MW431	RGA	Current	GWESBA	Q	A
MW432	RGA	Current	GWESBA	Q	A
MW433	RGA	Current	GWESBA	Q	A
MW434	RGA	Planned	GWESBA	Q	A
MW435	RGA	Current	GWESBA	Q	A
MW436	RGA	Planned	GWESBA	Q	A
MW437	RGA	Planned	GWESBA	Q	A
MW438	RGA	Planned	GWESBA	Q	A
MW439	RGA	Current	GWESBA, GC	Q	A
MW440	RGA	Current	GWESBA	Q	A
MW441	RGA	Current	GWESBA, GC	Q	A
MW442	RGA	Current	GWESBA	Q	A
MW443	RGA	Current	GWESBA	Q	A
MW444	RGA	Current	GWESBA	Q	A
MW445	RGA	Current	GWESBA	Q	A
MW446	RGA	Planned	GWESBA	Q	A
MW447	RGA	Current	GWESBA, GC	Q	A
MW448	RGA	Current	GWESBA	Q	A
MW449	RGA	Planned	GWESBA	Q	A
MW450	RGA	Current	GWESBA	Q	A
MW451	RGA	Current	GWESBA	Q	A
MW452	RGA	Current	GWESBA	Q	A
MW453	RGA	Current	GWESBA	Q	A
MW454	RGA	Current	GWESBA	Q	A
MW455	RGA	Current	GWNWQ	Q	A
MW456	RGA	Current	GWNWQ	Q	A
MW457	RGA	Current	GWNWQ	Q	A

<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
MW458	RGA	Current	GWNWQ	Q	A
MW459	RGA	Current	GWNWQ	Q	A
MW460	RGA	Current	GWNWQ	Q	A
MW461	RGA	Current	GWNWQ	Q	A
MW462	RGA	Current	GWNWQ	Q	A
MW463	RGA	Current	GWESBA	Q	A
MW464	RGA	Current	GWESBA	Q	A
MW465	RGA	Current	GWESA	Q	A
MW466	RGA	Current	GWESA	Q	A
MW467	RGA	Current	GWESBA	Q	A
MW468	RGA	Current	GWESBA, GC	Q	A
MW469	RGA	Current	GWESA	Q	A
MW470	RGA	Current	GWESA	Q	A
MW471	RGA	Current	GWESBA	Q	A
MW472	RGA	Current	GWESBA	Q	A
MW473	RGA	Current	GWESBA, GC	Q	A
MW474	RGA	Current	GWESBA, GC	Q	A
MW475	RGA	Current	GWESBA	Q	A
MW476	RGA	Current	GWESBA	Q	A
MW477	RGA	Current	GWESBA	Q	A
MW478	RGA	Current	GWESBA	Q	A
MW479	RGA	Current	GWESBA	Q	A
MW480	RGA	Current	GWESBA	Q	A
MW481	RGA	Current	GWESBA	Q	A
MW482	RGA	Current	GWESBA	Q	A
MW483	RGA	Current	GWESBA	Q	A
MW484	RGA	Current	GWESBA	Q	A
MW485	RGA	Current	GWESBA	Q	A
MW486	RGA	Current	GWESBA	Q	A
MW487	RGA	Current	GWESBA	Q	A
MW488	RGA	Current	GWESBA	Q	A
MW489	RGA	Current	GWESBA	Q	A
MW490	RGA	Current	GWESBA, GC	Q	A
MW491	RGA	Current	GWESBA	Q	A
MW492	RGA	Current	GWESBA	Q	A
MW493	RGA	Current	GWESBA	Q	A
MW494	RGA	Current	GWESBA	Q	A
MW495	RGA	Current	GWESBA	Q	A
MW496	RGA	Current	GWESBA	Q	A
MW497	URGA	Current	GWNWQ	Q	A
MW498	LRGA	Current	GWNWQ	Q	A
MW499	URGA	Current	GWNWQ	Q	A
MW500	LRGA	Current	GWNWQ	Q	A

Monitoring Well Program Inventory					
Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW501	URGA	Current	GWNWQ	Q	A
MW502	LRGA	Current	GWNWQ	Q	A
MW503	URGA	Current	GWNWQ	Q	A
MW504	LRGA	Current	GWNWQ	Q	A
PZ5G	Unknown	Current	NS	Q	A
PZ5S	Unknown	Current	NS	Q	A
Z12	Unknown	Current	NS	Q	A
Z16	Unknown	Current	NS	Q	A
CM01	PTZ Project	Current	NS	Q	A
CM02	PTZ Project	Current	NS	Q	A
CM03	PTZ Project	Current	NS	Q	A
CM04	PTZ Project	Current	NS	Q	A
CM05	PTZ Project	Current	NS	Q	A
CM06	PTZ Project	Current	NS	Q	A
CM07	PTZ Project	Current	NS	Q	A
CM08	PTZ Project	Current	NS	Q	A
CM09	PTZ Project	Current	NS	Q	A
CM10	PTZ Project	Current	NS	Q	A
CM11	PTZ Project	Current	NS	Q	A
CM12	PTZ Project	Current	NS	Q	A
R2	Unknown	Current	GWRESA	NS	A <sup>2</sup>
R5	Unknown	Current	NS	NS	A <sup>2</sup>
R9	Unknown	Current	GWRESA	NS	A <sup>2,4</sup>
R10	Unknown	Current	NS	NS	A <sup>2</sup>
R12	Unknown	Current	GWRESA	NS	A <sup>2</sup>
R13	Unknown	Current	GWRESA	NS	A <sup>2,4</sup>
R14	Unknown	Current	GWRESA	NS	A <sup>2,4</sup>
R16	Unknown	Current	NS	NS	A <sup>2</sup>
R17	Unknown	Current	NS	NS	NI <sup>1</sup>
R18	Unknown	Current	NS	NS	NI <sup>1</sup>
R19	Unknown	Current	GWRESA	NS	A <sup>2</sup>
R20	RGA	Current	GWRESA	NS	A <sup>2</sup>
R21	Unknown	Current	GWRESA	NS	A <sup>2</sup>
R22	Unknown	Current	NS	NS	A <sup>2</sup>
R23	Unknown	Current	NS	NS	A <sup>2</sup>
R24	Unknown	Current	NS	NS	NI <sup>1</sup>
R25 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>
R27	Unknown	Current	NS	NS	A <sup>2</sup>
R28	Unknown	Current	NS	NS	A <sup>2</sup>
R31	Unknown	Current	NS	NS	A <sup>2,4</sup>
R39	Unknown	Current	NS	NS	A <sup>2</sup>
R40	Unknown	Current	NS	NS	A <sup>2</sup>
R53 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>

Monitoring Well Program Inventory					
Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
R65	Unknown	Current	NS	NS	A <sup>2</sup>
R68	Unknown	Current	NS	NS	A <sup>2</sup>
R69 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>
R72	Unknown	Current	NS	NS	NI <sup>1</sup>
R82	Unknown	Current	NS	NS	NI <sup>1</sup>
R83	Unknown	Current	GWRESA	NS	A <sup>2</sup>
R90	Unknown	Current	GWRESA	NS	A <sup>2,4</sup>
R113	Unknown	Current	NS	NS	A <sup>2</sup>
R114	Unknown	Current	GWRESA	NS	A <sup>2,4</sup>
R245	Unknown	Current	NS	NS	A <sup>2,4</sup>
R246 <sup>1</sup>	Unknown	Current	NS	NS	NI <sup>1</sup>
R278	Unknown	Current	NS	NS	A <sup>2</sup>
R293	Unknown	Current	NS	NS	A <sup>2</sup>
R294	RGA	Current	GWRESM	NS	A <sup>2</sup>
R295	Unknown	Current	NS	NS	A <sup>2</sup>
R297	Unknown	Current	NS	NS	A <sup>2</sup>
R278	Unknown	Current	NS	NS	A <sup>2</sup>
R299	Unknown	Current	NS	NS	A <sup>2</sup>
R302	RGA	Current	GWRESM	NS	A <sup>2</sup>
R381	Unknown	Current	NS	NS	NI <sup>1</sup>
R382	Unknown	Current	NS	NS	NI <sup>1</sup>
R384	RGA	Current	GWRESA	NS	NI <sup>1</sup>
R386	Unknown	Current	NS	NS	A <sup>2,4</sup>
R387	RGA	Current	GWRESA	NS	A <sup>2,4</sup>
R392	RGA	Current	GWRESA	NS	A <sup>2,4</sup>
R424	RGA	Current	CARB	NS	NI <sup>1</sup>
R434	Unknown	Current	NS	NS	NI <sup>1</sup>
R512	Unknown	Current	NS	NS	NI <sup>1</sup>
R517 <sup>3</sup>	Unknown	Current	NS	NS	NI <sup>1</sup>
R518 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>
R519	Unknown	Current	NS	NS	A <sup>2</sup>
R520	Unknown	Current	NS	NS	A <sup>2</sup>
R521	Unknown	Current	NS	NS	A <sup>2</sup>
R522	Unknown	Current	NS	NS	A <sup>2</sup>
R523	Unknown	Current	NS	NS	A <sup>2</sup>
R524	Unknown	Current	NS	NS	A <sup>2</sup>
R525 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>
R527	Unknown	Current	NS	NS	A <sup>2</sup>
R528 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>
R529	Unknown	Current	NS	NS	A <sup>2</sup>
R530 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>
R531 <sup>3</sup>	Unknown	Current	NS	NS	A <sup>2</sup>

<b>Monitoring Well Program Inventory</b>					
<b>Well Number</b>	<b>Screened Zone</b>	<b>Status</b>	<b>Sampled</b>	<b>Water Level</b>	<b>Inspection</b>
R532	Unknown	Current	NS	NS	A <sup>2</sup>
R533	Unknown	Current	NS	NS	A <sup>2</sup>
R534	Unknown	Current	NS	NS	A <sup>2</sup>
R537	Unknown	Current	NS	NS	A <sup>2</sup>
R540	Unknown	Current	NS	NS	A <sup>2</sup>
R541	Unknown	Current	NS	NS	A <sup>2</sup>

<sup>1</sup> No current License Agreement with resident; no access to property.

<sup>2</sup> Wells will be inspected once each five years in conjunction with the renewal of the License Agreement, if any.

<sup>3</sup> Wells no longer accessible for inspection (e.g., owner has paved over, etc.)

<sup>4</sup> License Agreement being negotiated for renewals in fiscal year 2011.

**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. Noncommitment wells are those wells which are also measured within that time period, but the data is for information purposes only.

<b>C-404 Landfill<sup>1</sup> Quarterly Water Levels (9) Permitted Wells</b>	<b>C-746-U Landfill Quarterly Water Levels (21) Permitted Wells</b>	<b>C-746-S&amp;T Landfill Quarterly Water Levels (25) Permitted Wells</b>
MW84	MW357	MW368
MW87	MW358	MW369 <sup>2</sup>
MW90A	MW359	MW370 <sup>2</sup>
MW85	MW360	MW371
MW88	MW361	MW372 <sup>2</sup>
MW91	MW362	MW373 <sup>2</sup>
MW93	MW363	MW374
MW420	MW364	MW375
MW94	MW365	MW376
	MW366	MW377
	MW367	MW220
		MW221
		MW222
		MW223
		MW224
		MW225 <sup>3</sup>
		MW353 <sup>3</sup>
		MW384
		MW385
		MW386
		MW387
		MW388
		MW389
		MW390
		MW391
		MW392
		MW393
		MW394
		MW395
		MW396
		MW397
		MW369 <sup>2</sup>
		MW370 <sup>2</sup>
		MW372 <sup>2</sup>
		MW373 <sup>2</sup>
		<b>Noncommitment Wells (2)</b>
		MW418
		MW419

<sup>1</sup> 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.

<sup>2</sup> Wells are cited in both the C-746-U Landfill permit, as well as the C-746-S&T Landfill permit.

<sup>3</sup> Based on the approved permit on for the C-746-S&T Landfill, these two wells are permitted wells; however, only for water level measurements.

<sup>4</sup> These wells are also sampled under the Northwest Plume Program.

## **OTHER WATER LEVELS COLLECTED**

Water levels are collected quarterly for all other current wells as listed in the Monitoring Well Program Inventory table.



**APPENDIX C**  
**ENVIRONMENTAL SAMPLING FREQUENCY**  
**AND PARAMETERS**

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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
EMP	Environmental Monitoring Plan
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FY	fiscal year
GWPP	Groundwater Protection Program
IRA	interim remedial action
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
RGA	Regional Gravel Aquifer
ROD	Record of Decision
TLD	thermoluminescent dosimeter
WAG	waste area grouping
WKWMA	West Kentucky Wildlife Management Area

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## C.1. INTRODUCTION

A total of 368 monitoring wells are active and monitored under various sampling programs (see Figure C.1). This appendix includes a summary of each sampling program. Each summary includes the environmental sampling frequencies and parameters, the sampling drivers, rationale for conducting the sampling, which document (s) the sampling results are reported in, and a list of wells that are sampled.

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 monitoring well (MW) results and long-term trends,
- Analyses to determine if the MW meets the current and future objective of the Groundwater Protection Plan (GWPP), and
- Addition of new MWs that may eliminate the need for sampling older MWs.

A brief summary of changes that have been made from the fiscal year (FY) 2010 to the FY 2011 EMP is included in each sampling program section. The changes described in this appendix were made using the criteria listed above. Sampling frequencies and sampling parameters were not modified for any sampling program that is driven by a permit or collected as a result of a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) decision document. The only exception to this was in cases where a permit condition allowed for the sampling to be modified or deleted [i.e., Kentucky Pollutant Discharge Elimination System (KPDES) Permit]. Data collected under these sampling programs will be evaluated in FY 2011 and, based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification or via modification of the appropriate driver and reflected in the FY 2012 Environmental Monitoring Plan (EMP).

