PAD-ENM-0055/R3

Environmental Monitoring Plan
Fiscal Year 2014
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

This document is approved for public release per review by:

LATA Kentucky Classification Support

11-27-2013
Date

PAD-ENM-0055/R3

Environmental Monitoring Plan
Fiscal Year 2014
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

Date Issued—November 2013

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
AKGWA	Assembled Kentucky Ground Water Database
ASER	Annual Site Environmental Report
BWCS	B&W Conversion Services, LLC
CAP-88	Clean Air Act Assessment Package-88
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
DOD	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
ERPP	Environmental Radiation Protection Program
FFA	Federal Facility Agreement
FY	fiscal year
GSA	General Services Administration
ISMS	Integrated Safety Management System
KAR	*Kentucky Administrative Regulation*
KDOW	Kentucky Division of Water
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
MDL	method detection level
MW	monitoring well
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance
OU	operable unit
PGDP	Paducah Gaseous Diffusion Plant
PQL	practical quantification limit
QA	quality assurance
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SARA	Superfund Amendments Reauthorization Act
SPCC	spill prevention control and countermeasure
SSPP	Strategic Sustainability Performance Plan
TED	total effective dose
TLD	thermoluminescent dosimeter
USEC	United States Enrichment Corporation
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) 2014 is intended to document the rationale, sampling frequency, parameters, and analytical methods for environmental monitoring (EM) activities at the Paducah Site and provide 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, and sediment.

This EMP is comprised of the main text that details rationale and objectives, as well as four appendices. Appendix A is a summary of the Paducah Site permits and agreements; Appendix B is a well inventory; Appendix C lists all individual sampling programs, along with their sampling frequencies, methods, action limits, and parameter lists; and Appendix D contains quality assurance project plans for executing the work described in this EMP.

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 2014. If changes are deemed appropriate based on trending analyses, they will be proposed via a permit modification or decision document change (as applicable) and implemented immediately after approval by the regulatory agencies. These changes will be incorporated in the FY 2015 EMP. If sampling is modified due to a change in a sampling approach or by physical limitations, such as a dry well, then those conditions will be documented in the assessment file for that given project.

Changes to the sampling programs reflected in the FY 2014 EMP include, but are not limited to, the following actions, which are described later in more detail.

- Water Policy Boundary Monitoring Program: Samples will be analyzed for isotopic uranium and technetium-99 without a gross alpha and gross beta activity screening. Three wells were removed from the program—R12, R19, and R392.

- Environmental Radiation Protection Program: One location has been added to the program, L306, at Cairo, Illinois. This location will be monitored annually for the same parameters analyzed at the background location.

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1. INTRODUCTION

1.1 PURPOSE

This Paducah Site Environmental Monitoring Plan (EMP) for fiscal year (FY) 2014 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) 436.1, *Departmental Sustainability*; DOE O 458.1, *Radiation Protection of the Public and the Environment*; DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991), hereinafter identified as the Radiological Guide; and Commonwealth of Kentucky and federal regulations that implement federal environmental laws. The Radiological Guide establishes the elements of a radiological effluent monitoring and environmental surveillance program considered acceptable to DOE, in support of DOE O 458.1.

DOE O 436.1, *Departmental Sustainability*, was approved by DOE on May 5, 2011. It canceled DOE O 450.1A, *Environmental Protection Program*, and DOE O 430.2B, *Department of Energy, Renewable Energy and Transportation Management*. The development of DOE O 436.1 required sites to incorporate activities and programs to meet the goals of the Strategic Sustainability Performance Plan (SSPP), which are specified in Executive Order 13514. These environmental stewardship goals of the SSPP require sites to prevent pollution and eliminate waste; follow sustainable acquisition practices; encourage agency innovation; reduce greenhouse gas emissions; perform regional and local planning; execute and integrate high-performance sustainable design and green building best practices; and usher in electronic stewardship and data center energy efficiency. DOE O 458.1 establishes standards and requirements for DOE operations with respect to protection of the public and the environment against undue risk from radiation. Overall, the implementation of this Paducah EMP for FY 2014 will aid in planning for environmental remediation and monitoring efforts at the site and in meeting the goals of DOE O 436.1 and DOE O 458.1.

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, 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, 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. While this EMP addresses liquid effluent

monitoring from the depleted uranium hexafluoride conversion facility, which is operated by B&W Conversion Services, LLC (BWCS), this EMP does not address gaseous effluent monitoring that is conducted by BWCS in support of their air permit.

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 (MWs) that are sampled, 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 Environmental Services of Kentucky, LLC, evaluates optimization of sampling efforts in order to provide a comprehensive data set to the affected projects. Changes to the EMP, as a result of these evaluations, will be documented in the EMP rationale section and in each specific project section in Appendix C of the EMP. Optimization of permit-required sampling also is performed but will be implemented only when approved by the regulatory agencies. Changes that occur and are implemented during the fiscal year will be documented in the following year's EMP.

The Paducah Site EMP is evaluated and modified, as appropriate, using the data quality objective (DQO) methodology on an FY basis (i.e., October 1 through September 30) (EPA 2006). Measurement quality objectives are addressed in Appendix D, the Environmental Monitoring Quality Assurance Project Plan (QAPP), which is consistent with the Programmatic QAPP. The DOE prime contractor is responsible for implementing the EMP. Results are published and made available to the public in the form of the Annual Site Environmental Report (ASER).

QA is assured through assessments and management-by-walking-around. At a minimum, a management assessment of a sampling activity mandated by a permit will be conducted on a quarterly basis.

1.3 RATIONALE

The rationale for EM activities at the Paducah Site for FY 2014 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.

Data collected under existing permits and under CERCLA or Resource Conservation and Recovery Act (RCRA) decision documents will continue to be evaluated in FY 2014. 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 RCRA decision document were changed only if the permit or decision document allowed the change. If, during FY 2014, changes are deemed appropriate based on trending analyses, changes will be proposed via a permit modification or decision document change and implemented immediately after approval by the regulatory agencies. These changes will be incorporated in the FY 2015 EMP. If sampling is modified due to a change in a sampling approach or by physical limitations, such as a dry well, then those conditions will be documented in the assessment file for that given project.

Changes to the sampling programs reflected in the FY 2014 EMP include, but are not limited to, the following actions, which are described in more detail in Appendix C.

- Water Policy Boundary Monitoring Program: Samples will be analyzed for isotopic uranium and technetium-99 (Tc-99) without a gross alpha and gross beta activity screening. Three wells were removed from the program—R12, R19, and R392.

- Environmental Radiation Protection Program (ERPP): One location has been added to the program, L306, at Cairo, Illinois. This location will be monitored annually for the same parameters analyzed at the background location.

1.4 GENERAL CONSIDERATIONS

1.4.1 Site Description

The Paducah Site is located in a generally rural area of McCracken County, Kentucky [population approximately 65,000 (DOC 2011)]. Uranium enrichment ceased in August 2013. The uranium enrichment process facility consists of a diffusion cascade and extensive support facilities. The cascade, including product and tails withdrawal, is housed in six large process buildings. The plant is located on a reservation consisting of approximately 3,556 acres in western McCracken County, 10 miles west of Paducah, Kentucky, [population approximately 25,661 (DOC 2011)] and 3.5 miles south of the Ohio River (Figure 1). The facility is on approximately 1,350 acres with controlled access. Roughly 650 acres of the reservation are enclosed within a fenced security area. An uninhabited buffer zone of at least 400 yd surrounds the entire fenced area. During World War II, the Kentucky Ordnance Works was operated in an area southwest of the plant on what is now a wildlife management area. Three small communities are located within 3 miles of the DOE property boundary at PGDP: Heath and Grahamville to the east and Kevil to the southwest. The closest commercial airport is Barkley Regional Airport, approximately 5 miles to the southeast. The population within a 50-mile radius of PGDP is about 534,000. Within a 10-mile radius of PGDP, the population is about 66,000 (DOC 2011).

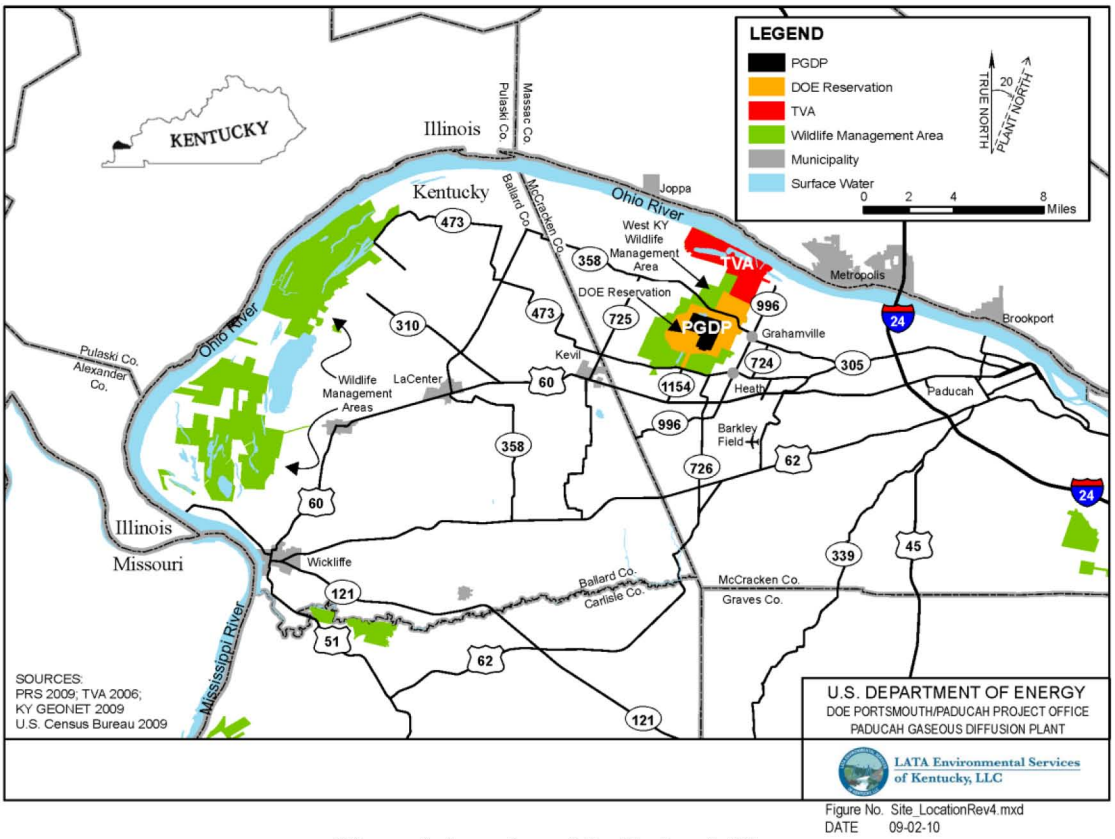

Figure 1. Location of the Paducah Site

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 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 [West Kentucky Wildlife Management Area (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 cascades 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 (Pu-239), 18,400 grams of neptunium-237 (Np-237), and 661,000 grams of Tc-99. The majority of the Pu-239 and Np-237 was separated out during the initial chemical conversion to uranium hexafluoride (UF_6). Concentrations of transuranics (e.g., Pu-239 and Np-237) and Tc-99 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. USEC operated the uranium enrichment process until August 2013, at which time USEC began transition of the facilities to DOE, as specified by the terms and conditions of the Lease Agreement.

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 of 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 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).

- Ensure 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 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

Section 1 is used to describe the program's relevant historical and current information. Section 2 of this document describes effluent monitoring for liquid and airborne radiological constituents. Section 3 discusses 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.

1.7 MEASURING FACILITY IMPACT

The Radiological Guide requires comparisons of the measured concentrations against measured concentrations at "background" locations. 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 Commonwealth of Kentucky 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. This table includes monitoring of liquid effluents, but it does not include gaseous effluents by BWCS operations. BWCS conducts gaseous effluent monitoring on their systems, as described in Section 1 of this EMP. No other DOE operations at the Paducah Site require an air permit. A summary of permits and compliance agreements is included in Appendix A.

Table 1. Routine Liquid Effluent Monitoring

Program	Number of Locations	Sampling Frequency
Surface Water		
C-746-S&T Landfills	3[a]	Quarterly
C-746-U Landfill	3[a]	Quarterly
Environmental Radiation Protection near Kentucky Pollutant Discharge Elimination System (KPDES) Outfalls	5	Monthly
KPDES		
Chemical/Radiological (K001)	1	Weekly
Chemical/Radiological (K015, K017, K019, K020)	4	Monthly[b]
Toxicity (K001, K015, K019, K020)	4	Quarterly
Toxicity (K017)	1	Monthly
Leachate		
C-746-S&T Landfills	1	As required and annually
C-746-U Landfill	1	As required and annually
C-404 Landfill	1	As required

[a] One location, L154, is permitted for both the C-746-S&T Landfills and for the C-746-U Landfill. Totals represent this location for each landfill, as shown in the applicable permits. Total number of locations sampled equals five.
[b] pH is required to be collected at K019 and K020 on a weekly basis.

The primary statute governing the monitoring of effluents to surface water is the Clean Water Act (with the exception of radionuclides), which requires the issuance of a National Pollutant Discharge Elimination System (NPDES) permit.[1] EPA has delegated the administration of the NPDES Program to the Kentucky Division of Water (KDOW) KPDES Program. The KPDES permit requires radiological monitoring at the permitted outfalls for reporting purposes only.

Sampling and analytical methods meet the requirements described in 40 *CFR* § 136 or the KPDES permit (KY0004049). In addition, DOE O 458.1, *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.

[1] Radioactive materials that are regulated under the Atomic Energy Act of 1954 are excluded from the Clean Water Act.

Rationale and Design Objectives. To ensure the protection of public health and the environment, the technical/regulatory objectives identified as part of DQOs for the Effluent Monitoring Program include the following:

- Verifying compliance with applicable federal, Commonwealth of Kentucky, 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, Section 2.0 of the Radiological Guide recommends that 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 required for each extraction (continuous monitoring and/or sampling) location;
- Method detection level (MDL)/minimum detectable activity and accuracy by analyte;
- QA components; and
- Effluent outfall alarms.

The preceding requirements are addressed as follows.

- Appendix C of this document lists all effluent monitoring locations. Appendix C specifies sampling and field measurements, as well as analytical method information. Appendix C also lists the sampling frequency at each location and the required analytical parameters, analytical method, and required reporting limits (as applicable) Additionally, Appendix C specifies the sampling driver for each sampling program (e.g., permit, CERCLA decision document, etc.). Generally, data collected as part of this document not only meets permit and CERCLA decision requirements, it also provides data sets that may be used in future CERCLA decision documents.
- Appendix D of this document provides the Quality Assurance Project Plan (QAPP). All QA components are outlined within this plan. The QAPP identifies reporting limits [or practical quantification limits (PQLs)] and MDLs. In cases where reporting limits (or PQLs) are specified under a given regulatory driver, those requirements are denoted as such within the QAPP.

- Each laboratory receives a statement of work for all sampling activities. The reporting limits (or PQLs) found in the QAPP are specified in the statement of work as a condition of work. If a laboratory cannot meet these limits, and if the limits are not a matter of regulatory compliance, the project manager may approve the increased reporting limits (or PQL) and/or MDLs.

- Monitoring results from the KPDES outfalls are summarized in the discharge monitoring reports, which are submitted on a monthly basis to the KDOW as required by the KPDES permit. Notifications of exceedances to the permit are submitted per the specifications within the permits. 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.

Evaluation of Effluents. Effluents, regardless of whether they contain radiological contaminants from new or modified facilities, are to be evaluated against permit conditions (as applicable) by the Environmental Compliance support personnel. Additionally, data are reviewed according to the ERPP organization for evaluation and trending purposes and to determine any required 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 establishes monitoring requirements for the discharge of effluent and surface water runoff. The KPDES permit became effective on November 1, 2009. This modification added Outfall 020 and removed some parameters. Other modifications to the permit have been made (i.e., contractor name change, etc.); however, these modifications have not affected the sampling locations or parameter list.

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.

Processes for DOE operations have been evaluated to determine the chemicals, radiological components, and physical parameters (e.g., temperature) likely to affect the KPDES-permitted effluents. Effluents from permitted landfills are evaluated during the reporting and permit renewal processes. An application for renewal was submitted in 2011. KDOW currently is reviewing the application.

Radiological. Based on the evaluation of emissions and the results of radiological monitoring from historical data sets, neither continuous monitoring nor continuous sampling with frequent analyses is required by DOE O 458.1. The KPDES permit requires monthly radiological analyses at the outfall locations (Figure C.12); however, the Commonwealth of Kentucky did not apply limits to radiological components of the liquid effluent.

Effluent sampling is required by the ERPP. Radiological data sets of effluent water near the KPDES outfalls (Figure C.13), along with surveillance data of surface water and sediments slightly downstream (Figures C.15 and C.16), will be evaluated as part of the ERPP.

Program Implementation Procedures. The EM manager (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the EM manager reports through a line organization to the manager of projects 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 Commonwealth of Kentucky 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 trichloroethene (TCE), in outfalls.

C-746-S&T and C-746-U Landfills Surface Water. Rainfall runoff from three locations at C-746-U and three locations at C-746-S&T Landfills (Figure C.11) 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 Landfills.

KPDES Monitoring. Five DOE-owned effluent sampling points covered by the KPDES permit (Outfalls 001, 015, 017, 019, and 020) are illustrated in Appendix C (Figure C.12). Sampling is conducted weekly at Outfall 001 and monthly at Outfalls 015, 017, 019, and 020, when water is flowing.

2.1.2 Leachate

C-746-S and C-746-U Landfills 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 Landfill 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.

2.2 AIRBORNE

Airborne emissions are regulated by the Kentucky Division for Air Quality. Emissions that may be harmful to the public or the environment are required to obtain permits from the Division for Air Quality. Operations at the depleted uranium hexafluoride facility require an air permit. Remaining DOE operations do not require a permit. Ambient air monitoring, which monitors fugitive emissions from all Paducah Site operations (including USEC operations), is conducted by eight continuous air monitors. Data from a background location also is collected.

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. The Paducah Site requires meteorological monitoring data to support both chemical and radiological evaluations. The Radiological Guide recommends that a meteorological monitoring program appropriate to site activities be established. In general, sites should have on-site measurements of basic meteorological data. The Paducah Site no longer operates the on-site meteorological tower to collect meteorological data. Meteorological data sets from other sources are used to model the radiological and chemical emissions.

3.1 CHEMICAL EMISSIONS

DOE operations may have airborne chemical emissions from various sources, such as CERCLA remedial actions, as well as fugitive emissions. Projects requiring dispersion modeling have purchased meteorological data from accredited meteorological measuring stations that are in close proximity to the site.

3.2 RADIOLOGICAL EMISSIONS

DOE operations may have airborne radiological emissions from various sources, such as CERCLA remedial actions, as well as fugitive emissions. Modeling to demonstrate compliance with NESHAP regulations is conducted using the Clean Air Act Assessment Package-88 (CAP-88). Meteorological data utilized for CAP-88 are compiled from historical data from the on-site meteorological tower. The historical data set meets the data quality requirements. Other dose modeling software such as RESRAD-OFFSITE or RESRAD-BIOTA may be used with appropriate meteorological data sets.

Actual ambient air radionuclide concentrations at PGDP are monitored continuously and the levels are bounded by conservative assumptions in the calculation of the dose to the maximum exposed individual. DOE operations at the PGDP site have limited potential for atmospheric release of radiological hazardous materials.

One of the most important decisions in preparing for an air quality modeling analysis involves the selection of the meteorological database. The CAP-88 computer model is used to estimate the public dose. The current meteorological data set is the five-year STAR distribution from the 60-m station on the PGDP meteorological tower for the years 1988 through 1992. (Meteorological tower operations ceased in 1993.) The historical data set was generated in compliance with the appropriate guidance and met the data quality requirements (EPA 2000; DOE 2004). This included meteorological conditions measured at two heights. The quality of the data set at PGDP is commensurate with the level of site radiological activities, the site topographical characteristics, and the distance to critical receptors. While the data set uses five years of data to account for all seasonal variations, the data set does not account for any long-term change in wind patterns over decades.

In general, for use in air quality modeling applications, meteorological data should be representative of conditions affecting the transport and dispersion of pollutants in the “area of interest,” as determined by the locations of the sources and receptors being modeled. A quantitative method does not exist for determining representativeness absolutely. Use of the historical data set still is considered representative of the site because the on-site terrain has remained constant—the terrain is an industrial site that is flat and partially wooded—and the on-site data set includes the resultant air flow from the terrain.

The public dose from air emissions is estimated by use of the EPA-supplied CAP-88 computer model. CAP-88 relies on the meteorological data set to estimate the dispersion of the pollutant radionuclides. The CAP-88 model assumes steady state air dispersion of emitted radionuclides results in a public dose based on multiple radionuclide uptake methods.

PGDP site operations historically have contributed little, if any, dose to the public. The ambient air concentration of radionuclides usually is below the detection ability of the ambient air stations. Since 2000, most of the ambient air monitoring stations have not detected any airborne radionuclides. The few detection results recorded have been below the 40 *CFR* § 61, Appendix E, Table 2, safe dose values. The CAP-88 model estimated dose modeled in previous ASERs also has been much lower than the regulatory safe public dose standard of 10 mrem/year.

Choosing a different meteorological data set for CAP-88 potentially would cause a small change in the dose estimate; however, based on the above discussion and due to the very low dose resulting from site radionuclide emissions, the model results would be much less than the safe public dose standard. Based on these conditions, the existing on-site data set will be utilized with the CAP-88 program for dose calculation purposes.

4. ENVIRONMENTAL SURVEILLANCE

Supporting the goal of DOE O 436.1, *Departmental Sustainability*, for planning environmental activities, the Paducah Site performs environmental surveillance. Environmental surveillance is the collection and analysis of samples or direct measurements of air, water, sediment, 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; therefore, the environmental surveillance program is a comprehensive environmental program addressing radiological and nonradiological parameters.

In support of DOE O 458.1, *Radiation Protection of the Public and the Environment*, the Paducah Site performs monitoring of remedial actions and activities to monitor that members of the public are not exposed to ionizing radiation at a total effective dose (TED) exceeding 100 mrem (1 mSv) in a year from all sources of ionizing radiation and exposure pathways. Air emissions are covered under 40 *CFR* § 61, *National Emissions Standards for Hazardous Air Pollutants (NESHAP)*. Because 40 *CFR* § 61 still operates under previous dosimetric terminology, dose calculated and reported to comply with 40 *CFR* § 61 will continue to be reported under the old terminology. Air emissions are required to be part of the total when calculating TED under the new 10 *CFR* § 835 dosimetric terminology; however, until 40 *CFR* § 61 is revised to incorporate new dosimetric terminology, then effective dose equivalent (EDE) calculated from the old terminology under NESHAP will be assumed to be approximately equivalent to effective dose defined under the new terminology for the purpose of incorporating it into the TED calculated. Any one air emission source is limited to 10 mrem EDE to the maximum exposed member of the public per 40 *CFR* § 61, Subpart H.

DOE activities must be conducted to ensure that radionuclides contained in liquid effluents do not cause private or public drinking water systems to exceed an annual dose of 4 mrem per year per 40 *CFR* § 141. For monitoring of public drinking water systems, 40 *CFR* § 141 allows for environmental surveillance data to be used in the vicinity of nuclear facilities. The nearest downstream public water withdrawal location is Cairo, Illinois, located on the Ohio River. To avoid potential readings from other sources that may be found in the Ohio River, the plant effluents can be evaluated against the 4 mrem standard within the Bayou and Little Bayou Creek systems prior to confluence with the Ohio River. Compliance demonstrated within the creeks shows compliance to 40 *CFR* § 141 for the nearest public drinking water system. The public is protected from contaminants in groundwater that would be accessed by private drinking water systems (i.e., wells) because of the protectiveness afforded by the Water Policy Box (see Figures. C.8 and C.9).

DOE O 458.1 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 radiological activity whether the exposure is within a DOE site boundary or off-site. It does not include doses received from radon and its decay products in air (regulated separately under DOE O 458.1), occupational exposures, doses received from naturally occurring “reference” radiation, or doses received by a patient from medical procedures. The determination of the public dose, as established by EPA regulation 40 *CFR* § 61, differs in that the 10 mrem EDE 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 effective dose to an individual or 100 person-rem collective effective dose within a radius of 80 km (about 50 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 EDE (individual) or 100 person-rem collective EDE.

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). (Note: An updated groundwater conceptual model for the site using data through 2012 has been developed. Because the updated model has not been finalized, the 2010 model was used for the development of this EMP. It should be noted, however, that the plume footprint in the 2012 model is similar to that of 2010 with notable differences in the TCE concentration on the outer edges of the plume contour. While these changes indicate progress in long-term site cleanup, it does not impact the sampling strategy development outlined within this EMP. The use of the 2010 model is considered adequate to meet the objectives of this plan.)

Table 2. Routine Environmental Surveillance

Program	Number of Locations	Sampling Frequency	Sample Type	Parameters
Groundwater				
Surveillance	25	Annually	Grab	See Appendix C
Surveillance	101	Biennially (Sampled FY 2013—not to be sampled in FY 2014)	Grab	See Appendix C
Surveillance Geochemical	39	Every 3 years (Sampled FY 2013—not to be sampled in FY 2014)	Grab	See Appendix C
C-746 S&T Landfills	25[a]	Quarterly	Grab	See Appendix C
C-746-U Landfill	21[a]	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	Semiannually	Grab	See Appendix C
Northeast Plume	5	Quarterly	Grab	See Appendix C
Northwest Plume	33	Semiannually	Grab	See Appendix C
C-400	9	Quarterly	Grab	See Appendix C
C-400	8	Semiannually	Grab	See Appendix C
Water Policy Boundary-NW	20	Quarterly	Grab	See Appendix C
Water Policy Boundary-NE	10	Annually	Grab	See Appendix C
Residential Carbon Filter System	1	Semiannually	Grab	See Appendix C

Table 2. Routine Environmental Surveillance (Continued)

Program	Number of Locations	Sampling Frequency	Sample Type	Parameters
Surface Water and Seeps				
Surface Water and Seeps	20	Quarterly	Grab	See Appendix C
Surface Water—ERPP	4/2	Quarterly/Annually	Grab	See Appendix C
C-613 Sediment Basin	1	Quarterly	Grab	See Appendix C
Sediment				
Sediment	14	Semiannually	Grab	See Appendix C
Sediment—ERPP	6	Annually	Grab	See Appendix C
Ambient Air	9	Weekly/Quarterly	N/A	See Appendix C
Meterologic[b]	N/A	N/A	N/A	N/A
Environmental TLDs	57	Quarterly	Continuous	External Gamma

[a] Four of the same wells are cited in both C-746-U and C-746-S&T Landfills 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 2 wells that are measured only for water level. The number of locations sampled for analytical laboratory parameters is 23 locations.
[b] 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 ensure the protection of public health and the environment. The technical criteria identified as part of DQOs for the groundwater monitoring program include 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. Neither DOE Orders nor the Radiological Guide requires specific groundwater sampling frequencies or parameters. Instead, DOE Orders require that sample collection programs reflect specific facility needs. Type and frequency of sampling shall be adequate to characterize effluent streams and to identify existing and potential groundwater contamination sources. Monitoring verifies that releases are sustainable without causing environmental harm. This EMP was written to include effluent monitoring and environmental surveillance at the Paducah Site. In order to provide a data set that is assessed for potential environmental impacts, a comparison data set from samples collected from areas that are not impacted by site operations also is required. Such sample locations are called “background” locations.

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* Section 5:037. This requirement was addressed by DOE, by writing and implementing a Groundwater Protection Plan, according to 401 *KAR* Section 5:037, prior to the deadline of August 24, 1995. This document was revised in August 2013. The review cycle for this plan is on a on a three-year basis.

Agreement in Principle Sampling. The Agreement in Principle (AIP) provides sampling and inspection of the differing monitoring programs. The oversight includes inspections (including MW inspections and surface water area inspections), 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 (attributed to historical releases from Paducah facilities). This requirement is addressed through the RI process and ongoing remedial actions for operable units at the Paducah Site, as well as the sampling under this EMP.

The *Action Memorandum for the Water Policy at Paducah Gaseous Diffusion Plant* (Water Policy) (DOE 1994) stipulated the need to ensure that residential landowners whose well water was contaminated by PGDP sources were provided with water (DOE 1995; DOE 1993). 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 Action Memorandum provided the sampling strategy only at the time the document was prepared and referred future sampling to the Sampling and Analysis Plan Addendum, which previously was superseded by the EMP. Currently, 33 wells are sampled in support of action (Figures C.8 and C.9).

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.

C-400 Program. Sampling of MWs provides a meaningful tool for evaluating the downgradient dissolved-phase contamination in the Northwest Plume and the efficacy of the C-400 Interim Remedial Action (Figure C.7). 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* (DOE 2011a). Additional sampling requirements are documented in PPPO-02-452-09, "Response to Letter from Kentucky Division of Waste Management Regarding Baseline Groundwater Sample Collection at the Northwest Corner of the C-400 Building," July 8, 2009.

FFA Requirement and Operation and Maintenance (O&M) 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, 33 wells are required to

be sampled for the Northwest Plume (Figure C.6) and 16 for the Northeast Plume (Figure C.5), according to their respective O&M Plans.

The number of MWs sampled in support of the Northwest Plume monitoring program increased due to completion of the Northwest Plume Optimization project in August 2010. The increase in the program will aid in determining the effectiveness of the new extraction wells installed as part of this optimization program.

O&M Plans also specify production sampling. Sampling and monitoring of treatment systems are not captured within this EMP.

4.1.2.1 Landfill groundwater monitoring program

C-746-S and C-746-T Landfills. C-746-S and C-746-T Solid Waste Landfills are closed landfills owned by DOE. These landfills currently are in postclosure status under the landfill permits SW07300014 and SW07300015. The groundwater is monitored utilizing a total of 25 MWs near the two landfills (Figure C.2). Of these 25, 23 are used for collection of samples to analyze organic, inorganic, and radiological parameters. The remaining two are used for water level measurements. Additional analytical information is found in Appendix C.

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; 21 MWs (Figure C.2) are monitored quarterly for organic, inorganic, and radiological parameter. Additional analytical information is found in Appendix C. Sampling and monitoring of treatment systems are not captured within this document because they are part of the daily operations of the landfill.

Technical Attachment 25, Appendix G, to the permits for C-746-S, C-746-T, and C-746-U Landfills specifies a sample collection order. The order is as follows: volatiles (including total organic halides), dissolved gases and total organic carbon, semivolatile organics, metals and cyanide, water quality cations and anions, and radionuclides. If samples are being collected at a location where it is anticipated that sample volume is not adequate, then the order of collection will be volatiles followed by radionuclides.

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, including Attachment E of the permit, “Groundwater Monitoring.” The groundwater is monitored utilizing nine MWs (Figure C.3). There are six downgradient and three upgradient compliance point wells. Per the permit, sample aliquots shall be withdrawn in the following order: volatiles, total metals, and radionuclides. Remaining permit requirements may follow the radionuclide sample collection. Samples are to be collected twice a year: January through March as one sampling event and July through September as the second event. Results from the January through March event are due to KDWM by May 30 and results from the July through September event are due to KDWM by November 30.

Prior to sample collection, KDWM shall be notified one week in advance. Notification may be made in writing or electronic format. Electronic mail shall be submitted to pgdp.notify@ky.gov, and other pertinent KDWM field personnel.

All groundwater MWs will be inspected annually during the third quarter of the calendar year. The wells will be inspected for the condition of the Assembled Kentucky Ground Water Database (AKGWA) identification, the outer casing, the concrete pad, the bumper posts, painting, the well cap, the lettering and numbers, lock and hasp, well access, vegetation control, and well fittings and tubing. Items will be

repaired, as necessary. The wells will be inspected annually for excessive sedimentation by performing a depth sounding at each MW.

C-746-K Landfill. Sampling of four MWs (Figure C.4) 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. The Record of Decision for Waste Area Groups 1 and 7 (DOE 1997) discussed sampling that was being conducted at the time of the ROD development; however, the ROD allowed for modifications to the sampling strategy with documentation of the strategy in an EMP. Sampling of these wells is not required by a permit, but is conducted in support of the FFA CERCLA investigation and RCRA facility investigations according to the Paducah FFA. Additional analytical information is found in Appendix C.

4.1.2.2 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, 97 non-background MWs are sampled biennially and 24 are monitored annually, as shown in Appendix C (Figure C.10). Sampling of these MWs is not driven by a permitted process, but is conducted in support of the FFA CERCLA investigations, as well as DOE O 436.1. The inclusion of these MWs in this program does not exclude them from other sampling programs. For ease of review, Appendix B of this document contains a well inventory list, which acts as a crosswalk for each MW and sampling program.

The sampling frequency for this program was modified in the FY 2011 EMP. The sampling frequency was modified from a quarter/semiannual basis to an annual/biennial basis. This modification was justified by an evaluation of the data collected over the last 10 years, which showed that there have not been significant changes that merited the need for sampling as frequently. The 25 MWs that were selected to be monitored annually were selected based on their location within the plumes. Some MWs are key for early detection of plume migration; others are key for ongoing CERCLA work. The balance of the MWs will be sampled in this FY 2015. Although not sampled during FY 2014, the sampling program is detailed in Appendix C. It is shaded to denote that sampling is not included in the FY 2014 sampling campaign but is planned in upcoming events.

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 3 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 O 436.1. The sampling frequency for this program was modified in the FY 2011 EMP. The sampling frequency was modified from an annual basis to a triennial basis. These MWs will be sampled in this FY 2016. They are included in this EMP; however, they are shaded and denoted that they are not included in FY 2014 sampling campaign.

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), MWs, parameters, analytical methods, required reporting limits (as applicable), and the sampling frequency.

4.1.4 Program Implementation Procedures

Organization. The EM manager (or designee) is responsible for implementing all relevant aspects of the EMP.

Plans. The Groundwater Protection Plan (LATA Kentucky 2013a) 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

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.

The Environmental Surveillance Watershed Monitoring Program at the Paducah Site for surface water and sediment has evolved over a number of years in response to regulatory and community concerns. Initially, the prudent action was to sample surface water at the permitted outfalls and upstream and downstream within the receiving streams to assess potential impacts. Since that time, DOE has conducted remediation/removal efforts at the site, which has decreased the potential for surface water and sediment contamination. Additionally, the effluent and surface water runoff from outfalls leaving the plant site is monitored to confirm no current impacts from ongoing operations. Monitoring at the outfalls is permitted by KDOW through the KPDES permit and radiological parameters are monitored under DOE O 458.1 requirements. Limited radiological samples for surface water and sediment are collected in the environment to verify the effectiveness of the outfall sampling and to evaluate the accumulation of radionuclides in the environment. Data collected provide documentation of limited surface water impacts related to the site.

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. Sample sites were selected to prioritize areas where the public had access and to capture any and all emissions from the plant site. Contaminant sources include both point sources (e.g., effluent outfalls) and nonpoint sources, such as waste disposal areas or burial grounds.

4.2.2 Extent and Frequency of Monitoring

4.2.2.1 Surface water program

Surface water is sampled on a quarterly basis for PCBs at 19 locations upstream and downstream from Paducah Site operations (Figure C.15). One seep location in Little Bayou Creek is sampled quarterly for TCE. Surface water monitoring at 19 locations for PCBs is specified by the KPDES permit.

For radiological parameters, surface water is sampled quarterly at four locations. One background location and a location near the nearest public water withdrawal location, Cairo, Illinois, (L30) is sampled annually. This sampling is performed to evaluate all potential radiological effluents leaving the site and to evaluate the effectiveness of the outfall sampling program. This supports the implementation of DOE O 458.1 through the ERPP, PAD-PROG-0055 (LATA Kentucky 2013b). Additional analytical information is found in Appendix C.