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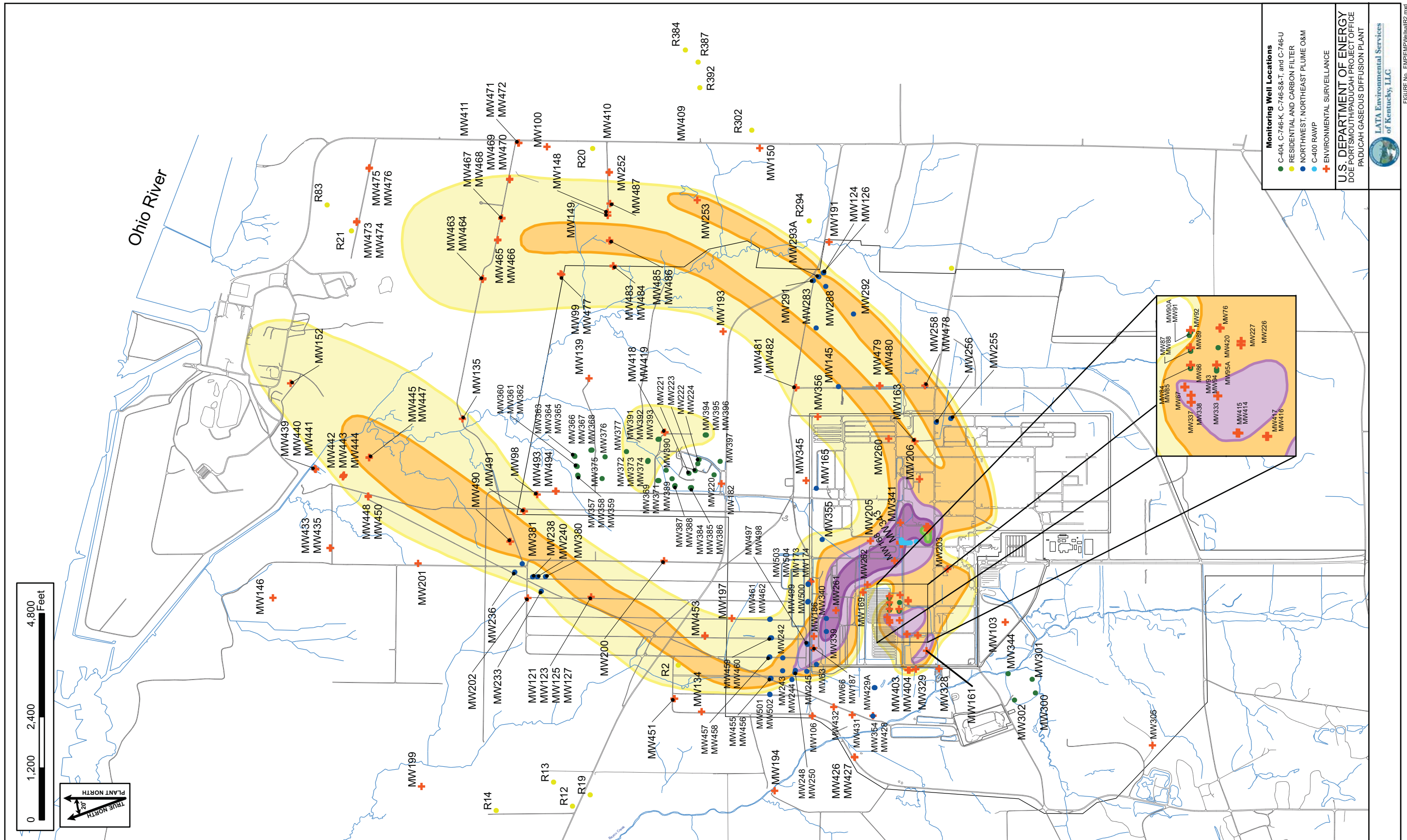


Figure C.1. Monitoring Wells Sampled Under the EMP

FIGURE No. EMP/EMP/WellMapR2.mxd  
DATE 12-13-2010

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## C.2. GROUNDWATER MONITORING

The Paducah Site samples individual monitoring and residential wells on a routine basis. Additionally, MWs are monitored for water levels on a routine basis. The environmental monitoring and reporting manager 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 environmental monitoring and reporting manager until all deficiencies have been corrected.

Of the 73 new MWs that were installed during FY 2009 and 2010, 54 of these wells have been added to the Environmental Surveillance Program and 19 have been moved to the Northwest Plume Sampling Program.

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*, PAD-PROJ-0025, outlines the MW evaluation and rehabilitation methods. Maintenance activities are documented and maintained by the environmental monitoring and reporting manager.

### 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 [401 *KAR* 48:300 Section 7].”

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 [401 *KAR* 48:300 Section 7].”

**Comments:** The current Solid Waste Landfill permits were received on August 2, 2010, for the C-746-S&T and C-746-U Landfills. Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2011, as it is permit driven. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification and reflected in the FY 2012 EMP.

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.2.

**Table C.1. C-746-S and C-746-T Landfill Wells (23)<sup>1</sup>**

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.

<sup>1</sup> The total number of permitted wells associated with the C-746-S&T Landfill is 25; however, two of these wells (MW225, MW353) 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**

<b>Volatiles</b>	<b>Anions</b>	<b>Field Parameters</b>
1,1,1,2-Tetrachloroethane	Bromide	Conductivity
1,1,1-Trichloroethane	Chloride	Depth to Water
1,1,2,2-Tetrachloroethane	Fluoride	Dissolved Oxygen
1,1,2-Trichloroethane	Nitrate as Nitrogen	Eh
1,1-Dichloroethane	Sulfate	pH
1,1-Dichloroethene		Temperature
1,2,3-Trichloropropane	<b>Metals</b>	Turbidity
1,2-Dibromo-3-chloropropane	Aluminum	<b>PCBs**</b>
1,2-Dibromoethane	Antimony	PCB, Total
1,2-Dichlorobenzene	Arsenic	PCB-1016
1,2-Dichloroethane	Barium	PCB-1221
1,2-Dichloropropane	Beryllium	PCB-1232
1,4-Dichlorobenzene	Boron	PCB-1242
2-Butanone	Cadmium	PCB-1248
2-Hexanone	Calcium	PCB-1254
4-Methyl-2-pentanone	Chromium	PCB-1260
Acetone	Cobalt	PCB-1268
Acrolein	Copper	
Acrylonitrile	Iodide	<b>Radionuclides</b>
Benzene	Iron	Alpha Activity
Bromochloromethane	Lead	Beta activity
Bromodichloromethane	Magnesium	Iodine-131
Bromoform	Manganese	Radium-226
Bromomethane	Mercury	Radium-228***
Carbon Disulfide	Molybdenum	Strontium-90
Carbon Tetrachloride	Nickel	Technetium-99
Chlorobenzene	Potassium	Thorium-230
Chloroethane	Rhodium	Thorium-232***
Chloroform	Selenium	Tritium
Chloromethane	Silver	
<i>cis</i> -1,2-Dichloroethene	Sodium	
<i>cis</i> -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	<b>Miscellaneous</b>	
<i>trans</i> -1,2-Dichloroethene	Chemical Oxygen Demand	
<i>trans</i> -1,3-Dichloropropene	Cyanide	
<i>trans</i> -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.

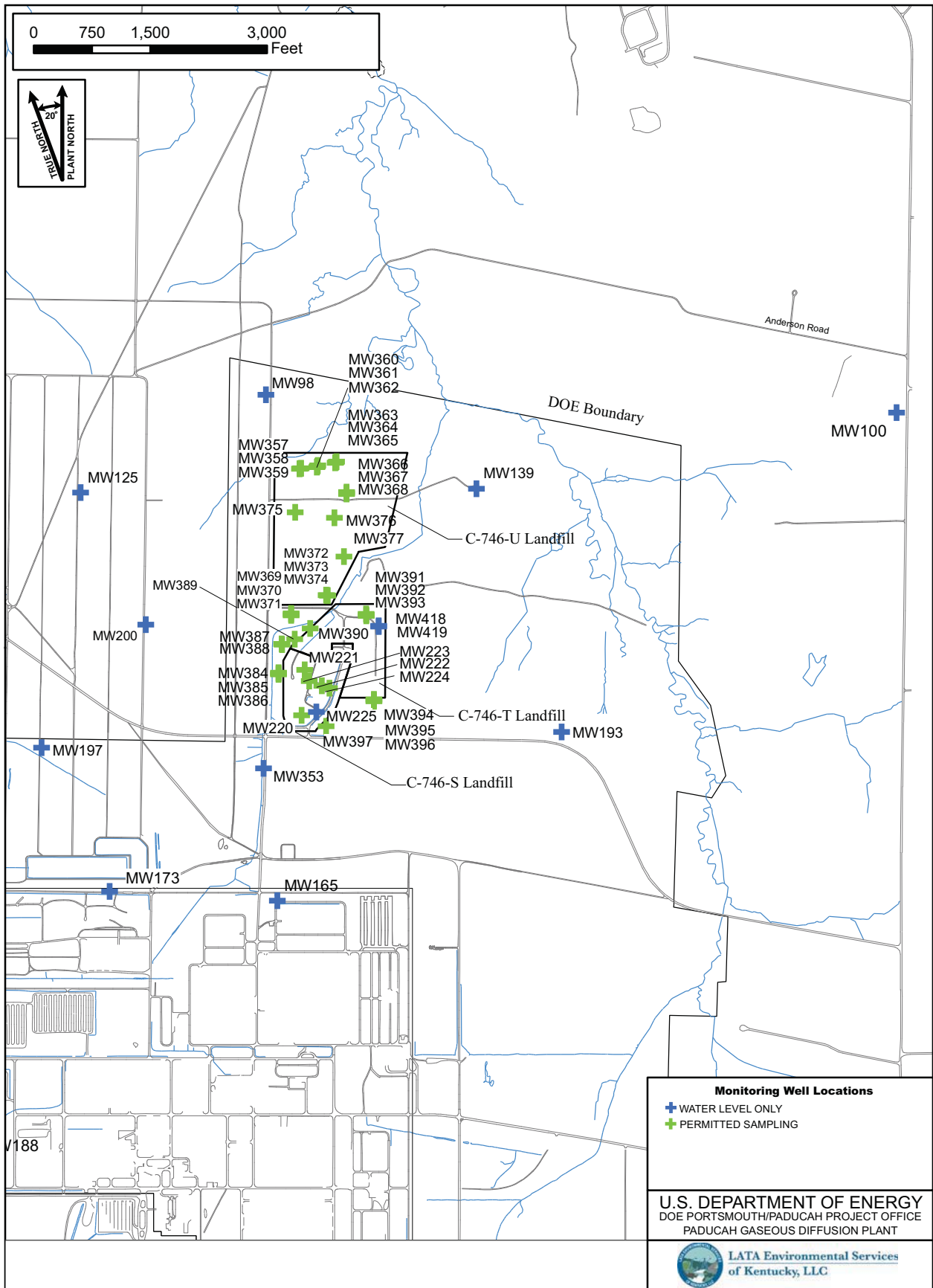


FIGURE No. EMPIEMPWellsSTU\_2011R0.mxd  
 DATE 09-20-2010

Figure C.2. 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 Hazardous Waste Facility 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.

Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2011, as it is permit driven. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification and reflected in FY 2012 EMP.

A listing of monitoring wells for C-404 Landfill is presented in Table C.4 and the analytical parameters are presented in Table C.5. Locations are shown on Figure C.3.

**Table C.4. C-404 Landfill Wells**

<b>C-404 Landfill Wells (9)</b>	<b>Option Noncommitted (10)<sup>1</sup> TCE, <sup>99</sup>Tc, and Depth of Water Only</b>
MW84	MW67
MW85	MW76
MW87	MW86
MW88	MW92
MW90A	MW95A
MW91	MW226
MW93	MW227
MW94	MW333
MW420	MW337
	MW338

<sup>1</sup> MWs 414 and 416 are also part of this special sampling event; however, only depth to water measurements are collected for these two wells.

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

<b>Volatiles</b>	<b>Field Parameters</b>
Trichloroethene	Barometric Pressure
	Conductivity
	Depth to water
	Dissolved Oxygen
	Eh
	pH
	Temperature
	Turbidity
	<b>Radionuclides</b>
	Technetium-99
	Uranium-234
	Uranium-235
	Uranium-238
	<b>Other</b>
	Sulfide
	Sulfite
	Sulfate
	Total Organic Carbon

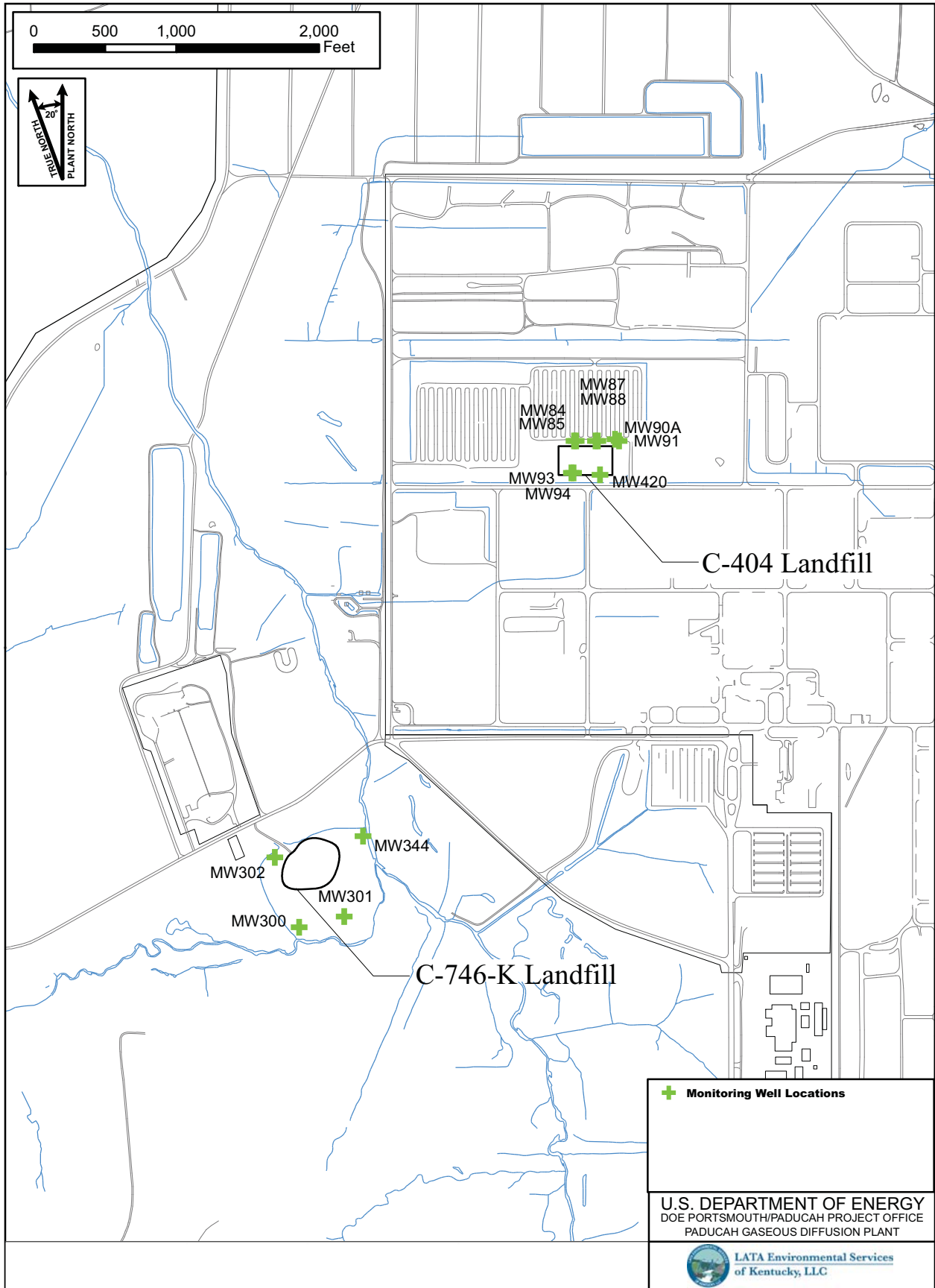


FIGURE No. EMP\EMPWells404K\_2011R0.mxd  
DATE 09-20-2010

Figure C.3. Groundwater Monitoring Wells Near C-404 and C-746-K Landfills

**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 Groupings (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 EMP.

**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.

Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, they will be proposed and reflected in FY 2012 EMP.

Tables C.6 and C.7 provide a listing of landfill wells and analytical parameters, respectively. Locations are shown on Figure C.3.

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

---

MW300
MW301
MW302
MW344

---

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

<b>Volatiles</b>	<b>Metals</b>
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
<i>cis</i> -1,2-Dichloroethene	Beryllium
Dimethylbenzene, Total*	Cadmium
Ethylbenzene	Calcium
Tetrachloroethene	Iron
Toluene	Lead
<i>trans</i> -1,2-Dichloroethene	Magnesium
Trichloroethene	Manganese
Vinyl Chloride	Nickel
	Potassium
	Sodium
	Uranium
<b>Field Parameters</b>	
Conductivity	
Barometric Pressure	
Depth to water	
Dissolved Oxygen	
pH	
Temperature	
Turbidity	
Eh	
	<b>Radionuclides</b>
	Alpha Activity
	Beta Activity
	Technetium-99
	<b>Anions</b>
	Chloride
	Sulfate
	Nitrate
<b>Other</b>	
Alkalinity	
Ferrous Iron (Fe <sup>+2</sup> )	

\*Xylenes

## C.2.2 NORTHEAST PLUME OPERATIONS AND MAINTENANCE PROGRAM

### Northeast Plume Monitoring

**Frequency:** Quarterly and Semiannually

**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.

Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, they will be included in the FY 2012 EMP.

Table C.8 provides a listing of Northeast Plume wells sampled semiannually and the associated parameters. Table C.9 provides a listing of Northeast Plume wells sampled quarterly and the associated parameters. Locations are shown on Figure C.4.

**Table C.8. Northeast Plume Semiannual Wells and Parameters**

Semiannual Wells (11)	Semiannual Analytical Parameters	
MW124	<b>Volatiles</b>	<b>Radionuclides</b>
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	<b>Field Parameters</b>
MW283	Benzene	Barometric Pressure
MW288	Bromodichloromethane	Conductivity
MW291	Carbon Tetrachloride	Depth to water
MW292	Chloroform	Dissolved Oxygen
MW293A	<i>cis</i> -1,2-Dichloroethene	pH
	Dimethylbenzene, Total/Xylenes	Temperature
	Ethylbenzene	Turbidity
	Tetrachloroethene	Eh
	Toluene	
	<i>trans</i> -1,2-Dichloroethene	
	Trichloroethene	
	Vinyl Chloride	



**Table C.9. Northeast Plume Quarterly Wells and Parameters\***

<b>Quarterly Wells (5)</b>	<b>Quarterly Analytical Parameters</b>
MW255	<b>Radionuclides</b>
MW256	Technetium-99
MW258	
MW288	<b>Field Parameters</b>
MW292	Conductivity
	Depth to water
	Dissolved Oxygen
	pH
	Temperature
	Turbidity

\* Sample MW409, MW410, MW411 at the same time for FY 2011.

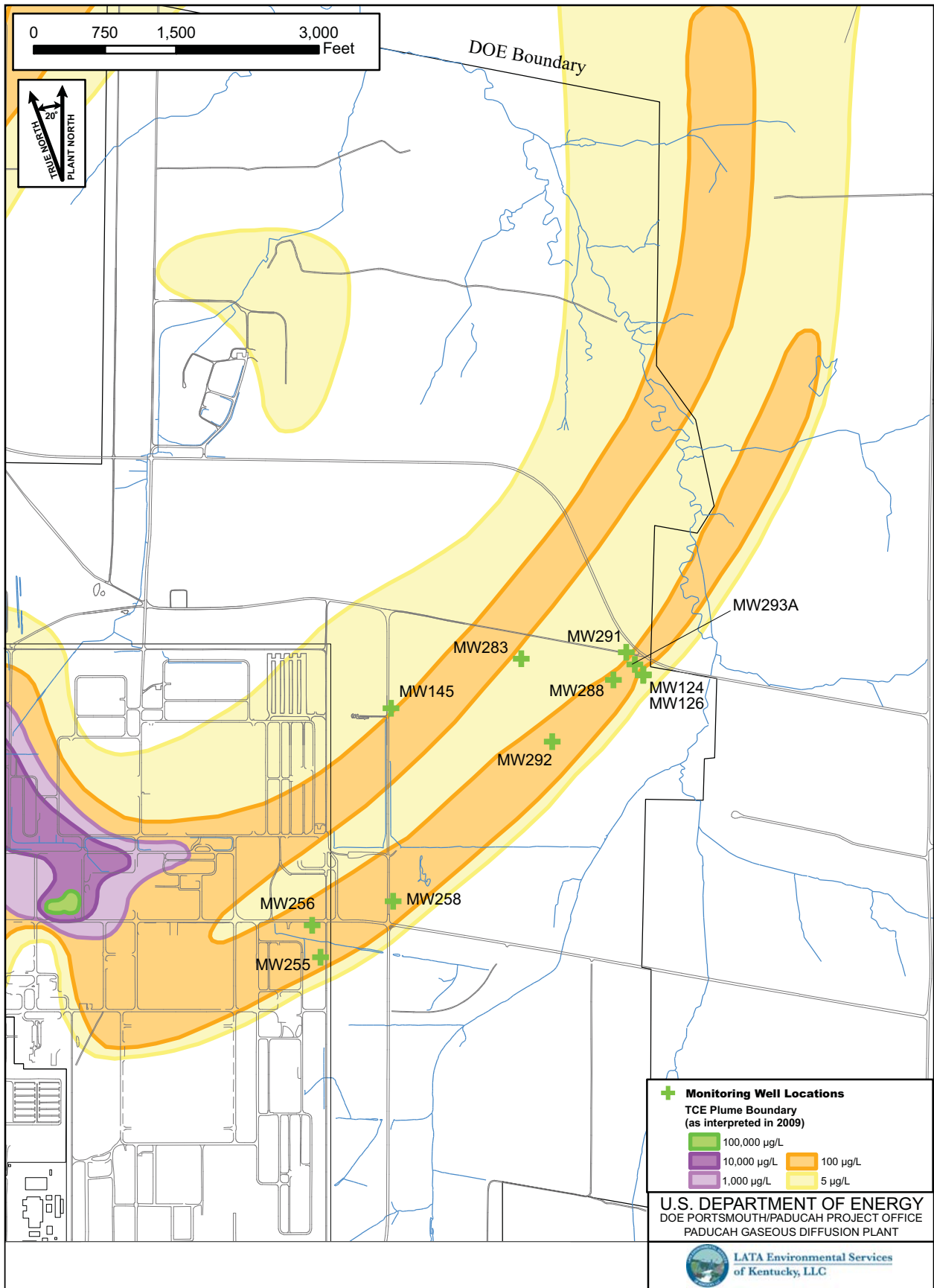


FIGURE No. EMP|EMPWellsNEP\_2011R0.mxd  
DATE 09-20-2010

Figure C.4. Northeast Plume Monitoring Wells

## C.2.3 NORTHWEST PLUME OPERATIONS AND MAINTENANCE PROGRAM

### Northwest Plume Monitoring

**Frequency:** Quarterly and Semiannually

**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 determine the effectiveness of the optimization of Northwest Plume operations, 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.

The number of monitoring wells sampled for the Northwest Plume has increased from 12 in FY 2010 to 32 in FY 2011. This is due to the completion of the Northwest Plume Optimization project in August 2010.

Table C.10 provides a listing of Northwest Plume wells sampled quarterly and semiannually and the associated parameters. Table C.11 provides the Northwest Plume analytical parameters. Locations are shown on Figure C.5.

**Table C.10. Northwest Plume Wells (33)**

<b>Quarterly Wells (22 )</b>		<b>Semiannual Wells (10)</b>
MW242	MW460	MW63
MW243	MW461	MW65
MW244	MW462	MW66
MW245	MW497	MW165
MW248	MW498	MW173
MW250	MW499	MW339
MW455	MW500	MW340
MW456	MW501	MW355
MW457	MW502	MW428
MW458	MW503	MW429A
MW459	MW504	MW 430

**Table C.11. Northwest Plume Analytical Parameters**

<b>Volatiles</b>	<b>Field Parameters</b>
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	
<i>cis</i> -1,2-Dichloroethene	<b>Radionuclides</b>
Dimethylbenzene, Total*	Alpha Activity
Ethylbenzene	Beta Activity
Tetrachloroethene	Technetium-99
Toluene	
<i>trans</i> -1,2-Dichloroethene	
Trichloroethene	
Vinyl Chloride	

\*Xylenes

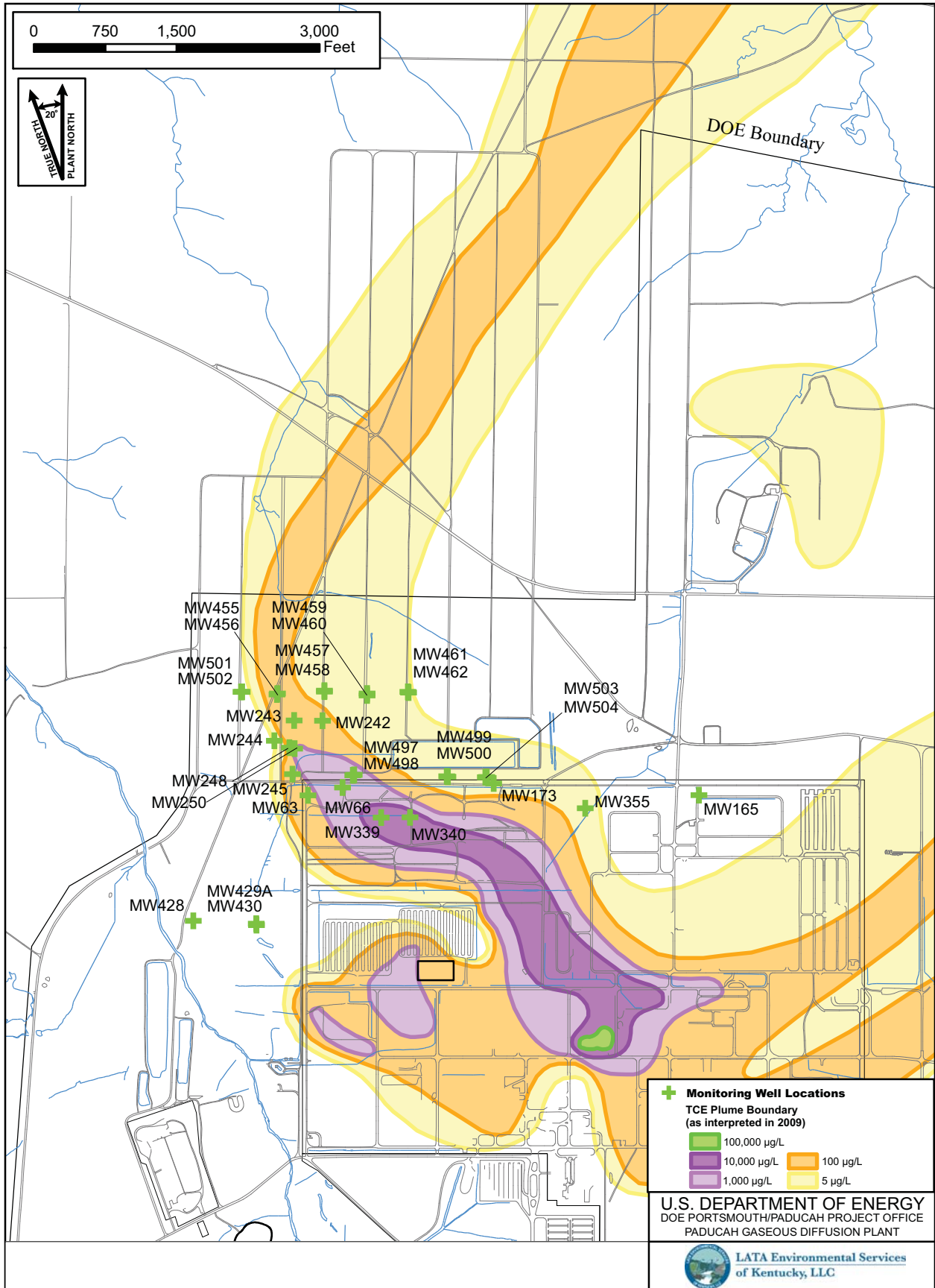


FIGURE No. EMP/EMPWellsNWP\_2011R2.mxd  
 DATE 12-15-2010

Figure C.5. 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 (IRA). 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. Regional Gravel Aquifer (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:** Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, the necessary CERCLA document will updated and approved changes will be implemented and reflected in the FY 2012 EMP.

Table C.12 provides a listing of the C-400 monitoring wells and Table C.13 provides the quarterly analytical parameters for these wells. Locations are shown on Figure C.6.