4.2.2.2 Sediment program

Sediment samples are collected semiannually from 14 locations, 2 of which are considered background locations (Figure C.16). Five locations and a background are sampled for radiological parameters to evaluate the effectiveness of the plant effluent monitoring and to monitor the accumulation of contaminants in the environment. Sediment is sampled near the surface water and biological stations at locations downstream from plant operations and in background (reference) streams. Station locations coincide with those for surface water in Bayou Creek and Little Bayou Creek. Of note: Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise. Additional analytical information is found in Appendix C. An assessment code of “DRY” has been added in OREIS with the description of “Result reported on a dry weight basis,” for data generated starting in FY 2014, as applicable.

4.2.3 Program Implementation Procedures

The EM manager (or designee) is responsible for implementing all relevant aspects of the EMP. In that role, the EM manager reports through a line organization to the manager of projects 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 Kentucky Department of Fish and Wildlife Resources sponsors field hunting trials for dogs within the WKWMA.

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. Due to downward trends and continued lack of detection results, this sampling is not performed. Additional details of these evaluations are discussed in below.

4.3.1 Rationale and Design Criteria

4.3.1.1 Soils

Very low amounts of airborne radionuclides are emitted at the Paducah Site. A portion of the airborne radionuclides is estimated to be deposited in soil. Irrigation and deposition through waterborne radionuclides is an incomplete pathway because municipal water is used at nearby residences for household purposes (including activities such as watering plants and lawns). AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the estimated released airborne radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

4.3.1.2 Animal products

Very low amounts of airborne radionuclides are emitted at the Paducah Site. A portion of the airborne radionuclides is estimated to be deposited in soil and on food crops where they may be absorbed into plants and then may be ingested by animals. Animal products then may be ingested by the public. Irrigation and deposition through waterborne radionuclides is an incomplete pathway because municipal water is used at nearby residences for household purposes (including activities such as watering plants and lawns). The Paducah Site estimates doses from animal products to the receptors based on these estimated airborne emissions. AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the estimated released airborne radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

4.3.1.3 Food crops and vegetation

Very low amounts of airborne radionuclides are emitted at the Paducah Site. A portion of the airborne radionuclides is estimated to be deposited in soil and on food crops and vegetation where they may be absorbed into food crops and vegetation. These food crops then may be ingested by the public. Irrigation and deposition through waterborne radionuclides is an incomplete pathway because municipal water is used at nearby residences for household purposes (including activities such as watering plants and lawns). The Paducah Site estimates doses from food crops to the receptors based on these estimated airborne emissions. AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the

estimated released radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

4.3.1.4 Wildlife

Deer monitoring has been eliminated from the Paducah Site monitoring program. During FY 2011, DOE performed an extensive review of data sets from 20 years of deer harvesting events. As a result of this review, DOE eliminated the deer monitoring because of a downward trend and a continued lack of detection in the results, as well as an overall downward trend in the concentration of contaminants found at the Paducah Site due to remediation efforts.

4.4 EXTERNAL GAMMA RADIATION

The Paducah Site conducts routine surveillance of external gamma radiation exposure to monitor any effects due to past releases of radionuclides and current operations involving radioactive sources (e.g., depleted uranium hexafluoride cylinder management). Historical monitoring has shown that the external gamma radiation dose from routine DOE operations at the Paducah Site boundary is well under 5 mrem per year effective dose (individual) and 100-person rem per year effective dose. Routine surveillance of external gamma radiation with thermoluminescent dosimeter (TLD) monitors is conducted as a conservative measure to provide data to model direct external radiation from sources located on-site consistent with DOE O 458.1. Area gamma and neutron TLD monitoring near cylinder yards has been in place in previous years to meet 10 *CFR* § 835 requirements. To reduce the duplication of monitoring locations along the security fence, DOE O 458.1, environmental gamma TLD program, and the 10 *CFR* § 835, area TLD monitoring program, were combined. The neutron monitoring provides data to determine if there is any potential neutron dose from cylinders to members of the public. This program is contained within the radiological control organization.

4.4.1 Objectives

A primary objective is to calculate the effective dose of the maximally exposed individual member of the public.

A second objective is to calculate effective dose to a member of the public in areas freely accessible to members of the public. The Paducah Site licenses a portion of the Paducah Site to the Kentucky Department of Fish and Wildlife for recreational uses. These areas are open to the public for use but do not have any residences within the Paducah Site boundary. 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. It is anticipated that any use would be limited to recreational purposes and durations of time spent in the area by the public would be less than full time.

A third objective is to calculate the effective dose to a member of the public at the Paducah Site boundary. No residences are on-site and any residential receptor would be beyond the Paducah Site boundary.

A forth objective is to establish the potential dose that a member of the public may receive while visiting or passing through the Paducah Site. This would be for visitors accessing the Paducah Site in the area closed for public access but outside DOE-controlled areas, as defined by 10 *CFR* § 835.

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

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 U-238. 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 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 sources for radiation exposure to areas outside the PGDP security fence are the UF_6 cylinder storage yards, which are located within the secured area, but in close proximity to the perimeter fence. Studies conducted within the cylinder storage yards have shown that the cylinders are sources of both gamma and neutron radiation. The neutrons are produced at moderate energy levels by the alpha-fluorine reaction taking place within the residual UF_6 material. Further studies have indicated that the range of the neutrons is such that the neutron dose rate falls off rapidly with distance. Past monitoring has demonstrated that neutron producing radionuclides have not been detected in sufficient quantity to create a significant source for neutron radiation in areas that are accessible to members of the public. Results from TLD monitoring in areas accessible by members of the public 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 57 locations, including the PGDP perimeter, outfalls, ditches, and background locations (Figure C.17). TLDs also have been placed in areas that historically have received the highest radiation exposure.

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, as well as in the ASER.

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 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. Historically, the Kentucky Cabinet for Health and Family Services (Radiation Health Branch) conducted this ambient air monitoring for the Paducah Site. Beginning in July 2012, EM began O&M of the air monitoring program. The network is comprised of 9 air monitoring stations, including one background station (Figure C.18). Additional analytical information is found in Appendix C. Air monitoring data are reviewed and included in the NESHAP report and ASER.

4.6 VEGETATION/SOIL

Very low amounts of airborne radionuclides are emitted at the Paducah Site. A portion of the airborne radionuclides is estimated to be deposited in soil and on vegetation. The Paducah Site estimates doses through the food chain to the receptors based on these estimated airborne emissions. AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the estimated released airborne radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

4.7 ANIMAL PRODUCTS

Very low amounts of airborne radionuclides are emitted at the Paducah Site. A portion of the airborne radionuclides are estimated to be deposited in soil and on food crops where they may be absorbed into plants and then may be ingested by animals. Animal products then may be ingested by the public. Irrigation and deposition through waterborne radionuclides is an incomplete pathway because municipal water is used at nearby residences for household purposes (including activities such as watering plants and lawns). The Paducah Site estimates doses from animal products to the receptors based on these estimated airborne emissions. AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the estimated released airborne radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

4.8 WATERSHED BIOLOGICAL MONITORING

Biological monitoring of receiving streams at the Paducah Site was initiated in 1987 and has been revised periodically in response to results and permit requirements. While the KPDES permit outlines requirements of the biological monitoring program, the KPDES permit also requires that biological monitoring design and rationale be presented in the site's Watershed Monitoring Plan (WMP) (LATA Kentucky 2011a).

The site's WMP was modified in FY 2011. This modification eliminated the requirement for biological monitoring in the creeks surrounding the site. The WMP requires that the watershed monitoring consist of the toxicity analysis conducted at the outfalls, as required by the KPDES permit. The toxicity analysis at the outfalls is discussed in Appendix C of this EMP. The justification for this elimination presented in the KPDES permit is that, over the years, the watersheds have been extensively sampled to the point that further collection of aquatic organisms could result in a deleterious effect on the aquatic community; therefore, biological sampling no longer is required.

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5. DOSE CALCULATIONS

Effluent releases due to operations at the Paducah Site may contain radionuclides. After release, these substances disperse through the environment by transport mechanisms by which they eventually may reach and affect humans. This section describes the methodologies used to model the dispersion of radionuclides and to estimate human exposure resulting from the intake of the dispersed radionuclides. Human exposures to radionuclides are characterized in terms of TED to the public maximally exposed individual and to the entire population residing within 50 miles of the site. Pathways may be used at the sites that have current or potential future pathways that are not listed in the Risk Methods Document (DOE 2013). Exposure factors will be based on information contained in the Risk Methods Document or in consultation with project teams for site-specific parameters. In addition to the dose assessments in support of the ASER, individual projects also may perform dose assessments to establish bounding scenarios to ensure that any future public radiological exposures are maintained within the limits established in DOE Orders. The assumptions and parameters used in these project-specific assessments are found within the individual project technical derivations.

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 codified or approved for use by DOE. The models 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 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 doses from the Paducah Site from materials released to the air and 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, farms for animal products, and vegetable gardens within a 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. Periodically, site personnel review this information and

Table 3. Environmental Transport Mechanisms Applicable to Releases from DOE Operations

Releases to water	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Deposit in sediment Uptake to biota
Releases to air	Remain suspended in air Deposit on ground Deposit on vegetation Uptake to biota

update it for accuracy. 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.

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 4-mile radius and to determine the number of surface water intakes on the Ohio River up to 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, 5.4, and 5.5 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 are codified or approved for use by DOE and 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.

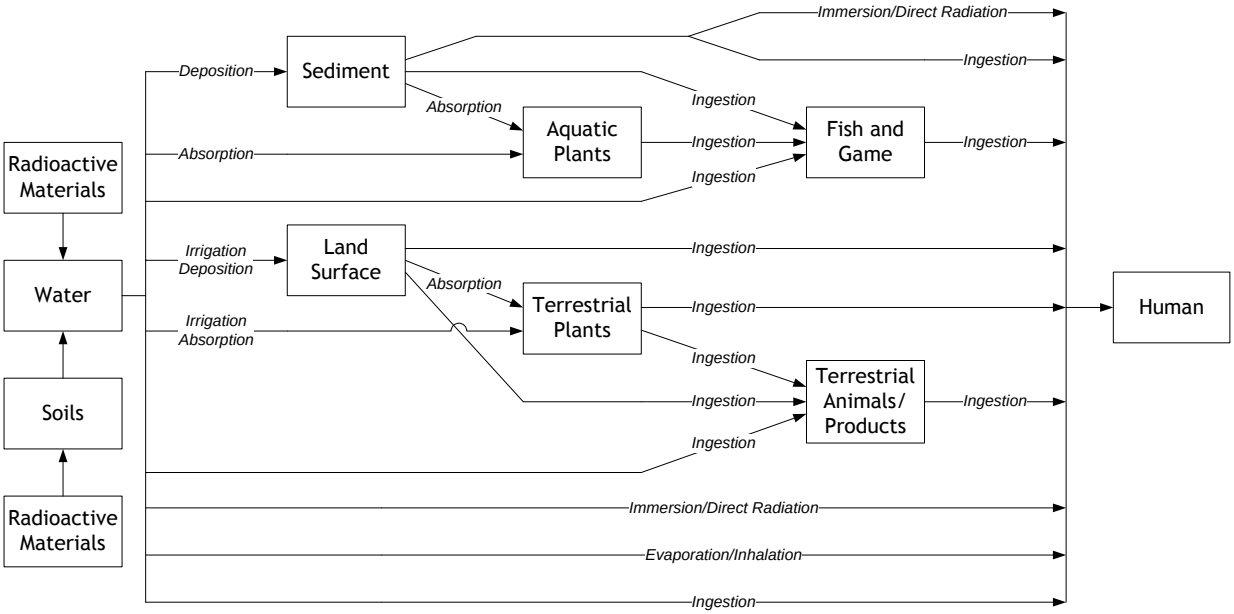

Figure 2. Possible Pathways between Radioactive Material Released to the Soil and/or Water and Humans

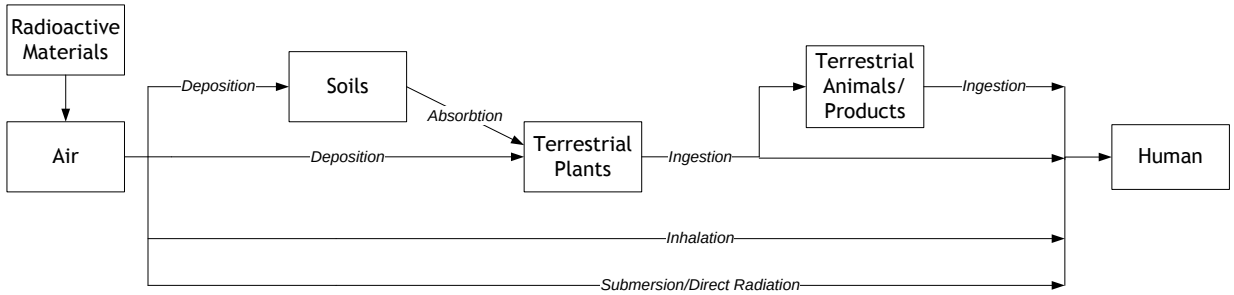

Figure 3. Possible Pathways between Radioactive Materials Released to the Air and Humans

5.3.1 Atmospheric Transport

Contaminants released to air may be inhaled by individuals, cause direct radiation by submersion, or deposit on vegetation that may be consumed by farm animals or humans.

Dose calculations on atmospheric releases are described in Section 5.4.1.

5.3.2 Water Transport

Contaminants released to water may remain dissolved or suspended in water (groundwater or surface water), deposited in sediment, deposited on ground or vegetation by irrigation, absorbed into plants and animals, or may infiltrate to the groundwater. Quantities of radionuclides released to surface waters are determined by sampling permitted outfalls in each of the local receiving streams. Contamination of private wells with both Tc-99 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 would be 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.

5.4.1 Contaminants in Air

The ambient air surrounding the Paducah Site is monitored to evaluate public exposure to airborne radionuclides. The results of this ambient air monitoring are used by DOE to demonstrate compliance with Commonwealth of Kentucky and federal regulations as well as with DOE directives. 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, 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 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. DOE uses EPA's latest version of the DARTAB computer code that 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 Water

Potential direct pathways of human exposure to contaminants in 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 deposition in sediment (Section 5.4.3), contaminants in soil (Section 5.4.4), contaminants in or on food crops (Section 5.4.5), and contaminants in terrestrial animals and fish (Section 5.4.6).

DOE O 458.1 requires compliance with 40 *CFR* § 141 radiological limits for drinking water systems. Per 40 *CFR* § 141, environmental surveillance data may be used in the vicinity of a nuclear facility to verify compliance with 40 *CFR* § 141 radiological limits for drinking water. Surveillance data from Bayou and

Little Bayou Creeks also may be used to verify compliance with 40 *CFR* § 141 prior to their entrance into the Ohio River.

If the surveillance data from Bayou and Little Bayou Creeks exceed the limits for drinking water, samples may be taken at the Cairo, Illinois, intake and compared to the Ohio River background upstream of the PGDP to demonstrate DOE compliance.

Surface water is not used for drinking or irrigation near the plant. 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 4-mile radius and to determine the number of surface water intakes on the Ohio River within 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 residents 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.

Dose calculations are made for the drinking water pathway if measurable concentrations of radionuclides are found in water samples collected from drinking water systems. Cairo, Illinois, about 36 miles downstream on the Ohio River, has the nearest drinking water intake to the plant. The dose to a resident from drinking water ingestion is evaluated based on EM data, which includes a sample taken at Cairo, Illinois. If site environmental surveillance data is insufficient to meet the requirements of 40 *CFR* § 141 and DOE Order 458.1, additional samples may be taken at the water intake of the drinking water system. Members of the public are assumed to ingest 730 liters of drinking water per year.

Measured concentrations are compared with federal and Commonwealth of Kentucky standards and with historical concentrations for each contaminant found.

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, indirect pathways, and ingestion. An example of an indirect pathway is a 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, Np-237 and Pu-239. Radionuclides deposited on the shores of rivers or creeks may accumulate over a period of time, leading to external irradiation of persons standing on contaminated surfaces. The amount of the nuclides built up on the shoreline depends on the concentration in the water, the depth of deposit, and the length of the period of buildup. The dose to persons depends on the time spent near the contaminants.

Incidental ingestion of contaminated sediment may result from exposure during fishing, hunting, or other recreational activities. This exposure time is expected to be minimal because signs are posted in this area stating that prolonged exposure could result in a dose above background.

5.5 CONTAMINANTS IN SOIL

A portion of the airborne radionuclides is estimated to be deposited in soil and on food crops where they may be absorbed into plants and then may be ingested by animals. Animal products then may be ingested by the public. The Paducah Site estimates doses from animal products to the receptors based on these estimated airborne emissions. AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the estimated released airborne radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

Contaminants also may be deposited in soil due to irrigation of crops from groundwater and/or surface water. 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 4-mile radius, as specified in the 1990 land use survey, and to determine the number of surface water intakes on the Ohio River up to 15 miles downstream from the site.

No resident or business responding to the survey reported using a private intake on the Ohio River, Bayou Creek, or Little Bayou Creek for any part of their water supply. Because irrigation of gardens and watering of livestock using contaminated well water has ceased, this form of exposure is not modeled.

5.6 CONTAMINANTS IN OR ON FOOD CROPS

A portion of the airborne radionuclides is estimated to be deposited in soil and on food crops where they may be absorbed into food crops. These food crops then may be ingested by the public. The Paducah Site estimates doses from food crops to the receptors based on these estimated airborne emissions. AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the estimated released airborne radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

Contaminants also may be deposited on vegetation due to irrigation of crops from groundwater and/or surface water. 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 4-mile radius and to determine the number of surface water intakes on the Ohio River up to 15 miles downstream from the site.

No resident or business responding to the survey reported using a private intake on the Ohio River, Bayou Creek, or Little Bayou Creek for any part of their water supply. Because irrigation of gardens and watering of livestock using contaminated well water has ceased this form of exposure is not modeled.

5.7 CONTAMINANTS IN TERRESTRIAL ANIMALS AND FISH

Contaminants may accumulate in animals from eating contaminated feed, drinking contaminated water, and breathing contaminated air. Contaminants may accumulate in fish when they eat contaminated foods

and equilibrate with surrounding waters. Indirect pathways for human exposure to contaminants in animals and fish are eating meat and fish. Because both measured concentrations and bioconcentration factors associated with radionuclides of concern at the Paducah Site in animals and fish are low, assessments of these pathways are not performed.

Biota in the watersheds has been sampled extensively, to the point that further collection of aquatic organisms could result in a deleterious effect on the aquatic community.

A portion of the airborne radionuclides are estimated to be deposited in soil and on food crops where they may be absorbed into plants and then may be ingested by domestic animals. Domestic animal products then may be ingested by the public. The Paducah Site estimates doses from animal products to the receptors based on these estimated airborne emissions. AIRDOS-EPA computer code contained in CAP-88, which implements a steady-state, Gaussian plume, atmospheric dispersion model, is used to calculate environmental concentrations of the estimated released airborne radionuclides and then uses Regulatory Guide 1.109 food chain models to calculate human exposures, both internal and external, to receptors. The human exposure values then are used by the EPA's version of the DARTAB computer code to calculate radiation doses to the public from radionuclides released during the year.

During the 20-year period of deer harvesting at the site, dose assessments from the ingestion of deer meat were performed using measured concentrations of contaminants. In 2011, DOE conducted an evaluation of the data sets from the years of deer harvesting events (LATA Kentucky 2011b). As a result of this review, DOE eliminated the deer harvest because of a downward trend and a continued lack of detection in the results, as well as an overall downward trend in the concentration of contaminants found at the Paducah Site due to remediation efforts. The elimination of the deer harvest program was documented in the FY 2012 EMP and is not referenced in Appendix C.

Direct Radiation. 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. It is very improbable that members of the public would be exposed to gamma radiation from these uranium cylinders found in the storage yards due to limited exposure time, distance from the access points of the public to the cylinder yards, and shielding.

5.8 INTERNAL DOSIMETRY MODELS

The results of all dose calculations are reported in terms of TED, the sum of effective dose received during the year from external exposures, plus the 50-year committed effective dose from intake of radionuclides during the year. Appropriate dose conversion factors based on site-specific factors and uses that are used in the calculations are obtained from DOE O 458.1 reference documents such as these: *International Commission on Radiological Protection (ICRP) Publication 60* and 40 *CFR* Part 141, *National Primary Drinking Water Regulations.* Although not used in specific dose calculations, the derived concentration standards given in DOE-STD-1196 given in DOE O 458.1 may be used to infer the acceptability or magnitude of doses associated with measured concentrations of radionuclides in environmental media.

5.9 RADIATION DOSE TO AQUATIC AND TERRESTRIAL BIOTA

Compliance with DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, regarding the absorbed dose rate limit to native organisms (e.g., invertebrates, fish, raccoons, 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.

5.10 REPORTS AND RECORDS

Doses to the maximally exposed member of the public and to the population are published in the ASER. In addition, if a radiological release that exceeds any limit contained in paragraphs 4.f.(2), 4.f.(5), 4.g.(4), 4.g.(5)(a), 4.g.(7), 4.g.(8)(a)4 or 4.i.(1) of DOE O 458.1 Chg 2, *Radiation Protection of the Public and the Environment*, dated 6-6-11 or exceeds the 40 *CFR* § 61.92 requirements, then Paducah Site notifies DOE Headquarters.

All input data used in dose calculations are considered as records requiring "permanent retention."

6. REPORTS

6.1 INTRODUCTION

This section provides an overview of the reporting requirements that are followed by DOE utilizing data generated under 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. In addition to the reporting requirements listed, data generated under the EMP also is used in preparing regulatory documents completed under the FFA, as appropriate. Revisions to the groundwater conceptual model use data generated under this EMP.

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
ASER	October 1	DOE O 231.1B and DOE O 458.1 (and ERPP)	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 *CFR* § 61 Subpart H	Reporting shall include results from monitoring of radionuclide emissions to the ambient air, as well as, required dose calculations. Ambient air monitoring data are included in the NESHAP reports for assessment of fugitive and diffuse emission sources.
Discharge Monitoring Report	Monthly and Quarterly	Clean Water Act	Discharge Monitoring Reports are required for compliance with KPDES permit KY0004049.

Table 4. Applicable Reporting Requirements (Continued)

Reporting	Due Date	Source of Requirement	Requirement
Toxicity Report	Monthly for K017 and Quarterly for Remaining Outfalls	Clean Water Act	Toxicity reports are required for compliance with KPDES permit KY0004049.
Annual PCB Document	July 1	40 *CFR* § 761.180	The Annual PCB Document is required for PCBs in use and PCB wastes.
SARA Section 313	June 1	SARA Title III	Covered facilities (see above) shall report to EPA and the Commonwealth of Kentucky, 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* Section 47:130	This report is required in accordance with landfill solid waste permit SW07300045.
C-746-U Landfill Quarterly Operating Report	Quarterly	401 *KAR* Section 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* Section 47:130	This report is required in accordance with landfill solid waste permits SW07300014 and SW07300015.
C-746-S&T Landfills Quarterly Operating Report	Quarterly	401 *KAR* Section 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* Section 34:060	This report is required in accordance with Paducah hazardous waste permit KY8-890-008-982.
Environmental Monitoring Plan	October 1 Annually	DOE O 436.1 DOE O 458.1 (and ERPP)	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; Last Updated August 2013	401 *KAR* Section 5:037	Requires a plan to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution.
Best Management Practices Plan	Review Annually; Last Updated September 2011	KPDES permit (KPDES permit is required by the Clean Water Act)	This plan is required by KPDES permit KY0004049.
Spill Prevention Control and Countermeasure (SPCC) Plan	Five Years; Last Updated September 2011	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 1	DOE O 458.1 (and ERPP)	This report estimates the external gamma dose on an annual basis; summary info also is included in the ASER.
FFA Semiannual Report	April 30 October 30	Paducah FFA	This report is required by the FFA.. Data generated in many of the sampling programs referenced in Appendix C are reported in this report.

*The Groundwater Protection Plan was revised and submitted as a draft in August 2013.

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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
WATER				
Kentucky Pollutant Discharge Elimination System	Kentucky Division of Water (KDOW)	10/31/2011[a]	KY0004049	U.S. Department of Energy (DOE), LATA Environmental Services of Kentucky, LLC, and B&W Conversion Services, LLC
SOLID WASTE				
C-746-S Residential Landfill (Closed)	Kentucky Division of Waste Management (KDWM)	11/04/2016	SW07300014	DOE/LATA Environmental Services of Kentucky, LLC
C-746-T Inert Landfill (Closed)	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
RCRA				
Hazardous Waste Facility Operating Permit	KDWM	10/31/2014	KY8-890-008-982	DOE/LATA Environmental Services of Kentucky, LLC
Hazardous and Solid Waste Amendments (HSWA) Portion of the RCRA Permit	EPA	04/23/2016	KY8-890-008-982	DOE/LATA Environmental Services of Kentucky, LLC

[a] The renewal application for the KPDES permit was filed with KDOW in May 2011. The requirements in the current permit will be followed until issuance of the renewed permit.

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)	02/1992	To be determined	EPA and DOE
Federal Facilities Compliance Act Agreed Order/Site Treatment Plan	09/1997	2015	KDWM and DOE
Federal Facility Agreement	02/1998	Ongoing	KDWM, EPA, and DOE
Agreed Order for Waste, Air, and Water Violations	10/2003	Ongoing	Commonwealth of Kentucky and DOE
Agreed Order for DUF_6 Management	10/2003	Ongoing	KDWM and DOE

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APPENDIX B

WELL PROGRAM INVENTORY

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ACRONYMS

400GQ	C-400 groundwater well quarterly
400GSA	C-400 groundwater well semiannually
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
DOE	U.S. Department of Energy
EW	extraction well
FYR	inspection coordinated with the submittal of the Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Review
GC	geochemical surveillance well
GWESA	environmental surveillance annual sampling
GWESBA	environmental surveillance biennial sampling
GWNEQ	groundwater Northeast Plume quarterly
GWNESA	groundwater Northeast Plume semiannual well
GWNWQ	groundwater Northwest Plume operation and maintenance quarterly
GWNWSA	groundwater Northwest Plume operation and maintenance semiannually
GWRESM	groundwater residential monthly well
GWRESA	groundwater residential annual well
KDFWR	Kentucky Department of Fish and Wildlife Resources
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 Environmental Monitoring Plan Program
NI	not inspected
NR	not required
NS	not sampled
PZ	piezometer
Q	In the Water Level column, “Q” indicates water levels are collected quarterly
R	residential
RGA	Regional Gravel Aquifer
SG	C-746-S&T Landfills groundwater well
TVA	Tennessee Valley Authority
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
WPB-NW	Water Policy Boundary Monitoring Program—Northwest
WPB-NE	Water Policy Boundary Monitoring Program—Northeast

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Table B.1 includes 338 monitoring wells (MWs) and a listing of the sampled residential wells.

Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW1	RGA	AB 94	NA	NA	NA	NA
MW2	Unknown	AB 88	NA	NA	NA	NA
MW3	Unknown	AB 88	NA	NA	NA	NA
MW4	Unknown	AB 88	NA	NA	NA	NA
MW5	Unknown	AB 88	NA	NA	NA	NA
MW6	Unknown	AB 88	NA	NA	NA	NA
MW7	UCRS	AB 94	NA	NA	NA	NA
MW8	RGA	AB 94	NA	NA	NA	NA
MW9	RGA	AB 94	NA	NA	NA	NA
MW10	RGA	AB	NA	NA	NA	NA
MW11	UCRS	AB 94	NA	NA	NA	NA
MW12	RGA	AB 94	NA	NA	NA	NA
MW13	UCRS	AB 94	NA	NA	NA	NA
MW14	UCRS	AB 94	NA	NA	NA	NA
MW15	RGA	AB 94	NA	NA	NA	NA
MW16	UCRS	AB 94	NA	NA	NA	NA
MW17	RGA	AB 94	NA	NA	NA	NA
MW18	UCRS	AB 94	NA	NA	NA	NA
MW19	RGA	AB 94	NA	NA	NA	NA
MW20 (also R4)	RGA	Current	KDFWR	NA	A	A
MW21	RGA	AB 94	NA	NA	NA	NA
MW22	RGA	AB 94	NA	NA	NA	NA
MW23	Porters Creek Clay Well	AB 94	NA	NA	NA	NA
MW24	Porters Creek Clay Well	AB 94	NA	NA	NA	NA
MW25	Porters Creek Clay Well	AB 94	NA	NA	NA	NA
MW26	Porters Creek Clay Well	AB 94	NA	NA	NA	NA
MW27	Porters Creek Clay Well	AB 94	NA	NA	NA	NA
MW28	UCRS	AB 94	NA	NA	NA	NA
MW29	UCRS	AB 94	NA	NA	NA	NA
MW30	UCRS	AB 94	NA	NA	NA	NA
MW31	UCRS	AB 94	NA	NA	NA	NA
MW32	UCRS	AB 94	NA	NA	NA	NA
MW33	UCRS	AB	NA	NA	NA	NA
MW34	UCRS	AB 94	NA	NA	NA	NA
MW35	UCRS	AB 94	NA	NA	NA	NA
MW36	UCRS	AB 94	NA	NA	NA	NA
MW37	UCRS	AB 94	NA	NA	NA	NA
MW38	RGA	AB 94	NA	NA	NA	NA
MW39	RGA	AB 94	NA	NA	NA	NA
MW40	RGA	AB 94	NA	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW41	RGA	AB 94	NA	NA	NA	NA
MW42	RGA	AB 94	NA	NA	NA	NA
MW43	RGA	AB 94	NA	NA	NA	NA
MW44	RGA	AB 94	NA	NA	NA	NA
MW45	RGA	AB 87	NA	NA	NA	NA
MW46	RGA	AB 94	NA	NA	NA	NA
MW47	UCRS	AB 94	NA	NA	NA	NA
MW48	RGA	AB 94	NA	NA	NA	NA
MW49	UCRS	AB 94	NA	NA	NA	NA
MW50	RGA	AB 94	NA	NA	NA	NA
MW51	RGA	AB 94	NA	NA	NA	NA
MW52	RGA	AB 94	NA	NA	NA	NA
MW53	RGA	AB 94	NA	NA	NA	NA
MW54	RGA	AB 94	NA	NA	NA	NA
MW55	RGA	AB 87	NA	NA	NA	NA
MW56	UCRS	AB 87	NA	NA	NA	NA
MW57	UCRS	AB 94	NA	NA	NA	NA
MW58	UCRS	AB 90	NA	NA	NA	NA
MW59	RGA	AB	NA	NA	NA	NA
MW60	UCRS	AB	NA	NA	NA	NA
MW61	RGA	AB	NA	NA	NA	NA
MW62	RGA	AB	NA	NA	NA	NA
MW63	RGA	Current	DOE	GWNWSA	A	A
MW64	UCRS	Current	DOE	NS	A	A
MW65	RGA	Current	DOE	GWNWSA	A	A
MW66	RGA	Current	DOE	GWNWSA	A	A
MW67	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW68	RGA	Current	DOE	NS	A	A
MW69	UCRS	Current	DOE	NS	A	A
MW70	RGA	AB 94	NA	NA	NA	NA
MW71	RGA	Current	DOE	NS	A	A
MW72	RGA	Current	DOE	NS	A	A
MW73	RGA	Current	DOE	NS	A	A
MW75	UCRS	Current	DOE	NS	A	A
MW76	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW77	RGA	Current	DOE	NS	A	A
MW78	RGA	Current	DOE	NS	A	A
MW79	RGA	Current	DOE	NS	A	A
MW80	RGA	Current	DOE	NS	A	A
MW81	RGA	Current	DOE	NS	A	A
MW82	UCRS	Current	DOE	NS	A	A
MW83	UCRS	Current	DOE	NS	A	A
MW84	RGA	Current	DOE	404G	A, Q	A
MW85	UCRS	Current	DOE	404G	A, Q	A
MW86	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW87	RGA	Current	DOE	404G	A, Q	A
MW88	UCRS	Current	DOE	404G	A, Q	A
MW89	RGA	Current	DOE	GWESBA, 404G	A, Q	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW90	RGA	AB 2001	NA	NA	NA	NA
MW90A	RGA	Current	DOE	404G	A, Q	A
MW91	UCRS	Current	DOE	404G	A, Q	A
MW92	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW93	RGA	Current	DOE	404G	A, Q	A
MW94	UCRS	Current	DOE	404G	A, Q	A
MW95	RGA	AB 2001	NA	NA	NA	NA
MW95A	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW96	UCRS	Current	DOE	NS	A	A
MW97	RGA	AB 97	NA	NA	NA	NA
MW98	RGA	Current	DOE	GWESA	A, Q	A
MW99	RGA	Current	TVA	GWESA, GC	A	A
MW100	RGA	Current	TVA	GWESA, GC	A, Q	A
MW102	McNairy	Current	DOE	NS	A	A
MW103	RGA	Current	DOE	GWESBA	A	A
MW104	UCRS	AB 96	NA	NA	NA	NA
MW105	RGA	AB	NA	NA	NA	NA
MW106	RGA	Current	DOE	GWESBA, WPB-NW	A	A
MW108	RGA	Current	DOE	NS	A	A
MW119	RGA	AB	NA	NA	NA	NA
MW120	McNairy	Current	DOE	NS	A	A
MW121	McNairy	Current	KDFWR	NS	A	A
MW122	McNairy	Current	DOE	NS	A	A
MW123	RGA	Current	KDFWR	NS	A	A
MW124	RGA	Current	DOE	GWNESA	A	A
MW125	RGA	Current	KDFWR	GWESBA, GC	A, Q	A
MW126	RGA	Current	DOE	GWNESA	A	A
MW127	UCRS	AB-IP	NA	NA	NA	NA
MW128	UCRS	AB-IP	NA	NA	NA	NA
MW129	Terrace Gravels	AB-IP	NA	NA	NA	NA
MW130	Terrace Gravels	AB-IP	NA	NA	NA	NA
MW131	Terrace Gravels	AB-IP	NA	NA	NA	NA
MW132	RGA	Current	DOE	NS	A	A
MW133	McNairy	Current	TVA	NS	A	A
MW134	RGA	Current	KDFWR	GWESBA, GC, WPB-NW	A	A
MW135	RGA	Current	TVA	GWESBA	A	A
MW136	UCRS	AB	NA	NA	NA	NA
MW137	RGA	Current	TVA	NS	A	A
MW138	UCRS	Current	TVA	NS	A	A
MW139	RGA	Current	DOE	GWESBA	A, Q	A
MW140	McNairy	AB	NA	NA	NA	NA
MW141	RGA	AB 98	NA	NA	NA	NA
MW142	RGA	AB 98	NA	NA	NA	NA
MW143	UCRS	AB 98	NA	NA	NA	NA
MW144	RGA	Current	DOE	NS	A	A
MW145	RGA	Current	DOE	GWNESA, GC	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW146	RGA	Current	TVA	GWESBA, WPB-NW	A	A
MW147	RGA	Current	TVA	NS	A	A
MW148	RGA	Current	Private—Residential	GWESBA	A	A
MW149	UCRS	Current	Private—Residential	GWESBA	A	A
MW150	RGA	Current	Private—Residential	GWESA	A	A
MW151	Terrace Gravels	Current	Private—Residential	NS	A	A
MW152	RGA	Current	TVA	GWESA, GC	A	A
MW153	UCRS	Current	TVA	NS	A	A
MW154	UCRS	Current	DOE	NS	A	A
MW155	RGA	Current	DOE	400GQ	A	A
MW156	RGA	Current	DOE	400GQ	A	A
MW157	UCRS	Current	DOE	NS	A	A
MW158	RGA	AB 99	NA	NA	NA	NA
MW159	RGA	AB 99	NA	NA	NA	NA
MW160	UCRS	AB 99	NA	NA	NA	NA
MW161	RGA	Current	DOE	GWESA, GC	A	A
MW162	UCRS	Current	DOE	NS	A	A
MW163	RGA	Current	DOE	GWESBA, GC	A	A
MW164	UCRS	Current	DOE	NS	A	A
MW165	RGA	Current	DOE	GWNWSA	A, Q	A
MW166	UCRS	Current	DOE	NS	A	A
MW167	UCRS	Current	DOE	NS	A	A
MW168	RGA	Current	DOE	GWESBA	A	A
MW169	RGA	Current	DOE	GWESBA	A	A
MW170	UCRS	Current	DOE	NS	A	A
MW171	UCRS	Current	DOE	NS	A	A
MW172	UCRS	Current	DOE	NS	A	A
MW173	RGA	Current	DOE	GWNWSA	A, Q	A
MW174	UCRS	Current	DOE	GWESBA	A	A
MW175	RGA	Current	DOE	400GSA	A	A
MW176	UCRS	Current	DOE	NS	A	A
MW177	UCRS	Current	DOE	NS	A	A
MW178	RGA	Current	DOE	NS	A	A
MW179	RGA	AB 2003	NA	NA	NA	NA
MW180	UCRS	Current	DOE	NS	A	A
MW181	RGA	AB 2000	NA	NA	NA	NA
MW182	UCRS	Current	DOE	GWESA	A	A
183, Not Installed	NA	NA	NA	NA	NA	NA
MW184	UCRS	AB 98	NA	NA	NA	NA
MW185	RGA	Current	DOE	NS	A	A
MW186	UCRS	Current	DOE	GWESBA	A	A
MW187	UCRS	Current	DOE	GWESBA	A	A
MW188	RGA	Current	DOE	GC	A	A
MW189	UCRS	Current	DOE	NS	A	A
MW190	UCRS	Current	DOE	NS	A	A
MW191	RGA	Current	DOE	GWESA	A	A
MW192	UCRS	Current	DOE	NS	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW193	RGA	Current	DOE	GWESBA, GC	A, Q	A
MW194	RGA	Current	KDFWR	GWESBA, WPB-NW	A	A
MW195	UCRS	AB 94	NA	NA	NA	NA
MW196	Terrace Gravels	Current	DOE	NS	A	A
MW197	RGA	Current	DOE	GWESBA	A, Q	A
MW198	UCRS	Current	DOE	NS	A	A
MW199	RGA	Current	Private—Residential	GWESBA, WPB-NW	A	A
MW200	RGA	Current	KDFWR	GWESBA	A, Q	A
MW201	RGA	Current	KDFWR	GWESBA, GC, WPB-NW	A	A
MW202	RGA	Current	KDFWR	GWESBA, WPB-NW	A	A
MW203	RGA	Current	DOE	GWESA	A	A
MW204	UCRS	Current	DOE	NS	A	A
MW205	RGA	Current	DOE	GWESBA	A	A
MW206	RGA	Current	DOE	GWESA, GC	A	A
MW207	UCRS	Current	DOE	NS	A	A
MW208	UCRS	AB 2012	NA	NA	NA	NA
MW209	UCRS	Current	DOE	NS	A	A
MW210	UCRS	Current	DOE	NS	A	A
MW211	UCRS	Current	DOE	NS	A	A
MW212	UCRS	Current	DOE	NS	A	A
MW213	UCRS	Current	DOE	NS	A	A
MW214	UCRS	Current	DOE	NS	A	A
MW215	UCRS	Current	DOE	NS	A	A
MW216	UCRS	Current	DOE	NS	A	A
MW217	UCRS	Current	DOE	NS	A	A
MW218	UCRS	Current	DOE	NS	A	A
MW219	UCRS	Current	DOE	NS	A	A
MW220	RGA	Current	DOE	SG	A, Q	A
MW221	RGA	Current	DOE	SG	A, Q	A
MW222	RGA	Current	DOE	SG	A, Q	A
MW223	RGA	Current	DOE	SG	A, Q	A
MW224	RGA	Current	DOE	SG	A, Q	A
MW225	RGA	Current	DOE	NS	A, Q	A
MW226	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW227	RGA	Current	DOE	GWESBA, 404G	A, Q	A
232, Not Installed	NA	NA	NA	NA	NA	NA
MW233	RGA	Current	KDFWR	GWESA	A	A
MW234	RGA	AB 2002	NA	NA	NA	NA
MW235	RGA	AB 2002	NA	NA	NA	NA
MW236	RGA	Current	KDFWR	GWESA	A	A
MW237	UCRS	Current	KDFWR	NS	A	A
MW238	RGA	Current	KDFWR	NS	A	A
MW239	McNairy	Current	KDFWR	NS	A	A
MW240	RGA	Current	KDFWR	GWESA	A	A
MW241	RGA	AB 2003	NA	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW241A	RGA	Current	KDFWR	NS	A	A
MW242	RGA	Current	DOE	GWNWQ, GC	A	A
MW243	RGA	Current	DOE	GWNWQ	A	A
MW244	RGA	Current	DOE	GWNWQ	A	A
MW245	RGA	Current	DOE	GWNWQ	A	A
MW246	UCRS	Current	DOE	NS	A	A
MW247	McNairy	Current	DOE	NS	A	A
MW248	RGA	Current	DOE	GWNWQ	A	A
MW249	RGA	Current	DOE	NS	A	A
MW250	RGA	Current	DOE	GWNWQ	A	A
PZ251	UCRS	Current	DOE	NS	A	A
MW252	RGA	Current	Private—Residential	GWESA	A	A
MW253	RGA	Current	Private—Residential	GWESA	A	A
254, Not Installed	NA	NA	NA	NA	NA	NA
MW255	RGA	Current	DOE	GWNEQ	A	A
MW256	RGA	Current	DOE	GWNEQ, GC	A	A
MW257	RGA	Current	DOE	GC	A	A
MW258	RGA	Current	DOE	GWNEQ, GC	A	A
259, Not Installed	NA	NA	NA	NA	NA	NA
MW260	RGA	Current	DOE	GWESBA, GC	A	A
MW261	RGA	Current	DOE	GWESA, GC	A	A
MW262	RGA	Current	DOE	GWESBA	A	A
MW263	RGA	AB 2003	NA	NA	NA	NA
MW264	RGA	AB 2003	NA	NA	NA	NA
MW265	RGA	AB 2000	NA	NA	NA	NA
MW266	RGA	AB 2003	NA	NA	NA	NA
MW267	RGA	AB 2003	NA	NA	NA	NA
MW268	RGA	AB 2002	NA	NA	NA	NA
MW269	RGA	AB 2002	NA	NA	NA	NA
MW270	RGA	AB 2000	NA	NA	NA	NA
MW271	RGA	AB 2002	NA	NA	NA	NA
MW272	RGA	AB 2002	NA	NA	NA	NA
MW273	RGA	AB 2002	NA	NA	NA	NA
MW274	RGA	AB 2002	NA	NA	NA	NA
MW275	RGA	AB 2002	NA	NA	NA	NA
MW276	RGA	AB 2002	NA	NA	NA	NA
MW277	RGA	AB 2000	NA	NA	NA	NA
MW283	RGA	Current	DOE	GWNESA	A	A
MW284	RGA	Current	DOE	NS	A	A
285, Not Installed	NA	NA	NA	NA	NA	NA
286, Not Installed	NA	NA	NA	NA	NA	NA
MW288	RGA	Current	DOE	GWNEQ, GC	A	A
MW291	RGA	Current	DOE	GWNESA	A	A
MW292	RGA	Current	DOE	GWNEQ, GC	A	A
MW293	RGA	AB 2003	NA	NA	NA	NA
MW293A	RGA	Current	DOE	GWNESA	A	A
MW294	RGA	AB 2003	NA	NA	NA	NA
MW294A	RGA	Current	DOE	NS	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
295, Not Installed	NA	NA	NA	NA	NA	NA
296, Not Installed	NA	NA	NA	NA	NA	NA
297, Not Installed	NA	NA	NA	NA	NA	NA
298, Not Installed	NA	NA	NA	NA	NA	NA
299, Not Installed	NA	NA	NA	NA	NA	NA
MW300	Terrace Gravels	Current	DOE	KG	A	A
MW301	Terrace Gravels	Current	DOE	KG	A	A
MW302	Terrace Gravels	Current	DOE	KG	A	A
MW303	Terrace Gravels	AB 94	NA	NA	NA	NA
MW304	Terrace Gravels	Current	DOE	NS	A	A
MW305	Eocene	Current	DOE	GWESBA	A	A
MW306	Eocene	Current	DOE	NS	A	A
MW307	Eocene	Current	DOE	NS	A	A
MW308	Eocene	Current	DOE	NS	A	A
MW309	Terrace Gravels	Current	DOE	NS	A	A
MW310	Terrace Gravels	Current	DOE	NS	A	A
MW311	Terrace Gravels	Current	DOE	NS	A	A
MW312	UCRS	Current	DOE	NS	A	A
MW313	UCRS	Current	DOE	NS	A	A
MW314	UCRS	Current	DOE	NS	A	A
MW315	UCRS	Current	DOE	NS	A	A
MW316	UCRS	Current	DOE	NS	A	A
MW317	Terrace Gravels	Current	DOE	NS	A	A
MW318	Terrace Gravels	Current	DOE	NS	A	A
319, Not Installed	NA	NA	NA	NA	NA	NA
320, Not Installed	NA	NA	NA	NA	NA	NA
321, Not Installed	NA	NA	NA	NA	NA	NA
322, Not Installed	NA	NA	NA	NA	NA	NA
323, Not Installed	NA	NA	NA	NA	NA	NA
324, Not Installed	NA	NA	NA	NA	NA	NA
MW325	RGA	Current	DOE	NS	A	A
MW326	RGA	Current	DOE	NS	A	A
MW327	RGA	Current	DOE	NS	A	A
MW328	RGA	Current	DOE	GWESBA, GC	A	A
MW329	RGA	Current	DOE	GWESBA, GC	A	A
MW330	RGA	Current	DOE	NS	A	A
MW333	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW337	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW338	RGA	Current	DOE	GWESBA, 404G	A, Q	A
MW339	RGA	Current	DOE	GWNWSA, GC	A	A
MW340	RGA	Current	DOE	GWNWSA	A	A
MW341	RGA	Current	DOE	GWESBA	A	A
MW342	RGA	Current	DOE	400GSA	A	A
MW343	RGA	Current	DOE	GWESBA, 400GSA, GC	A	A
MW344	Terrace Gravels	Current	DOE	KG	A	A
MW345	Rubble Zone	Current	DOE	GWESA	A	A
MW346	Rubble Zone	Current	DOE	NS	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW347	Rubble Zone	Current	DOE	NS	A	A
MW352	RGA	AB 2002	NA	NA	NA	NA
MW353	RGA	Current	DOE	NS	A, Q	A
MW354	RGA	Current	DOE	GWESBA	A	A
MW355	RGA	Current	DOE	GWNWSA	A	A
MW356	RGA	Current	DOE	GWESBA	A	A
MW357	URGA	Current	DOE	UG	A, Q	A
MW358	LRGA	Current	DOE	UG	A, Q	A
MW359	UCRS	Current	DOE	UG	A, Q	A
MW360	URGA	Current	DOE	UG	A, Q	A
MW361	LRGA	Current	DOE	UG	A, Q	A
MW362	UCRS	Current	DOE	UG	A, Q	A
MW363	URGA	Current	DOE	UG	A, Q	A
MW364	LRGA	Current	DOE	UG	A, Q	A
MW365	UCRS	Current	DOE	UG	A, Q	A
MW366	URGA	Current	DOE	UG	A, Q	A
MW367	LRGA	Current	DOE	UG	A, Q	A
MW368	UCRS	Current	DOE	UG	A, Q	A
MW369	URGA	Current	DOE	UG/SG	A, Q	A
MW370	LRGA	Current	DOE	UG/SG	A, Q	A
MW371	UCRS	Current	DOE	UG	A, Q	A
MW372	URGA	Current	DOE	UG/SG	A, Q	A
MW373	LRGA	Current	DOE	UG/SG	A, Q	A
MW374	UCRS	Current	DOE	UG	A, Q	A
MW375	UCRS	Current	DOE	UG	A, Q	A
MW376	LRGA	Current	DOE	UG	A, Q	A
MW377	UCRS	Current	DOE	UG	A, Q	A
378, Not Installed	NA	NA	NA	NA	NA	NA
379, Not Installed	NA	NA	NA	NA	NA	NA
MW380	RGA	Current	KDFWR	NS	A	A
MW381	RGA	Current	KDFWR	GC	A	A
382, Not Installed	NA	NA	NA	NA	NA	NA
383, Not Installed	NA	NA	NA	NA	NA	NA
MW384	URGA	Current	DOE	SG	A, Q	A
MW385	LRGA	Current	DOE	SG	A, Q	A
MW386	UCRS	Current	DOE	SG	A, Q	A
MW387	URGA	Current	DOE	SG	A, Q	A
MW388	LRGA	Current	DOE	SG	A, Q	A
MW389	UCRS	Current	DOE	SG	A, Q	A
MW390	UCRS	Current	DOE	SG	A, Q	A
MW391	URGA	Current	DOE	SG	A, Q	A
MW392	LRGA	Current	DOE	SG	A, Q	A
MW393	UCRS	Current	DOE	SG	A, Q	A
MW394	URGA	Current	DOE	SG	A, Q	A
MW395	LRGA	Current	DOE	SG	A, Q	A
MW396	UCRS	Current	DOE	SG	A, Q	A
MW397	LRGA	Current	DOE	SG	A, Q	A
398, Not Installed	NA	NA	NA	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
399, Not Installed	NA	NA	NA	NA	NA	NA
400, Not Installed	NA	NA	NA	NA	NA	NA
MW401	RGA	Current	DOE	NS	A	A
MW402	RGA	Current	DOE	NS	A	A
MW403	RGA	Current	DOE	GWESBA, GC	A	A
MW404	RGA	Current	DOE	GWESBA, GC	A	A
MW405	RGA	Current	DOE	GWESBA, 400GQ	A	A
MW406	RGA	Current	DOE	GWESBA, 400GQ	A	A
MW407	RGA	Current	DOE	GWESBA, 400GQ	A	A
MW408	RGA	Current	DOE	GWESBA, 400GQ	A	A
MW409	RGA	Current	Private—Residential	GWESA, GC	A	A
MW410	RGA	Current	Private—Residential	GWESA	A	A
MW411	RGA	Current	Private—Residential	GWESA	A	A
412, Not Installed	NA	NA	NA	NA	NA	NA
413, Not Installed	NA	NA	NA	NA	NA	NA
MW414	RGA	Current	DOE	GWESBA, GC	A, Q	A
MW415	RGA	Current	DOE	GWESBA	A, Q	A
MW416	RGA	Current	DOE	GWESBA	A, Q	A
MW417	RGA	Current	DOE	GWESBA	A	A
MW418	RGA	Current	DOE	GWESA	A, Q	A
MW419	RGA	Current	DOE	GWESA	A, Q	A
MW420	URGA	Current	DOE	404G	A, Q	A
MW421	RGA	Current	DOE	400GSA	A	A
MW422	RGA	Current	DOE	400GSA	A	A
MW423	RGA	Current	DOE	400GSA	A	A
MW424	RGA	Current	DOE	400GSA	A	A
MW425	RGA	Current	DOE	400GSA	A	A
MW426	RGA	Current	DOE	GWESBA, GC, WPB-NW	A	A
MW427	RGA	Current	DOE	GWESBA, GC, WPB-NW	A	A
MW428	RGA	Current	DOE	GWNWSA	A	A
MW429	RGA	AB 2009	NA	NA	NA	NA
MW429 A	RGA	Current	DOE	GWNWSA	A	A
MW430	RGA	Current	DOE	GWNWSA	A	A
MW431	RGA	Current	DOE	GWESBA	A	A
MW432	RGA	Current	DOE	GWESBA, WPB-NW	A	A
MW433	RGA	Current	TVA	GWESBA, WPB-NW	A	A
434, Not Installed	NA	NA	NA	NA	NA	NA
MW435	RGA	Current	TVA	GWESBA, WPB-NW	A	A
436, Not Installed	NA	NA	NA	NA	NA	NA
437, Not Installed	NA	NA	NA	NA	NA	NA
438, Not Installed	NA	NA	NA	NA	NA	NA
MW439	RGA	Current	TVA	GWESBA, GC	A	A
MW440	RGA	Current	TVA	GWESBA	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW441	RGA	Current	TVA	GWESBA, GC, WPB-NW	A	A
MW442	RGA	Current	KDFWR	GWESBA	A	A
MW443	RGA	Current	KDFWR	GWESBA	A	A
MW444	RGA	Current	KDFWR	GWESBA	A	A
MW445	RGA	Current	TVA	GWESBA	A	A
446, Not Installed	NA	NA	NA	NA	NA	NA
MW447	RGA	Current	TVA	GWESBA, GC	A	A
MW448	RGA	Current	KDFWR	GWESBA	A	A
449, Not Installed	NA	NA	NA	NA	NA	NA
MW450	RGA	Current	KDFWR	GWESBA	A	A
MW451	RGA	Current	KDFWR	GWESBA	A	A
MW452	RGA	Current	KDFWR	GWESBA, WPB-NW	A	A
MW453	RGA	Current	KDFWR	GWESBA	A	A
MW454	RGA	Current	KDFWR	GWESBA	A	A
MW455	RGA	Current	DOE	GWNWQ	A	A
MW456	RGA	Current	DOE	GWNWQ	A	A
MW457	RGA	Current	DOE	GWNWQ	A	A
MW458	RGA	Current	DOE	GWNWQ	A	A
MW459	RGA	Current	DOE	GWNWQ	A	A
MW460	RGA	Current	DOE	GWNWQ	A	A
MW461	RGA	Current	DOE	GWNWQ	A	A
MW462	RGA	Current	DOE	GWNWQ	A	A
MW463	RGA	Current	TVA	GWESBA	A	A
MW464	RGA	Current	TVA	GWESBA	A	A
MW465	RGA	Current	Private—Residential	GWESA	A	A
MW466	RGA	Current	Private—Residential	GWESA	A	A
MW467	RGA	Current	Private—Residential	GWESBA	A	A
MW468	RGA	Current	Private—Residential	GWESBA, GC	A	A
MW469	RGA	Current	Private—Residential	GWESA	A	A
MW470	RGA	Current	Private—Residential	GWESA	A	A
MW471	RGA	Current	Private—Residential	GWESA	A	A
MW472	RGA	Current	Private—Residential	GWESA	A	A
MW473	RGA	Current	Private—Residential	GWESBA, GC	A	A
MW474	RGA	Current	Private—Residential	GWESBA, GC	A	A
MW475	RGA	Current	Private—Residential	GWESBA	A	A
MW476	RGA	Current	Private—Residential	GWESBA	A	A
MW477	RGA	Current	TVA	GWESBA	A	A
MW478	RGA	Current	DOE	GWESBA	A	A
MW479	RGA	Current	DOE	GWESBA	A	A
MW480	RGA	Current	DOE	GWESBA	A	A
MW481	RGA	Current	DOE	GWESBA	A	A
MW482	RGA	Current	DOE	GWESBA	A	A
MW483	RGA	Current	Private—Residential	GWESBA	A	A
MW484	RGA	Current	Private—Residential	GWESBA	A	A
MW485	RGA	Current	Private—Residential	GWESBA	A	A
MW486	RGA	Current	Private—Residential	GWESBA	A	A
MW487	RGA	Current	Private—Residential	GWESBA	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Property Where Located	Sampled	Water Level	Inspection
MW488	RGA	Current	Private—Residential	GWESBA	A	A
MW489	RGA	Current	KDFWR	GWESBA	A	A
MW490	RGA	Current	KDFWR	GWESBA	A	A
MW491	RGA	Current	DOE	GWESBA	A	A
MW492	RGA	Current	DOE	GWESBA	A	A
MW493	RGA	Current	DOE	GWESBA	A	A
MW494	RGA	Current	DOE	GWESBA	A	A
MW495	RGA	Current	DOE	GWESBA	A	A
MW496	RGA	Current	DOE	GWESBA	A	A
MW497	URGA	Current	DOE	GWNWQ	A	A
MW498	LRGA	Current	DOE	GWNWQ	A	A
MW499	URGA	Current	DOE	GWNWQ	A	A
MW500	LRGA	Current	DOE	GWNWQ	A	A
MW501	URGA	Current	DOE	GWNWQ	A	A
MW502	LRGA	Current	DOE	GWNWQ	A	A
MW503	URGA	Current	DOE	GWNWQ	A	A
MW504	LRGA	Current	DOE	GWNWQ	A	A
MW505	RGA	Current	DOE	400GQ	A	A
MW506	RGA	Current	DOE	400GQ	A	A
MW507	RGA	Current	DOE	400GQ	A	A
R2	Unknown	Current	Private—Residential	WPB-NW	A	FYR
R9	Unknown	Current	Private—Residential	WPB-NE	A	FYR
R13	Unknown	Current	Private—Residential	WPB-NW	A	FYR
R14	Unknown	Current	Private—Residential	WPB-NW	A	FYR
R20	RGA	Current	Private—Residential	WPB-NE	A	FYR
R21	Unknown	Current	Private—Residential	WPB-NE	A	FYR
R26	Unknown	Current	Private—Residential	WPB-NW	A	FYR
R53	Unknown	Current	Private—Residential	WPB-NW	A	FYR
R83	Unknown	Current	Private—Residential	WPB-NE	A	FYR
R90	Unknown	Current	Private—Residential	WPB-NE	A	Outside Water Policy
R114	Unknown	Current	Private—Residential	WPB-NE	A	Outside Water Policy
R245	Unknown	Current	Private—Residential	WPB-NW	A	FYR
R294	RGA	Current	Private—Residential	WPB-NE	A	FYR
R302	RGA	Current	Private—Residential	WPB-NE	A	FYR
R384	RGA	Current	Private—Residential	WPB-NE	A	Outside Water Policy
R387	RGA	Current	Private—Residential	WPB-NE	A	Outside Water Policy
R424	RGA	Current	Private—Residential	CARB	NS	FYR

Note: Residential wells inside of the water policy box will be inspected during a Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Review period to verify that the well is not functioning as a water source. Those residential wells outside of the water policy box may be accessed by the landowner.

WATER LEVELS

Water level measurements are divided into two programs: (1) measurement of water levels at wells that support potentiometric surface map development in relation to the permitted landfills (measured quarterly); and (2) measurement of water levels at wells of remaining wells (measured annually). The remaining wells are defined as those remaining wells from Appendix B of this Environmental Monitoring Plan. Wells associated with the potentiometric surface maps at the permitted landfills are measured within as short a time period as possible, not to exceed a three-day period. (Note: Wells denoted as "commitment wells" are those wells formally agreed upon to be measured, but are not listed specifically in the permit. Wells denoted as "noncommitment wells" are measured as a best management practice.) All remaining wells are measured on an annual basis. In fiscal year 2014, the remaining wells will be measured between August 1 and September 30.

WATER LEVELS IN SUPPORT OF PERMITTED LANDFILLS

C-404 Landfill Quarterly Water Levels (9) Permitted Wells
MW84
MW87
MW90A
MW85
MW88
MW91
MW93
MW94
MW420
Commitment Wells (7)[a]
MW67
MW76
MW227
MW333
MW337
MW414
MW416
Noncommitment Wells (7)
MW86
MW89
MW92
MW95A
MW226
MW338
MW415

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

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

[a] Per a DOE commitment, PPPO-02-640-08, (pertaining to C-404 Landfill permitting process) 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 water level measurement data will be reported to Kentucky Division of Waste Management as part of the semiannual report.

[b] Wells are cited in both the C-746-U Landfill permit and the C-746-S&T Landfill permit.

[c] Based on the approved permit on for the C-746-S&T Landfills, these two wells are permitted wells; however, they are permitted only for water level measurements.

APPENDIX C

ENVIRONMENTAL SAMPLING FREQUENCY AND PARAMETERS

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ACRONYMS

ASER	Annual Site Environmental Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
EM	environmental monitoring
EMP	Environmental Monitoring Plan
ERPP	Environmental Radiation Protection Program
FFA	Federal Facility Agreement
FY	fiscal year
KDWM	Kentucky Division of Waste Management
KPDES	Kentucky Pollutant Discharge Elimination System
MCL	maximum contaminant level
MW	monitoring well
PGDP	Paducah Gaseous Diffusion Plant
RFI	Resource Conservation and Recovery Act Facility Investigation
RGA	Regional Gravel Aquifer
ROD	record of decision
TRE	toxicity reduction evaluation
TLD	thermoluminescent dosimeter
TSS	total suspended solids

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C.1. INTRODUCTION

Three-hundred thirty-eight monitoring wells (MWs) are active and monitored as part of the Environmental Monitoring (EM) Program. Active wells are either in an analytical sampling program or may be evaluated only for water level measurements. This appendix shows a summary of each analytical sampling program. Figure C.1 shows the locations of each MW that is included in an analytical sampling program.

In addition to MW locations, the sampling programs within this appendix include sampling parameters for other locations covered in the EM Program (i.e., surface water and sediment programs).

Each summary includes the environmental sampling frequencies, parameters, analytical methods, the sampling drivers, rationale for conducting the sampling, which document(s) the sampling results are reported in, and a list of locations that are sampled.

An effort has been made to reduce the amount of sampling performed to support fiscal responsibility of the EM program at the site. The criteria used to determine less frequent sampling include the following:

- New understanding of contaminant migration pathways and contaminants present,
- Review of historical results and long-term trends,
- Analyses to determine if the MW meets the current and future objectives of the Groundwater Operable Unit, 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) 2013 to the FY 2014 Environmental Monitoring Plan (EMP) is included in each sampling program section. The changes described in this appendix were made using the criteria listed above. Data collected under the sampling programs defined in this appendix will be evaluated in FY 2014. 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 2014 EMP. In those cases where sampling cannot be performed due to an uncontrollable condition, such as blocked access to an MW due to flooding conditions, the sampling staff will denote the reason as to why the sample could not be collected.

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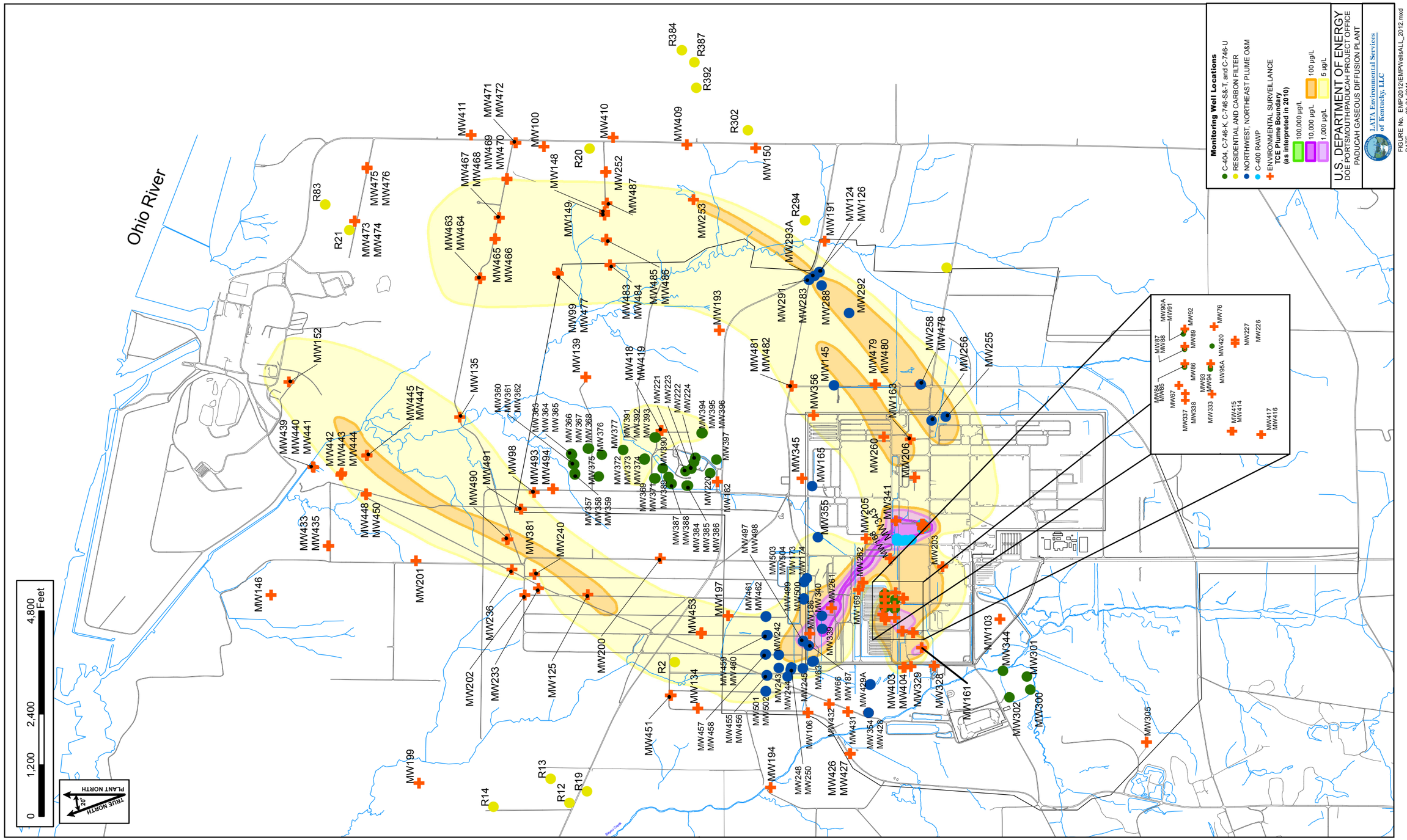

Figure C.1. Monitoring Wells Sampled under the EMP

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C.2. GROUNDWATER MONITORING

The Paducah Site samples MWs 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 EM manager until all deficiencies have been corrected. More specific requirements to the acceptance of MWs are detailed in procedure PAD-ENM-0069, *Monitoring Well and Associated Infrastructure Installation*. MWs are inspected, at a minimum, on an annual basis per the procedure PAD-ENM-0074, *Monitoring Well Inspection and Maintenance*. Outlines for well rehabilitation methods are found in the *Monitoring Well Maintenance Implementation Plan for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, PAD-PROJ-0025.

Specified methods found in Appendix C are EPA approved methods, as applicable. In some instances, such as with radionuclides, EPA approved methods are unavailable. For this EMP, the currently used laboratory's analytical procedure is noted as the method of choice. If an analysis is conducted at another laboratory during FY 2014, an equivalent procedure will be requested.

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 permits and the Annual Site Environmental Report (ASER)

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.

Comments: The current solid waste landfill permits were effective on July 20, 2012, and expire on November 4, 2016.

For all three solid waste permits, SW07300014, SW07300015, and SW07300045, the reporting requirement for maximum contaminant limit (MCL) is as follows: "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]."

C-746-S and C-746-T Landfills have independent solid waste permits; however, MW sampling is performed and reported collectively. Per Technical Attachment 25, Appendix G, to the permits for C-746-S, C-746-T, and C-746-U Landfills, sample collection order is specified. The order is as follows: volatiles (including total organic halides), dissolved gases and total organic carbon, semivolatile organics, metals and cyanide, water quality cations and anions, and radionuclides. If samples are being collected at a location where it is anticipated that sample volume is not adequate, then the order of collection will be volatiles followed by radionuclides.

Data collected under this program will be evaluated. Based on trending results, if changes are deemed appropriate, they will be proposed via a permit modification and reflected in the FY 2014 EMP.

Tables C.1 and C.2 list MWs 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. (Note: Permit Technical Attachment 25 currently is being revised to reflect current EPA-approved analytical methods, as shown in Table C.3). Locations are shown on Figure C.2.

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

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

[a] The total number of permitted wells associated with the C-746-S&T Landfills 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.

[b] 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 the Compliance Monitoring Reports for both 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.

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

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

[a] These four wells are not counted in the totals for the C-746-S&T Landfills, but are reported in the Compliance Monitoring Reports for both 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.

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

Volatiles—Method 8260B unless noted		
1,1,1,2-Tetrachloroethane	Acetone	Dibromochloromethane
1,1,1-Trichloroethane	Acrolein	Dibromomethane
1,1,2,2-Tetrachloroethane	Acrylonitrile	Dimethylbenzene, Total[a]
1,1,2-Trichloroethane	Benzene	Ethylbenzene
1,1-Dichloroethane	Bromochloromethane	Iodomethane
1,1-Dichloroethene	Bromodichloromethane	Methylene Chloride
1,2,3-Trichloropropane	Bromoform	Styrene
1,2-Dibromo-3-chloropropane—8011	Bromomethane	Tetrachloroethene
1,2-Dibromoethane	Carbon Disulfide	Toluene
1,2-Dichlorobenzene	Carbon Tetrachloride	*trans*-1,2-Dichloroethene
1,2-Dichloroethane	Chlorobenzene	*trans*-1,3-Dichloropropene
1,2-Dichloropropane	Chloroethane	*trans*-1,4-Dichloro-2-Butene
1,4-Dichlorobenzene	Chloroform	Trichloroethene
2-Butanone	Chloromethane	Trichlorofluoromethane
2-Hexanone	*cis*-1,2-Dichloroethene	Vinyl Acetate
4-Methyl-2-pentanone	*cis*-1,3-Dichloropropene	Vinyl Chloride
Anions—Method 9056 unless noted		
Bromide	**Fluoride—9214**	Sulfate
Chloride	Nitrate as Nitrogen	
Metals—Method 6020 unless noted		
Aluminum—6010B		Silver
Antimony	**Iron—6010B**	**Sodium—6010B**
Arsenic	Lead	Tantalum
Barium	**Magnesium—6010B**	Thallium
Beryllium	Manganese	Uranium
Boron—6010B	**Mercury—7470A**	Vanadium
Cadmium	Molybdenum	Zinc
Calcium—6010B	Nickel	Barium, Dissolved
Chromium	**Potassium—6010B**	Chromium, Dissolved
Cobalt	Rhodium	Uranium, Dissolved
Copper	Selenium	
Miscellaneous—Method as follows		
Chemical Oxygen Demand—410.4	**Iodide—345.1**	**Total Dissolved Solids—160.1**
Cyanide—9010C	**Total Organic Carbon—9060**	**Total Organic Halides—9020B**
Field Parameters		
Conductivity	Redox	Temperature
Depth to Water	pH	Turbidity
Dissolved Oxygen		
PCBs[b]—Method 8082		
PCB, Total	PCB-1232	PCB-1254
PCB-1016	PCB-1242	PCB-1260
PCB-1221	PCB-1248	PCB-1268
Radionuclides—Method as follows		
Alpha Activity—9310	**Radium-228[c]—RL-7129**	**Thorium-230—RL-7128**
Beta Activity—9310	**Strontium-90—RL-7140**	**Thorium-232[c]—RL-7128**
Radium-226—RL-7129	**Technetium-99—RL-7100**	**Tritium—EPA906.0**

[a] Xylenes
[b] Polychlorinated biphenyls (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.
[c] 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.
Bolded parameters are sampled by different method than specified in header.