<b>Table C.12. C-400 Monitoring Wells (8)</b>	<b>Table C.13. C-400 Monitoring Well Quarterly Analytical Parameters</b>	
MW175	<b>Volatiles</b>	<b>Metals</b>
MW342	1,1-Dichloroethene	Uranium
MW343	<i>cis</i> -1,2-Dichloroethene	
MW421	<i>trans</i> -1,2-Dichloroethene	<b>Anions</b>
MW422	Trichloroethene	Chloride
MW423	Vinyl Chloride	
MW424	<b>PCBs</b>	<b>Radionuclides</b>
MW425	PCB-1232	Technetium-99
	PCB, Total	Alpha Activity
	PCB-1016	Beta Activity
	PCB-1221	<b>Field Parameters</b>
	PCB-1242	Conductivity
	PCB-1248	Depth to Water
	PCB-1254	Dissolved Oxygen
	PCB-1260	Eh
	PCB-1268	pH
		Temperature
		Turbidity

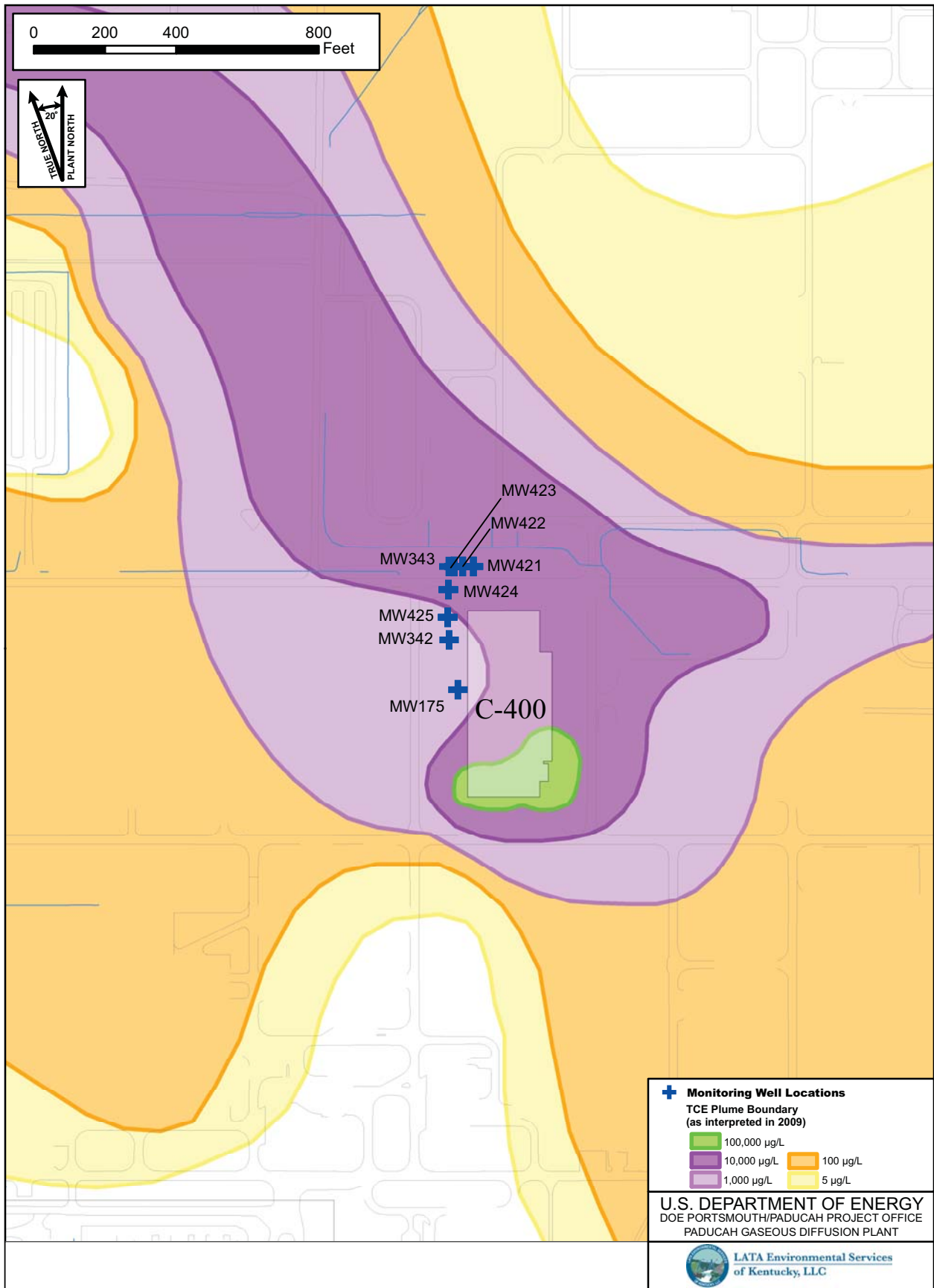


FIGURE No. EMPJEMPWells400\_2011R1.mxd  
DATE 09-28-2010

Figure C.6. C-400 Monitoring Wells

## C.2.5 C-613 NORTHWEST STORM WATER CONTROL FACILITY

### C-613 Sed Basin—Storm Water<sup>1</sup>

- 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 KPDES Outfall 001 to exceed regulatory limits.
- Reported:** Reported to KDWM via electronic mail.
- Comments:** Table C.14 provides a listing of the C-613 Sed Basin quarterly water parameters. Location of the C-613 Sed Basin is shown on Figure C.7.

### 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.15 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 11
- 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.16 provides a listing of the C-613 Sed Basin annual sediment parameters.

---

<sup>1</sup> Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, the necessary CERCLA document will be updated and approved changes will be incorporated in the FY 2012 EMP.



**Table C.14. C-613 Sed Basin  
Quarterly Water Parameters**

---

<b>Miscellaneous</b>
pH
Total Suspended Solids
Turbidity
<b>Field Parameters</b>
pH
Turbidity

---

**Table C.15. C-613 Sed Basin  
Third Quarter Water Analytical Parameters**

---

<b>Metals</b>	<b>Miscellaneous</b>
Antimony	Total Suspended Solids
Arsenic	
Beryllium	<b>Radionuclides</b>
Cadmium	Gross alpha
Chromium	Gross beta
Copper	Uranium
Iron	
Lead	<b>Field Parameters</b>
Nickel	pH
Selenium	Turbidity
Silver	
Thallium	
Uranium	
Zinc	
Mercury	

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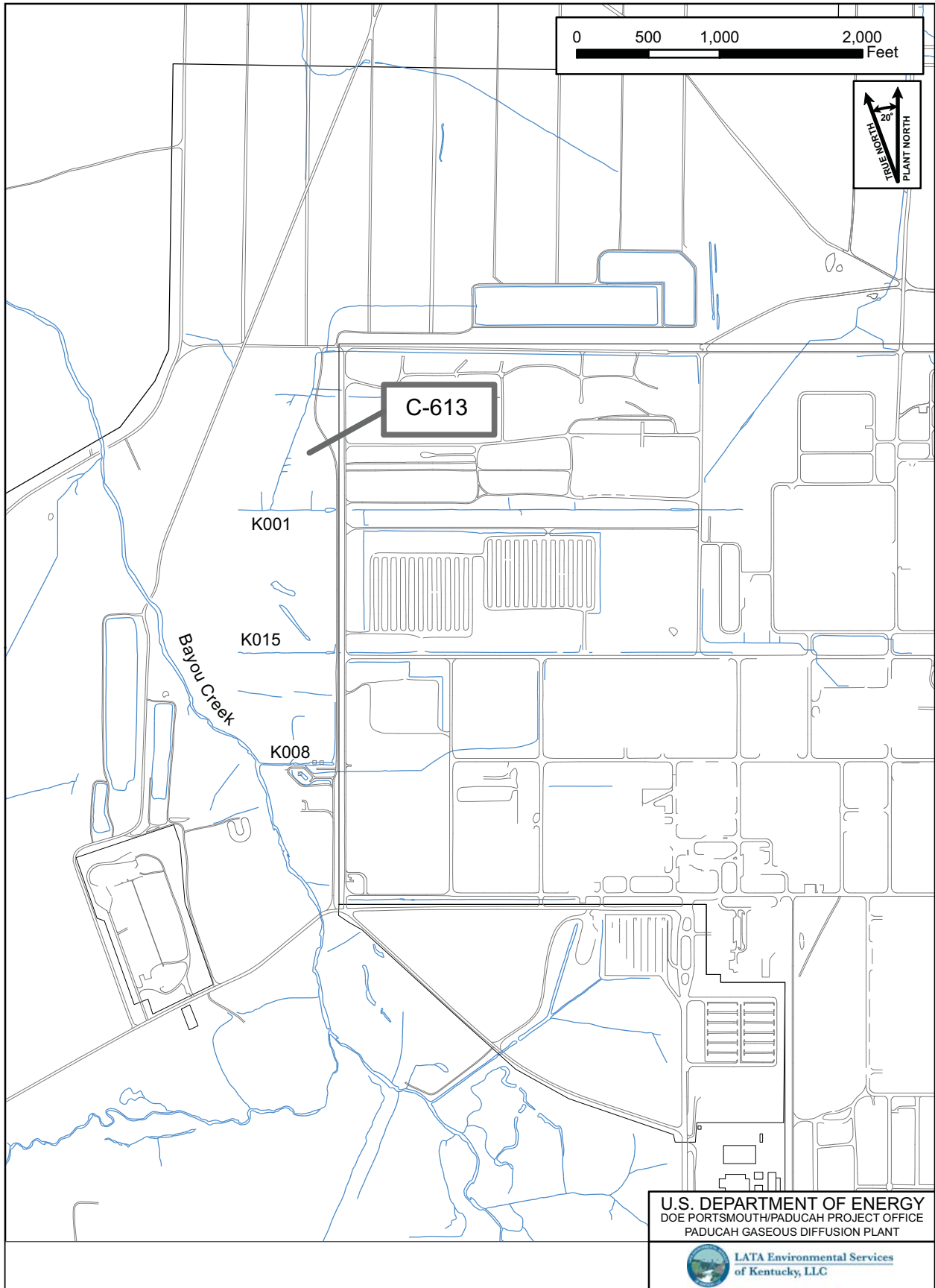


FIGURE No. EMP/IMP-6132011R0.mxd  
DATE 09-21-2010

Figure C.7. C-613 Sedimentation Basin

**Table C.16. C-613 Sed Basin Annual Sediment Parameters**

<b>Volatiles</b>	<b>Semivolatiles</b>	
1,1,1-Trichloroethane	1,2,4-Trichlorobenzene	Benzo(ghi)perylene
1,1,2,2-Tetrachloroethane	1,2-Dichlorobenzene	Benzo(k)fluoranthene
1,1,2-Trichloroethane	1,3-Dichlorobenzene	Bis(2-chloroethoxy)methane
1,1-Dichloroethane	1,4-Dichlorobenzene	Bis(2-chloroethyl) ether
1,1-Dichloroethene	2,4,5-Trichlorophenol	Bis(2-chloroisopropyl) ether
1,2-Dichloroethane	2,4,6-Trichlorophenol	Bis(2-ethylhexyl)phthalate
1,2-Dichloropropane	2,4-Dichlorophenol	Butyl benzyl phthalate
1,2-Dimethylbenzene	2,4-Dimethylphenol	Chrysene
2-Butanone	2,4-Dinitrophenol	Di-n-butyl phthalate
2-Hexanone	2,4-Dinitrotoluene	Di-n-octylphthalate
4-Methyl-2-pentanone	2,6-Dinitrotoluene	Dibenz(a,h)anthracene
Acetone	2-Chloronaphthalene	Dibenzofuran
Benzene	2-Chlorophenol	Diethyl phthalate
Bromodichloromethane	2-Methyl-4,6-dinitrophenol	Dimethyl phthalate
Bromoform	2-Methylnaphthalene	Fluoranthene
Bromomethane	2-Methylphenol	Fluorene
Carbon disulfide	2-Nitrobenzenamine	Hexachlorobenzene
Carbon tetrachloride	2-Nitrophenol	Hexachlorobutadiene
Chlorobenzene	3,3-Dichlorobenzidine	Hexachlorocyclopentadiene
Chloroethane	3-Nitrobenzenamine	Hexachloroethane
Chloroform	4-Bromophenyl phenyl ether	Indeno(1,2,3-cd)pyrene
Chloromethane	4-Chloro-3-methylphenol	Isophorone
Dibromochloromethane	4-Chlorobenzenamine	N-Nitroso-di-n-propylamine
Ethylbenzene	4-Chlorophenyl phenyl ether	N-Nitrosodiphenylamine
Methylene chloride	4-Nitrobenzenamine	Naphthalene
Styrene	4-Nitrophenol	Pentachlorophenol
Tetrachloroethene	Acenaphthene	Phenanthrene
Toluene	Acenaphthylene	Phenol
Trichloroethene	Anthracene	Pyrene
Vinyl Chloride	Benz(a)anthracene	Pyridine
<i>cis</i> -1,2-Dichloroethene	Benzo(a)pyrene	m,p-Cresol
<i>cis</i> -1,3-Dichloropropene	Benzo(b)fluoranthene	
m,p-Xylene		
<i>trans</i> -1,2-Dichloroethene		
<i>trans</i> -1,3-Dichloropropene		
<b>PCBs</b>	<b>Metals</b>	<b>Radionuclides</b>
PCB, Total	Aluminum	Activity of U-235
PCB-1016	Antimony	Americium-241
PCB-1221	Arsenic	Cesium-134
PCB-1232	Barium	Cesium-137
PCB-1242	Beryllium	Cobalt-60
PCB-1248	Cadmium	Neptunium-237
PCB-1254	Calcium	Plutonium-238
PCB-1260	Chromium	Plutonium-239/240
PCB-1268	Cobalt	Technetium-99
	Copper	Thorium-228
	Iron	Thorium-230
	Lead	Thorium-232
		Thorium-234
		Uranium-234
		Uranium-235
		Uranium-238

## C.2.6 RESIDENTIAL GROUNDWATER MONITORING PROGRAM

### Monthly Residential Monitoring<sup>2</sup>

**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 U.S. Environmental Protection Agency (EPA).

**Reported:** Quarterly letter to the 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 <sup>99</sup>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 <sup>99</sup>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, the sampling frequency for well R2 was changed from monthly to annually. Tables C.17 and C.18 identify residential wells and residential analytical parameters, respectively. Locations are shown on Figure C.8.

### Annual Residential Monitoring<sup>2</sup>

**Driver:** As required per the Action Memorandum outlined in DOE/OR/106-1142&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 <sup>99</sup>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 <sup>99</sup>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, 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. In 2010, sampling at monitoring well R23 was discontinued due to safety and access issues with this well.

### Carbon Filter Treatment System<sup>2</sup>

**Frequency:** Semiannually

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<sup>2</sup> Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, the necessary CERCLA document will be updated and approved changes will be incorporated in the FY 2012 EMP.

**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 Location is shown on Figure C.8.

**Table C.17. Residential Wells (17)**

---

<b>Monthly (2)</b>
R294 (P)
R302 (P)
<b>Annually (14)</b>
R2 (P)
R114 (H)
R12 (P)
R13 (P)
R14 (P)
R19 (P)
R20 (P)
R21(P)
R384 (H)
R387 (H)
R392 (H)
R83 (P)
R9 (H)
R90 (H)
<b>Carbon Filter (1)</b>
R424 Port 1 direct groundwater
R424 Port 2 after carbon filter
R424 Port 3 after ultraviolet light

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

**Table C.18. Residential Analytical Parameters**

---

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

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\* Not available at all locations