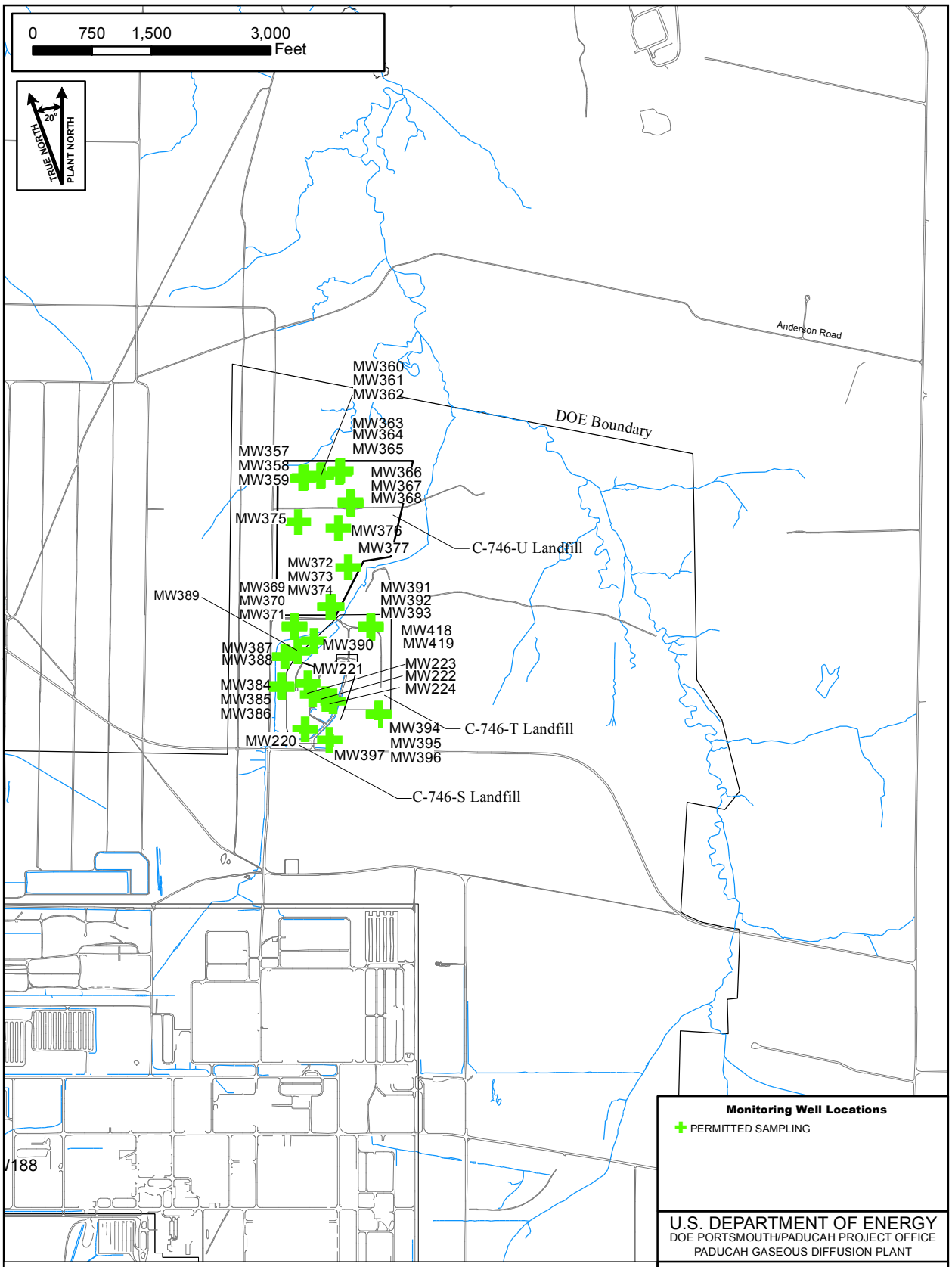


Figure C.2. Groundwater Monitoring Wells Near the C-746-S, T, and U Landfills

FIGURE No. EMP\2013\EMPWellsSTU_2013.mxd
DATE 09-13-2012

C-404 Low-Level Radioactive Waste Burial Ground (Resource Conservation and Recovery Act Detection Status Monitoring)

Frequency: Semiannually

Driver: The semiannual parameters are required to be sampled per Hazardous Waste Facility Permit, KY8-890-008-982.

MWs 226, 227, 333, 337, and 338 are monitored in support of the *Record of Decision for Interim Remedial Action at Solid Waste Management Unit 2 and 3 of Waste Area Group 22 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1351&D1, July 1995.

Reported: Semiannual C-404 Groundwater Monitoring Report required by the permit, Semiannual Federal Facility Agreement (FFA) Progress Report, and the ASER

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 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: In the event that only a partial sample can be obtained, the following priority will be followed: field parameters, trichloroethene (TCE), and metals. The dissolved metal samples (arsenic, cadmium, chromium, lead, mercury, selenium, and uranium) are filtered in the on-site laboratory or field laboratory.

Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2014. Data collected under this program were evaluated. Based on trending results, LATA Environmental Services of Kentucky, LLC, proposed changes to the permit regarding statistical trending. The changes still are under consideration by KDWM.

Field parameters (pH, temperature, conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity) are measured using a Hydrolab water quality meter. Other field parameters, such as depth to water and barometric pressure, are measured prior to sampling.

Prior to sample collection, KDWM shall be notified one week in advance. Notification may be made in writing or electronic format. Electronic mail shall be submitted to pgdp.notify@ky.gov, and other pertinent KDWM field personnel.

A listing of MWs for the 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

C-404 Landfill Wells (9)			
MW84	MW88	MW91	MW94
MW85	MW90A	MW93	MW420
MW87			
Opted to Sample—Not Committed to KDWM (11)[a]			
TCE, Tc-99, and Field Parameters			
MW67	MW89	MW226[b]	MW337[b]
MW76	MW92	MW227[b]	MW338[b]
MW86	MW95A	MW333[b]	

[a] MWs 414 and 416 are also part of this special sampling event; however, only depth to water measurements are collected for these two wells.
[b] MWs 226, 227, 333, 337, and 338 are monitored in support of the *Record of Decision for Interim Remedial Action at Solid Waste Management Unit 2 and 3 of Waste Area Group 22 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1351&D1, July 1995.

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

Volatiles—Method 8260B			
Trichloroethene			
Metals—6020 unless noted			
Arsenic	Lead	Uranium	Lead, Dissolved
Cadmium	Manganese	Arsenic, Dissolved	**Mercury, Dissolved—7470A**
Chromium	**Mercury—7470A**	Cadmium, Dissolved	Selenium, Dissolved
Iron—6010B	Selenium	Chromium, Dissolved	Uranium, Dissolved
Field Parameters			
Barometric Pressure	Depth to Water	Redox	Temperature
Conductivity	Dissolved Oxygen	pH	Turbidity
Radionuclides—Method RL-7128 unless noted			
Technetium-99—RL7100	Uranium-234	Uranium-235	Uranium-238
Miscellaneous—Method as follows*			
Sulfide—376.1	**Sulfite—377.1**	**Sulfate—9056**	**Total Organic Carbon—9060**

*Not required by the permit.
Bolded parameters are sampled by different method than specified in header.

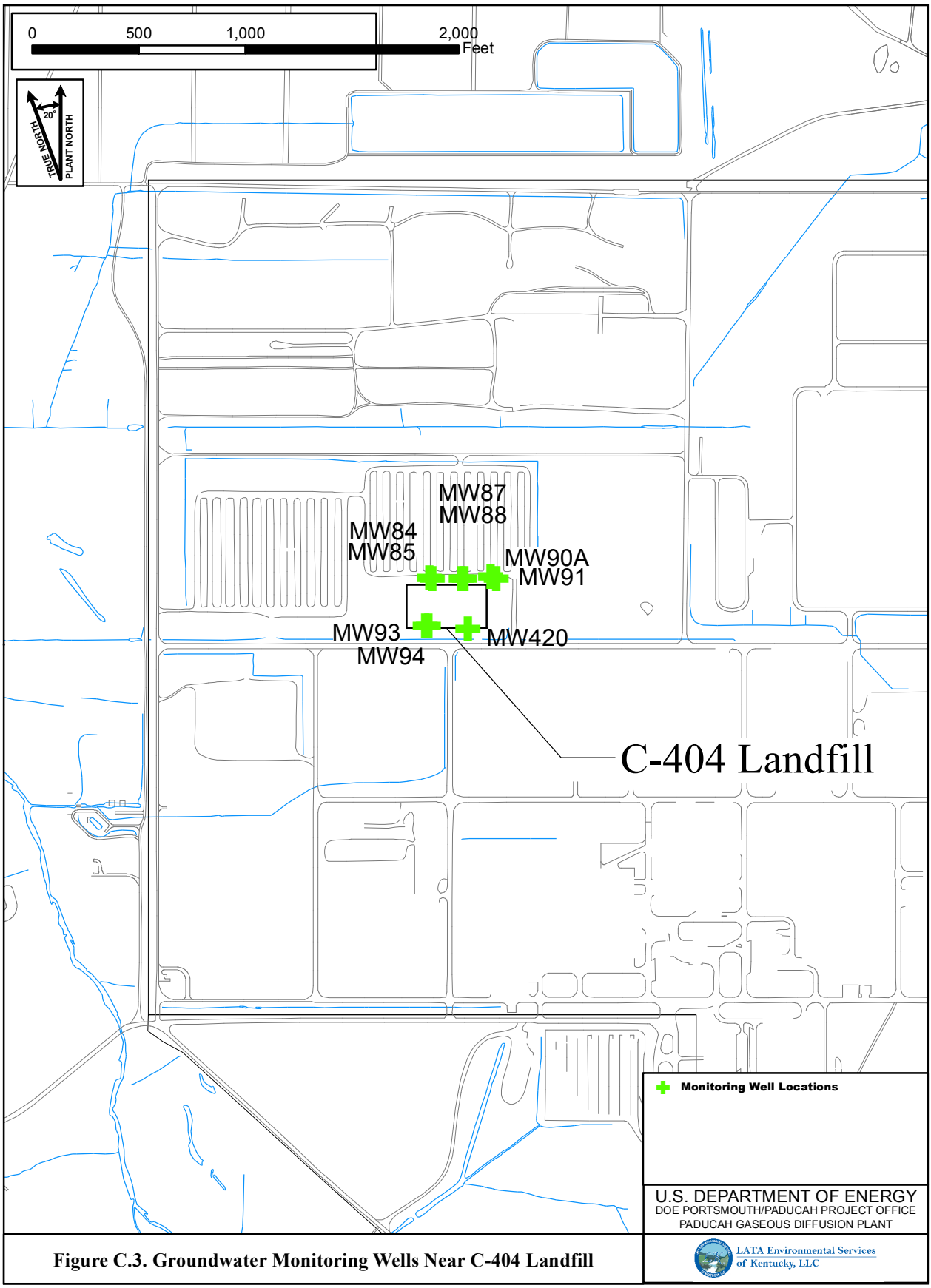


Figure C.3. Groundwater Monitoring Wells Near C-404 Landfill

FIGURE No. EMP\EMPWells404_2013.mxd
DATE 09-12-2012

C-746-K Landfill Monitoring

Frequency: Semiannually

Driver: *Record of Decision for Waste Area Groups 1 and 7 for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1470&D2, September 1997: Even though the Record of Decision (ROD) for Waste Area Groups 1 and 7 was a Surface Water Operable Unit decision document, sampling of MWs is noted in the ROD. The ROD also allows for annual evaluation of the program with documentation in the *Sampling and Analysis Plan Addendum*, KY/ER-2, which previously was superseded by the EMP.

Reported: Semiannual FFA Progress Report and the ASER

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. 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 2014.

An inspection of MW301, as part of the routine well maintenance program, identified an issue with the casing. An evaluation was conducted to assess repair to the casing, and it was found that it would not be cost-effective for repair. A review of the data suggested that MW300 data is sufficient and that there is no value added in replacing MW301. Upon approval by the regulators, MW301 will be abandoned, and no replacement will be installed.

Tables C.6 and C.7 provide a listing of landfill wells and analytical parameters, respectively. Locations are shown on Figure C.4.

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

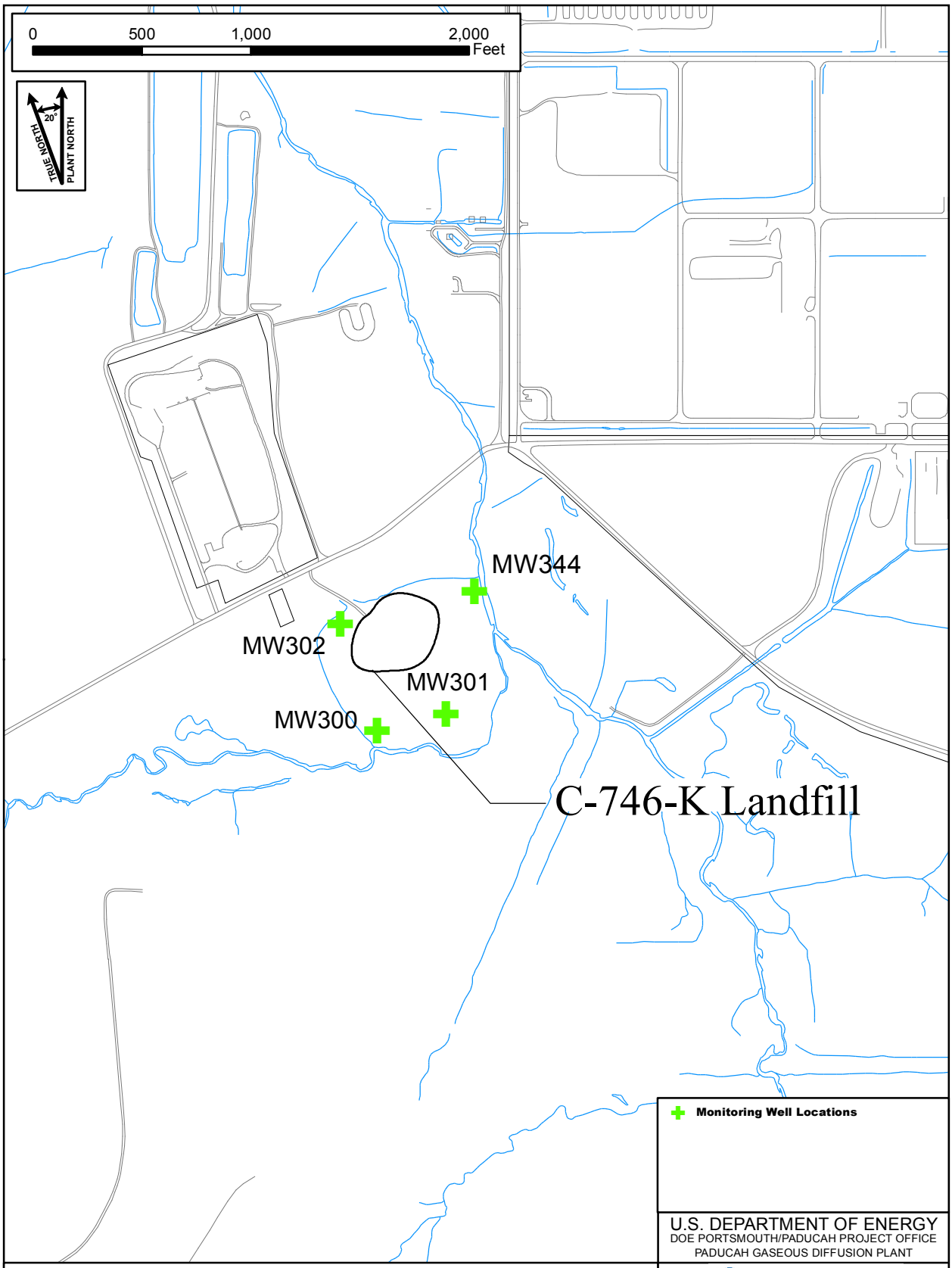
MW300	MW301	MW302	MW344

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

Volatiles—Method 8260B			
1,1,1-Trichloroethane	Benzene	*cis*-1,2-Dichloroethene	Toluene
1,1,2-Trichloroethane	Bromodichloromethane	Dimethylbenzene, Total[a]	*trans*-1,2-Dichloroethene
1,1-Dichloroethane	Carbon Tetrachloride	Ethylbenzene	Trichloroethene
1,1-Dichloroethene	Chloroform	Tetrachloroethene	Vinyl Chloride
1,2-Dichloroethane			
Field Parameters			
Conductivity	Depth to Water	pH	Turbidity
Barometric Pressure	Dissolved Oxygen	Temperature	Redox
Miscellaneous—Method as follows			
Alkalinity—310.1	**Ferrous Iron (Fe^{+2})—3500-FeB**		
Metals—Method 6020 unless noted			
Barium, Dissolved	Uranium, Dissolved	Cadmium	Manganese
Beryllium, Dissolved	**Aluminum—6010B**	**Calcium—6010B**	Nickel
Cadmium, Dissolved	Arsenic	**Iron—6010B**	**Potassium—6010B**
Lead, Dissolved	Barium	Lead	**Sodium—6010B**
Arsenic, Dissolved	Beryllium	**Magnesium—6010B**	Uranium
Radionuclides—Method 9310 unless noted			
Alpha Activity	Beta Activity	**Technetium-99—RL-7100**	
Anions—Methods 9056			
Chloride	Sulfate	Nitrate	

[A] Xylenes

Bolded parameters are sampled by different method than specified in header.



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

Figure C.4. Groundwater Monitoring Wells Near C-746-K Landfill

LATA Environmental Services of Kentucky, LLC

FIGURE No. EMP\EMPWellsK_2013.mxd
DATE 09-12-2013

C.2.2 NORTHEAST PLUME OPERATIONS AND MAINTENANCE PROGRAM

Northeast Plume Monitoring

Frequency: Quarterly and Semiannually

Driver: The MWs are required to be sampled by the *Operation and Maintenance Plan for the Northeast Plume Containment System Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1535&D3/R2, January 2002.

Reported: Semiannual FFA Progress Report and ASER

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 (or other operational samples) are not sampled under the groundwater program as part of the EM Program. They are sampled as specified under the Operations and Maintenance Plan for the Northeast Plume, but are sampled by the operational manager or designee.

Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2014.

Table C.8 provides a listing of MWs sampled semiannually and the associated parameters. Table C.9 provides a listing of MWs sampled quarterly and the associated parameters. Locations are shown on Figure C.5.

Table C.8. Northeast Plume Semiannual Wells and Parameters

Semiannual Wells (14)			
MW124	MW256	MW291	MW410 [a]
MW126	MW258	MW292	MW411 [a]
MW145	MW283	MW293A	
MW255	MW288	MW409[a]	
Semiannual Analytical Parameters			
Volatiles—Method 8260B			
1,1,1-Trichloroethane	Benzene	*cis*-1,2-Dichloroethene	Toluene
1,1,2-Trichloroethane	Bromodichloromethane	Dimethylbenzene, Total[b]	*trans*-1,2-Dichloroethene
1,1-Dichloroethane	Carbon Tetrachloride	Ethylbenzene	Trichloroethene
1,1-Dichloroethene	Chloroform	Tetrachloroethene	Vinyl Chloride
1,2-Dichloroethane			
Radionuclides—Method 9310 unless noted			
Alpha Activity	Beta Activity	**Technetium-99—RL-7100**	
Field Parameters			
Barometric Pressure	Depth to Water	Redox	Temperature
Conductivity	Dissolved Oxygen	pH	Turbidity

[a] MW409, MW410, and MW411 are sampled in this program as a best management practice. Adding these wells to this program does not increase the frequency at which they are sampled. This change captures the program designation under which they are sampled for ease in sample management. They were identified as part of the surveillance program in the FY 2013 EMP with a footnote to be sampled semiannually, as opposed to annually.
[b] Xylenes
Bolded parameters are sampled by different method than specified in header.

Table C.9. Northeast Plume Quarterly Wells and Parameters

Quarterly Wells (5)			
MW255	MW258	MW288	MW292
MW256			
Quarterly Analytical Parameters			
Radionuclides—Method RL-7100			
Technetium-99			
Field Parameters			
Barometric Pressure	Depth to Water	Redox	Temperature
Conductivity	Dissolved Oxygen	pH	Turbidity

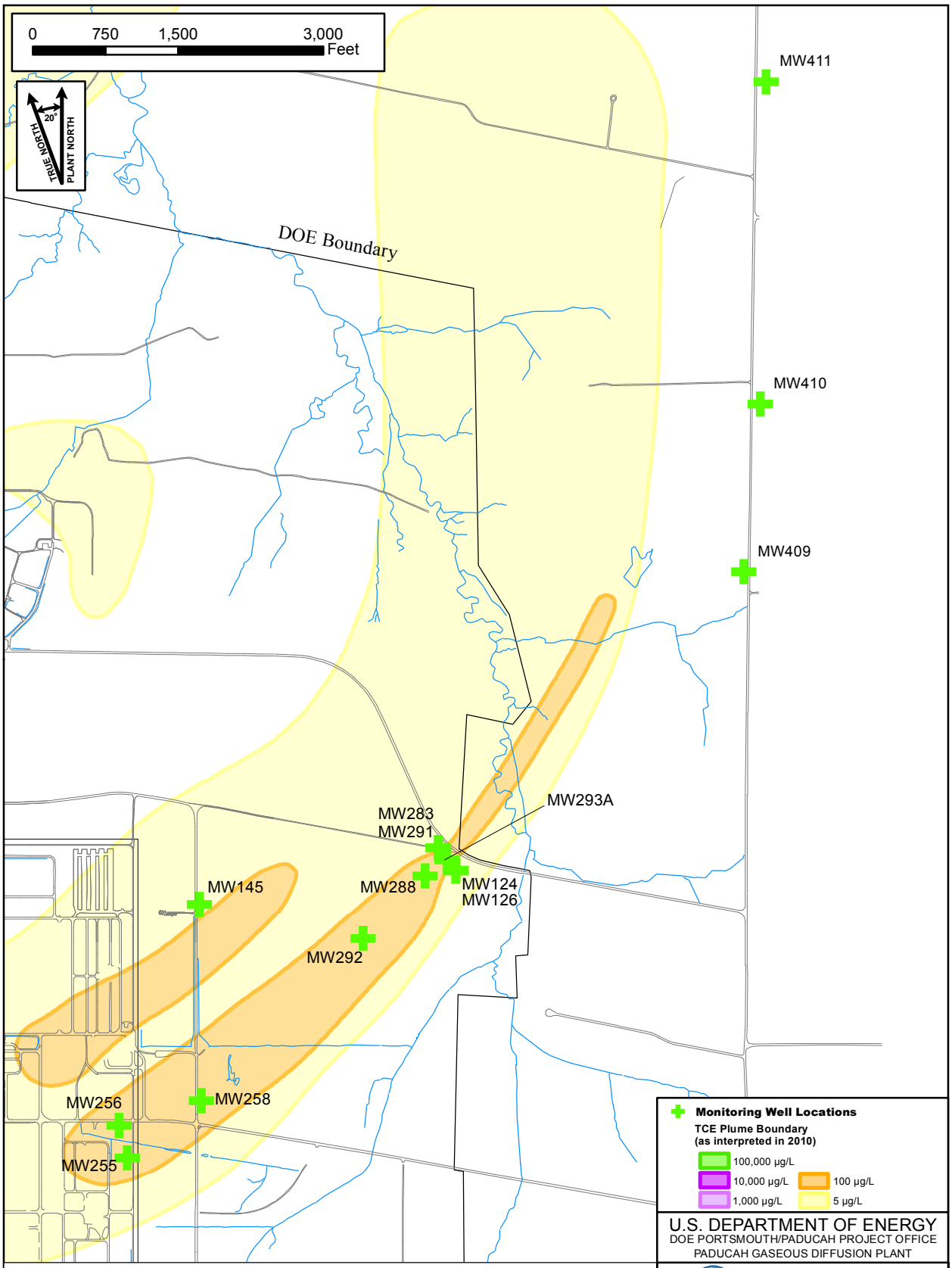


Figure C.5. Northeast Plume Monitoring Wells

FIGURE No. EMP\2014\EMPWellsNEP_2014.mxd
DATE 08-28-2013

C.2.3 NORTHWEST PLUME OPERATIONS AND MAINTENANCE PROGRAM

Northwest Plume Monitoring

Frequency: Semiannually

Driver: The MWs are required to be sampled by the *Operation and Maintenance Plan for the Northwest Plume Groundwater System Interim Remedial Action at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1253&D4/R5, September 2010.

Reported: Semiannual FFA Progress Report and the ASER

Rationale: To determine the effectiveness of the optimization of Northwest Plume operations, monitor the nature and extent of groundwater contamination, and evaluate any cyclic trends in water quality that may affect contaminant migration.

Comments: The extraction wells (or other operational samples) are not sampled under the groundwater program as part of the EM Program. They are sampled as specified under the Operations and Maintenance Plan for the Northwest Plume, but are sampled by the operational manager or designee.

Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2014.

Table C.10 provides a listing of MWs and the associated parameters, and Table C.11 provides the analytical parameters. Locations are shown on Figure C.6.

Table C.10. Northwest Plume Wells

Semiannual Wells (33)					
MW63	MW243	MW340	MW456	MW461	MW500
MW65	MW244	MW355	MW457	MW462	MW501
MW66	MW245	MW428	MW458	MW497	MW502
MW165	MW248	MW429A	MW459	MW498	MW503
MW173	MW250	MW430	MW460	MW499	MW504
MW242	MW339	MW455			

Table C.11. Northwest Plume Analytical Parameters

Volatiles—Method 8260B			
1,1,1-Trichloroethane	Benzene	*cis*-1,2-Dichloroethene	Toluene
1,1,2-Trichloroethane	Bromodichloromethane	Dimethylbenzene, Total[a]	*trans*-1,2-Dichloroethene
1,1-Dichloroethane	Carbon Tetrachloride	Ethylbenzene	Trichloroethene
1,1-Dichloroethene	Chloroform	Tetrachloroethene	Vinyl Chloride
1,2-Dichloroethane			
Field Parameters			
Barometric Pressure	Depth to Water	Redox	Temperature
Conductivity	Dissolved Oxygen	pH	Turbidity
Radionuclides—Method RL-7111 unless noted			
Alpha Activity	Beta Activity	**Technetium-99—RL-7100**	

[a] Xylenes
Bolded parameters are sampled by different method than specified in header.

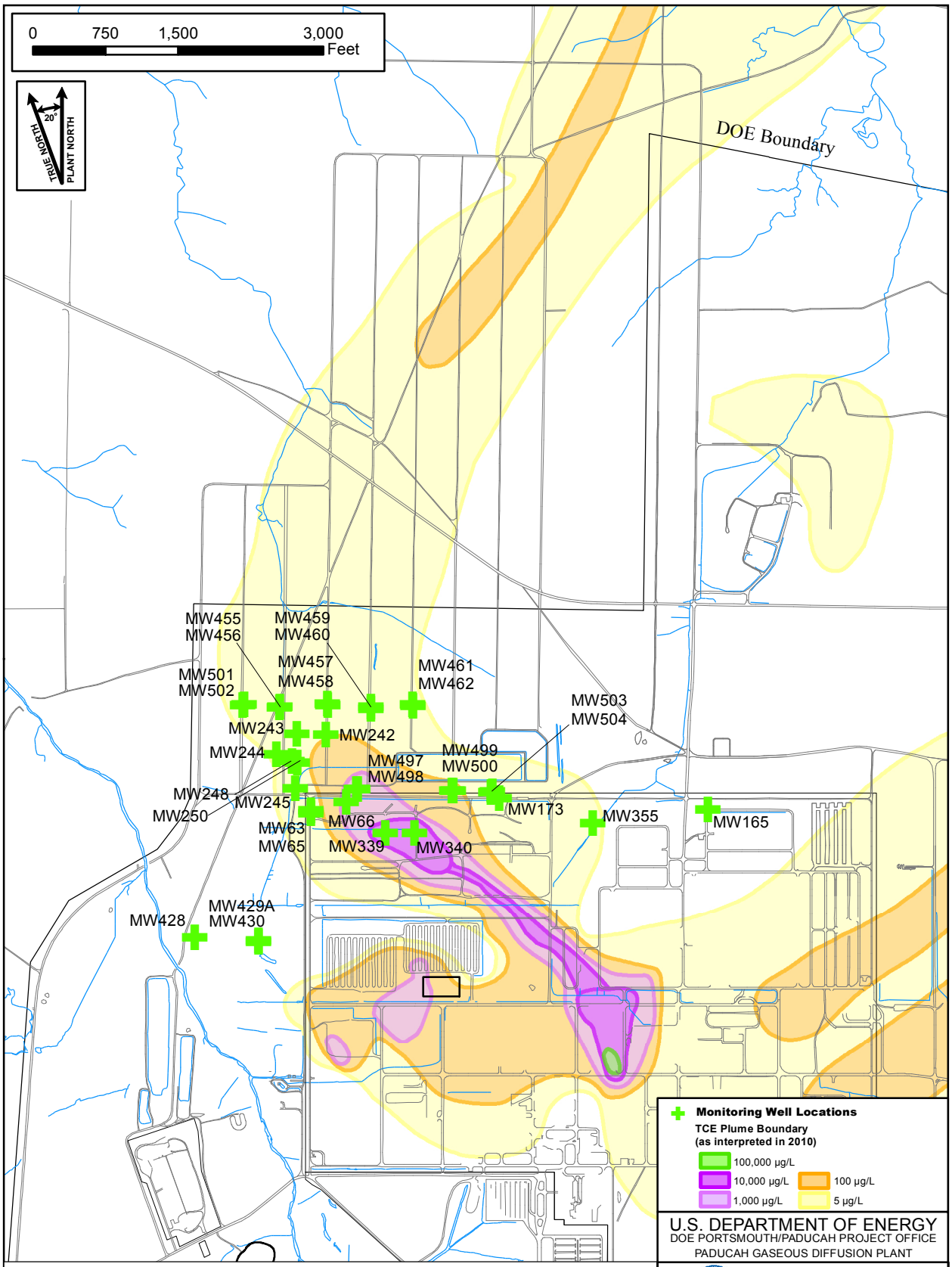


Figure C.6. Northwest Plume Monitoring Wells

FIGURE No. EMP\2013\EMPWellsNWP_2013.mxd
DATE 09-14-2012

C.2.4 C-400 MONITORING WELLS

C-400 Wells

Frequency: Quarterly and Semiannually

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/A1/R2. Additional sampling requirements are documented in PPPO-02-452-09, "Response to Letter from Kentucky Division of Waste Management Regarding Baseline Groundwater Sample Collection at the Northwest Corner of the C-400 Building," July 8, 2009.

Reported: Semiannual FFA Progress Report and the ASER

Rationale: These MWs 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.

Comments: Sampling frequencies and sampling parameters were not modified for this sampling program for FY 2014.

Due to ongoing field remediation activities, access to some of the monitoring wells may be limited and sampling may not be possible. In such cases, the sampling staff will document the issue on the deactivated chain of custody.

Table C.12 provides a listing of the C-400 MWs, and Table C.13 provides the analytical parameters for these MWs. Locations are shown on Figure C.7.

Table C.12. C-400 Monitoring Wells (17)

Quarterly Wells (9)		
MW155	MW406: Port 5	MW505
MW156	MW407: Port 4	MW506
MW405: Port 5	MW408: Port 5	MW507
Semiannual Wells (8)		
MW175	MW421: Port 1, Port 2, Port 3	MW424: Port 1, Port 2, Port 3
MW342	MW422: Port 1, Port 2, Port 3	MW425
MW343	MW423: Port 1, Port 2, Port 3	

Table C.13. C-400 Monitoring Wells Analytical Parameters

Volatiles—Method 8260B			
1,1-Dichloroethene	*trans*-1,2-Dichloroethene	Trichloroethene	Vinyl Chloride
cis-1,2-Dichloroethene			
Anions—Method 9056			
Chloride			
Radionuclides—Method RL-7100			
Technetium-99			
Field Parameters[b]			
Barometric Pressure	Depth to Water[a]	Redox	Temperature
Conductivity	Dissolved Oxygen	pH	Turbidity

[a] As applicable, depth to water measurements cannot be obtained for multiport wells.
[b] Sampling staff may be prohibited from collecting some field measurements due to elevated temperatures as a result of the remediation field activities. In such cases, the sampling staff will document the issue on the deactivated chain of custody.

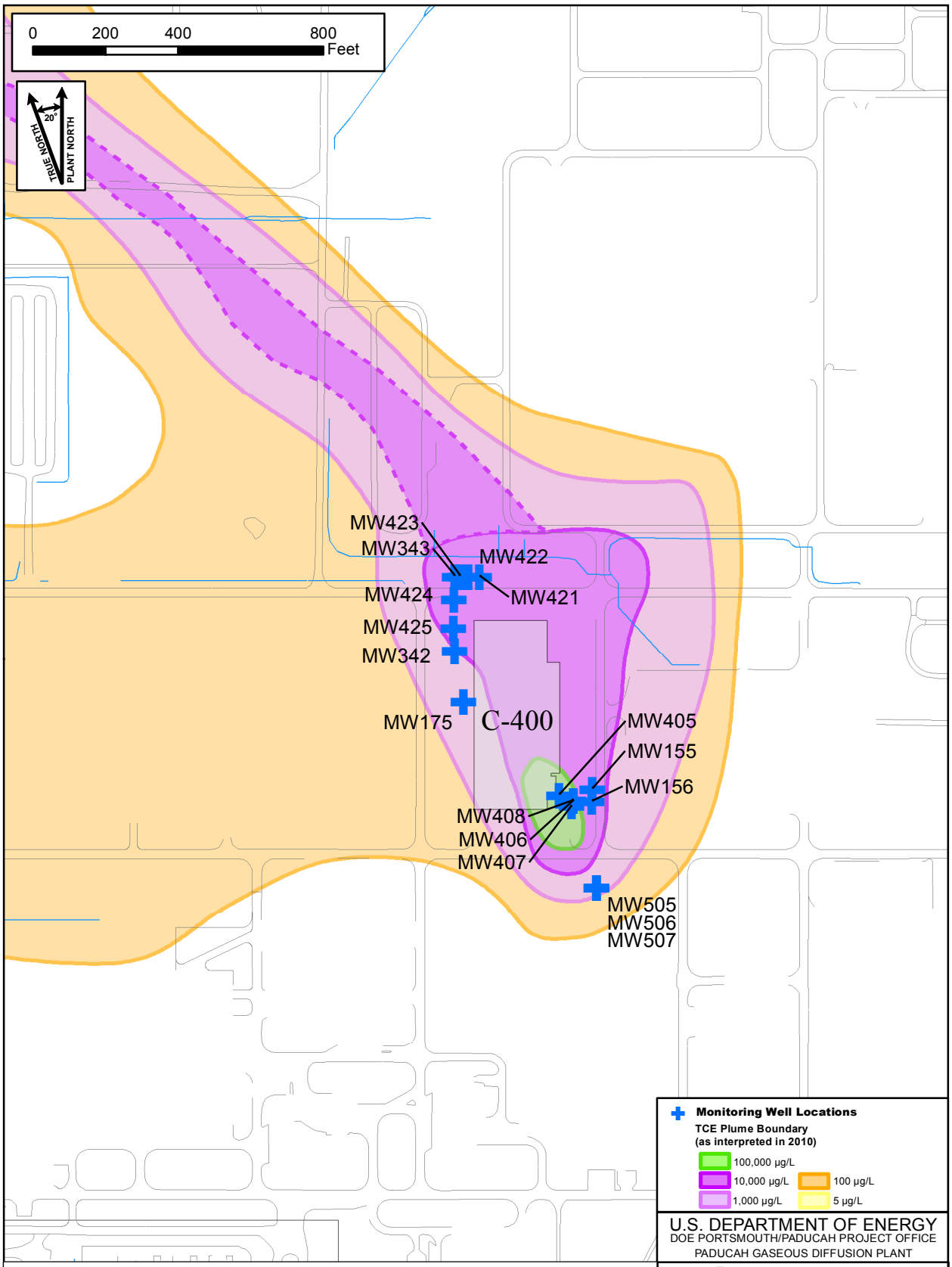


Figure C.7. C-400 Monitoring Wells

FIGURE No. EMP\2013\EMPWells400_2013.mxd
DATE 09-14-2012

C.2.5 WATER POLICY BOUNDARY MONITORING PROGRAM

Frequency: Quarterly and Annually

Driver: The *Action Memorandum for the Water Policy at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1201&D2, June 1994 stipulated the need to ensure that residential landowners were provided with water whose well water is contaminated by Paducah Gaseous Diffusion Plant (PGDP) sources. The Action Memorandum provided the sampling strategy only at the time the document was prepared and referred future sampling to the Sampling and Analysis Plan Addendum, which previously was superseded by the EMP.

Reported: Residential well data will be reported to the landowner on an annual basis and may be reported in the ASER. Monitoring wells, regardless if located on private property or on DOE property, will be reported only in the ASER.

Rationale: A group of residential wells and MWs were chosen to confirm plume migration paths of the Northwest and Northeast Plumes, near the boundaries of the Water Policy Box. Because of the predominant northern flow of groundwater from the site, the concentration of selected wells is more toward the west and east of the site, as opposed to south (see Tables C.14, C.15, and C.16).

Reviews of the data generated through this program may warrant changes to the Water Policy Box [see Figure C.8 (northwest wells) and Figure C.9 (northeast wells)].

Comments: The Water Policy Boundary Monitoring Program was introduced in FY 2013 under this format. Sampling of the residential wells and MWs stated below were previously a part of other programs contained in prior years' EMPs. In order to better capture the objectives stated above, this program was defined as a unique sampling program.

In FY 2014, sampling was eliminated from R12, R19, and R392. Gross alpha and gross beta activity analysis was eliminated from the FY 2014 EMP. Instead, technetium-99 and uranium isotopes will be analyzed without first evaluating for gross alpha and gross beta activity. The gross alpha and gross beta activity analyses were being used as a screening mechanism prior to performing the isotopic analyses. These screening analyses took a longer period of time and did not yield a great deal of cost savings; therefore were removed.

Table C.14. Northwestern Wells

Quarterly (20)						
R2[a]	R26	MW106	MW194	MW202	MW432	MW441
R13[a]	R53	MW134	MW199	MW426	MW433	MW452
R14[a]	R245	MW146	MW201	MW427	MW435	

[a] Wells that have been in recent residential well monitoring program.

Table C.15. Northeastern Wells

Annually (10)				
R9[a]	R21[a]	R90[a]	R294[a]	R384[a]
R20[a]	R83[a]	R114[a]	R302[a]	R387[a]

[a] Wells that have been in recent residential well monitoring program.

Table C.16. Residential Analytical Parameters—Northwest and Northeast Analytical Parameters

Field Parameters		
Barometric Pressure	Dissolved Oxygen	pH
Conductivity	Redox	Temperature
Depth to Water[a]		
Radionuclides—Method as follows		
Technetium-99—RL-7100	**Uranium-235—RL-7128**	
Uranium-234—RL-7128	**Uranium-238—RL-7128**	
Volatiles—Method 8260B		
Trichloroethene		

[a] As applicable.
Bolded parameters are sampled by different method than specified in header.

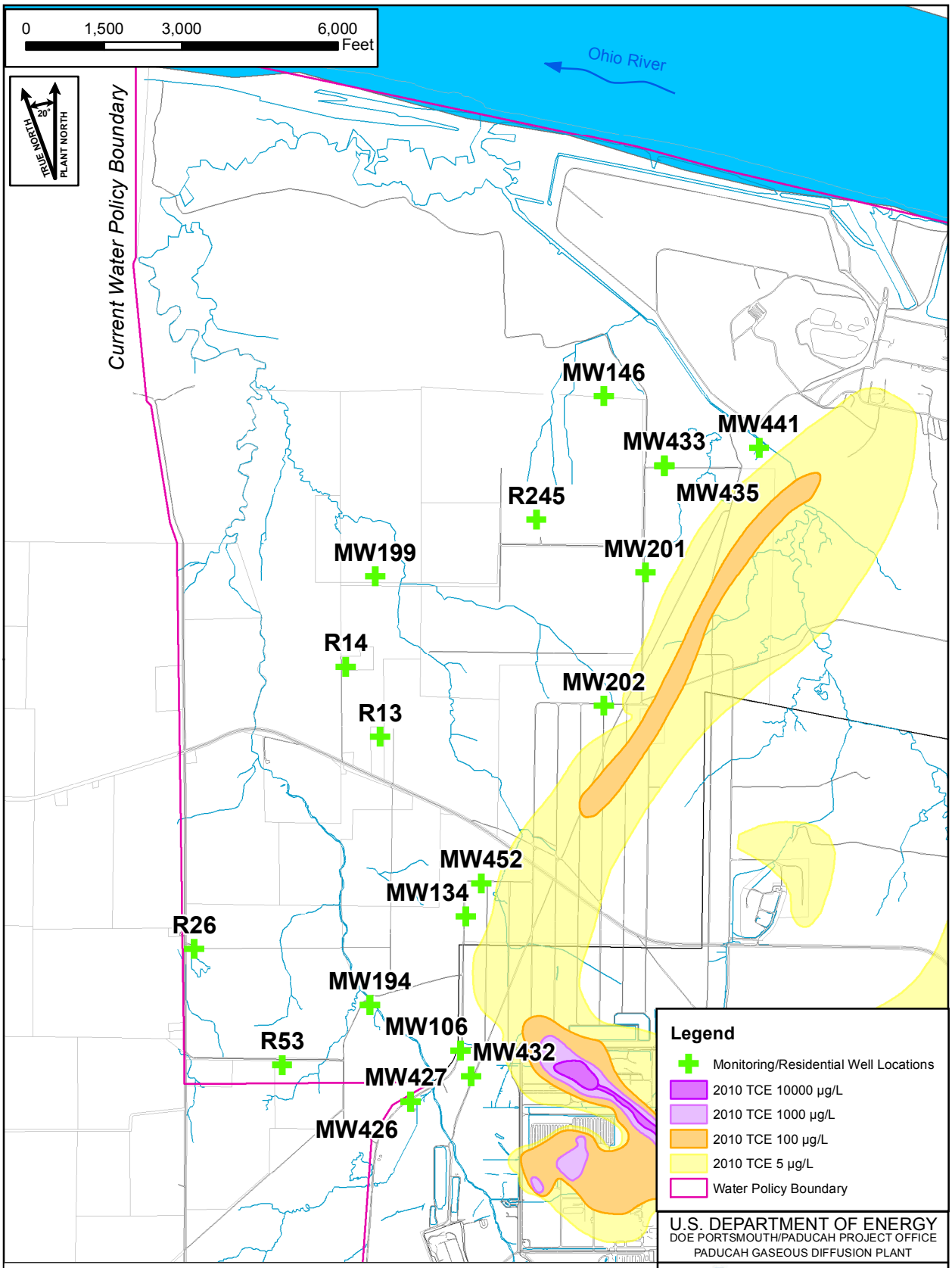


Figure C.8. Water Policy Boundary Monitoring Wells, Northwest

FIGURE No. EMP\2014\EMPWellsWPB-SW_2014.mxd
DATE 08-28-2013

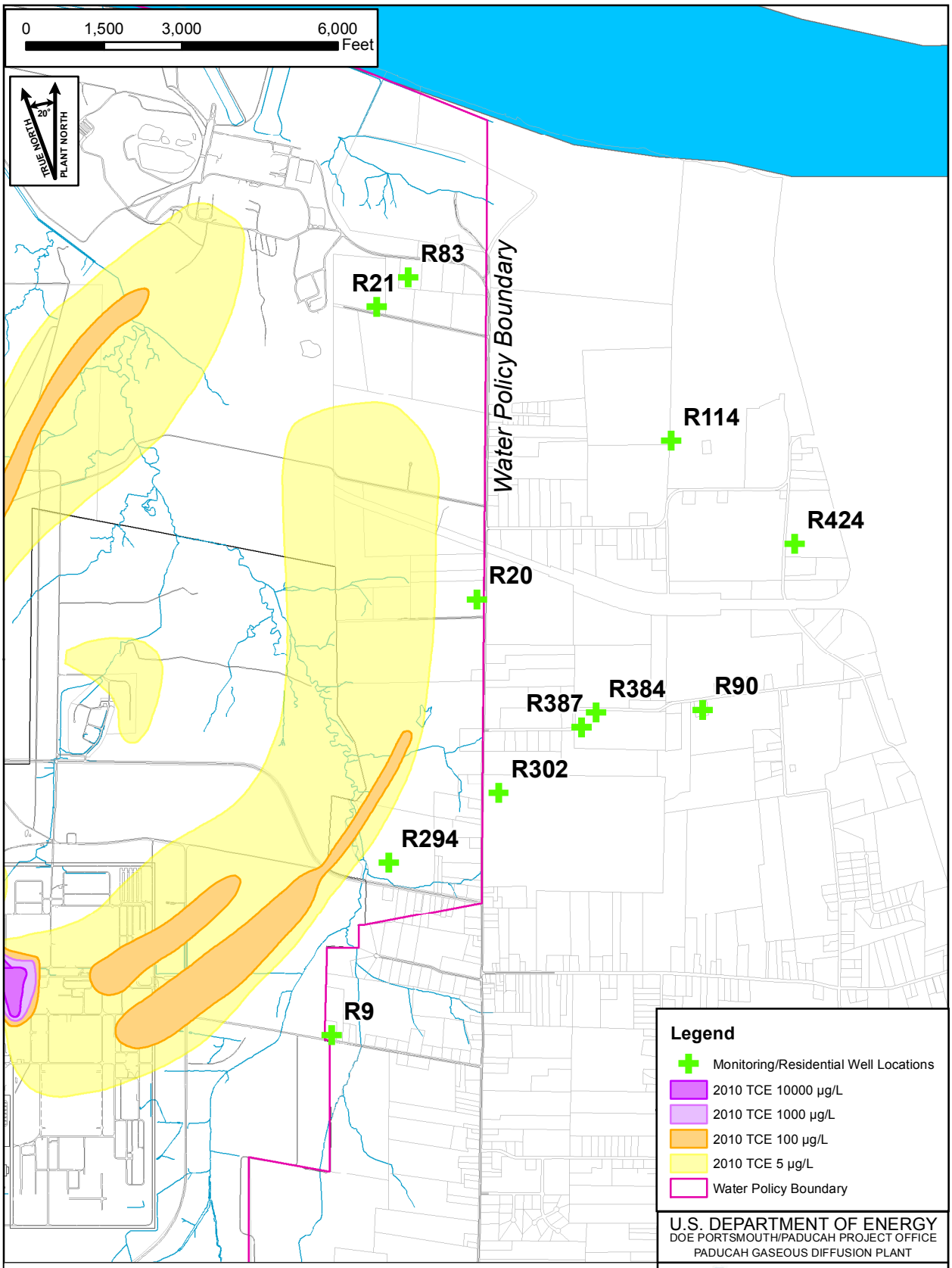


Figure C.9. Water Policy Boundary Monitoring Wells, Northeast

FIGURE No. EMP\2014\EMPWellsWPB-NE_2014.mxd
DATE 08-28-2013

C.2.6 CARBON FILTER TREATMENT SYSTEM

Frequency: Semiannually (two events per each semiannual event)

Driver: DOE Order 458.1 (based on a DOE decision)

Reported: Letter to landowner on a semiannual basis and the ASER

Comments: DOE is maintaining a treatment system for one landowner who is outside the Water Policy Box.

DOE Order 458.1 requires that contractors implement radiation protection for persons consuming water from a drinking water system operated by DOE or its contractors equivalent to 40 *CFR* § 141. Provisions of 40 *CFR* § 141 allow for environmental surveillance to be used for reduced sampling requirements. Review of the historical analytical data at this location indicates minimal risk and reduced monitoring is appropriate; therefore sampling for radiological parameters has been reduced from the specified frequencies in DOE Order 458.1. Parameters required by 40 *CFR* § 141 are beta emitters, tritium, and strontium-90 (Sr-90). Tc-99 is the only radiological parameter in this group that is a contaminant of potential concern in groundwater from DOE activities; however, based on reviews of the groundwater modeling and historical data, the groundwater at this location is not impacted by site operations. Based on these conditions, Tritium and Sr-90 will not be sampled, nor will alpha activity or beta activity be analyzed; and Tc-99 sampling frequency will be reduced from the monthly requirement to semiannual requirement to verify the technetium is below reporting limits. A review of the FY 2013 Tc-99 did not indicate a need for increased radionuclide analysis; therefore, no changes in sample strategy were made.

In 2013, a replacement to the carbon filtration system was made due to the age and condition of the unit. Samples of the direct groundwater and the final treated groundwater will continue to be collected. Samples from the intermediate treatment step have been eliminated because only the final treated water is of relevance.

Tables C.17 and C.18 identify carbon filter treatment system well and carbon filter treatment system analytical parameters, respectively. Location is shown on Figure C.9.

Table C.17. Carbon Filtration System (1)

R424: Port 1 direct groundwater	R424: Port 3 after ultraviolet light and carbon filter

Table C.18. Carbon Filtration System Analytical Parameters

Field Parameters		
Conductivity	Redox	Temperature
Dissolved Oxygen	pH	
Radionuclides—Method RL-7100		
Technetium-99		
Volatiles—Method 8260B		
Trichloroethene		
Miscellaneous—Method 9222 B		
Total Coliform		

C.2.7 ENVIRONMENTAL SURVEILLANCE GROUNDWATER MONITORING PROGRAM

Environmental Surveillance Monitoring

Frequency: Annually and Biennially

Driver: DOE Order 450.1A and the Paducah FFA

Reported: ASER

Rationale: Monitoring is conducted to determine the nature and extent of groundwater contamination and groundwater quality. Sampling of these MWs is conducted in support of the Paducah FFA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Investigation; Resource Conservation and Recovery Act Facility Investigations (RFIs); and DOE Order 436.1.

Comments: The program was modified in FY 2011 to focus on sampling key MWs annually and reduce sampling of other MWs to a biennial basis. The biennial grouping of MWs was sampled in FY 2013; therefore, they will not be sampled in FY 2014. The MWs remain included in the FY 2014 EMP discussion in order to capture the program and document the schedule.

The MWs 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 decisions.

Tables C.19 and C.20 identify MWs and analytical parameters, respectively. Locations are shown on Figure C.10.

Table C.19. Surveillance Wells (126)

Biennial (101)					
MW67	MW174	MW338	MW431	MW454	MW485
MW76	MW186	MW341	MW432	MW463	MW486
MW86	MW187	MW343	MW433	MW464	MW487
MW89	MW193	MW354	MW435	MW467	MW488
MW92	MW197	MW356	MW439	MW468	MW489
MW95A	MW200	MW403: Port 3	MW440	MW473	MW490
MW106	MW201	MW404: Port 4	MW441	MW474	MW491
MW125	MW202	MW405: Port 5	MW442	MW475	MW492
MW134	MW205	MW406: Port 5	MW443	MW476	MW493
MW135	MW226	MW407: Port 4	MW444	MW477	MW494
MW139	MW227	MW408: Port 5	MW445	MW478	MW495
MW146	MW260	MW414	MW447	MW479	MW496
MW148	MW262	MW415	MW448	MW480	**Background (4)**
MW149	MW328	MW416	MW450	MW481	MW103
MW163	MW329	MW417	MW451	MW482	MW194
MW168	MW333	MW426	MW452	MW483	MW199
MW169	MW337	MW427	MW453	MW484	MW305
Annual (25)					
MW98	MW182[a]	MW236	MW345	MW469	**Background (1)**
MW99	MW191	MW240	MW418[a]	MW470	MW150
MW100	MW203	MW252	MW419[a]	MW471	
MW152	MW206	MW253	MW465	MW472	
MW161	MW233	MW261	MW466		

[a] These three wells will be sampled for PCBs in addition to the remaining parameters.

Table C.20. Environmental Surveillance and Analytical Parameters

Annual and Biennial			
Field Parameters			
Barometric Pressure	Depth to Water	pH	Temperature
Conductivity	Dissolved Oxygen	Redox	Turbidity
PCBs (MW182, MW418, and MW419)—Method 8082			
PCB, Total	PCB-1232	PCB-1248	PCB-1260
PCB-1016	PCB-1242	PCB-1254	PCB-1268
PCB-1221			
Radionuclides—Method RL-7100			
Technetium-99			
Volatiles—Method 8260B			
1,1,1-Trichloroethane	Benzene	*cis*-1,2-Dichloroethene	Toluene
1,1,2-Trichloroethane	Bromodichloromethane	Dimethylbenzene, Total*	*trans*-1,2-Dichloroethene
1,1-Dichloroethane	Carbon Tetrachloride	Ethylbenzene	Trichloroethene
1,1-Dichloroethene	Chloroform	Tetrachloroethene	Vinyl Chloride
1,2-Dichloroethane			

* Xylenes

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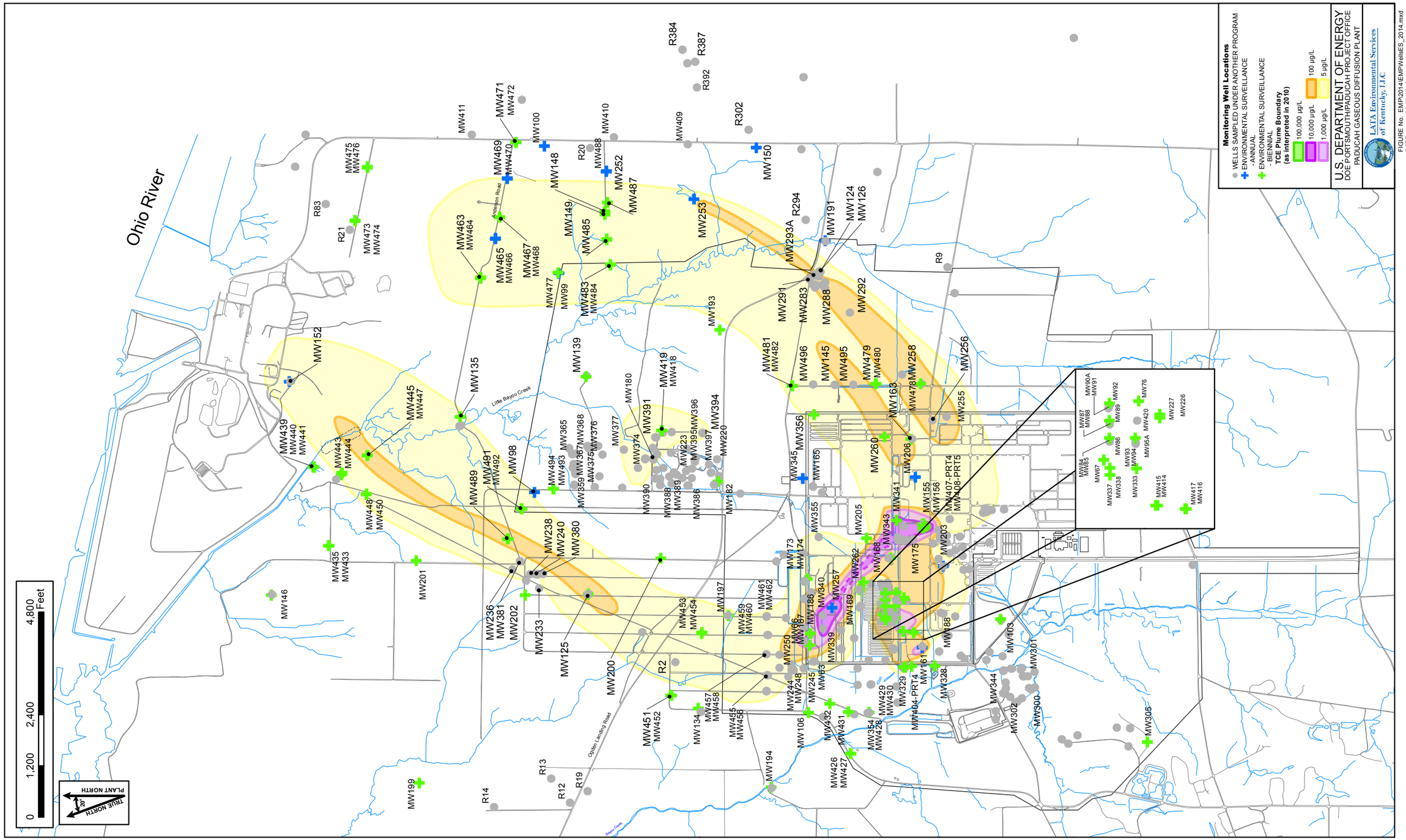

Figure C.10. Environmental Surveillance Groundwater Monitoring Wells

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Geochemical Environmental Surveillance Monitoring

Frequency: Triennially

Driver: DOE Order 436.1 and the Paducah FFA

Reported: ASER

Rationale: Monitor the extent of groundwater contamination and groundwater quality. Sampling of these MWs is conducted in support of the Paducah FFA CERCLA Investigation, RFIs, and DOE Order 436.1.

Comments: The program was modified in FY 2011 to reduce sampling from an annual basis to a triennial basis. The MWs were sampled in FY 2013; therefore, they will not be sampled in FY 2014. The MWs remain included in the FY 2014 EMP discussion in order to capture the program and document the schedule. They will be sampled again in FY 2016.

Tables C.21 and C.22 show MWs and analytical parameters, respectively. Locations are shown on Figure C.10.

Table C.21. Surveillance Geochemical Wells (39)

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

Table C.22. Surveillance Geochemical Annual Analytical Parameters

Anions			
Chloride	Nitrate	Phosphate	Sulfate
Miscellaneous—As noted			
Alkalinity—310-1	**Ferrous Iron (Fe^{+2})—3500-Fe B**	**Fluoride—9214**	**Silica—370-1**
Total Dissolved Solids—160.1	**Total Organic Carbon—9060**		
Field Parameters			
Barometric Pressure	Depth to Water	Redox	Temperature
Conductivity	Dissolved Oxygen	pH	
Volatiles—Procedure RSK 175			
Ethene	Ethane	Methane	
Metals—Method 6020 unless noted			
Aluminum—6010B	**Calcium—6010B**	**Magnesium—6010B**	Silver
Antimony	Chromium	Manganese	Selenium
Arsenic	Cobalt	Molybdenum	**Sodium—6010B**
Barium	Copper	Nickel	Zinc
Beryllium	**Iron—6010B**	**Potassium—6010B**	Uranium
Cadmium	Lead		

Bolded parameters are sampled by different method than specified in header.

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

C.3.1 EFFLUENT WATERSHED MONITORING PROGRAM

C-746-S, C-746-T, and C-746-U Landfills Surface Water

Frequency: Quarterly

Driver: Solid waste landfill permits, Technical Attachment 24, as follows: SW07300014 (C-746-S Landfill), SW07300015 (C-746-T Landfill), and SW07300045 (C-746-U Landfill), which includes the surface water monitoring plans.

Reported: Quarterly C-746-S&T and C-746-U Landfills Groundwater Compliance Monitoring Reports and the ASER

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

Comments: Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2014, as it is permit driven.

C-746-S and C-746-T Landfills have independent solid waste permits; however, MW sampling is performed and reported collectively.

Tables C.23 and C.24 show landfill surface water locations and landfill surface water parameters, respectively. Locations are shown on Figure C.11.

Table C.23. Landfill Surface Water Locations (6)

C-746-S&T		
L135	L136	L154[a]
C-746-U		
L150	L154[a]	L351

[a] L154 is listed on both the C-746-S&T Landfill and the C-746-U Landfill permits.

Table C.24. Landfill Surface Water Parameters

Anions—Method 300.0		
Chloride	Sulfate	
Field Measurements		
Conductivity	Dissolved Oxygen	Flow Rate
pH	Temperature	
Metals—Method 200.8		
Iron	Sodium	Uranium
Miscellaneous—Methods as follows		
Total Dissolved Solids—160.1	**Total Solids—160.3**	**Total Organic Carbon—9060**
Total Suspended Solids—160.2	**Chemical Oxygen Demand—410.4**	
Radionuclides—Method 900.0		
Alpha Activity	Beta Activity	

Bolded parameters are sampled by different method than specified in header.

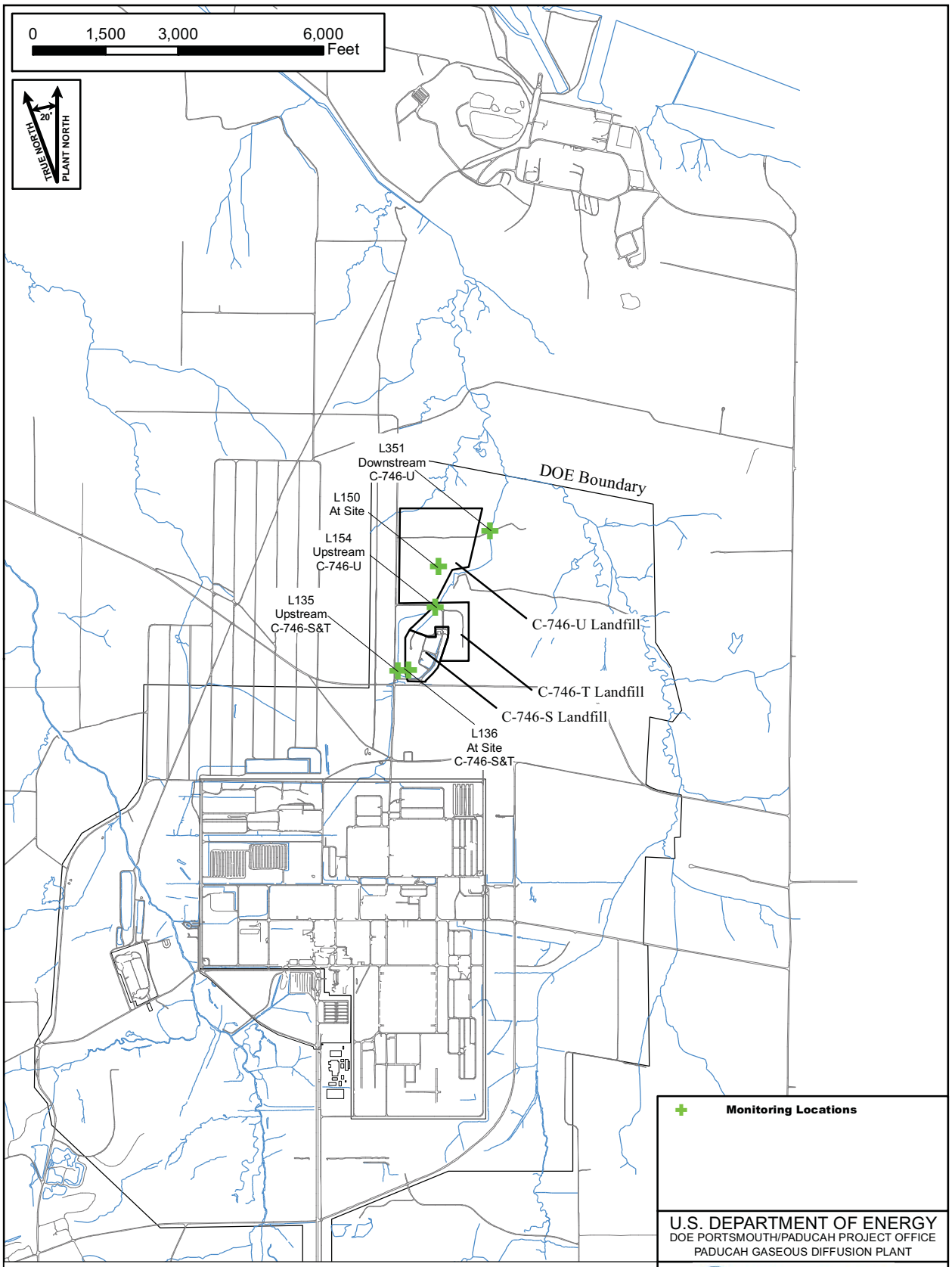

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Figure C.11. Landfill Surface Water Locations

FIGURE No. EMP\2013\EMPLF_2013.mxd
DATE 09-14-2012

Kentucky Pollutant Discharge Elimination System Outfall Sampling

Frequency: Weekly, Monthly, and Quarterly

Driver: Kentucky Pollutant Discharge Elimination System (KPDES) permit for PGDP, permit number KY0004049, McCracken County, Kentucky

Reported: Monthly and Quarterly Discharge Monitoring Reports; weekly sampling is reported in the monthly reports and the ASER

Rationale: Monitor effluent and surface water runoff as it is discharged to the receiving streams and tributaries.

Comments: The KPDES permit became effective on December 1, 2009. This modification added Outfall 020 and removed some parameters. A modification to the permit became effective on September 1, 2010. This modification did not affect the sampling locations or parameter list.

Temperature readings at Outfall 017 began at the end of FY 2011 due to start-up and testing of operations at the depleted uranium conversion facility. As required by the permit for Outfall 017, monthly chronic toxicity sampling replaced quarterly acute toxicity sampling at the start of operations at the depleted uranium conversion facility. Operational status was achieved in January 2012 at which time the toxicity sampling was modified to meet permit requirements. Based on this change, acute toxicity was removed from Table C.25 as a requirement parameter for Outfall 017. Additionally, due to zinc exceedances and whole effluent toxicity failures at Outfall 017, a toxicity reduction evaluation (TRE) study is ongoing. KPDES permit requirements that are outlined below are not replaced by any sampling conducted as a part of the TRE.

Table C.25 shows the current KPDES outfall sampling locations, frequency of sampling, and parameters. Locations are shown on Figure C.12.

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

Analysis-Method	Frequency of Sampling at KPDES Locations D—Daily; W—Weekly; M—Monthly; Q—Quarterly				
	K001	**K015**	**K017**	**K019**	**K020**
Flow (Mgd)—Field	D	M	M	M	M
Total Suspended Solids (mg/L)—160.2	W	M	M	M	M
Oil & Grease (mg/L)—1664	W	M	M	M	M
Total Residual Chlorine (mg/L)—Field	W				
Temperature (°F)—Field	W		M		
PCBs (mg/L)—8082	W	M	M	M	Q
Trichloroethene (mg/L)—624	W				Q
Total Phosphorus (mg/L)—365.3	W				
Alpha Activity (pCi/L)—RL-7111	W	M	M	M	M
Beta Activity (pCi/L)—RL-7111	W	M	M	M	M
Uranium (µg/L)—200.8	W	M	M	M	M
Total Recoverable Zinc (µg/L)—6020			M	M	Q
Total Recoverable Arsenic (µg/L)—200.8					Q
Total Recoverable Nickel (µg/L)—200.8					Q
Nitrates (mg/L N)—300.0					Q
1,1,1-Trichloroethane (mg/L)—624					Q
Chlorides (mg/L)—300.0					Q
Acute Toxicity (TU_A)[a]		Q		Q	Q
Chronic Toxicity (TU_c)[b]	Q		M		
Technetium-99 (pCi/L)—RL-7100	Q	Q	Q	Q	Q
Hardness (as mg/L $CaCO_3$)—130.2	Q	Q	Q	Q	Q
Phosphorous (mg/L)—365.3					Q
CBOD (mg/L)—5210B					Q
Dissolved Oxygen (mg/L)—Field					Q
Total Recoverable Iron (µg/L)—200.8		Q		Q	Q
Benzo(a)anthracene (µg/L)—8270SIM		Q	Q		
Benzo(k)fluoranthene (µg/L)—8270SIM		Q			
Free Cyanide (µg/L)—9010	Q				
Heptachlor (µg/L)—8081A	Q	Q	Q		
Indeno(1,2,3-cd) pyrene (µg/L)—8270SIM	Q				
pH (between 6–9)—Field	W	M	M	W[c]	W[c]

[a] Acute toxicity sampling requires two grab samples.
[b] Chronic toxicity sampling requires three 24-hour composite samples.
[c] These effluents are sampled weekly when the C-746-U Landfill leachate/sedimentation pond is discharging to the outfalls.

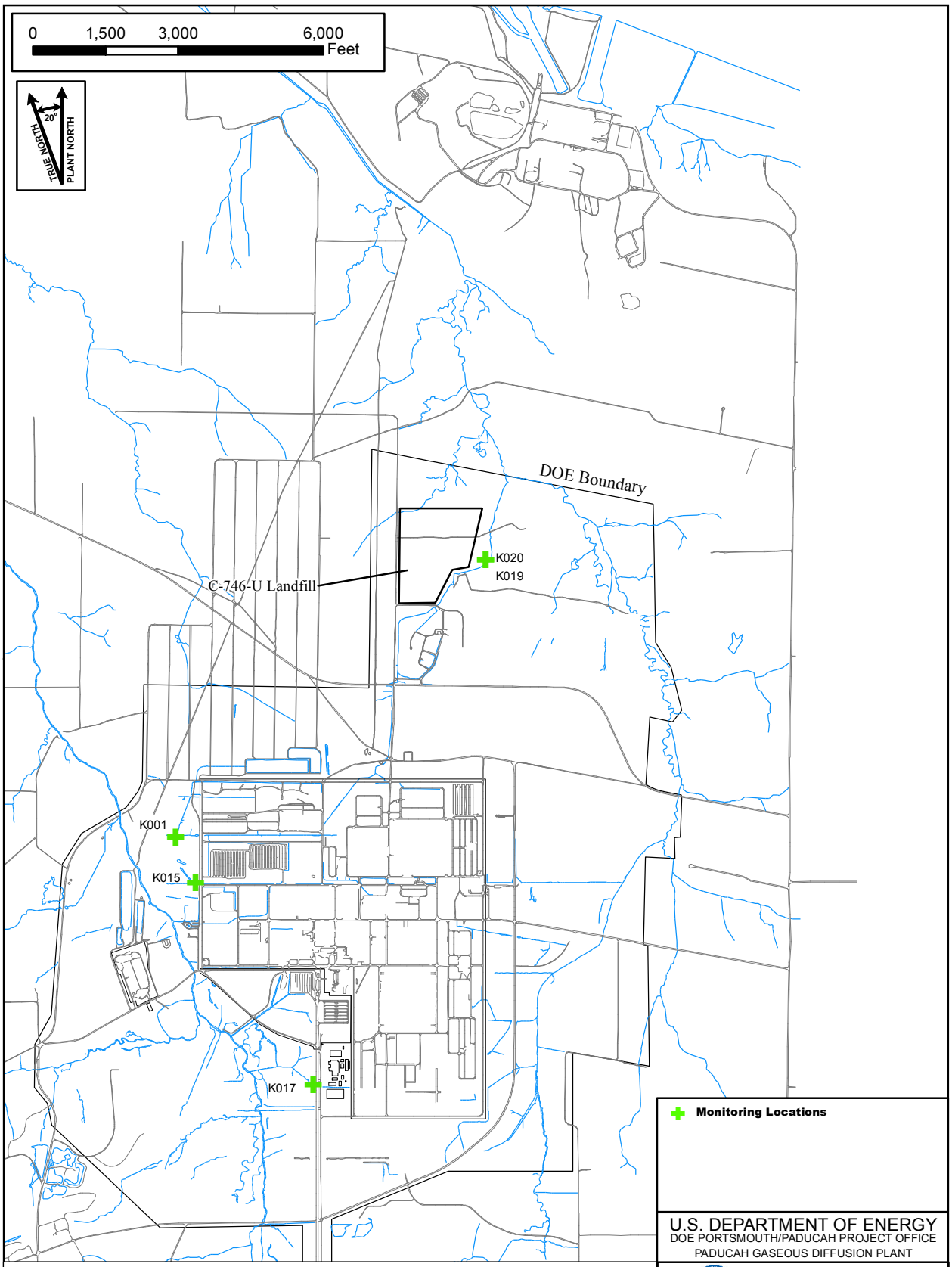

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Figure C.12. KPDES Outfall Sampling Locations

FIGURE No. EMP\2013\EMPKPDES_2013.mxd
DATE 09-14-2012

C.3.2 ENVIRONMENTAL RADIATION PROTECTION PROGRAM—EFFLUENT AND SURFACE WATER RUNOFF

Frequency: Monthly

Driver: DOE Order 458.1 and DOE-STD-1196-2011, Derived Concentration Technical Standard

Reported: ASER

Rationale: Monitor effluent and surface water runoff for radiological constituents as it is discharged to the receiving streams and tributaries.