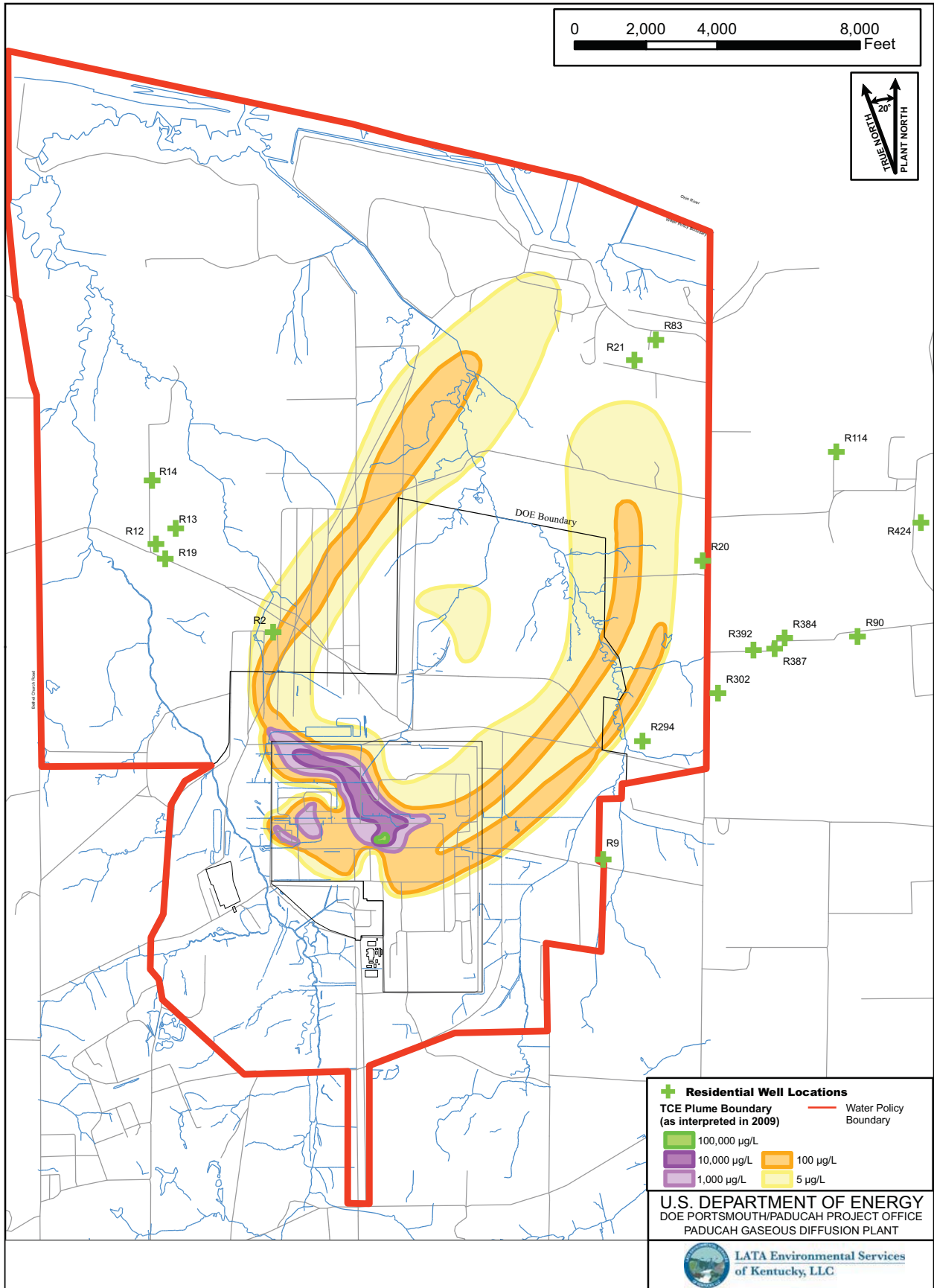


FIGURE No. EMPJEMPWellsRes2011R1.mxd  
DATE 12-13-2010

Figure C.8. Residential Wells

## C.2.7 ENVIRONMENTAL SURVEILLANCE GROUNDWATER MONITORING PROGRAM

### Annual and Biennial Environmental Surveillance Monitoring

**Driver:** DOE Order 450.1A 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 CERCLA Investigation; Resource Conservation and Recovery Act Facility Investigations (RFIs); and DOE Order 450.1A. 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 <sup>99</sup>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 <sup>99</sup>Tc greater than 25 pCi/L), then sample other residential wells in the vicinity.

**Comments:** Evaluation of the data collected to date shows that no significant changes have occurred that merits the need for sampling these wells quarterly and/or semiannually. The program has been focused to sample key wells annually and reduce sampling of other wells biennial. The wells to be monitored annually were selected based on their location within the plumes. Some are key for early detection of plume migration; others are key for ongoing CERCLA work.

Tables C.19 and C.20 identify surveillance wells and environmental surveillance analytical parameters, respectively. Tables C.21 and C.22 show surveillance geochemical wells and surveillance geochemical annual analytical parameters, respectively. Locations are shown on Figure C.9.

**Table C.19. Surveillance Wells (137)**

<b>Biennial (111)</b>			
MW67	MW226	MW434 <sup>2</sup>	MW474
MW76	MW227	MW435	MW475
MW86	MW260	MW436 <sup>2</sup>	MW476
MW89	MW262	MW437 <sup>2</sup>	MW477
MW92	MW328	MW438 <sup>2</sup>	MW478
MW95A	MW329	MW439	MW479
MW106	MW333	MW440	MW480
MW125	MW337	MW441	MW481
MW134	MW338	MW442	MW482
MW135	MW341	MW443	MW483
MW139	MW343	MW444	MW484
MW146	MW354	MW445	MW485
MW148	MW356	MW446 <sup>2</sup>	MW486
MW149	MW403 Port 3	MW447	MW487
MW155 <sup>1</sup>	MW404 Port 4	MW448	MW488
MW156 <sup>1</sup>	MW405 Port 5 <sup>1</sup>	MW449 <sup>2</sup>	MW489
MW163	MW406 Port 5 <sup>1</sup>	MW450	MW490
MW168	MW407 Port 4 <sup>1</sup>	MW451	MW491
MW169	MW408 Port 5 <sup>1</sup>	MW452	MW492
MW174	MW414	MW453	MW493
MW186	MW415	MW454	MW494
MW187	MW416	MW463	MW495
MW193	MW417	MW464	MW496
MW197	MW426	MW467	<b>Background (4)</b>
MW200	MW427	MW468	MW103
MW201	MW431	MW471	MW194
MW202	MW432	MW472	MW199
MW205	MW433	MW473	MW305
<b>Annually (26)</b>			
MW98	MW182 <sup>3</sup>	MW419 <sup>3</sup>	MW470
MW 99	MW206	MW409 <sup>4</sup>	MW233
MW 100	MW252	MW410 <sup>4</sup>	MW236
MW152	MW253	MW411 <sup>4</sup>	MW240
MW161	MW261	MW465	<b>Background (1)</b>
MW191	MW345	MW466	MW150
MW203	MW418 <sup>3</sup>	MW469	

<sup>1</sup> These wells are within the C-400 treatment zone; not accessible during remediation operations.

<sup>2</sup> These monitoring wells have not been installed yet.

<sup>3</sup> These three wells are sampled for PCBs.

<sup>4</sup> These wells will be sampled quarterly in FY 2011 for TCE to evaluate Northeast Plume migration.

**Table C.20. Environmental Surveillance Analytical Parameters**

<b>Annual and Biennial</b>	
<b>Field Parameters</b>	<b>Volatiles</b>
Barometric Pressure	1,1,1-Trichloroethane
Conductivity	1,1,2-Trichloroethane
Depth to water	1,1-Dichloroethane
Dissolved Oxygen	1,1-Dichloroethene
pH	1,2-Dichloroethane
Temperature	Benzene
Turbidity	Bromodichloromethane
	Carbon Tetrachloride
	Chloroform
<b>PCBs, Total and Dissolved (MW182, 418 and 419)</b>	<i>cis</i> -1,2-Dichloroethene
PCB, Total	Dimethylbenzene, Total*
PCB-1016	Ethylbenzene
PCB-1221	Tetrachloroethene
PCB-1232	Toluene
PCB-1242	<i>trans</i> -1,2-Dichloroethene
PCB-1248	Trichloroethene
PCB-1254	Vinyl Chloride
PCB-1260	*Xylenes
PCB-1268	
<b>Radionuclides</b>	
Alpha Activity	
Beta Activity	
Technetium-99	
Uranium	



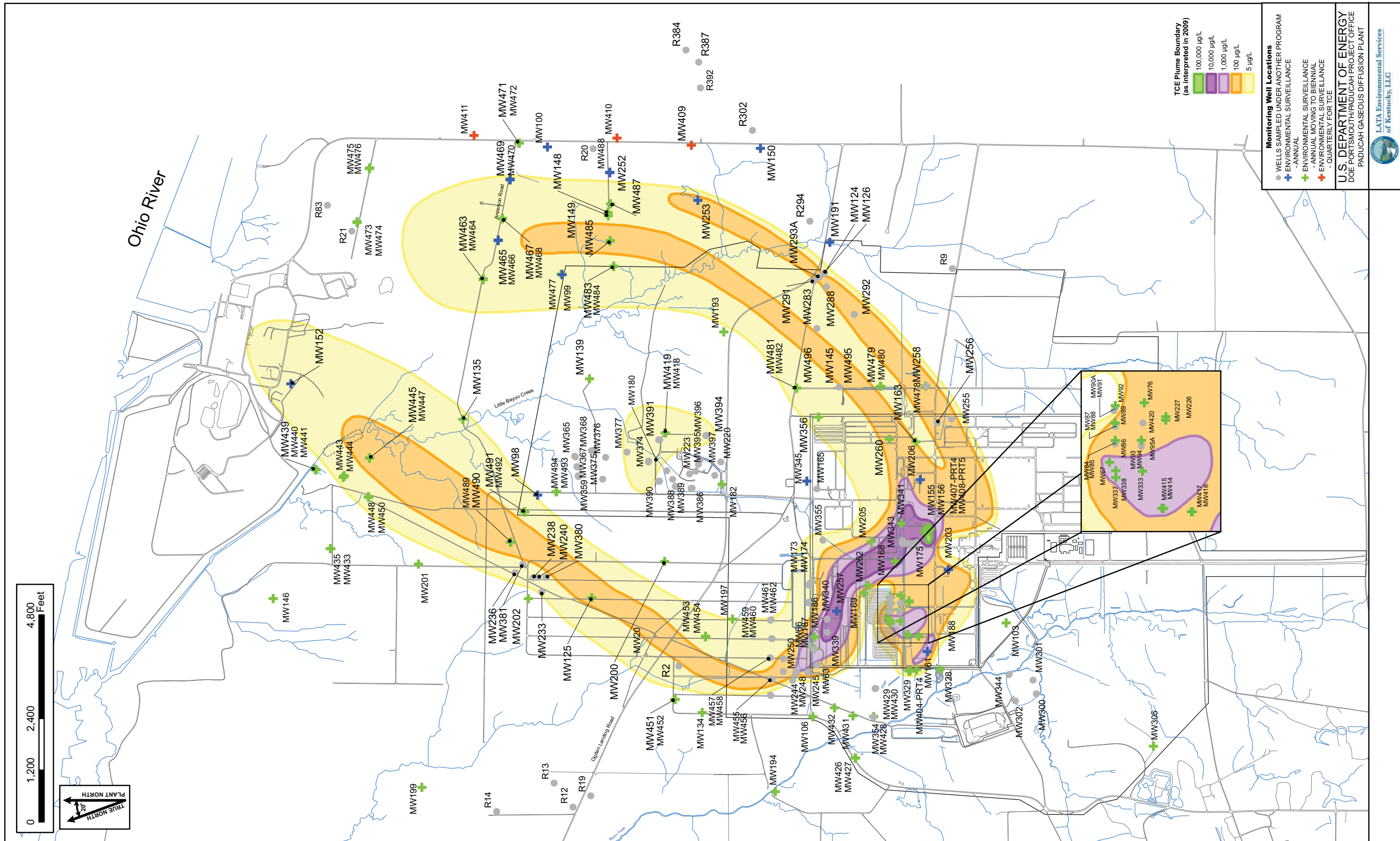
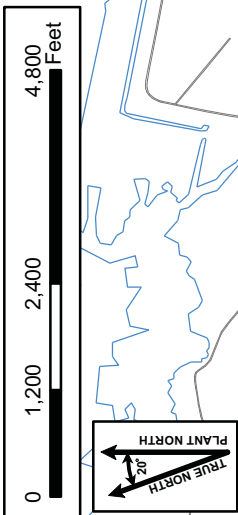


Figure C.9. Environmental Surveillance Groundwater Monitoring Wells

**Monitoring Well Locations**  
 ● WELLS SAMPLED UNDER ANOTHER PROGRAM  
 + ENVIRONMENTAL SURVEILLANCE  
 - ANNUAL  
 - ENVIRONMENTAL SURVEILLANCE  
 - ANNUAL MOVING TO BIENNIAL  
 - ENVIRONMENTAL SURVEILLANCE  
 - QUARTERLY FOR TCE

**TCE Plume Boundary**  
(as interpreted in 2009)  
 100,000 µg/L  
 10,000 µg/L  
 1,000 µg/L  
 100 µg/L  
 5 µg/L



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## Geochemical Environmental Surveillance Monitoring

**Frequency:** Every three years

**Driver:** DOE Order 450.1A 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 450.1A.

**Reported:** Annual Site Environmental Report.

**Comments:** Nine new wells will be sampled in FY 2011. This will complete the information needed to establish a baseline for the geochemistry data. The next sampling event under this program is projected for FY 13 and will include all 44 wells.

Tables C.21 and C.22 show surveillance geochemical wells and surveillance geochemical annual analytical parameters, respectively. Locations are shown on Figure C.9.

**Table C.21. 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*

\* These are new surveillance geochemical wells. The first sampling event for these wells is scheduled for FY 2011.

**Table C.22. Surveillance Geochemical Annual  
Analytical Parameters**

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

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

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## 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.
- Comments:** Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2011, as it is permit driven. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification and reflected in FY 2012 EMP.

Tables C.23 and C.24 show landfill surface water locations and landfill surface water parameters, respectively. Locations are shown on Figure C.10.

**Table C.23. 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.24. Landfill Surface Water Parameters**

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

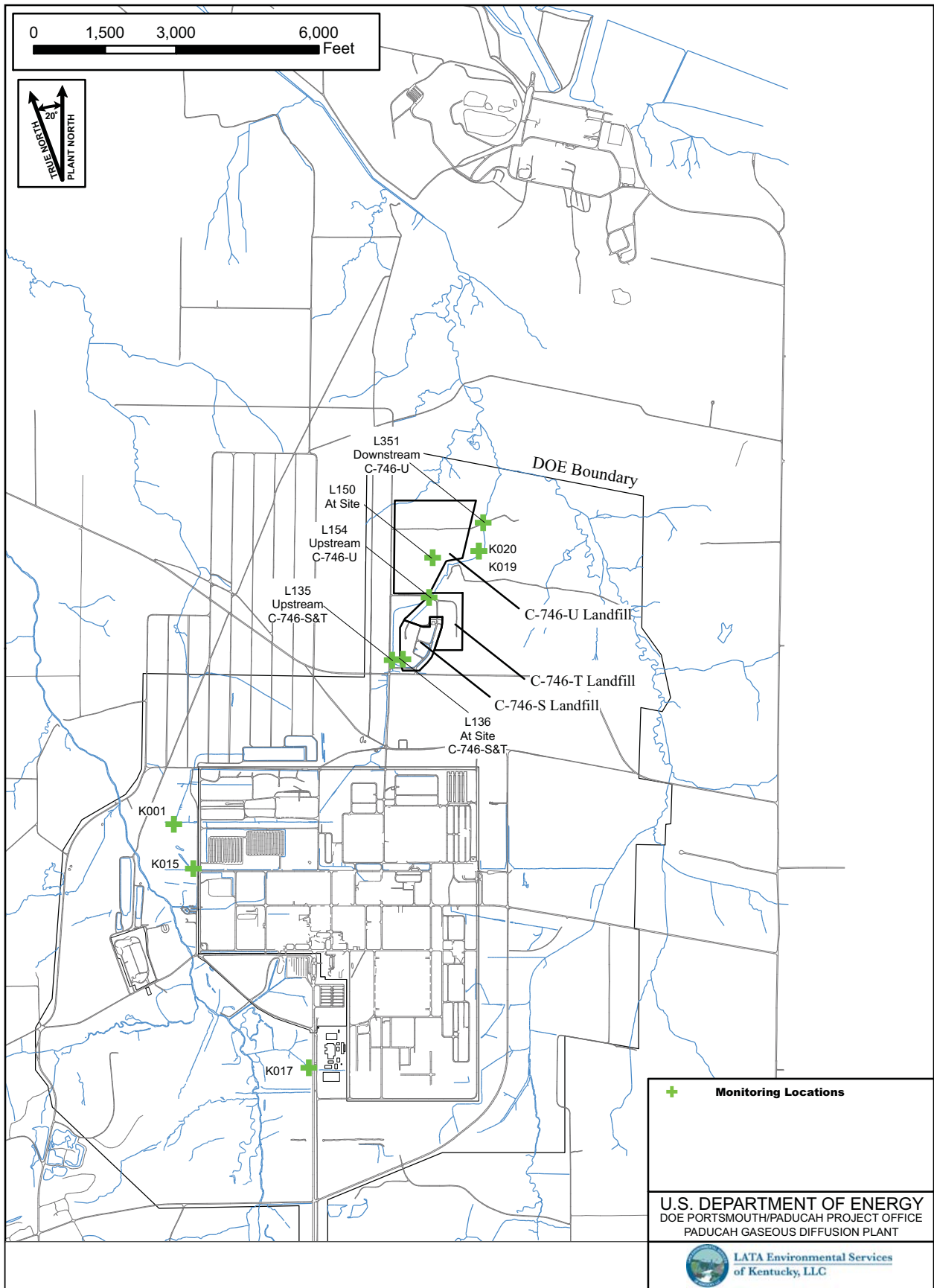


FIGURE No. EMPIEMPDPDES-LF2011R0.mxd  
DATE 09-21-2010

Figure C.10. KPDES and Landfill Surface Water Locations

**KPDES Outfall Sampling**

**Driver:** DOE 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. A modification to this permit became effective on December 1, 2009. The modification added Outfall 20. In accordance with the revised KPDES Permit, analysis requirements for 45 parameters added as a result of the permit renewal in 2006 were removed (except 3 at Outfall 001, 3 at Outfall 015, and 2 at Outfall 017) and replaced 6 parameters with 6 more appropriate parameters for Outfall 020.