Comments: DOE Order 458.1 was implemented during FY 2013 with the effective date being January 2, 2013. DOE Order 458.1 requires compliance in accordance with DOE-STD-1196-2011, *Derived Concentration Technical Standard*. DOE Order 458.1 also requires that settleable solids on liquid discharges do not exceed limits set forth in DOE Order 458.1, Attachment 1 2.g.(4).

Isotopic analysis for all radionuclides listed will be performed at each location unless the alpha and beta activity levels are below established threshold limits. These limits are established at activity based concentration values, so that radionuclides could not be present in concentrations greater than 10% of the quantities specified in the Derived Concentration Standard. Based on a review of historical data sets from plant effluent and surface water runoff, the threshold limit established for alpha activity is 14 pCi/L and the beta activity is 300 pCi/L. If the threshold values are not exceeded at a location, then the dose calculated according to the pathway assumptions in the Risk Methods Document will be less than 0.09 mrem/yr. This is assumed to pose minimal risk to the public or the environment. If, by the end of the calendar year, no threshold values have been exceeded at a location, then the isotopic analysis for all radionuclides will be performed on the final sample of each year to provide a data point for calculation of dose. Also, it should be noted, that the sample aliquots collected for the isotopic analysis will be submitted to the laboratory; however, the analysis only will be performed, pending the alpha and beta activity results.

Table C.26 lists the sampling location, frequency, and parameter. Locations are shown on Figure C.13.

Table C.26. ERPP Effluent and Surface Water Runoff

Analysis—Method	Analytical Parameters M—Monthly				
	K001 ERPP	K015 ERPP	K017 ERPP	K019 ERPP	K020 ERPP
Alpha activity (pCi/L)—RL-7111	M	M	M	M	M
Beta activity (pCi/L)—RL-7111	M	M	M	M	M
Cesium-137[a]—RL-7124		M			
Neptunium-237 (pCi/L)[a]—RL-7128	M	M			
Plutonium-238 (pCi/L)[a]—RL-7128	M	M			
Plutonium-239/240 (pCi/L)[a]—RL-7128	M	M			
Potassium-40 (pCi/L)[a]—RL-7124		M			
Technetium-99 (pCi/L)[a]—RL-7100	M	M	M	M	M
Thorium-234 (pCi/L)[a]—RL-7124		M			
Alpha activity on the filtered material [Settleable Solids (pCi/g)]—RL7111	M	M	M	M	
Beta activity on the filtered material [Settleable Solids (pCi/g)]—RL-7111	M	M	M	M	
Uranium-234 (pCi/L)[a]—RL-7128	M	M	M	M	M
Uranium-235 (pCi/L)[a]—RL-7128	M	M	M	M	M
Uranium-238 (pCi/L)[a]—RL-7128	M	M	M	M	M

[a] Sample will be collected but will not be analyzed unless alpha activity exceeds 14 pCi/L or beta activity exceeds 300 pCi/L.

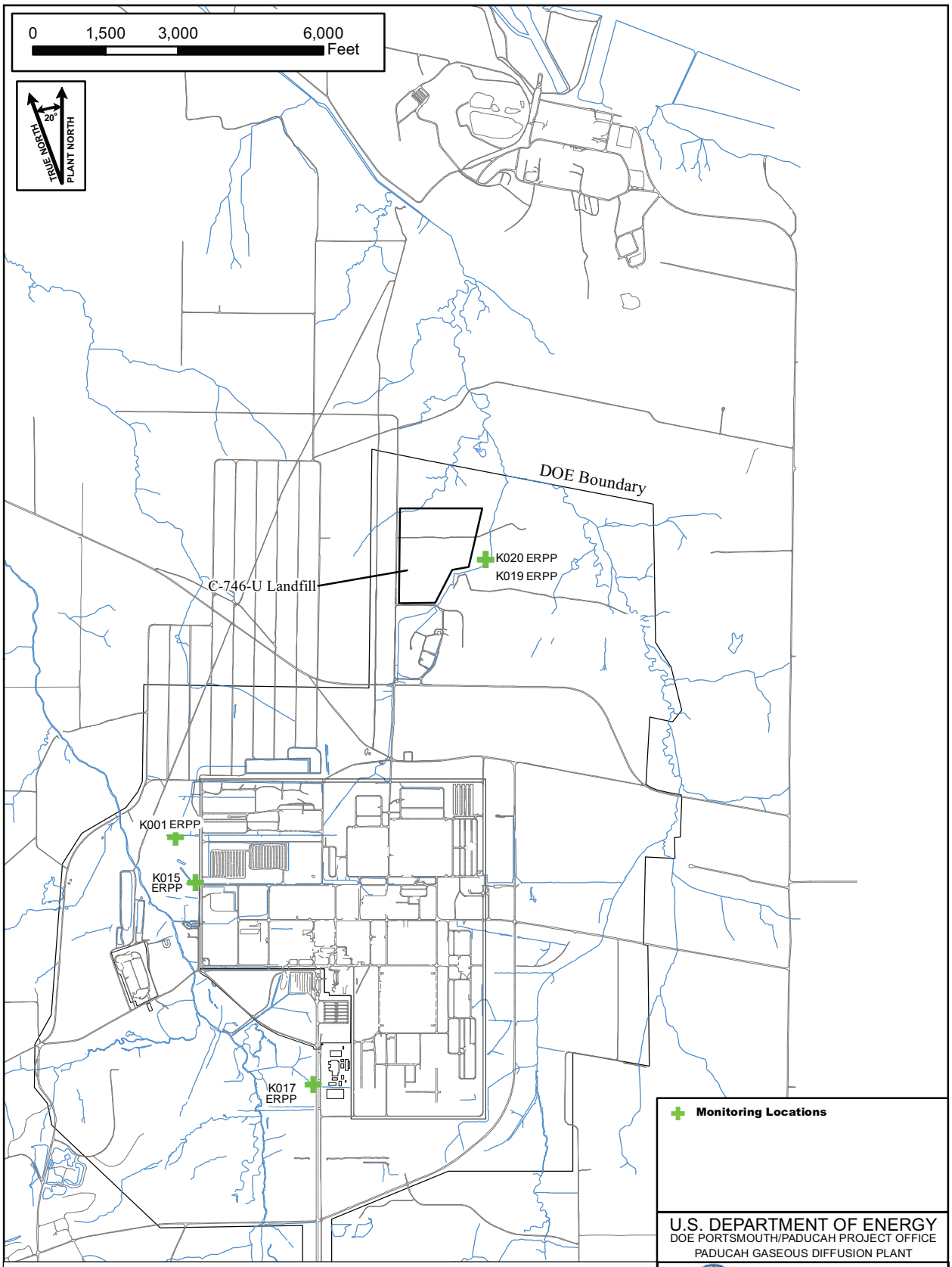

Figure C.13. Surface Water Monitoring Near KPDES Outfalls

FIGURE No. EMP\2013\EMPSWKPDES_2013.mxd
DATE 09-14-2012

C.3.3 C-613 NORTHWEST STORM WATER CONTROL FACILITY

C-613 Sediment Basin—Storm Water

Frequency: Quarterly

Driver: Quarterly sampling is required by the *Operation and Maintenance Plan for the Northwest Storm Water Control Facility at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-2044&D1/R4, September 2009.

Reported: May be reported to KDWM via electronic mail.

Rationale: Prior to a discharge event, the pH and total suspended solids (TSS) is measured to prevent a discharge that would cause the effluent monitored at KPDES Outfall 001 to exceed regulatory limits. That operational monitoring is not covered under the EM Program but is managed by the operations manager or designee. As specified in the Operations and Maintenance Plan, a sample is to be collected each quarter to confirm the pH and TSS field measurements.

Comments: Table C.27 provides a listing of the analytical parameters. Location of the C-613 Sediment Basin is shown on Figure C.14.

Split sampling that had been conducted with KDWM during the third quarter of each year was eliminated in FY 2013. This sampling had been conducted for comparison purposes and was not required by the Operations and Maintenance Plan. The sampling is conducted by KDWM during non-discharge operations of the C-613 Sediment Basin. A review of historical data was conducted, and the review found a strong consistency in the data sets. Because no relative change to the data sets is expected due to consistent site operations, this sampling was eliminated.

Table C.27. C-613 Sediment Basin Quarterly Water Parameters

Miscellaneous—Method as follows	
	Total Suspended Solids—160.2
Field Parameters	
pH	Turbidity

Bolded parameters are sampled by different method than specified in header.

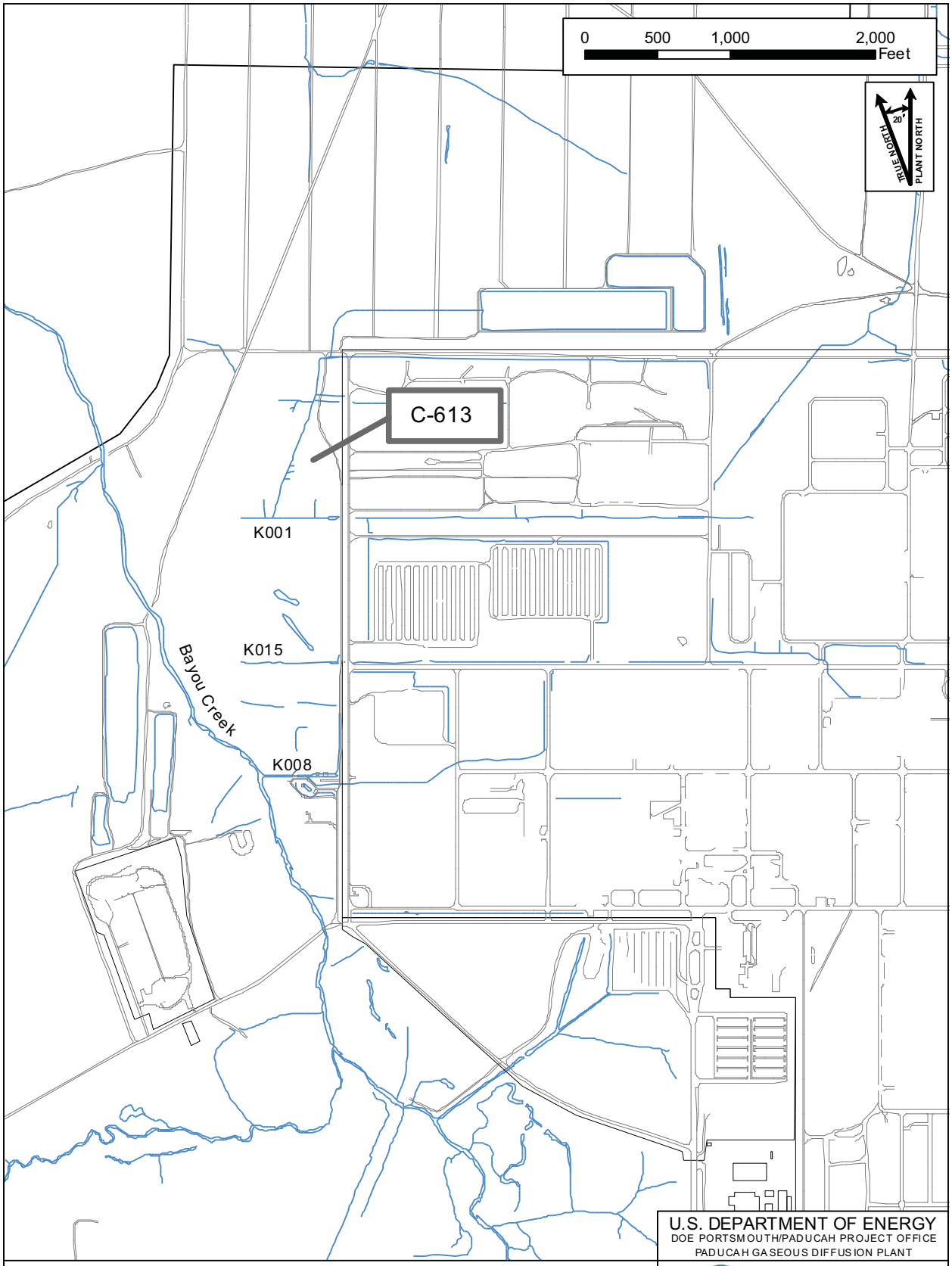

Figure C.14. C-613 Sediment Basin

FIGURE No. EMP\2012\EMP613_2012.mxd
DATE 08-24-2011

C.3.4 ENVIRONMENTAL SURVEILLANCE WATERSHED MONITORING PROGRAM

Surface Water Monitoring

Frequency: Quarterly and Annually

Driver: DOE KPDES permit for PGDP, permit number KY0004049, McCracken County, Kentucky requires 19 in-stream surface water locations be sampled quarterly for PCBs and TCE. DOE Order 458.1 requires radiological monitoring.

Reported: ASER

Rationale: To monitor potential contamination released into Bayou Creek and Little Bayou Creek surface water from plant operations.

Comments: DOE Order 458.1 requires that environmental surveillance be performed in accordance with DOE/EH-0173T. Sampling locations were selected to determine site-specific radiation exposure pathway analysis. Locations were prioritized for areas of public access, introduction of plant effluents to the environment and verification of the effectiveness of PGDP effluent monitoring. Isotopic analysis for all radionuclides listed will be performed at each location unless the alpha and beta activity levels are below established threshold limits. These limits are established at activity based concentration values, so that radionuclides could not be present in concentrations greater than 10% of the quantities specified in the Derived Concentration Standard. Based on a review of historical data sets from plant effluent and surface water runoff, the threshold limit established for alpha activity is 14 pCi/L and the beta activity is 300 pCi/L. If the threshold values are not exceeded at a location, then the dose calculated according to the pathway assumptions in the Risk Methods Document will be less than 0.09 mrem/yr. This is assumed to pose minimal risk to the public or the environment. If, by the end of the calendar year, no threshold values have been exceeded at a location, then the isotopic analysis for all radionuclides will be performed on the final sample of each year to provide a data point for calculation of dose. Background location, L1, was chosen to support data comparisons of data generated as part of this program, as well as the ERPP Effluent and Surface Water Runoff program outlined in Section C.3.2.

One change was made to the program in FY 2014 EMP. Sampling at L30, Cairo, Illinois, was added to provide additional radiological data at the nearest public drinking water supply. The review of the data did not require the additional sampling; however, the addition is justified due to an increase in the amount of remediation efforts at the site.

Table C.28 details surface water and the seep sampling locations. Tables C.29 and C.30 detail the surface water and seep sampling analytical parameters that are driven by the KPDES permit. Tables C.31 through C.34 detail the surface water and seep sampling analytical parameters by location for the ERPP. Sampling to support the ERPP will be conducted on a quarterly basis, with the exception of the background location, L1, which will be sampled annually. Locations are shown on Figure C.15.

Table C.28. Surface Water and Seep Sampling Locations (20)

Surface Water (19)		
C612 (SP)[a]	L194	L241
C616	L29A (BG/R)[a]	L6
C746K-5	L291	L64(BG)
C746KTB1A	L30 (R)[a]	S31
L1 (BG)	L306 (R)[a]	K001UP
L10	L5	**Seep (1)**
L11	L12	LBCSP5[a]

BG = Background locations
R = Ohio River locations
SP = Sampling port
[a] Unable to obtain flow rates.

Table C.29. Surface Water Quarterly Analytical Parameters

PCBs—Method 608		
PCB, Total	PCB-1232	PCB-1254
PCB-1016	PCB-1242	PCB-1260
PCB-1221	PCB-1248	PCB-1268
Field Measurements		
Alkalinity	Dissolved Oxygen	pH
Conductivity	Flow[a]	Temperature
Volatiles—Method 624		
Trichloroethene		

[a] See Table C.28 for locations where flow rates are not collected.

Table C.30. Seep Location Quarterly Analytical Parameters

Volatiles—Method 624	
Trichloroethene	
Field Measurements	
pH	Dissolved Oxygen
Temperature	Conductivity

Table C.31. Surface Water—ERPP Little Bayou Creek Locations and Quarterly Analytical Parameters

Locations	
L10	L241
Radionuclides—Method RL-7128 unless noted	
Alpha Activity—RL-7111	Uranium-234[a]
Beta Activity—RL-7111	Uranium-235[a]
Technetium-99[a]—RL-7100	Uranium-238[a]
Uranium[a]	

[a] Sample will be collected but will not be analyzed unless alpha activity at the associated location exceeds 14 pCi/L or beta activity at the associated location exceeds 300 pCi/L.
Bolded parameters are sampled by different method than specified in header.

Table C.32. Surface Water—ERPP Bayou Creek Location and Quarterly Analytical Parameters

Location	
L5	
Radionuclides—Method RL-7128 unless noted	
Alpha Activity—RL-7111	**Potassium-40[a]—RL-7124**
Beta Activity—RL-7111	**Cesium-137[a]—RL-7124**
Neptunium-237[a]	**Technetium-99[a]—RL-7100**
Plutonium-238[a]	Uranium-234[a]
Plutonium-239/240[a]	Uranium-235[a]
Thorium-234[a]—RL-7124	Uranium-238[a]

[a] Sample will be collected but will not be analyzed unless alpha activity at the associated location exceeds 14 pCi/L or beta activity at the associated location exceeds 300 pCi/L.
Bolded parameters are sampled by different method than specified in header.

Table C.33. Surface Water—ERPP North-South Diversion Ditch Location and Quarterly Analytical Parameters

Locations	
L11	
Radionuclides—Method RL-7128 unless noted	
Alpha Activity—RL-7111	**Technetium-99[a]—RL-7100**
Beta Activity—RL-7111	Uranium[a]
Thorium-228[a]	Uranium-234[a]
Thorium-230[a]	Uranium-235[a]
Thorium-232[a]	Uranium-238[a]

[a] Sample will be collected but will not be analyzed unless alpha activity at the associated location exceeds 14 pCi/L or beta activity at the associated location exceeds 300 pCi/L.
Bolded parameters are sampled by different method than specified in header.

Table C.34. Surface Water—ERPP Background and Nearest Public Water Source Location and Annual Analytical Parameters

Locations	
L1 and L30 (Cairo, Illinois)	
Radionuclides—Method RL-7128 unless noted	
Alpha Activity—RL-7111	**Thorium-234—RL-7124**
Beta Activity—RL-7111	**Potassium-40—RL-7124**
Neptunium-237	**Cesium-137—RL-7124**
Plutonium-238	**Technetium-99—RL7100**
Plutonium-239/240	Uranium
Thorium-228	Uranium-234
Thorium-230	Uranium-235
Thorium-232	Uranium-238

Alpha Activity on the filtered material [Settleable Solids (pCi/g)]
Beta Activity on the filtered material [Settleable Solids (pCi/g)]
Bolded parameters are sampled by different method than specified in header.

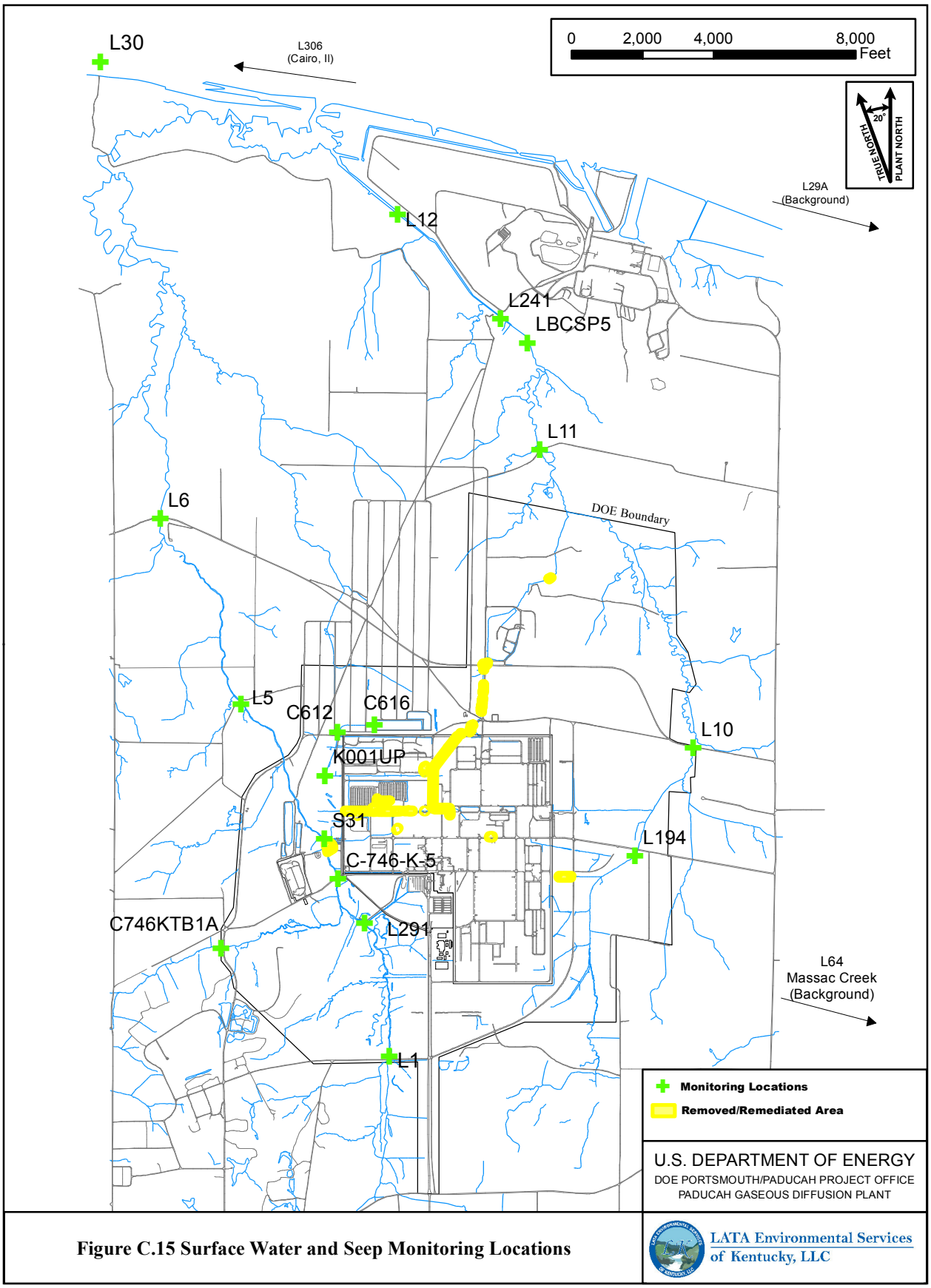

Figure C.15 Surface Water and Seep Monitoring Locations

FIGURE No. EMP\2013\EMP-SW2013.mxd
DATE 09-14-2012

Sediment Monitoring

Frequency: Semiannually (PCBs) and Annually (Radionuclides)

Driver: DOE KPDES Permit for PGDP, permit number KY0004049, McCracken County, Kentucky requires 14 locations be sampled quarterly for PCBs. DOE Order 458.1 requires radiological monitoring. This radiological monitoring will be conducted on an annual basis.

Reported: ASER

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

Comments: DOE Order 458.1 requires that environmental surveillance of sediment be performed in accordance with DOE/EH-0173T. Sampling locations were selected to determine site-specific radiation exposure pathway analysis and to provide an indication of the accumulation of undissolved radionuclides in the aquatic environment. Locations were prioritized for areas of public access, introduction of plant effluents to the environment, and verification of the effectiveness of PGDP effluent monitoring. Sampling for radionuclides will occur annually.

Tables C.35 details sediment sampling locations and parameters driven by the KPDES permit. Tables C.36 details the sediment sampling locations and parameters driven by the ERPP. Locations are shown on Figure C.16.

Table C.35. Sediment—Location and Semiannual Analytical Parameters Sampling Locations (14)

Locations		
C612	S1	S31
C616	S2	S32
C746KTB2	S20 (BG)	S33
K001	S27	S34
L194	S28 (BG)	
PCBs—Method 8082		
PCB, Total	PCB-1232	PCB-1254
PCB-1016	PCB-1242	PCB-1260
PCB-1221	PCB-1248	PCB-1268

Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.

Table C.36. Sediment—ERPP Location and Annual Analytical Parameters Sampling Locations (6)

Locations		
S1	S20 (BG)	S33
S2	S27	S34
Radionuclides—Method RL-7128 unless noted		
Alpha Activity—RL—7111	Thorium-230	**Technetium-99—RL7100**
Beta Activity—RL-7111	Thorium-232	Uranium
Neptunium-237	**Thorium-234—RL-7124**	Uranium-234
Plutonium-238	**Potassium-40—RL-7124**	Uranium-235
Plutonium-239/240	**Cesium-137—RL-7124**	Uranium-238
Thorium-228		

Bolded parameters are sampled by different method than specified in header.
Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.

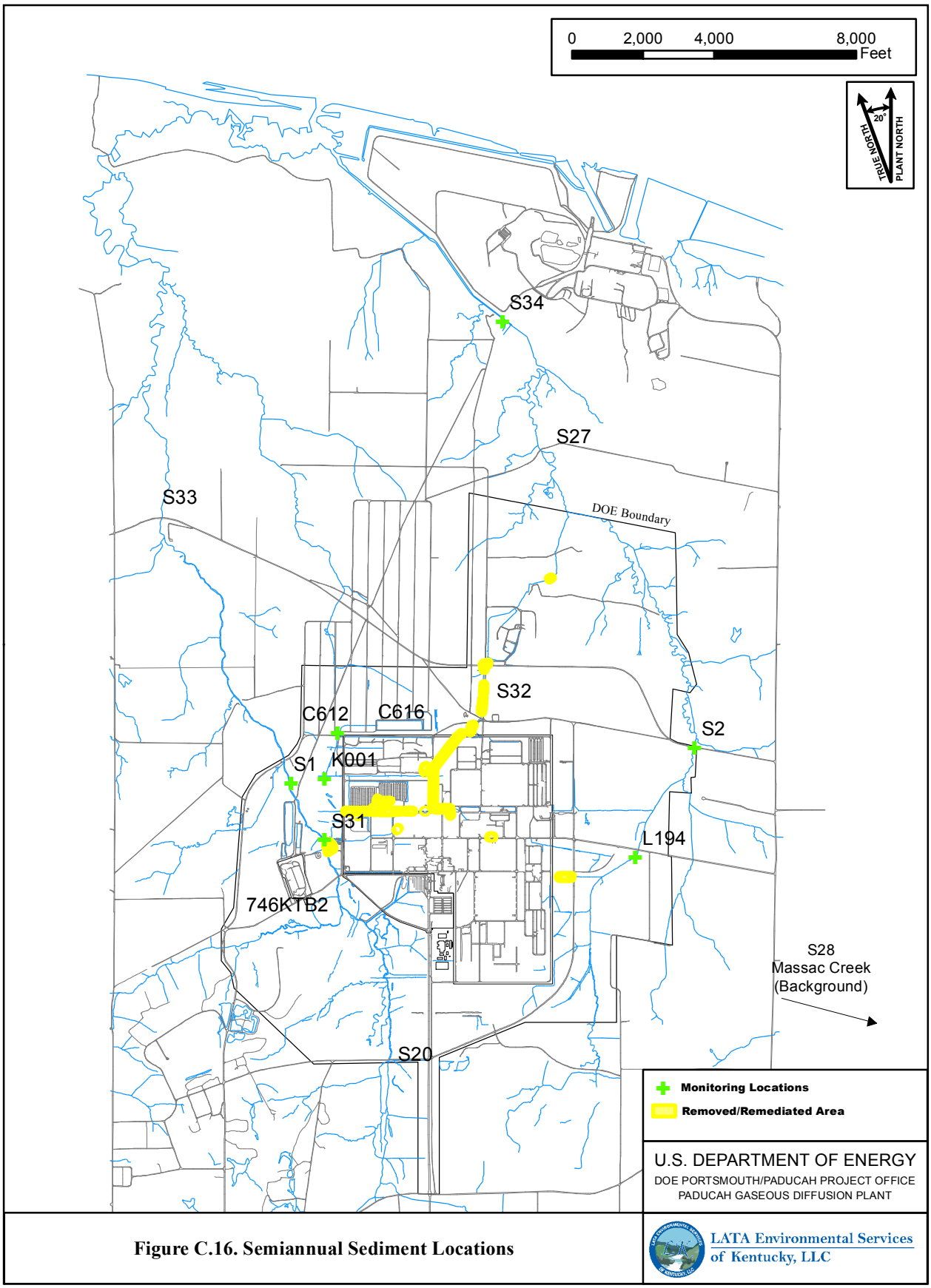

Figure C.16. Semiannual Sediment Locations

FIGURE No. EMP\2013\EMP-SD2013.mxd
DATE 09-14-2012

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C.4. LANDFILL LEACHATE SAMPLING

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

Frequency: Annually

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

Reported: Quarterly Compliance Operating Reports, as required by the applicable solid waste landfill permits and the ASER

Rationale: Solid waste landfill permits as follows: SW07300014 (C-746-S Landfill), SW07300015 (C-746-T Landfill), and SW07300045 (C-746-U Landfill)

Comments: C-746-S and C-746-T Landfills have independent solid waste permits; however, MW sampling is performed and reported collectively.

Annual leachate parameters for C-746-S, C-746-T, and C-746-U Landfills are presented in Table C.37.

Table C.37. C-746-S&T and C-746-U Landfills Annual Leachate Parameters

Volatiles—Method 624 unless noted			
1,1,1,2-Tetrachloroethane	1,4-Dichlorobenzene	Carbon Disulfide	Iodomethane
1,1,1-Trichloroethane	2-Butanone	Carbon Tetrachloride	Methylene Chloride
1,1,2,2-Tetrachloroethane	2-Hexanone	Chlorobenzene	Styrene
1,1,2-Trichloroethane	4-Methyl-2-pentanone	Chloroethane	Tetrachloroethene
1,1-Dichloroethane	Acetone	Chloroform	Toluene
1,1-Dichloroethene	Acrolein	Chloromethane	*trans*-1,2-Dichloroethene
1,2,3-Trichloropropane	Acrylonitrile	*cis*-1,2-Dichloroethene	*trans*-1,3-Dichloropropene
1,2-Dibromo-3-chloropropane—8011	Benzene	*cis*-1,3-Dichloropropene	*trans*-1,4-Dichloro-2-Butene
1,2-Dibromoethane	Bromochloromethane	Dibromochloromethane	Trichloroethene
1,2-Dichlorobenzene	Bromodichloromethane	Dibromomethane	Trichlorofluoromethane
1,2-Dichloroethane	Bromoform	Dimethylbenzene, Total[a]	Vinyl Acetate
1,2-Dichloropropane	Bromomethane	Ethylbenzene	Vinyl Chloride
PCBs—Method 8082			
PCB, Total	PCB-1232	PCB-1248	PCB-1260
PCB-1016	PCB-1242	PCB-1254	PCB-1268
PCB-1221			
Radionuclides—Method RL-7128 unless noted			
Alpha Activity—900.0	**Cobalt-60—RL-7124**	**Dissolved Alpha—RL-7111**	Plutonium-239/240, Dissolved
Beta Activity—900.0	**Thorium-234—RL-7124**	**Dissolved Beta—RL-7111**	Thorium-230, Dissolved
Radium-226—RL-7129	Americium-241	**Technetium-99, Dissolved—RL-7100**	Activity of Uranium-235, Dissolved
Strontium-90—RL-7140	Neptunium-237	**Cesium-137, Dissolved—RL-7124**	Uranium-234, Dissolved
Technetium-99—RL-7100	Plutonium-239/240	**Cobalt-60, Dissolved—RL-7124**	Uranium-238, Dissolved
Thorium-230	Activity of Uranium-235	**Thorium-234, Dissolved—RL-7124**	Uranium
Tritium—EPA906.0	Uranium-234	Americium-241, Dissolved	Uranium, Dissolved
Cesium-137—RL-7124	Uranium-238	Neptunium-237, Dissolved	
Metals—Method 200.8 unless noted			
Aluminum	Lead	Thallium	Lead, Dissolved
Antimony	Magnesium	**Uranium—also 6020**	Manganese, Dissolved
Arsenic	Manganese	Vanadium	Nickel, Dissolved
Barium	**Mercury—7470**	Zinc	Selenium, Dissolved
Beryllium	Molybdenum	Barium, Dissolved	Silver, Dissolved
Boron	Nickel	Chromium, Dissolved	Tin
Cadmium	Potassium	Uranium, Dissolved	Tin, Dissolved
Calcium	Rhodium	Antimony, Dissolved	Titanium
Chromium	Selenium	Arsenic, Dissolved	Titanium, Dissolved
Cobalt	Silver	Cadmium, Dissolved	Uranium, Dissolved
Copper	Sodium	Cobalt, Dissolved	Vanadium, Dissolved
Iron	Tantalum	Copper, Dissolved	Zinc, Dissolved
Anions—Method 300.0 unless noted			
Bromide	**Fluoride—9214**	Nitrate as Nitrogen	Sulfate
Chloride			
Field Parameters			
Conductivity	Redox	Temperature	pH
Dissolved Oxygen			
Miscellaneous—Method as follows			
Total Dissolved Solids—160.1	**Total Organic Halides—9020B**	**Phosphorus—365.3**	**Carbonaceous Biochemical—5210B**
Chemical Oxygen Demand—410.4	**Total Organic Carbon—9060**	**Hardness—Total as $CaCO_3$—130.2**	**Oxygen Demand—410.4**
Cyanide—335.4	**Oil and Grease—1664**	**Iodide—345.1**	

[a] Xylenes

Bolded parameters are sampled by different method than specified in header.

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 and the ASER

Rationale: Hazardous Waste Facility Permit, KY8-890-008-982

Comments: Leachate analytical parameters for C-404 Landfill are presented in Table C.38.

Table C.38. C-404 Landfill Leachate Analytical Parameters

Volatiles—Method 8260B			
Trichloroethene			
Radionuclides—RL-7128 unless noted			
Technetium-99—RL7100	Uranium-235	Plutonium-239/240	**Cesium-137[1]—RL-7124**
Uranium-234	Uranium-238	Thorium-230	Neptunium-237
PCBs[2]—Method 808			
PCB, Total	PCB-1232	PCB-1248	PCB-1260
PCB-1016	PCB-1242	PCB-1254	PCB-1268
PCB-1221			
Metals—Method 6020 unless noted			
Barium	**Iron—6010B**	Silver	**Mercury—7470A**
Cadmium	Lead	Zinc	Selenium
Chromium	Nickel	Arsenic	Uranium
Copper			
Miscellaneous—Method as follows			
Fluoride—9056	**Ammonia as Nitrogen—350.3**		
Field Parameters			
pH	Dissolved Oxygen	Redox	Temperature
Conductivity			

[1] Cesium is not required by the HWFP but is requested per management decision.
[2] PCBs are not required by the HWFP for disposal purposes.
Bolded parameters are sampled by different method than specified in header.

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C.5. EXTERNAL GAMMA RADIOLOGICAL MONITORING

Frequency: Collected continuously and analyzed quarterly; thermoluminescent dosimeters (TLDs) at 57 monitoring locations are changed quarterly for gamma radiation monitoring.

Driver: DOE Order 436.1 and DOE Order 458.1

Reported: ASER

Rationale: **Monitor the effective dose from site operations in order to ensure operational limits are not exceeded.**

Comments: No changes were made to this program in FY 2014.

Figure C.17 shows TLD monitoring locations.

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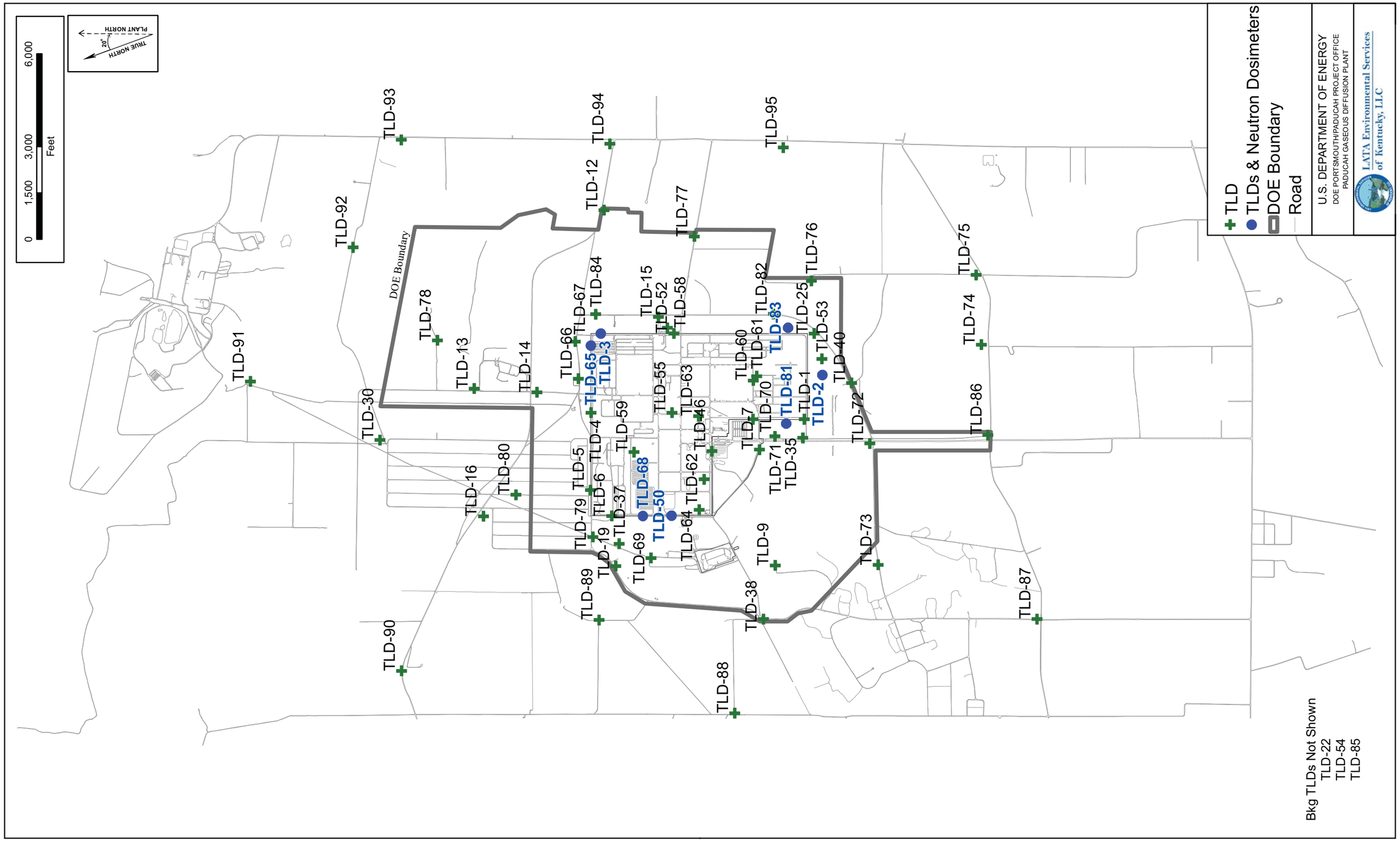

Figure C.17. TLD Monitoring Locations

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C.6. AMBIENT AIR MONITORING

Frequency: Weekly/Quarterly

Driver: *Department of Energy National Emission Standards for Hazardous Air Pollutants (NESHAP) Management Plan*, BJC/PAD-141, February 2000

Reported: NESHAP Annual Report and ASER

Rationale: Monitor radionuclide emissions from Paducah Site activities

Comments: The ambient air monitoring program has been operated and managed by the Kentucky Cabinet for Health and Family Services since the program was initiated. The EM Program began managing the program on July 1, 2012, using nine solar-powered air monitoring units. Eight of the units are situated on DOE property near the units that the Kentucky Cabinet for Health and Family Services owned and operated. The remaining unit is located off-site near the Kevil community and functions as a collection site to be used for background monitoring.

Location identifications are found in Table C.39. Filter samples are collected on a weekly basis and analyzed for gross alpha and beta, as shown in Table C.40. The laboratory retains the filter and compiles all of the weekly samples for each quarterly period. At the end of each quarter, the filters are compiled and analyzed for the isotopes defined in the quarterly analysis table, C.41. Locations are shown on Figure C.18.

Table C.39. Ambient Air Monitoring Locations (9)

AMDBCP (BG)	AMD002	AMD612
AMD57	AMDNE	AMD746S
AMD012	AMD015	AMD746U

BG = Background

Table C.40. Ambient Air Monitoring Weekly Analytical Parameters

Radionuclides—Method RL-7111	
Alpha Activity	Beta Activity

Table C.41. Ambient Air Monitoring Quarterly Analytical

Radionuclides—Method RL-7128 unless noted		
Americium-241—RL-7124	Plutonium-239/240	Uranium-234
Neptunium-237/Protactinium-233—RL-7124	**Technetium-99—RL-7100**	Uranium-235
Plutonium-238	**Thorium-234/Uranium-238—RL-7124**	Uranium-238

Bolded parameters are sampled by different method than specified in header.

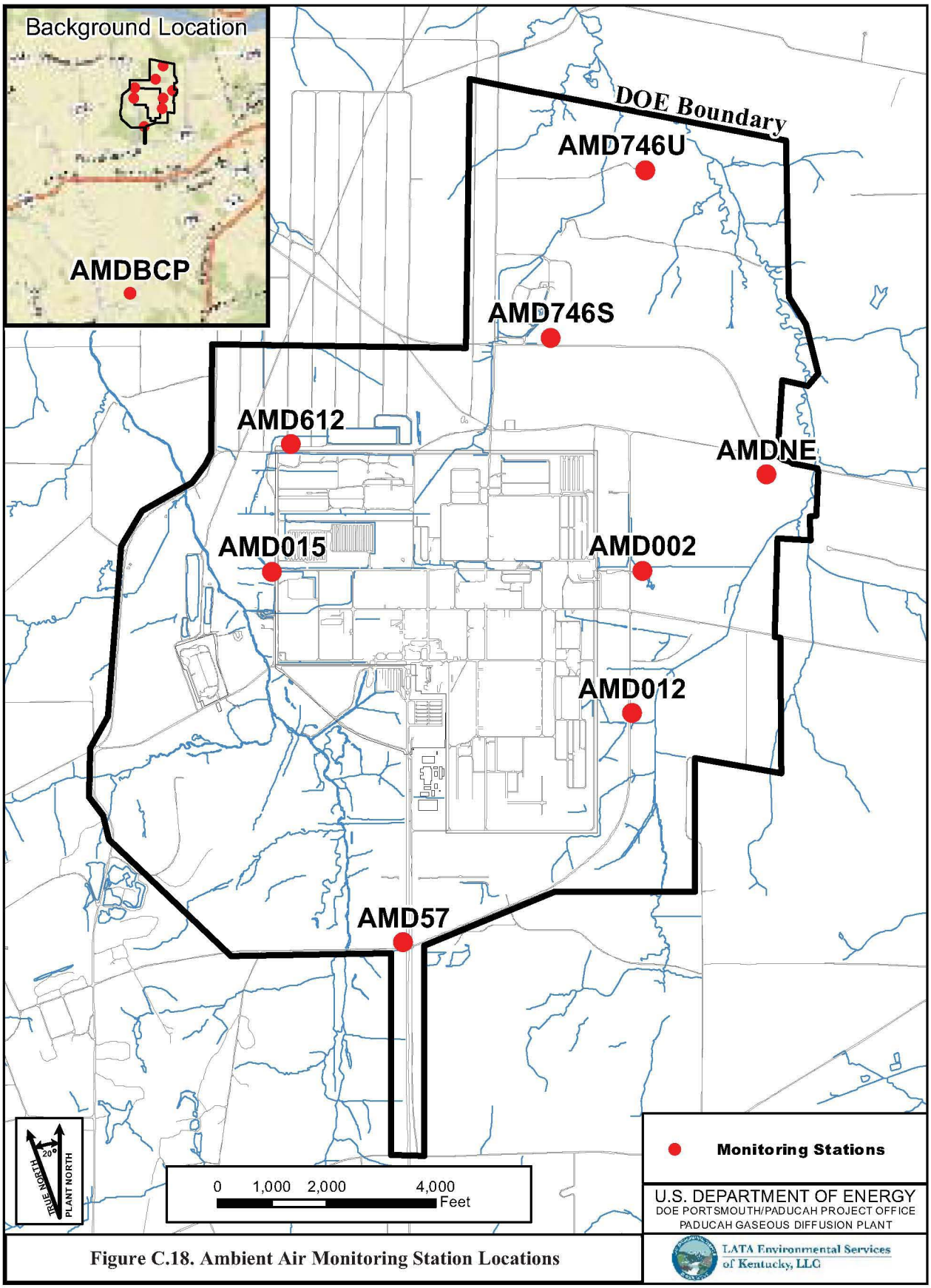

Figure C.18. Ambient Air Monitoring Station Locations

FIGURE No. EMP/AMD2012.mxd
DATE 07-17-2012

APPENDIX D

ENVIRONMENTAL MONITORING QUALITY ASSURANCE PROJECT PLAN

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ACRONYMS

CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COPC	chemical of potential concern
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DQI	Data Quality Indicator
DQO	data quality objective
ECD	electron capture detector
EDD	Electronic Data Deliverable
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FID	flame ionization detector
FIDLER	field instrument for detection of low energy
GS	gas chromatography
GS-MS	gas chromatography mass spectrometer
GPS	Global Positioning System
ICP-AES	inductively coupled plasma atomic emission spectroscopy
KDEP	Kentucky Department for Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
LATA Kentucky	LATA Environmental Services of Kentucky, LLC
MBWA	management by walking around
MCL	maximum contaminant limit
MDA	minimum detectable activity
MDL	method detection limit
MS	matrix spike
NAL	no action level
NDIRD	nondispersive infrared detector
OREIS	Paducah Oak Ridge Environmental Information System
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
PQL	practical quantitation limit
PT	proficiency testing
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
SOP	standard operating procedure
TOC	total organic carbon
UFP	Uniform Federal Policy
VOC	volatile organic compound
XRF	X-ray fluorescence

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INTRODUCTION

The Environmental Monitoring (EM) Quality Assurance Project Plan (QAPP) has been prepared by LATA Environmental Services of Kentucky, LLC (LATA Kentucky) based on the approved programmatic QAPP, DOE/LX/07/1269&D2/R1 *Programmatic Quality Assurance Project Plan*, which was based on the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP Manual) guidelines for QAPPs (Publication # DoD DTIC ADA 427785).

This EM QAPP is Appendix D to the *Environmental Monitoring Plan Fiscal Year 2014*, PAD-ENM-0055/R3. It describes the project-specific quality assurance activities that will be conducted to support ongoing monitoring programs of varying media (e.g., groundwater, surface water, air, and sediment) at the site.

This EM QAPP does the following:

- Refers to the SOPs already developed for the site and in place;
- Identifies analytical limits, units of reporting, and methods requested by each program; these values will be used to procure laboratory services. If the laboratory cannot meet the limits, units, or methods specified in the QAPP, the project manager and/or compliance organization will be contacted so a determination can be made if the proposed conditions are acceptable to meet current project objectives. If the conditions are found to be acceptable, the Sample and Data Management manager (or designee) will document the acceptance with rationale;
- Identifies analytical limits and methods that may be required by a given project (ex., permits, maximum contaminant level (MCL), etc.);
- Incorporates the *Data and Documents Management and Quality Assurance Plan for Paducah Environmental Management and Enrichment Facilities*, DOE/OR/07-1595&D2 (DOE 1998); and
- Standardizes data validation processes by linking the process to SOPs (see Worksheet #21).

This document supports the EM procedures *Quality Assured Data*, PAD-ENM-5003, *Environmental Monitoring Data Management Plan*, PAD-ENM-0063, and *Developing, Implementing, and Maintaining Data Management Implementation Plans*, PAD-ENM-1003.

This QAPP focuses on fixed laboratory methods, although the Appendix C of the EMP identifies field measurements requested on each of the programs. Field methods [e.g., X-ray fluorescence (XRF), bioassay, colorimetric methods for polychlorinated biphenyls (PCBs), and radionuclide surveys] that may be implemented in support of the programs within this EMP are not covered in either of the discussion of the EMP or within this QAPP.

This QAPP does not cover the analysis of the thermoluminscent devices (TLDs) for gamma emissions although the program is detailed with sample locations in Appendix C of the EMP. Those analyses are conducted utilizing quality standards set forth and evaluated by the environmental, safety and health organization. Additionally, filters collected in the ambient air monitoring program are not covered in this QAPP. While the ambient air monitoring program, like the TLD environmental monitoring program, are important for overall evaluation of site operations, they are not considered to fit the typical QAPP guidelines and should not be forced into the parameter listing within the QAPP on the sole reason that they are included in Appendix C of the EMP.

This QAPP provides limited information on some analyses considered as miscellaneous tests. Miscellaneous tests are defined in Worksheet #23. Samples for these analyses are collected using standard operating procedures (SOPs) employed by the sampling staff and quality assurance standards specified in procedures such as PAD-ENM-5003, *Quality Assured Data.* They are not listed in Worksheets #12 and #15 because they are not considered contaminants of concern at the site. These parameters are requested by programs within Appendix C of the EMP because they are indicators of overall water quality or, in some instances are required as conditions of permits (e.g., toxicity, ferrous iron, and coliform).

QAPP Worksheet #1
Title Page

Document Title: *Environmental Monitoring Quality Assurance Project Plan*

Lead Organization: DOE

Preparer's Name and Organizational Affiliation: Kelly Layne, LATA Environmental Services of Kentucky, LLC (LATA Kentucky)

Preparer's Address, Telephone Number, and E-mail Address: 761 Veterans Avenue, Kevil, KY, 42053, Phone (270) 441-5217, kelly.layne@lataky.com

Preparation Date (Month/Year): 11/2013

Document Control Number: PAD-ENM-0055/R3, Appendix D

LATA Kentucky Environmental Remediation Project Manager	_____ Signature Mark J. Duff	Date:_____
LATA Kentucky Regulatory Manager	_____ Signature Myrna Espinosa Redfield	Date:_____
LATA Kentucky Sample/Data Management Manager	_____ Signature Lisa Crabtree	Date:_____

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Paducah Gaseous Diffusion Plant
Site Location: Paducah, Kentucky
Site Number/Code: KY8890008982
Contractor Name: LATA Kentucky
Contractor Number: DE-AC30-10CC40020
Contract Title: Paducah Gaseous Diffusion Plant Paducah Environmental Remediation Project
Work Assignment Number: N/A

1. Identify guidance used to prepare QAPP:

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Implementing Environmental Quality Systems, Version 2.0, 126 pages.

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Quality Assurance Project Plans: Part 1 UFP QAPP Manual, Version 1.0, 177 pages (DTIC ADA 427785 or EPA-505-B-04-900A).

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Quality Assurance Project Plans: Part 2A UFP QAPP Worksheets, Version 1.0, 44 pages.

   Intergovernmental Data Quality Task Force, March 2005. The Uniform Federal Policy for Quality Assurance Project Plans: Part 2B Quality Assurance/Quality Control Compendium: Minimum QA/QC activities, Version 1.0, 76 pages.

   Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan, DOE/LX/07-1269&D2/R1

2. Identify regulatory program: The EMP is not submitted to regulatory agencies for review or approval; however, many of the sampling programs defined within the EMP are required by regulatory decision documents, permits or DOE Orders (O); therefore, those regulatory programs are pertinent. They include Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant*, DOE/OR/07-1707 (FFA), Kentucky Department for Environmental Protection (Kentucky Division of Waste Management, Kentucky Division of Water), Department of Energy (DOE) Orders.

3. Identify approval entity: DOE

4. Indicate whether the QAPP is a generic or a project-specific QAPP (circle one).

5. List dates of scoping sessions that were held: August 2013—Data Quality Objective (DQO) Session with LATA Kentucky and DOE

QAPP Worksheet #2 (Continued)
QAPP Identifying Information

6. List dates and titles of QAPP documents written for previous site work, if applicable:

Title:	**Approval Date:**
Data and Documents Management and Quality Assurance Plan for Paducah Environmental Management and Enrichment Facilities, DOE/OR/07-1595&D2 (DOE 1998)	10/5/1998
Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan, Paducah, Kentucky, DOE/LX/07-1269&D21R1 (QAPP)	5/14/2013

7. List organizational partners (stakeholders) and connection with lead organization:
EPA Region 4 (FFA member), KDEP (Regulates hazardous and solid waste landfills, effluent discharge permits, FFA member), DOE (Lead Organization), LATA Kentucky (DOE Prime Contractor)

8. List data users: DOE, LATA Kentucky, subcontractors, EPA Region 4, Commonwealth of Kentucky

9. This QAPP includes 35 worksheets that are required based on UFP-QAPP guidance. Worksheets #10 and #17 have been omitted because the problem definitions are described in detail within the body of the Environmental Monitoring Plan, of which this QAPP is an appendix.

QAPP Worksheet #2 (Continued)
QAPP Identifying Information

NOTE: Information is entered only in the "Crosswalk to Related Documents" if the information is not contained in the QAPP worksheets, as indicated in first two columns. Additionally, if the required QAPP element fulfills other quality requirements, that requirement is noted in the "Crosswalk to Related Documents" column.

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Worksheet No.	Crosswalk to Related Documents
2.1 Title and Approval Page	• Title and Approval Page	1	
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	• Table of Contents • QAPP Identifying Information	2	
2.3 Distribution List and Project Personnel Signoff Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	• Distribution List • Project Personnel Sign-Off Sheet	3 4	
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	• Project Organizational Chart • Communication Pathways • Personnel Responsibilities and Qualifications Table • Special Personnel Training Requirements Table	5 6 7 8	
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background (See EMP)	• Project Planning Session Documentation (including Data Needs tables) • Project Scoping Session Participants Sheet • Problem Definition, Site History, and Background (see EMP) • Site Maps (historical and present) (see EMP)	9	
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	• Site-Specific Project Quality Objectives • Measurement Performance Criteria Table	11 12	
2.7 Secondary Data Evaluation	• Sources of Secondary Data and Information • Secondary Data Criteria and Limitations Table	13	

QAPP Worksheet #2 (Continued)
QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Worksheet No.	Crosswalk to Related Documents
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	• Summary of Project Tasks • Reference Limits and Evaluation Table • Project Schedule/Timeline Table	14 15 16	
Measurement/Data Acquisition			
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	• Sampling Design and Rationale (see Appendix C of the EMP) • Sample Location Map (see Appendix C of the EMP) • Sampling Locations and Methods/SOP Requirements Table (see Appendix C of the EMP) • Analytical Methods/SOP Requirements Table • Field Quality Control Sample Summary Table • Sampling SOPs • Project Sampling SOP References Table • Field Equipment Calibration, Maintenance, Testing, and Inspection Table	18/19/20 21 22	
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	• Analytical SOPs • Analytical SOP References Table • Analytical Instrument Calibration Table • Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	23 25	
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	• Sample Collection Documentation Handling, Tracking, and Custody SOPs • Sample Container Identification • Sample Handling Flow Diagram • Example Chain-of-Custody Form and Seal	26 27	

QAPP Worksheet #2 (Continued)
QAPP Identifying Information

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Worksheet No.	Crosswalk to Related Documents
3.4 Quality Control Samples 3.4.1 Sampling Quality Control Samples 3.4.2 Analytical Quality Control Samples	• QC Samples Table • Screening/Confirmatory Analysis Decision Tree	28	
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	• Project Documents and Records Table • Analytical Services Table • Data Management SOPs	29 30	
Assessment/Oversight			
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	• Assessments and Response Actions • Planned Project Assessments Table • Audit Checklists • Assessment Findings and Corrective Action Responses Table	31 32	
4.2 QA Management Reports	• QA Management Reports Table	33	
4.3 Final Project Report			
Data Review			
5.1 Overview			
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	• Verification (Step I) Process Table • Validation (Steps IIa and IIb) Process Table • Validation (Steps IIa and IIb) Summary Table • Usability Assessment	34 35 36 37	
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining			

DOE = U.S. Department of Energy
QC = quality control
QA = quality assurance
SOP = standard operating procedure
QAPP = Quality Assurance Project Plan

QAPP Worksheet #3
Minimum Distribution List

Controlled copies of the QAPP will be distributed according to the distribution list below. This list will be updated, as needed, and kept by the LATA Kentucky Records Management Department. Each person receiving a controlled copy also will receive any updates/revisions. If uncontrolled copies are distributed, it will be the responsibility of the person distributing the uncontrolled copy to provide updates/revisions.

Position Title	Organization	QAPP Recipients	Current Telephone Number	Current E-mail Address	Document Control Number
Acting Paducah Site Lead	DOE	Rachel H. Blumenfeld	(270) 441-6825	rachel.blumenfeld@lex.doe.gov	1
Project Manager	DOE	Dave Dollins	(270) 441-6819	dave.dollins@lex.doe.gov	2
Environmental Remediation Project Manager	LATA Kentucky	Mark Duff	(270) 441-5030	mark.duff@lataky.com	3
Regulatory Manager	LATA Kentucky	Myrna Redfield	(270) 441-5113	myrna.redfield@lataky.com	4
Project Integration and Operations Manager	LATA Kentucky	Craig Jones	(270) 441-5114	craig.jones@lataky.com	5
Risk Assessment Manager	LATA Kentucky	Joe Towarnicky	(270) 441-5134	joseph.towarnicky@lataky.com	6
FFA Manager	LATA Kentucky	Jana White	(270) 441-5185	jana.white@lataky.com	7
Quality Assurance Manager	LATA Kentucky	Michelle Dudley	(270) 462-4544	michelle.dudley@lataky.com	8
Environmental Monitoring and Reporting Program Manager	LATA Kentucky	Kelly Layne	(270) 441-5217	kelly.layne@lataky.com	9
Environment, Safety, and Health Manager	LATA Kentucky	Dave Kent	(270) 441-5404	dave.kent@lataky.com	10
Regulatory Compliance Manager	LATA Kentucky	Michael Gerle	(270) 441-5069	michael.gerle@lataky.com	11
Sample/Data Management Manager	LATA Kentucky	Lisa Crabtree	(270) 441-5135	lisa.crabtree@lataky.com	12

Distribution is based on the position title. A change in the individual within an organization will not trigger a resubmission of this QAPP. DOE may choose to update the sheet and submit changes to the programmatic document holders. These managers will be responsible for distribution of the EMP, including this QAPP, to their staff.

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

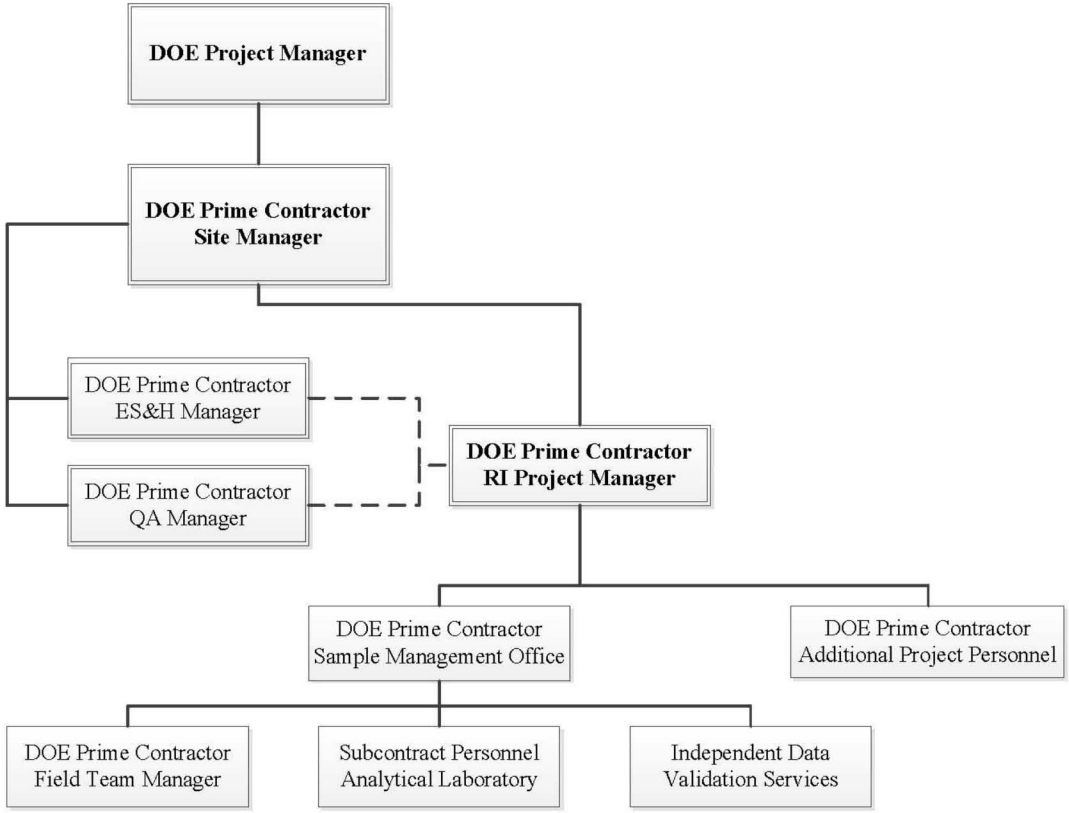
Personnel actively engaged in sample collection, data analysis, and data validation for the projects are required to read applicable sections of this QAPP and sign a Personnel Sign-off Sheet. The master list of signatures will be kept by the Environmental Monitoring and Reporting Program Manager (or designee) and will be made available upon request.

Project Position Title	Organization	Signature	Date
Environmental Monitoring and Reporting Program Manager	LATA Kentucky		
Environmental Monitoring Sample and Data Management Manager	LATA Kentucky		
Sampling/Well Activities Manager	LATA Kentucky		
Environmental Radiation Protection Program Manager	LATA Kentucky		

QAPP Worksheet #5
Project Contractor Organizational Chart

This portion of the QAPP addresses the project organization as it provides for QA/Quality Control (QC) coordination and responsibilities.

Project Level Organizational Chart



QAPP Worksheet #6
Communication Pathways

NOTE: Formal communication across company or regulatory boundaries occurs via letter. Other forms of communication, such as e-mail, meetings, etc., will occur throughout the project.

Communication Drivers	Organizational Affiliation	Position Title Responsible	Procedure
Federal Facility Agreement DOE/OR/07-1707	DOE Paducah Site Lead	Paducah Site Lead	All formal communication among DOE, EPA, and KDEP.
Federal Facility Agreement DOE/OR/07-1707	DOE Paducah	DOE Project Manager	All formal communication between DOE and contractor for Environmental Remediation Projects.
All project requirements	LATA Kentucky	Environmental Remediation Project Manager	All formal communication between the project, the Site Lead, and the DOE Project Manager.
All project requirements	LATA Kentucky	Project Manager	All communication between the project and the LATA Kentucky Environmental Remediation Project Manager.
Project QA requirements	LATA Kentucky	Quality Assurance Manager	All project quality related communication between the QA department and LATA Kentucky project personnel.
FFA compliance	LATA Kentucky	Regulatory Manager	All internal communication regarding FFA compliance with the LATA Kentucky Project Manager.

QAPP Worksheet #6 (Continued)
Communication Pathways

Communication Drivers	Organizational Affiliation	Position Title Responsible	Organizational Department Manager	Procedure
Sampling Requirements	LATA Kentucky	Sampling/Well Activities Manager	Environmental Monitoring	All internal communication regarding field sampling with the LATA Kentucky Project Manager.
Analytical Laboratory Interface	LATA Kentucky	Laboratory Coordinator	Environmental Monitoring	All communication between LATA Kentucky and analytical laboratory.
Waste Management Requirements	LATA Kentucky	Waste Coordinator	Project Integration and Operations Manager	All internal communication regarding project waste management with LATA Kentucky Project Manager.
Environmental Compliance Requirements	LATA Kentucky	Compliance Manager	Regulatory Manager	All internal correspondence regarding environmental requirements and compliance with the LATA Kentucky Project Manager.
Subcontractor Requirements (if applicable)	LATA Kentucky	Subcontract Administrator	Business Manager	All correspondence between the project and subcontractors, if applicable.
Health and Safety Requirements	LATA Kentucky	Environment, Safety, and Health Manager	Environment, Safety, and Health Manager	All internal communication regarding safety and health requirements with the LATA Kentucky Project Manager.

QAPP Worksheet #7
Personnel Responsibility and Qualifications Table

Position Title Responsible	Organization Affiliation	Responsibilities	Education and Experience Qualifications[1]
Project Manager	LATA Kentucky	Overall project responsibility	> 4 years relevant work experience
Environmental Engineer	LATA Kentucky	Project sampling and analysis plan	Bachelor of Science plus > 1 year relevant work experience
Environmental Compliance Manager	LATA Kentucky	Project environmental compliance responsibility	Bachelor degree plus > 4 years work experience
FFA Manager	LATA Kentucky	Project compliance with the FFA	> 4 years work relevant experience
Environmental Monitoring and Reporting Program Manager	LATA Kentucky	Support project on sampling and reporting activities	> 4 years relevant work experience
Sample/Data Management Manager	LATA Kentucky	Project sample and data management	> 1 year relevant work experience
Health and Safety Representative	LATA Kentucky	Project safety and health responsibility	Bachelor degree plus > 1 year relevant experience
Waste Coordinator	LATA Kentucky	Overall project waste management responsibility	> 4 years relevant experience
Data Validator	Independent third party contractor	Performing data validation according to specified procedures	Bachelor degree plus relevant experience
Analytical Laboratory Project Manager	Analytical Laboratory	Sample analysis and data reporting	Bachelor degree plus relevant experience

[1] Candidates who do not have a certificate or required degree but demonstrate additional "equivalent relevant work experience" can be considered when evaluating qualifications. This assessment will be conducted by the PM as he/she assembles the appropriate team for the project.

QAPP Worksheet #8
Special Personnel Training Requirements Table

Personnel are trained in the safe and appropriate performance of their assigned duties in accordance with requirements of work to be performed. This QAPP has been developed as a generalized quality plan. There are no special training requirements other than what normally is required for work at the PGDP site. QAPP development uses a graded approach.

Project Function	Specialized Training—Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates*
Project Tasks	There will be no specialized training required for this program other than what normally is required for site work at PGDP. The contractor will evaluate specific tasks and personnel will be assigned training as necessary to perform those tasks. Training may address health and safety aspects of specific tasks as well as contractor-specific, site-specific, and task-specific requirements.	LATA Kentucky	Prior to Monitoring	Based upon required duties	LATA Kentucky staff, subcontractors	Training files are maintained by the LATA Kentucky training organization. A training database is utilized to manage and track training.

*Training records are maintained by the LATA Kentucky training department. If training records and/or certificates do not exist or are not available, then this should be noted.
TBD = to be determined

QAPP Worksheet #9
Project Scoping Session Participant Sheet

Project scoping is the key to the success of any project and is part of the systematic planning process. For this QAPP, this included review of past documents produced, previous years DQO sessions, and a DQO session to discuss FY 2014 planning objectives. The worksheet identifies participants who discussed the sampling strategy in the DQO session held on August 1, 2013.

Name of Project: Environmental Monitoring Plan Fiscal Year 2014
Date of Session: August 1, 2013
Scoping Session Purpose: Identify sampling strategies of EM programs

Position Title	Affiliation	Name	Phone #	E-mail Address	Project Role
Project Manager	Department of Energy	Cynthia Zvonar	859-219-4066	cynthia.zvonar@lex.doe.gov	Project Management
Facility Representative/ Health Physicist	Department of Energy	Don Dihel	270-441-6824	donald.dihel@lex.doe.gov	Subject Matter Expert
Risk Analyst	Department of Energy	Rich Bonczek, Ph.D.	859-219-4051	rich.bonczek@lex.doe.gov	Subject Matter Expert
Sample/Data Management Manager	LATA Kentucky	Lisa Crabtree	270-441-5135	lisa.crabtree@lataky.com	Laboratory requirements
Environmental Monitoring and Reporting Program Manager	LATA Kentucky	Kelly Layne	270-441-5217	kelly.layne@lataky.com	Project Management
Senior Project Manager	Pro2Serve	Tracey Duncan	270-461-6803	tracey.duncan@lex.doe.gov	Subject Matter Expert

QAPP Worksheet #11

Project Quality Objectives/Systematic Planning Process Statements

This QAPP has been prepared to detail the minimum standards, particularly for field and analytical data quality. Analytical data will be generated by DOE Consolidated Audit Program (CAP) laboratories utilizing approved laboratory test methods. The overall project quality objectives are to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, instrument calibration/preventive maintenance, chemical analysis, internal QC, reporting data, audits, and corrective actions are described in other sections of this QAPP.

QAPP Worksheet #11 details the project quality objectives developed through the systematic planning process.

Who will use the data? DOE, LATA Kentucky, Commonwealth of Kentucky, and EPA.

What will the data be used for? Data required to be reported via permits or other regulatory decision documents will be reported as required (Appendix C of the EMP lists applicable reports).

What type of data is needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques) Required list of analytes are specified by program within Appendix C of the EMP. Both field screening and on-site and off-site laboratory analyses are used for data collection.

How "good" do the data need to be in order to support the environmental decision? Data needs to meet the measurement quality objective and data quality indicators established by the systematic planning process consistent with procedures *Quality Assured Data*, PAD-ENM-5003, *Environmental Monitoring Data Management Plan*, PAD-ENM-0063, and PAD-ENM-1003, *Developing, Implementing, and Maintaining Data Management Implementation Plans.*

Where, when, and how should the data be collected/generated? See Appendix C for frequency of sample collection.

Who will collect and generate the data? LATA Kentucky. Additionally, meteorological data may be acquired from other sources (as needed).

How will the data be reported? Field data will be recorded on chain-of-custody forms, in field logbooks, and field data sheets. The fixed-base laboratory will provide data in an Electronic Data Deliverable (EDD). Project data following verification assessment and validation will be placed into and reported from the Paducah Oak Ridge Environmental Information System (OREIS).

How will the data be archived? Electronic data will be archived in OREIS in accordance with Section 8.5 (Data and Records Archival) of the Data and Documents Management and Quality Assurance Plan.

QAPP Worksheet #12-D
Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group[1]	PCBs
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2302, *Collection of Sediment Samples Associated with Surface Water*	SW846-8082	Precision—Lab	RPD–≤ 43%	Laboratory Duplicates	A
		Precision	RPD–≤ 43%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias-Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

PQL = practical quantitation limit; RPD = Relative Percent Difference
Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-E
Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group[1]	Radionuclides (uranium[8], uranium-234, uranium-235, uranium-238)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2302, *Collection of Sediment Samples Associated with Surface Water*	Alpha spectroscopy[7]	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 50%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > MDA	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > MDA	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > MDA	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

MDA = minimum detectable activity; RPD = Relative Percent Difference
Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.
[7] Appendix C of the EMP references the USEC Analytical Laboratory's SOP; however, for the purpose of the QAPP, general analytical methodology is denoted so as to document the preferred analytical method should another laboratory be utilized.
[8] The total uranium listed represents the total of the uranium isotopes that is analyzed by alpha spectroscopy.