Table C.25 shows the KPDES outfall sampling locations, frequency of sampling, and parameters. Locations are shown on Figure C.11.

**Table C.25. KPDES Outfall Sampling Locations, Frequency, and Parameters**

Analysis	Frequency of Sampling at KPDES Locations D—Daily; W—Weekly; M—Monthly; Q—Quarterly				
	K001	K015	K017	K019	K020
Flow (MGD)	D	M	M	M	M
Total Suspended Solids (mg/L)	W	M	M	M	M
Oil & Grease (mg/L)	W	M	M	M	M
Total Residual Chlorine (mg/L)	W				
Temperature (°F)	W		M <sup>†</sup>		
PCBs (mg/L)	W	M	M	M	Q
Trichloroethene (mg/L)	W				Q
Total Phosphorus (mg/L)	W				
Total Alpha (pCi/L)	W	M	M	M	M
Total Beta (pCi/L)	W	M	M	M	M
Uranium (µg/L)	W	M	M	M	M
Total Recoverable Zinc (µg/L)			M	M	Q
Total Recoverable Arsenic (µg/L)					Q
Total Recoverable Nickel (µg/L)					Q
Nitrates (mg/L N)					Q
1,1,1 –Trichloroethane (mg/L)					Q
Chlorides (mg/L)					Q
Acute Toxicity (TU <sub>A</sub> )*		Q	Q	Q	Q
Chronic Toxicity (TU <sub>C</sub> )**	Q		M <sup>†</sup>		
Technetium-99 (pCi/L)	Q	Q	Q	Q	Q
Hardness (as mg/L CaCO <sub>3</sub> )	Q	Q	Q	Q	Q
Phosphorous (mg/L)					Q
CBOD (mg/L)					Q
Dissolved Oxygen (mg/L)					Q
Total Recoverable Iron (µg/L)		Q		Q	Q
Benzo(a)anthracene (µg/L)		Q	Q		

**Table C.25. KPDES Outfall Sampling Locations, Frequency, and Parameters (Continued)**

Analysis	Frequency of Sampling at KPDES Locations D—Daily; W—Weekly; M—Monthly; Q—Quarterly				
	K001	K015	K017	K019	K020
Benzo(k)fluoranthene (µg/L)		Q			
Free Cyanide (µg/L)	Q				
Heptachlor (µg/L)	Q	Q	Q		
Indeno(1,2,3-cd)pyrene (µg/L)	Q				
pH (between 6–9)	W	M	M	W***	W***
<p>* Acute toxicity sampling requires two grab samples.  ** Chronic toxicity sampling requires three 24-hour composite samples.  *** These effluents are sampled weekly when discharging to the outfalls.</p> <p>†NOTE: Temperature and chronic toxicity for Outfall 017 shall become effective upon completion and commencement of operation of the depleted uranium conversion facility.  NOTE: This table is subject to change upon renegotiating the permit in 2011.</p>					

**Watershed KPDES Permit Biological Sampling**

**Frequency:** Benthic Macroinvertebrates—Annually

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

**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.26 for location names and Figure C.10 for a map of the locations.)

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

**Comments:** A new KPDES permit was issued in November 2006. A modification to this permit became effective on December 1, 2009. Changes to the Watershed Monitoring Program included the elimination of bioaccumulation sampling or fish community ecological health. The final Watershed Monitoring Plan, which required benthic macroinvertebrates multihabitat assessment, was submitted to Kentucky Division of Water on February 2010. Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and, based on trending results, if changes are deemed appropriate, the Watershed Monitoring Plan will be modified and approved changes will be implemented and incorporated in the FY 2012 EMP.

Table C.26 provides the watershed monitoring locations and analyses parameters.



**Table C.26. Watershed Monitoring Locations and Analyses**

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

\* Locations are shown on Figure C.11.

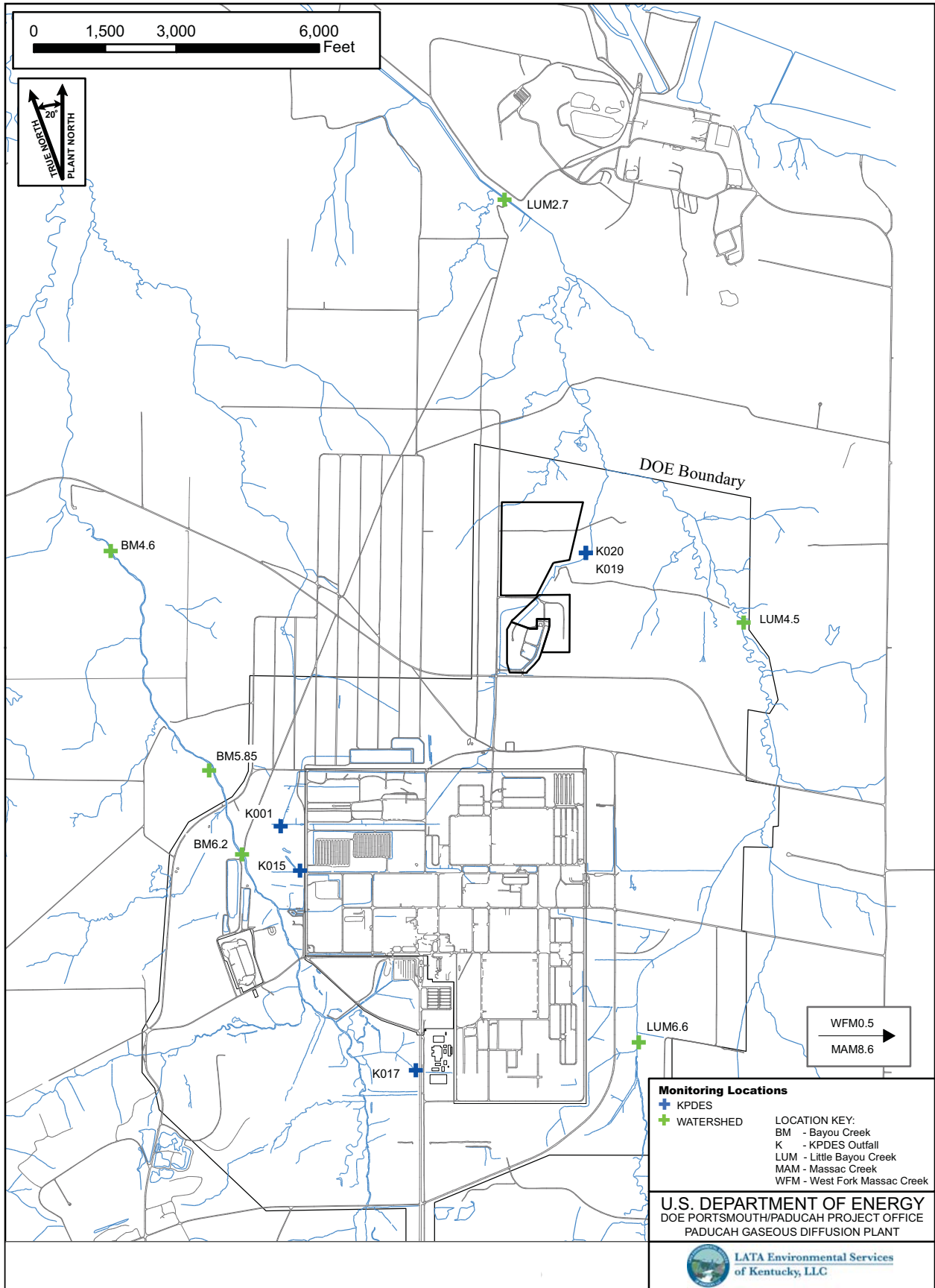


FIGURE No. EMP\EMP\KPDES-WS2011R0.mxd  
 DATE 09-21-2010

Figure C.11. Watershed Monitoring Locations

### C.3.2 ENVIRONMENTAL SURVEILLANCE WATERSHED MONITORING PROGRAM

#### Surface Water Monitoring

- Frequency:** Quarterly
- Driver:** DOE KPDES Permit for the Paducah Gaseous Diffusion Plant (PGDP), permit number KY0004049, McCracken County, Kentucky.
- Rationale:** To monitor potential contamination released into Bayou Creek and Little Bayou Creek surface water from historical plant operations.
- Reported:** Annual Site Environmental Report.
- Comments:** The KPDES Permit requires only that in-stream surface water be sampled quarterly for PCBs and TCE in Little Bayou Creek, Bayou Creek, and the Ohio River. Accordingly, FY 2011 sampling has been adjusted to limit sampling to these two parameters.

Tables C.27, C.28, and C.29 show surface water and seep sampling locations, quarterly analytical parameters, and quarterly seep location analytical parameters, respectively. Locations are shown on Figure C.12.

---

**Table C.27. Surface Water and Seep  
Sampling Locations (20)**

---

**Surface Water (19)**

C612 (SP)\*  
C616  
C746K-5  
C746KTB1A  
L1 (BG)  
L10  
L11  
L194  
L29A (BG/R)\*  
L291  
L30 (R)\*  
L306 (R)\*  
L5  
L12  
L241  
L6  
L64(BG)  
S31  
K001UP PCB & TCE Grab

**Seeps (1)**  
LBCSP5\*

---

BG – Background locations  
R – Ohio River locations  
SP – Sampling port  
\* – Unable to obtain flow rates

**Table C.28. Surface Water  
Quarterly Analytical Parameters**

<b>PCBs</b>	<b>Field Measurements</b>
PCB, Total	pH
PCB-1016	Flow*
PCB-1221	Dissolved Oxygen
PCB-1232	Temperature
PCB-1242	Conductivity
PCB-1248	Alkalinity
PCB-1254	
PCB-1260	<b>Volatiles</b>
PCB-1268	Trichloroethene

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

**Table C.29. Quarterly Seep Location  
Analytical Parameters**

<b>Volatiles</b>
Trichloroethene
<b>Field Measurements</b>
pH
Dissolved Oxygen
Temperature
Conductivity

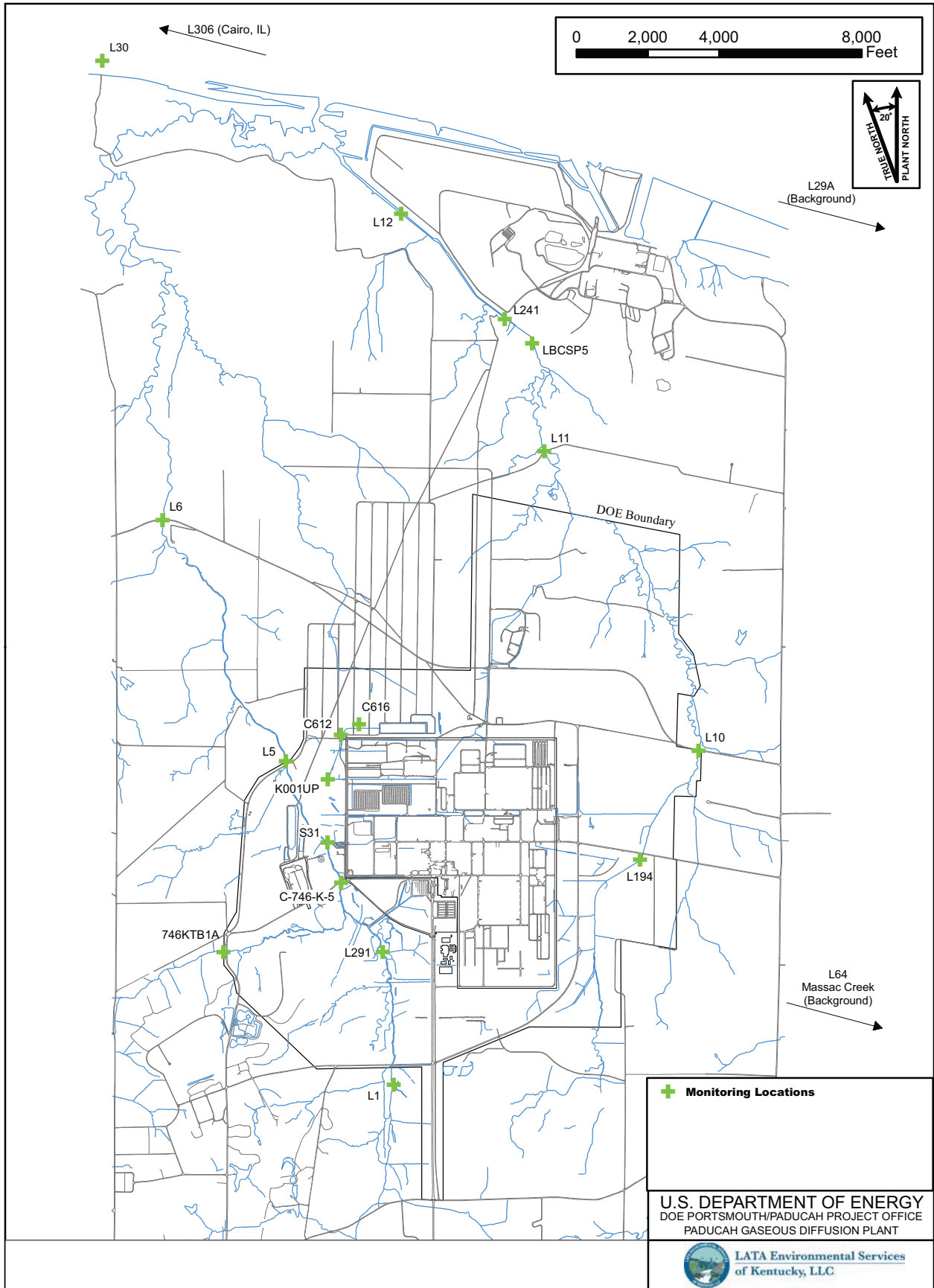


FIGURE No. EMP|EMP-SW2011R0.mxd  
 DATE 09-23-2010

**Figure C.12. Surface Water and Seep Monitoring Locations**

## Sediment Monitoring

**Frequency:** Semiannually

**Driver:** DOE KPDES Permit for the Paducah Gaseous Diffusion Plant (PGDP), permit number KY0004049, McCracken County, Kentucky.

**Rationale:** Monitor potential contamination released into Bayou Creek and Little Bayou Creek sediments from historical plant operations.

**Reported:** Annual Site Environmental Report.

**Comments:** The sampling frequency or sampling locations for this program were not modified in FY 2011; however, the sampling parameters were. The KPDES Permit requires only that sediments be monitored for PCBs semiannually at 14 locations in Little Bayou Creek and Bayou Creek. Tables C.30 and C.31 show sediment sampling locations and analytical parameters. Locations are shown on Figure C.13.

**Table C.30. 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.31. Sediment Analytical  
Parameters**

---

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

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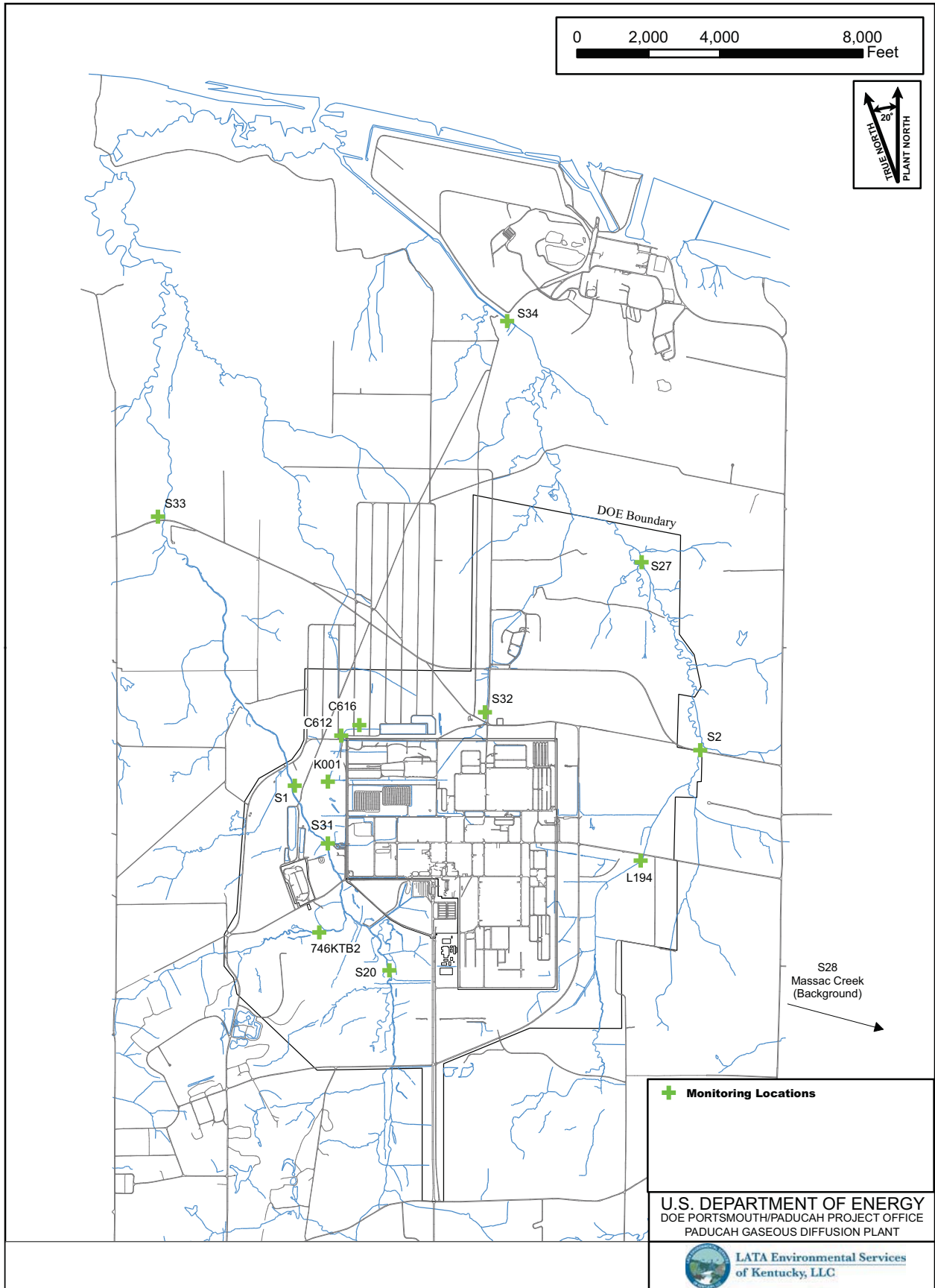


FIGURE No. EMP|EMP-SD2011R1.mxd  
DATE 12-13-2010

Figure C.13. Semiannual Sediment Locations

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## C.4. ANNUAL DEER HARVESTING

- Frequency:** Annually<sup>3</sup>
- Driver:** DOE Order 450.1A and Real Estate License No. REEMCBC DOE-03-06-0710 (Deer Bow Hunting).
- 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.
- 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.
- Reported:** Annual Site Environmental Report and to WKWMA personnel.
- Comments:** Real Estate License No. REEMCBC DOE-03-06-0710 requires that a deer sampling program be established and analytical results be provided to the WKWMA prior to the first scheduled deer hunt that occurs each year. Evaluation of data collected over the years is underway. Two deer will be sampled in FY 2011.<sup>4</sup> FY 2011 sampling parameters will be limited to radiological analyses.

Table C.32 provides annual deer sampling parameters.

**Table C.32. Annual Deer Sampling Parameters (Two Site Deer)**

Liver and Muscle	Bone	Thyroid
<b>Radionuclides</b>	<b>Radionuclides</b>	<b>Radionuclides</b>
Technetium-99	Technetium-99	Technetium-99
Neptunium-237	Neptunium-237	
Plutonium-239	Plutonium-239	
Uranium-234	Uranium-233/234	
Uranium-235	Uranium-235	
Uranium-238	Uranium-238	
Thorium-230	Thorium-230	

<sup>3</sup> Deer harvesting sampling program is projected to be discontinued in FY 2012.

<sup>4</sup> Based on trending analysis results and if agreement is reached with the WKWMA that sampling is not needed, deer harvesting sampling program may be discontinued in FY 2011.

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## C.5. LANDFILL LEACHATE SAMPLING

### C-746-S and C-746-U Landfills Leachate Monitoring

**Frequency:** Annually

**Driver:** C-746-S, and C-746-U Landfill permits issued by KDWM, Permit Numbers SW07300014, SW07300015, and SW07300045, respectively.

**Reported:** Annual Environmental Compliance Report required by landfill permits.

**Comments:** Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification and reflected in FY 2012 EMP.

Annual leachate parameters for C-746-S and C-746-U Landfills are presented in Table C.33.

**Table C.33. C-746-S 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	<b>Field Parameters</b>
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	<b>Radionuclides</b>	Copper	Temperature
1,2-Dichloropropane	Alpha Activity	Iodide	pH
1,4-Dichlorobenzene	Beta activity	Iron	
2-Butanone	Iodine-131	Lead	<b>Miscellaneous</b>
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 <sup>1</sup>	Potassium	Oil and Grease <sup>1</sup>
Bromochloromethane	Cobalt-60 <sup>1</sup>	Rhodium	Phosphorus <sup>1</sup>
Bromodichloromethane	Thorium-234 <sup>1</sup>	Selenium	Hardness—Total as CaCO <sub>3</sub> <sup>1</sup>
Bromoform	Americium-241 <sup>1</sup>	Silver	Carbonaceous Biochemical Oxygen Demand <sup>1</sup>
Bromomethane	Neptunium-237 <sup>1</sup>	Sodium	Total Suspended Solids <sup>1</sup>
Carbon Disulfide	Plutonium-239/240 <sup>1</sup>	Tantalum	
Carbon Tetrachloride	Activity of Uranium-235 <sup>1</sup>	Thallium	
Chlorobenzene	Uranium-234 <sup>1</sup>	Uranium	

**Table C.33. C-746-S and C-746-U Annual Leachate Parameters (Continued)**

<b>Volatiles</b>	<b>Radionuclides</b>	<b>Metals</b>
Chloroethane	Uranium-238 <sup>1</sup>	Vanadium
Chloroform	Dissolved Alpha <sup>1</sup>	Zinc
Chloromethane	Dissolved Beta <sup>1</sup>	Barium, Dissolved <sup>1</sup>
<i>cis</i> -1,2-Dichloroethene	Technetium-99, Dissolved <sup>1</sup>	Chromium, Dissolved <sup>1</sup>
<i>cis</i> -1,3-Dichloropropene	Cesium-137, Dissolved <sup>1</sup>	Uranium, Dissolved <sup>1</sup>
Dibromochloromethane	Cobalt-60, Dissolved <sup>1</sup>	Antimony, Dissolved <sup>1</sup>
Dibromomethane	Thorium-234, Dissolved <sup>1</sup>	Arsenic, Dissolved <sup>1</sup>
Dimethylbenzene, Total*	Americium-241, Dissolved <sup>1</sup>	Cadmium, Dissolved <sup>1</sup>
Ethylbenzene	Neptunium-237, Dissolved <sup>1</sup>	Cobalt, Dissolved <sup>1</sup>
Iodomethane	Plutonium-239/240, Dissolved <sup>1</sup>	Copper, Dissolved <sup>1</sup>
Methylene Chloride	Thorium-230, Dissolved	Lead, Dissolved <sup>1</sup>
Styrene	Activity of Uranium-235, Dissolved <sup>1</sup>	Manganese, Dissolved <sup>1</sup>
Tetrachloroethene	Uranium-234, Dissolved <sup>1</sup>	Nickel, Dissolved <sup>1</sup>
Toluene	Uranium-238, Dissolved <sup>1</sup>	Selenium, Dissolved <sup>1</sup>
<i>trans</i> -1,2-Dichloroethene	Uranium	Silver, Dissolved <sup>1</sup>
<i>trans</i> -1,3-Dichloropropene	Uranium, Dissolved	Tin <sup>1</sup>
<i>trans</i> -1,4-Dichloro-2-Butene		Tin, Dissolved <sup>1</sup>
Trichloroethene		Titanium <sup>1</sup>
Trichlorofluoromethane		Titanium, Dissolved <sup>1</sup>
Vinyl Acetate		Uranium, Dissolved <sup>1</sup>
Vinyl Chloride		Vanadium, Dissolved <sup>1</sup>
		Zinc, Dissolved <sup>1</sup>

\* Xylenes

<sup>1</sup> 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 Hazardous Waste Facility Permit, number KY8-890-008-982.

**Reported:** C-404 Semiannual Groundwater Report.

**Comments:** Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification and reflected in FY 2012 EMP.

Leachate analytical parameters for C-404 Landfill are presented in Table C.34.

**Table C.34. C-404 Landfill  
Leachate Analytical Parameters**

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

<sup>1</sup> Additional operation parameters that are not listed in the C-404 Landfill Permit, KY8-890-008-982.

<sup>2</sup> 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.

**Driver:** DOE Order 450.1A.

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

**Comments:** Sampling frequencies and sampling locations were not modified for this sampling program for FY 2011. Data collected under this program will be evaluated, and based on trending results, if changes are deemed appropriate, the necessary CERCLA document will updated and approved changes will be incorporated in the FY 2012 EMP.

Figure C.14 shows TLD monitoring locations.

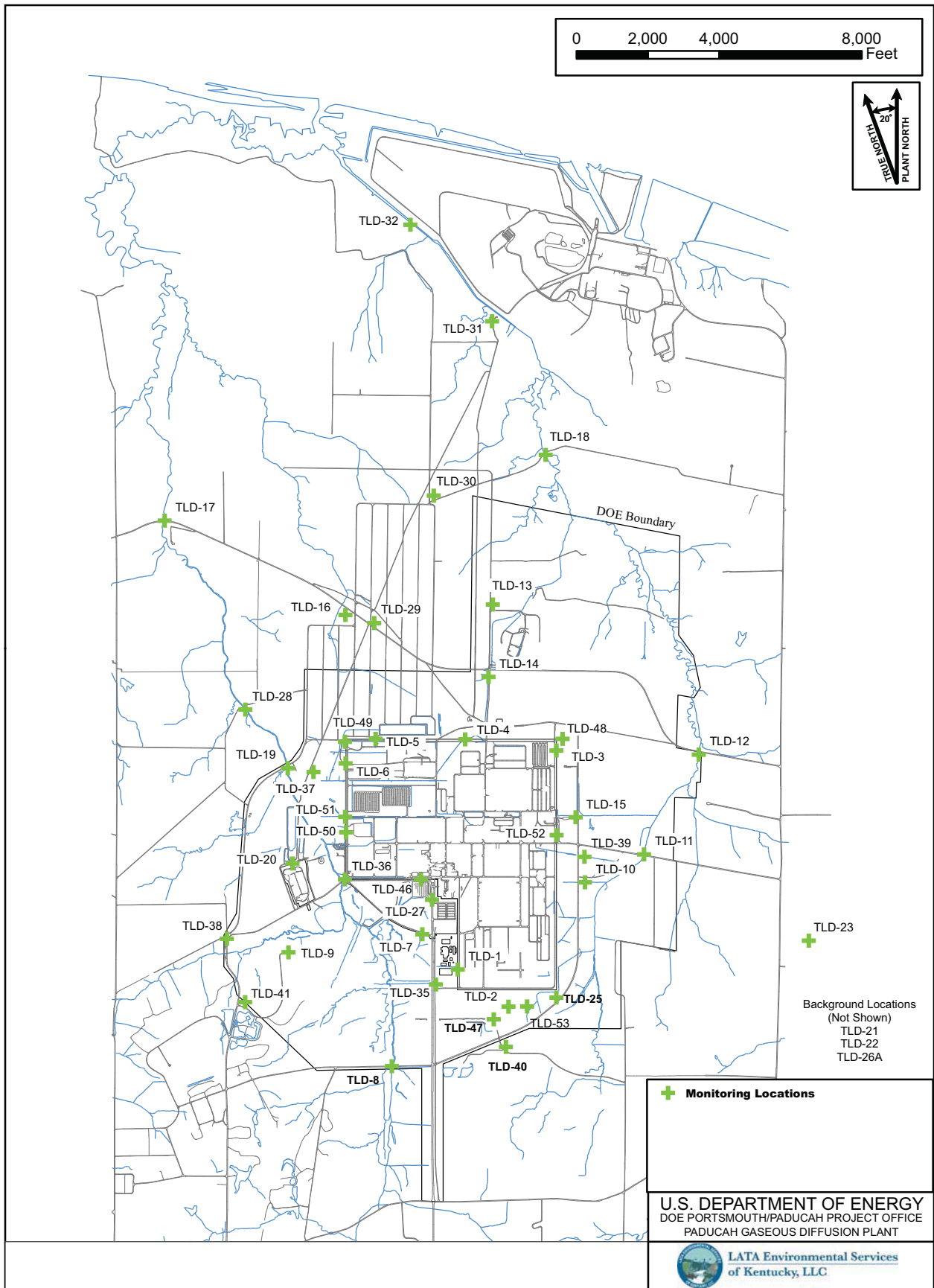


FIGURE No. EMPIEMP-TLD2011R1.mxd  
DATE 12-13-2010

Figure C.14. 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—September 2010

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

LATA ENVIRONMENTAL SERVICES OF KENTUCKY, LLC  
managing the  
Environmental Remediation Activities at the  
Paducah Gaseous Diffusion Plant  
under contract DE-AC30-10CC40020

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## ACRONYMS

ACO	Administrative Consent Order
AOC	Areas of Concern
CFR	<i>Code of Federal Regulations</i>
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 QAPIP	Environmental Monitoring Quality Assurance Project Plan
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
ES	environmental services
FFA	Federal Facility Agreement
HSWA	Hazardous Solid Waste Amendment
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
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
QAPIP	Quality Assurance Program and Implementation 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
<sup>99</sup> 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 LATA Environmental Services of Kentucky, LLC, (LATA Kentucky) and its subcontractors, performs environmental monitoring, effluent monitoring, environmental surveillance, and compliance reporting. The EM Quality Assurance Project Plan (QAPIP) describes the responsibilities and activities that affect the quality of the operations, maintenance, and scientific and technical information collected. This EM QAPIP is a stand-alone project plan that supports and is included as an attachment to the *Environmental Monitoring Plan (EMP)*, PAD-ENM-0055. The EMP provides overall direction for EM activities.

The DOE Prime Contractor Quality Assurance Program and Implementation Plan (QAPIP) (PAD-PLA-QM-001) implements the Quality Assurance requirements established in 10 *CFR* § 830.120, DOE Order 414.1C, and American Society of Mechanical Engineers Nuclear Quality Assurance-1 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 QAPIP follows the format established in the U.S. Environmental Protection Agency (EPA), *Requirements for Quality Assurance Project Plans (QA/R-5)* (May 2006). This EPA document applies specifically to environmental data collected and used in decision making and provides the structure, content, and guidance for QAPIPs associated with environmental data collection.

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

## ***Reference Documents***

- PAD-ENM-0055, *Environmental Monitoring Plan*
- Kentucky Pollutant Discharge Elimination System (KPDES) Permit, KY0004049, December 1, 2009
- 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*
- PAD-PLA-QM-001 *LATA Kentucky Quality Assurance Program and Implementation Plan for the Paducah Environmental Remediation Project*

# 2. PROJECT/TASK ORGANIZATION AND RESPONSIBILITY

## 2.1 PROJECT PERSONNEL

The Organizational Chart for Site Operations is shown in Attachment 1. The Environmental Monitoring and Reporting Manager, who is responsible for implementing all relevant aspects of the EMP, reports to the Site Operation Manager. 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 Monitoring and Reporting Manager**

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

### **2.2.2 Environmental Sampling/Well Activities Manager**

The Environmental Sampling/Well Activities 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/Well Activities Manager is responsible for ensuring that the monitoring activities are consistent with the sitewide groundwater program and other EM policies and procedures. The Environmental Sampling/Well Activities 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 Monitoring and Reporting 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 Environmental Monitoring and Reporting Manager 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 Sample/Data Coordinator**

The Sample/Data Coordinator enters the data into ES PEMS, including chain-of-custody (COC) information, field data, validation qualifiers, and any pertinent sampling information. After receiving a notification that a fixed-base lab electronic data deliverable (EDD) is available to download, the Sample/Data Coordinator loads the EDD to environmental services (ES) Project Environmental Measurements Service (PEMS), performs electronic verification of the data, and then compiles the data assessment package. The Sample/Data Coordinator also prepares data for transfer from ES PEMS to Paducah Oak Ridge Environmental Information System (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 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 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.

### **2.2.8 Sample/Data Management Manager**

Sample/Data Management 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 Management Manager ensures compliance with policies and procedures relating to data management with respect to the project and that the requirements of PAD-ENM-5003 are followed.

### **2.2.9 Lab/Data Validation Coordinator**

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

### **2.2.10 Subcontractors**

Subcontractors provide sampling support to the Environmental Monitoring and Reporting Manager for all sampling activities up to biological monitoring activities (including deer and watershed monitoring sampling).

### **3. PROGRAM DEFINITION/BACKGROUND**

#### **3.1 PROGRAM STATEMENT**

The Environmental Monitoring 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 LATA Kentucky effective July 26, 2010, to manage and integrate the EM 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 (<sup>99</sup>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 groundwater contamination.



## 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 (KDPEP), 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 in-plume 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, compliance 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 QAPIP.

#### **4.3 REQUIREMENTS**

The EM QAPIP 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**

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.

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 have 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:

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

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

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

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 data quality objective (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 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. Subcontractors maintain copies of training records at the appropriate satellite Document Control Center (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, and procedures 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.

**Table 7.1. DOE/DOE Prime Contractor Documents, Plans, and Procedures**

<b>Number</b>	<b>Title</b>
PAD-ENM-0016	Maintenance and Use of ASTM Type II Water System
PAD-ENM-0014	Deer Sampling
DOE/OR/07-1707	Federal Facility Agreement for the Paducah Gaseous Diffusion Plant
PAD-ENM-0811	Pesticide and PCB Data Verification and Validation
PAD-ENM-5007	Data Management Coordination
PAD-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
PAD-ENM-5102	Radiochemical Data Verification and Validation
PAD-ENM-5103	Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans Data Verification and Validation
PAD-ENM-5105	Volatile and Semivolatile Data Verification and Validation
PAD-ENM-5003	Quality Assured Data
PAD-ENM-5004	Sample Tracking, Laboratory Coordination, and Sample Handling Guidance
PAD-RM-1009	Records Management, Administrative Record, and Document Control
PAD-ENM-0026	Wet Chemistry and Miscellaneous Analyses Data Verification and Validation
PAD-ENM-0055	Environmental Monitoring Plan
PAD-ENM-2100	Groundwater Level Measurement
PAD-ENM-2101	Groundwater Sampling
PAD-ENM-2203	Surface Water Sampling
PAD-ENM-2300	Collection of Soil Samples
PAD-ENM-2302	Collection of Sediment Samples Associated with Surface Water
PAD-ENM-2700	Logbooks and Data Forms
PAD-ENM-2702	Decontamination of Sampling Equipment and Devices
PAD-ENM-2704	Trip, Equipment, and Field Blank Preparation
PAD-ENM-2708	Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals
PAD-ENM-5107	Inorganic Data Verification and Validation
PAD-QA-1210	Issues Management Program
PAD-QA-1220	Occurrence Notification and Reporting
PAD-QA-1420	Conduct of Assessment
PAD-ENM-0023	Composite Sampling
PAD-ENM-0018	Sampling Containerized Waste

**7.2 RECORDS MANAGEMENT**

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

**7.2.1 Description of the Records Management System**

The records management system is defined by PAD-RM-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 Environmental Monitoring and Reporting 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 includes, but is 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.

### **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.

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.

**Table 7.2. Transfer of Records to the DMC**

<b>Record Type</b>	<b>Storage Location</b>	<b>Frequency of Transfer</b>	<b>Comments</b>
Training records	Kevil	As required	Submittal letter with a copy of training records will be submitted to the DMC and QA Manager.
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 and QA Manager.
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.
Chain-of-custody	C-755-T-01	Monthly	Copy of each chain-of-custody is sent to Sample/Data Management.

## **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 PAD-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.

### 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. PAD-ENM-5007, *Data Management Coordination*, provides the process of evaluating the quality of laboratory EDDs.

**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).	<ul style="list-style-type: none"> <li>• pH must read within the <math>\pm 0.2</math> range;</li> <li>• temperature must read within <math>\pm 0.2^{\circ}\text{C}</math>;</li> <li>• conductivity must read <math>\pm 1\%</math> of reading, <math>\pm 1</math> count;</li> <li>• dissolved oxygen must read within <math>\pm \pm 0.2 \text{ mg/L} \leq 20 \text{ mg/L}</math>, <math>\pm 0.6 \text{ mg/L} &gt; 20 \text{ mg/L}</math>;</li> <li>• turbidity must read within <math>\pm 5\%</math> of reading <math>\pm 1</math> nephelometric turbidity unit;</li> <li>• oxidation reduction potential must read within <math>\pm 25 \text{ mV}</math></li> </ul>
Surface Water Sampling	Field measurements for pH, specific conductance, temperature, dissolved oxygen, total residual chlorine, and flow rate.	<ul style="list-style-type: none"> <li>• pH must read within the <math>\pm 0.2</math> range;</li> <li>• temperature must read within <math>\pm 1^{\circ}\text{C}</math>;</li> <li>• conductivity must read <math>\pm 20 \mu\text{mhos/cm}</math>;</li> <li>• dissolved oxygen must read within <math>\pm 0.5 \text{ mg/L}</math>;</li> <li>• total residual chlorine is performed using amperometric titrator; no particular range is required;</li> <li>• 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</li> </ul>

## 10. SAMPLING METHODS REQUIREMENTS

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 PAD-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.

**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:

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

<b>QC Samples</b>	<b>Frequency</b>
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 LATA Kentucky Quality Program and 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 are not available from Paducah OREIS, other databases, records, etc., may be used with the approval of the Data Manager.

## **18. DATA MANAGEMENT**

LATA Kentucky 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 are 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.

Management assessments are conducted in accordance with a schedule prepared by the Environmental Monitoring and Reporting Manager.

Corrective actions of internal audit/surveillance findings and nonconformances are managed in accordance with the LATA Kentucky Quality Program 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 PAD-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.

### **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 Environmental Monitoring and Reporting Manager, Sample/Data Management Manager, and other EM team members, as appropriate.

### **20.4 VALIDATION AND VERIFICATION METHODS**

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

- PAD-ENM-5105 *Volatile and Semivolatile Data Verification and Validation*
- PAD-ENM-5107, *Inorganic Data Verification and Validation*
- PAD-ENM-5103, *Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans Verification and Validation*
- PAD-ENM-5102, *Radiochemical Data Verification and Validation*
- PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analyses Data Verification and Validation*
- PAD-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.

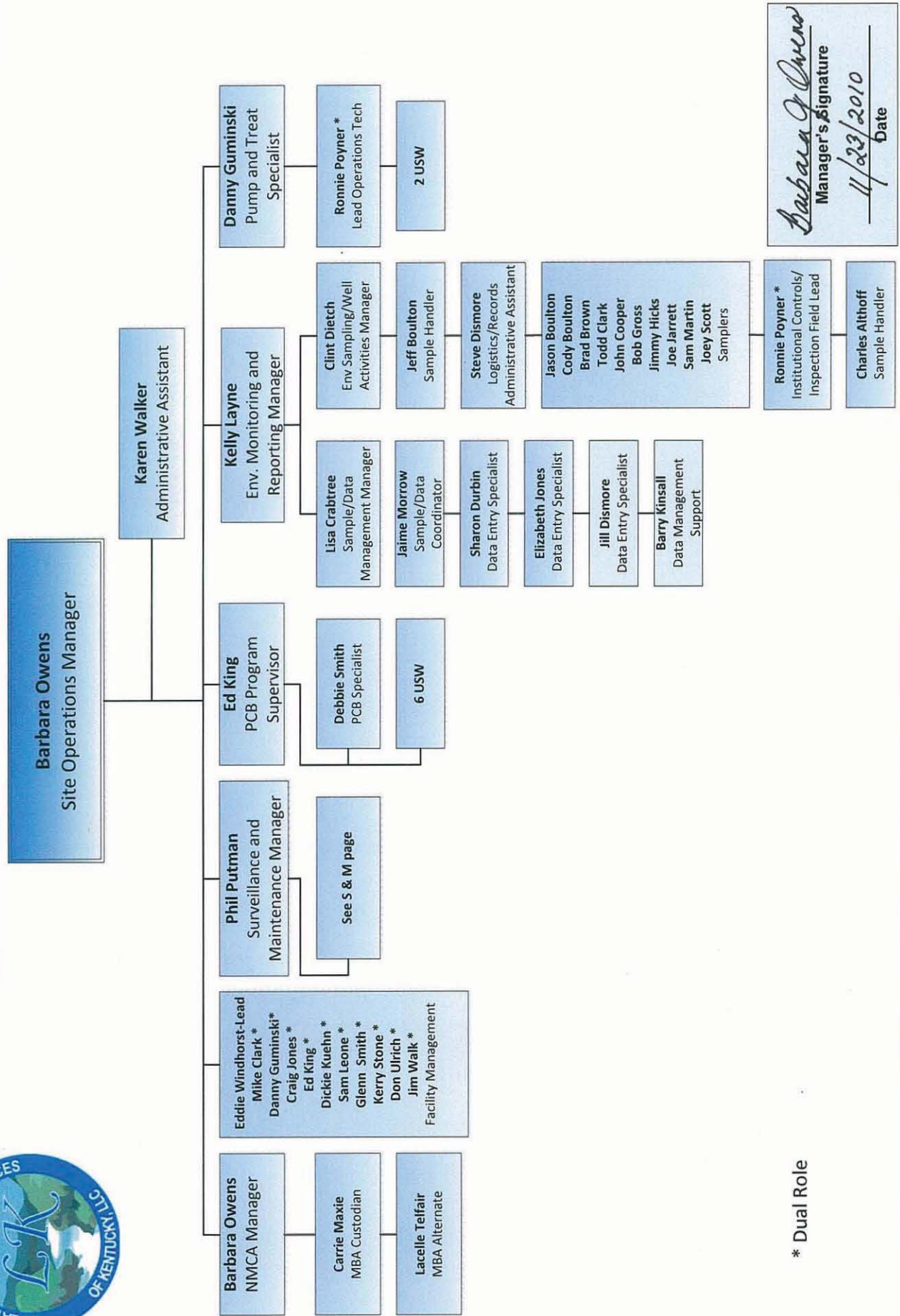


**ATTACHMENT 1**  
**SITE OPERATIONS ORGANIZATIONAL CHART**

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# Site Operations



\* Dual Role

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