QAPP Worksheet #12-F
Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group[1]	Radionuclides (neptunium-237, plutonium-238, plutonium-239/240, thorium-230)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2302, *Collection of Sediment Samples Associated with Surface Water*	Alpha spectroscopy[7]	Precision—Lab	RPD–≤ 50%	Laboratory Duplicates	A
		Precision	RPD–≤ 50%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > MDA	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > MDA	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > MDA	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

MDA = minimum detectable activity; RPD = Relative Percent Difference
Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.
[7] Appendix C of the EMP references the USEC Analytical Laboratory's SOP; however, for the purpose of the QAPP, general analytical methodology is denoted so as to document the preferred analytical method should another laboratory be utilized.

QAPP Worksheet #12-G
Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group[1]	Radionuclides (cesium-137)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2302, *Collection of Sediment Samples Associated with Surface Water*	Gamma spectroscopy[7]	Precision—Lab	RPD–≤ 50%	Laboratory Duplicates	A
		Precision	RPD–≤ 50%	Field Duplicates	S
		Accuracy/Bias Contamination	No target compounds > MDA	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > MDA	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

MDA = minimum detectable activity; RPD = Relative Percent Difference
Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Appendix C of the EMP references the USEC Analytical Laboratory's SOP; however, for the purpose of the QAPP, general analytical methodology is denoted so as to document the preferred analytical method should another laboratory be utilized.

QAPP Worksheet #12-H
Measurement Performance Criteria Table

Matrix	Sediment
Analytical Group[1]	Radionuclides (technetium-99)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2302, *Collection of Sediment Samples Associated with Surface Water*	Liquid scintillation[7]	Precision—Lab	RPD–≤ 50%	Laboratory Duplicates	A
		Precision	RPD–≤ 50%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > MDA	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > MDA	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > MDA	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

MDA = minimum detectable activity; RPD = Relative Percent Difference
Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.
[7] Appendix C of the EMP references the USEC Analytical Laboratory's SOP; however, for the purpose of the QAPP, general analytical methodology is denoted so as to document the preferred analytical method should another laboratory be utilized.

QAPP Worksheet #12-K
Measurement Performance Criteria Table

Matrix	Water/Groundwater and Surface Water
Analytical Group[1]	VOC
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[3, 4]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PAD-ENM-2101, *Groundwater Sampling* and PAD-ENM-2203, *Surface Water Sampling*	SW846-8260 and EPA-624	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > PQL	Trip Blanks	S
		Accuracy/Bias Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

PQL = practical quantitation limit; RPD = Relative Percent Difference
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-L
Measurement Performance Criteria Table

Matrix	Water/Groundwater and Surface Water
Analytical Group[1]	Metals (all except mercury)
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[3, 4]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PAD-ENM-2101, *Groundwater Sampling* and PAD-ENM-2203, *Surface Water Sampling*	EPA-200.8/ SW846-6010/6020	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias-Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

PQL = practical quantitation limit; RPD = Relative Percent Difference
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-M
Measurement Performance Criteria Table

Matrix	Water/Groundwater and Surface Water
Analytical Group[1]	Metals (Mercury)
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[3, 4]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PAD-ENM-2101, *Groundwater Sampling* and PAD-ENM-2203, *Surface Water Sampling*	SW846-7470	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias-Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

PQL = practical quantitation limit; RPD = Relative Percent Difference
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-N
Measurement Performance Criteria Table

Matrix	Water/Groundwater and Surface Water
Analytical Group[1]	PCBs and Heptachlor
Concentration Level	Low

Sampling Procedure[2]	**Analytical Method/SOP**[3, 4]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
PAD-ENM-2101, *Groundwater Sampling* and PAD-ENM-2203, *Surface Water Sampling*	SW846-8082 and SW-846-8081	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Method Blanks/Instrument Blanks	A
		Accuracy/Bias-Contamination	No target compounds > PQL	Field Blanks	S
		Accuracy/Bias-Contamination	No target compounds > PQL	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

PQL = practical quantitation limit; RPD = Relative Percent Difference
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

QAPP Worksheet #12-O
Measurement Performance Criteria Table

Matrix	Water/Groundwater and Surface Water
Analytical Group[1]	Radionuclides (neptunium-237, plutonium-238, plutonium-239/240, thorium-230, uranium,[8] uranium-234, uranium-235, uranium-238)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2101, *Groundwater Sampling*, and PAD-ENM-2203, *Surface Water Sampling*	Alpha spectroscopy[7]	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > MDA	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > MDA	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > MDA	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

MDA = minimum detectable activity; RPD = Relative Percent Difference

[1] If information varies within an analytical group, separate by individual analyte.

[2] Reference number from QAPP Worksheet #21.

[3] Reference number from QAPP Worksheet #23.

[4] The most current version of the method will be used.

[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.

[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.

[7] Appendix C of the EMP references the USEC Analytical Laboratory's SOP; however, for the purpose of the QAPP, general analytical methodology is denoted so as to document the preferred analytical method should another laboratory be utilized.

[8] The total uranium listed represents the total of the uranium isotopes that is analyzed by alpha spectroscopy.

QAPP Worksheet #12-P
Measurement Performance Criteria Table

Matrix	Water/ Surface Water
Analytical Group[1]	Radionuclides (cesium-137)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2101, *Groundwater Sampling* and PAD-ENM-2203, *Surface Water Sampling*	Gamma spectroscopy[6]	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 25%	Field Duplicates	S
		Accuracy/Bias Contamination	No target compounds > MDA	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > MDA	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

MDA = minimum detectable activity; RPD = Relative Percent Difference
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Appendix C of the EMP references the USEC Analytical Laboratory's SOP; however, for the purpose of the QAPP, general analytical methodology is denoted so as to document the preferred analytical method should another laboratory be utilized.

QAPP Worksheet #12-Q
Measurement Performance Criteria Table

Matrix	Water/Groundwater and Surface Water
Analytical Group[1]	Radionuclides (technetium-99)
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3, 4]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
PAD-ENM-2101, *Groundwater Sampling* and PAD-ENM-2203, *Surface Water Sampling*	Liquid scintillation[7] and EPA-906.0	Precision—Lab	RPD–≤ 25%	Laboratory Duplicates	A
		Precision	RPD–≤ 25%	Field Duplicates	S
		Accuracy/Bias	% recovery[6]	Laboratory Sample Spikes	A
		Accuracy/Bias-Contamination	No target compounds > MDA	Method Blanks/Instrument Blanks	A
		Accuracy/Bias Contamination	No target compounds > MDA	Field Blanks	S
		Accuracy/Bias Contamination	No target compounds > MDA	Equipment Rinseates	S
		Completeness[5]	90%	Data completeness check	S&A

MDA = minimum detectable activity; RPD = Relative Percent Difference
[1] If information varies within an analytical group, separate by individual analyte.
[2] Reference number from QAPP Worksheet #21.
[3] Reference number from QAPP Worksheet #23.
[4] The most current version of the method will be used.
[5] Completeness is calculated as the number of samples planned to be collected divided by the number of sample results that were rejected.
[6] Percent recovery is laboratory-specific, calculated from studies performed every six months. Percent recovery ranges will be provided in the laboratory data packages based on the most current study.
[7] Appendix C of the EMP references the USEC Analytical Laboratory's SOP; however, for the purpose of the QAPP, general analytical methodology is denoted so as to document the preferred analytical method should another laboratory be utilized.

QAPP Worksheet #13
Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
OREIS Database	Various	Various	Data will be used to determine the nature and extent of sediment, surface water, and groundwater contamination.	Data have been verified, assessed, and validated (if validation is required). Rejected data will not be used if there is sufficient time to resample and obtain a result that will not be rejected during validation. All data are assessed based on *Quality Assured Data*, PAD-ENM-5003.
Historical Documentation	Various	Various	Information will be used as guidance on related project work.	Information from historical documents will be limited to the available documentation as it relates to a specific project. Use of historical data may be limited based on how long ago the data were collected and whether site conditions have changed since data collection.

QAPP Worksheet #14
Summary of Project Tasks*

QAPP Worksheet #14 will be utilized for subsequent project-specific field sampling plans.

Sampling Tasks: Collect samples by the specified program listed in Appendix C of the EMP

Analysis Tasks: Analysis according to current version of standard methods as listed in Worksheet 12.

Quality Control Tasks: QC will be per QAPP worksheets as follows:

- QC samples—Worksheets #20 and #28
- Equipment calibration—Worksheets #22 and #24
- Data review/validation—Worksheets #34, #35, #36, and #37

Secondary Data: See Worksheet #13

Data Management Tasks: Data management will be per procedures PAD-ENM-5007, *Data Management Coordination;* PAD-ENM-1003, *Developing, Implementing, and Maintaining Data Management Implementation Plans*; PAD-ENM-0063, *Environmental Monitoring Data Management Plan at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky.*

Documentation and Records: Documentation and records will be per procedure PAD-DOC-1009, *Records Management, Administrative Records, and Document Control.*

Assessment/Audit Tasks: Assessments and audits will be per procedure PAD-QAP-1420, *Conduct of Assessments*.

Data Review Tasks: Data review tasks, including selection of data sets for validation by a third-party independent validator(s), will be per procedure PAD-ENM-5003, *Quality Assured Data* and PAD-ENM-0063, *Environmental Monitoring Data Management Plan at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky.* Groundwater data from the quarterly sampling events at the C-746-U and C-746-S&T Landfills and the semiannual sampling events at the C-404 Landfill will be validated. The groundwater data to be validated was chosen because groundwater comprises the majority of the media collected by EM. Additionally, the landfill requirements encompass the majority of all types of analyses specified within the EM program. Therefore, these programs are considered an adequate representation of EM data targeted for data validation. Validation will follow LATA Kentucky validation procedures.

*It is understood that SOPs are contractor specific.

QAPP Worksheet #15
Reference Limits and Evaluation Table

The application of Worksheet #15 should be evaluated via a graded approach because the sampling dictated within the EMP is with the objective of monitoring and not as a site investigation or remediation effort wherein an "action limit" may appropriately describe the objective of the sampling efforts.

For example, Worksheets #15A through #15D pertain to the parameters of groundwater; however, trichloroethene detected in a groundwater well located in the close proximity to the DOE boundary that had never shown trichloroethene (TCE) may have a differing response action than a response to the exact same TCE concentration in a well located within the groundwater plume which has shown TCE at or above that concentration since monitoring commenced in the 1990s. A better approach would be comparing the data sets to the historical data for the specific locations in question.

Worksheets #15A through #15D combine groundwater and surface water information. Laboratory methods for groundwater and surface water typically do not vary. Action limits between the two may differ. For example, the laboratory will use the same method for the requested analytes on a groundwater sample as they do on a surface water sample regardless if it was collected from a groundwater monitoring well or from an effluent outfall location. But, response actions to the same concentration for a given parameter may or may not differ between the two samples because it would be dependent upon the program under which it is monitored and the location from where the samples were collected. Therefore, the matrices for "water" in the following spreadsheets are shown with groundwater being the primary driver with the exception of the last worksheet, Worksheet #15-K, which specifically addresses the surface water samples required by the Kentucky Pollutant Discharge Elimination System (KPDES) permit that have a permit limit associated with the parameter. The action limits included in worksheets #15A through #15D are well below MCL or derived concentration technical standard values. These action limits were included in the Programmatic QAPP for those projects that perform routine monitoring. These limits will allow those projects to evaluate trends at lower concentrations successfully.

QAPP Worksheet #15-A
Reference Limits and Evaluation Table

Matrix: Water
Analyte Group: VOCs

VOCs	CAS Number	Project Action Limit/NAL (µg/L)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific	
					PQLs (µg/L)	MDLs (µg/L)
Acrylonitrile	107-13-1	0.045/0.0477	Tap water[c]/NAL	Yes	10	5
Benzene	71-43-2	5/0.427	MCL/NAL	Yes	5	2.5
Carbon tetrachloride	56-23-5	5/0.419	MCL/NAL	Yes	5	2.5
Chloroform	67-66-3	80/0.227	MCL/NAL	Yes	5	2.5
1,1-Dichloroethene	75-35-4	7/0.0511	MCL/NAL	Yes	5	2.5
1,2-Dichloroethene	540-59-0	2.24	NAL	Yes	5	2.5
cis-1,2-Dichloroethene	156-59-2	70/1.25	MCL/NAL	Yes	1	0.5
Ethylbenzene	100-41-4	700/1.51	MCL/NAL	Yes	5	2.5
Tetrachloroethene	127-18-4	5/0.0781	MCL/NAL	Yes	5	2.5
Trichloroethene	79-01-6	5/0.0465	MCL/NAL	Yes	1	0.5
Vinyl Chloride	75-01-4	2/0.0725	MCL/NAL	Yes	2	1

QAPP Worksheet #15-A (Continued)
Reference Limits and Evaluation Table

VOCs	CAS Number	Project Action Limit/NAL (µg/L)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific	
					PQLs (µg/L)	MDLs (µg/L)
Total Xylenes	1330-20-7	9.01	NAL	Yes	15	7.5
o-Xylene	95-47-6	48.5	NAL	Yes	15	7.5
m-Xylene	108-38-3	48.3	NAL	Yes	15	7.5
p-Xylene	106-42-3	48.4	NAL	Yes	15	7.5

CAS = Chemical Abstracts Service
COPC = chemical of potential concern
MCL = maximum contaminant limit
MDL = method detection limit
NAL = no action level for child resident scenario from the Risk Methods Document (DOE 2011)
PQL = practical quantitation limit
VOC = volatile organic compound

[a] This QAPP references the MCLs (or EPA screening level for tap water if no MCL) to support project planning and identify whether lower reporting limits may be needed for some constituents. The worksheet also lists the NALs established by the Risk Methods Document for the child resident scenario.
[b] Analytes marked with COPC are from Table 2.1 of the Risk Methods Document (DOE 2011) and represent the list of chemicals, compounds, and radionuclides compiled from chemicals of potential concern retained as contaminants of concern in risk assessments performed at PGDP between 1990 and 2008.
[c] Tap water—Source: EPA regional screening levels, June 2011.

QAPP Worksheet #15-B
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: Metals

Metals	CAS Number	Project Action Limit/NAL (mg/L)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific	
					PQLs (mg/L)	MDLs (mg/L)
Aluminum	7429-90-5	37/1.04	Tap Water[c]/NAL	Yes	0.200	0.100
Antimony	7440-36-0	0.006/0.000415	MCL/NAL	Yes	0.005	0.0025
Arsenic	7440-38-2	0.010/0.0000380	MCL/NAL	Yes	0.001	0.0005
Barium	7440-39-3	2/0.206	MCL/NAL	Yes	0.005	0.0025
Beryllium	7440-41-7	0.004/0.0000112	MCL/NAL	Yes	0.001	0.0005
Boron	7440-42-8	7.3/0.208	Tap Water[c]/NAL	Yes	0.200	0.100
Cadmium	7440-43-9	0.005/0.000146	MCL/NAL	Yes	0.001	0.0005
Chromium (total)	7440-47-3	0.1/1.47	MCL/NAL	Yes	0.010	0.005
Chromium VI	18540-29-9	0.000103	NAL	Yes	0.010	0.005
Cobalt	7440-48-4	0.011/0.000313	Tap Water[c]/NAL	Yes	0.001	0.0005
Copper	7440-50-8	1.3/0.0417	MCL/NAL	Yes	0.020	0.010
Iron	7439-89-6	26/0.729	Tap Water[c]/NAL	Yes	0.100	0.050
Lead	7439-92-1	0.015/0.0150	MCL[d]/NAL	Yes	0.0013	0.00065
Manganese	7439-96-5	0.88/0.0245	Tap Water[c]/NAL	Yes	0.005	0.0025

QAPP Worksheet #15-B (Continued)
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: Metals

Metals	CAS Number	Project Action Limit/ NAL (mg/L)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific	
					PQLs (mg/L)	MDLs (mg/L)
Mercury	7439-97-6	0.002/0.000309	MCL/NAL	Yes	0.0002	0.0001
Molybdenum	7439-98-7	0.18/0.00521	Tap Water[c]/NAL	Yes	0.001	0.0005
Nickel	7440-02-0	0.73/0.0208	Tap Water[c]/NAL	Yes	0.005	0.0025
Selenium	7782-49-2	0.05/0.00521	MCL/NAL	Yes	0.005	0.0025
Silver	7440-22-4	0.00515	NAL	Yes	0.001	0.0005
Thallium	7440-28-0	0.002/0.0000834	MCL/NAL	Yes	0.002	0.001
Uranium	7440-61-1	0.03/0.00313	MCL/NAL	Yes	0.001	0.0005
Vanadium	7440-62-2	0.0000706	NAL	Yes	0.020	0.010
Zinc	7440-66-6	11/0.313	Tap Water[c]/NAL	Yes	0.020	0.010

CAS = Chemical Abstracts Service
COPC = chemical of potential concern
MCL = maximum contaminant limit
MDL = method detection limit
NAL = no action level for child resident scenario from the Risk Methods Document (DOE 2011)
PQL = practical quantitation limit

[a] This QAPP references the MCLs (or EPA screening level for tap water if no MCL) to support project planning and identify whether lower reporting limits may be needed for some constituents. The worksheet also lists the NALs established by the Risk Methods Document for the child resident scenario
[b] Analytes marked with COPC are from Table 2.1 of the Risk Methods Document (DOE 2011) and represent the list of chemicals, compounds, and radionuclides compiled from chemicals of potential concern retained as contaminants of concern in risk assessments performed at PGDP between 1990 and 2008.
[c] Tap water—Source: EPA regional screening levels, June 2011.
[d] The MCL established by the EPA for lead is based on a treatment technique action level of 0.015 mg/L.

QAPP Worksheet #15-C
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: PCBs

PCBs	CAS Number	Project Action Limit (µg/L)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific	
					PQLs (µg/L)	MDLs (µg/L)
Aroclor-1016	12674-11-2	0.0199	NAL	Yes	0.17	0.085
Aroclor-1221	11104-28-2	0.0673	NAL	Yes	0.18	0.09
Aroclor-1232	11141-16-5	0.0673	NAL	Yes	0.14	0.07
Aroclor-1242	53469-21-9	0.0159	NAL	Yes	0.1	0.05
Aroclor-1248	12672-29-6	0.0149	NAL	Yes	0.12	0.06
Aroclor-1254	11097-69-1	0.00187	NAL	Yes	0.07	0.035
Aroclor-1260	11096-82-5	0.00172	NAL	Yes	0.05	0.025
Aroclor-1268	11100-14-4	0.5	MCL	Unknown	0.09	0.045

CAS = Chemical Abstracts Service
COPC = chemical of potential concern
MCL = maximum contaminant limit
MDL = method detection limit
NAL = no action level for child resident scenario from the Risk Methods Document (DOE 2011)
PCB = polychlorinated biphenyl
PQL = practical quantitation limit

[a] This QAPP references the MCLs (or EPA screening level for tap water if no MCL) to support project planning and identify whether lower reporting limits may be needed for some constituents. The worksheet also lists the NALs established by the Risk Methods Document for the child resident scenario.
[b] Analytes marked with COPC are from Table 2.1 of the Risk Methods Document (DOE 2011) and represent the list of chemicals, compounds, and radionuclides compiled from chemicals of potential concern retained as contaminants of concern in risk assessments performed at PGDP between 1990 and 2008.

QAPP Worksheet #15-D
Reference Limits and Evaluation Table

Matrix: Water
Analytical Group: Radionuclides

Radionuclides	CAS Number	Project Action Limit (pCi/L)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific MDAs (pCi//L)
Americium-241	14596-10-2	0.906	NAL	Yes	3
Cesium-137	10045-97-3	3.10	NAL	Yes	60
Cobalt-60	10198-40-0	6.00	NAL	Yes	50
Neptunium-237	13994-20-2	1.40	NAL	Yes	3
Plutonium-238	13981-16-3	0.719	NAL	Yes	4
Plutonium-239/240	15117-48-3/14119-33-6	0.698	NAL	Yes	3
Technetium-99	14133-76-7	4 mRem/year-dose (34.3 pCi/L)	MCL (NAL)	Yes	25
Thorium-230	14269-63-7	1.04	NAL	Yes	50 (4[c])
Uranium-234	13966-29-5	1.33	NAL	Yes	30 (17[c])
Uranium-235	15117-96-1	1.31	NAL	Yes	30 (18[c])
Uranium-238	24678-82-8	1.08	NAL	Yes	30 (19[c])

CAS = Chemical Abstract Service; COPC = chemical of potential concern; MDA = minimum detectable activity; N/A = not applicable; analyte not identified as a site COPC; NAL = no action level for child resident scenario from the Risk Methods Document (DOE 2011)

[a] This QAPP references the MCLs (or EPA screening level for tap water if no MCL) to support project planning and identify whether lower reporting limits may be needed for some constituents. The worksheet also lists the NALs established by the Risk Methods Document for the child resident scenario
[b] Analytes marked with COPC are from Table 2.1 of the Risk Methods Document (DOE 2011) and represent the list of chemicals, compounds, and radionuclides compiled from chemicals of potential concern retained as contaminants of concern in risk assessments performed at PGDP between 1990 and 2008.
[c] The value in parentheses reflects MDAs requested under the Environmental Radiation Protection Program.

QAPP Worksheet #15-F
Reference Limits and Evaluation Table

Matrix: Sediment
Analytical Group: PCBs

PCBs	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific	
					PQLs (mg/kg)	MDLs (mg/kg)
Aroclor-1016	12674-11-2	0.0633	NAL	Yes	0.13	0.065
Aroclor-1221	11104-28-2	0.0437	NAL	Yes	0.13	0.065
Aroclor-1232	11141-16-5	0.0437	NAL	Yes	0.13	0.065
Aroclor-1242	53469-21-9	0.0644	NAL	Yes	0.13	0.065
Aroclor-1248	12672-29-6	0.0682	NAL	Yes	0.13	0.065
Aroclor-1254	11097-69-1	0.0501	NAL	Yes	0.13	0.065
Aroclor-1260	11096-82-5	0.0662	NAL	Yes	0.13	0.065
Aroclor-1268	11100-14-4	Not calculated	none	Unknown	0.13	0.065

CAS = Chemical Abstracts Service
COPC = chemical of potential concern
MDL = method detection limit
NAL = no action level for child resident scenario from the Risk Methods Document (DOE 2011)
PCB = polychlorinated biphenyl
PQL = practical quantitation limit

Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.
[a] This QAPP references the MCLs (or EPA screening level for tap water if no MCL) to support project planning and identify whether lower reporting limits may be needed for some constituents. The worksheet also lists the NALs established by the Risk Methods Document for the child resident scenario.
[b] Analytes marked with COPC are from Table 2.1 of the Risk Methods Document (DOE 2011) and represent the list of chemicals, compounds, and radionuclides compiled from chemicals of potential concern retained as contaminants of concern in risk assessments performed at PGDP between 1990 and 2008.

QAPP Worksheet #15-G
Reference Limits and Evaluation Table

Matrix: Sediment
Analytical Group: Radionuclides

Radionuclides	CAS Number	Project Action Limit (pCi/g)	Project Action Limit Reference[a]	Site COPC?[b]	Laboratory-Specific MDAs (pCi/g)
Cesium-137	10045-97-3	0.0267	NAL	Yes	0.1
Neptunium-237	13994-20-2	0.0839	NAL	Yes	0.05
Plutonium-238	13981-16-3	3.21	NAL	Yes	0.05
Plutonium-239/240	15117-48-3/ 14119-33-6	3.15/ 3.16	NAL	Yes	0.05
Technetium-99	14133-76-7	101	NAL	Yes	1.0
Thorium-230	14269-63-7	4.10	NAL	Yes	0.05
Uranium-234	13966-29-5	5.47	NAL	Yes	0.15
Uranium-235	15117-96-1	0.122	NAL	Yes	0.05
Uranium-238	24678-82-8	0.517	NAL	Yes	0.15

CAS = Chemical Abstracts Service
COPC = chemical of potential concern
NAL = no action level for child resident scenario from the Risk Methods Document (DOE 2011)
MDA = minimum detectable activity

Analytical laboratory results will be reported on a dry weight basis, as applicable, unless specified otherwise.
[a] This QAPP references the MCLs (or EPA screening level for tap water if no MCL) to support project planning and identify whether lower reporting limits may be needed for some constituents. The worksheet also lists the NALs established by the Risk Methods Document for the child resident scenario.
[b] Analytes marked with COPC are from Table 2.1 of the Risk Methods Document (DOE 2011) and represent the list of chemicals, compounds, and radionuclides compiled from chemicals of potential concern retained as contaminants of concern in risk assessments performed at PGDP between 1990 and 2008.

QAPP Worksheet #15-K
Reference Limits and Evaluation Table

Matrix: Surface
Analyte Group: KPDES permit

KPDES Parameters with Permit Limits	CAS Number	Project Action Limit	KPDES Outfall	Site COPC?[b]	Laboratory-Specific	
					PQLs	MDLs[e]
1,1,1-Trichloroethane	71-55-6	0.2 mg/L	Outfall 020	No	0.005 mg/L	0.0025 mg/L
Trichloroethene	79-01-6	0.0308 mg/L	Outfall 020	No	0.001 mg/L	0.0005 mg/L
Total Suspended Solids	N/A	30 mg/L	Outfall 001, Outfall 019, Outfall 020	No	20 mg/L	10 mg/L
Oil & Grease	N/A	10 mg/L	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	7 mg/L	3.5 mg/L
Total Phosphorus	7723-14-0	1 mg/L	Outfall 001	No	0.04 mg/L	0.02 mg/L
Arsenic	7440-38-2	150 µg/L	Outfall 020	No	10 µg/L	5 µg/L
Nickel	7440-02-0	94 µg/L	Outfall 020	No	5 µg/L	2.5 µg/L
Zinc	7440-66-6	216 µg/L	Outfall 017, Outfall 020	No	20 µg/L	10 µg/L
Nitrates	N/A	500 mg/L	Outfall 020	No	1 mg/L	0.5 mg/L
Chlorides	16887-00-6	600 mg/L	Outfall 020	No	2 mg/L	1 mg/L
Aroclor-1016	12674-11-2	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.17	0.085
Aroclor-1221	11104-28-2	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.18	0.09
Aroclor-1232	11141-16-5	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.14	0.07
Aroclor-1242	53469-21-9	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.1	0.05
Aroclor-1248	12672-29-6	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.12	0.06
Aroclor-1254	11097-69-1	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.07	0.035
Aroclor-1260	11096-82-5	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.05	0.025
Aroclor-1268	11100-14-4	PQL	Outfall 001, Outfall 015, Outfall 017, Outfall 019, Outfall 020	No	0.09	0.045

QAPP Worksheet #16
Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Routine sampling conducted throughout the fiscal year	LATA Kentucky	October 1, 2013	September 30, 2014	See Appendix C of the EMP for deliverable information	See Appendix C of the EMP for deliverable information, as well as the Appendix J of the DOE/LATA Kentucky contract for deliverable due date information

QAPP Worksheet #18
Sampling Locations and Methods/Standard Operating Procedure Requirements Table for Screening Samples

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group	Concentration Level[a]	Number of Samples (Identify Field Duplicates)	Sampling SOP Reference[b]	Rationale for Sampling Location
Sitewide (See Appendix C of the EMP for specific locations)	Sediment	Surface (Creek Bed Samples)	See Appendix C of the EMP	Varies by location and analyte	See Appendix C of the EMP (Minimum of 5%)	PAD-ENM-2302, *Collection of Sediment Samples Associated with Surface Water*	See Appendix C of the EMP
	Surface Water	Surface Water in Creeks and Effluent Discharge	See Appendix C of the EMP	Varies by location and analyte	See Appendix C of the EMP (Minimum of 5%)	PAD-ENM-2203, *Surface Water Sampling*	
	Groundwater	UCRS, URGA, LRGA	See Appendix C of the EMP	Varies by location and analyte	See Appendix C of the EMP (Minimum of 5%)	PAD-ENM-2101, *Groundwater*	

[a] If historic data provide information on anticipated concentration, that information will be populated on this sheet.
[b] See Analytical SOP References Table (Worksheet #23).

N/A = not applicable
SOP = standard operating procedure

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference*	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Water	VOC	See Worksheet #18	See Worksheet #23	120 mL	3 x 40 mL Glass VOA Vial	HCl; pH < 2, cool to < 4°C, no headspace	14 days for preserved
Water	Metals	See Worksheet #18	See Worksheet #23	1 liter	1 liter Plastic	HNO_3 pH < 2, Cool to < 4°C	6 months (28 days for Hg)
Water	Anions	See Worksheet #18	See Worksheet #23	125 mL	125 mL Plastic	Cool to < 4°C	28 days (2 days for nitrate)
Water	PCBs	See Worksheet #18	See Worksheet #23	1 liter	1 liter Amber Glass	Cool to < 4°C	N/A[b]
Water	RADs	See Worksheet #18	See Worksheet #23	3 liters	3 x 1 liter Plastic	HNO_3 pH < 2, Cool to < 4°C[a]	6 months
Sediment	PCBs	See Worksheet #18	See Worksheet #23	30 g	125 mL wide-mouth Amber Glass	Cool to < 4°C	N/A[b]
Sediment	RADs	See Worksheet #18	See Worksheet #23	250 g	500 mL wide-mouth plastic straight side	Cool to < 4°C	6 months

NOTE: Sample volume and container requirements will be specified by the laboratory. This table includes standard requirements for routine analytical groups.
*See Analytical SOP References table (Worksheet #23).
[a] Check with specific laboratory conducting analyses to ensure that acidification will not interfere with laboratory procedures.
[b] A 45-day holding time is an expectation of the laboratory; however, since SW846 does not indicate a holding time for PCBs, any data that exceeds the 45 days will be identified, but not qualified.

HCl = hydrochloric acid
Hg = mercury
HNO_3 = nitric acid
PCB = polychlorinated biphenyl
RAD = radionuclide
VOC = volatile organic compound

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	Inorganic No. of MS	No. of Field Blanks	No. of Equip. Blanks	Total No. of Samples to Lab
Sediment	PCBs	Low	See Worksheet #12	See Appendix C of the EMP	5%	5%	5%	5%	See Appendix C of EMP
Sediment	Radionuclides	Low	See Worksheet #12	See Appendix C of the EMP	5%	5%	5%	5%	See Appendix C of EMP
Water (Groundwater and Surface Water)	VOCs	Low	See Worksheet #12	See Appendix C of the EMP	5%	5%	5%	5%	See Appendix C of EMP
Water (Groundwater and Surface Water)	Metals	Low	See Worksheet #12	See Appendix C of the EMP	5%	5%	5%	5%	See Appendix C of EMP
Water (Groundwater and Surface Water)	PCBs	Low	See Worksheet #12	See Appendix C of the EMP	5%	5%	5%	5%	See Appendix C of EMP
Water (Groundwater and Surface Water)	Radionuclides	Low	See Worksheet #12	See Appendix C of the EMP	5%	5%	5%	5%	See Appendix C of EMP

MS = matrix spike
PCB = polychlorinated biphenyl
VOC = volatile organic compound

QAPP Worksheet #21
Project Sampling SOP References Table

Site-specific standard operating procedures (SOPs) have been developed for site sampling and data management activities.

Reference Number	Title and Number[a]	Originating Organization[b]	Equipment Type	Modified for Project Work? (Y/N)	Comments
1	PAD-ENM-0016, *Maintenance and Use of the ASTM Type II Water System*	Contractor	Sampling	N	N/A
2	PAD-ENM-0021, *Temperature Control for Sample Storage*	Contractor	Sampling	N	N/A
3	Pad-ENM-0025, *Paducah Environmental Monitoring Waste Management Plan*	Contractor	N/A	N	N/A
4	PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analyses Data Verification and Validation*	Contractor	N/A	N	N/A
5	PAD-ENM-0811, *ROAC1 Pesticide and PCB Data Verification and Validation*	Contractor	N/A	N	N/A
6	PAD-ENM-1001, *Transmitting Data to the Paducah Oak Ridge Environmental Information System (OREIS)*	Contractor	N/A	N	N/A
7	PAD-ENM-0063, *Environmental Monitoring Data Management Plan*	Contractor	N/A	N	N/A
8	PAD-ENM-2100, *Groundwater Level Measurement*	Contractor	Sampling	N	N/A
9	PAD-ENM-2101, *Groundwater Sampling*	Contractor	Sampling		N/A
10	PAD-ENM-2203, *Surface Water Sampling*	Contractor	Sampling	N	N/A
12	PAD-ENM-2302, *Collection of Sediment Samples Associated with Surface Water*	Contractor	Sampling	N	N/A
13	PAD-ENM-0074, *Monitoring Well Inspection and Maintenance*	Contractor	Sampling	N	N/A
14	PAD-ENM-2700, *Logbooks and Data Forms*	Contractor	N/A	N	N/A
15	PAD-ENM-2702, *Decontamination of Sampling Equipment and Devices*	Contractor	Sampling	N	N/A
16	PAD-ENM-2704, *Trip, Equipment, and Field Blank Preparation*	Contractor	N/A	N	N/A
17	PAD-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*	Contractor	N/A	N	N/A

QAPP Worksheet #21 (Continued)
Project Sampling SOP References Table

Reference Number	Title and Number[a]	Originating Organization[b]	Equipment Type	Modified for Project Work? (Y/N)	Comments
18	PAD-ENM-5003, *Quality Assured Data*	Contractor	N/A	N	N/A
19	PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance*	Contractor	N/A	N	N/A
20	PAD-ENM-5007, *Data Management Coordination*	Contractor	N/A	N	N/A
21	PAD-ENM-5102, *Radiochemical Data Verification and Validation*	Contractor	N/A	N	N/A
22	PAD-ENM-5103, *Polychlorinated Dibenzodioxins-Polychlorinated Dibenzofurans Verification and Validation*	Contractor	N/A	N	N/A
23	PAD-ENM-5105, *ROAC1 Volatile and Semivolatile Data Verification and Validation*	Contractor	N/A	N	N/A
24	PAD-ENM-5107, *Inorganic Data Validation and Verification*	Contractor	N/A	N	N/A
25	PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analyses Data Verification and Validation*	Contractor	N/A	N	N/A
26	PAD-ENM-1003, *Developing, Implementing, and Maintaining Data Management Implementation Plans.*	Contractor	N/A	N	N/A
27	PAD-ENM-1002, *Submitting, Reviewing, and Dispositioning Changes to the Environmental Databases OREIS and PEMS*	Contractor	N/A	N	N/A

[a] SOPs are posted to the LATA Kentucky intranet Web site. External FFA parties can access this site using remote access with privileges upon approval.
[b] The work will be conducted by LATA Kentucky staff or a subcontractor. In either case, SOPs listed will be followed.
N/A = not applicable

QAPP Worksheet #22

Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment*	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Water Quality Meter (permit application of the landfills specify Hydrolab)	Calibration check at the beginning of the day	Performed monthly and as needed	Measure solutions with known values (National Institute for Standards and Technology traceable buffers and conductivity calibration solutions)	Upon receipt, successful operation	Daily before each use	Per manufacturer's specifications	Recalibrate or service as necessary	Field Team Leader	Manufacturers specifications
Turbidity Meter (Nephthelometer)	Accuracy check at the beginning of each day's use	As needed	Measure solutions with known turbidity standards	Upon receipt, successful operation	Check daily before each use	N/A (instrument zeroed)	Service by manufacturer or replace	Field Team Leader	Manufacturer's specifications
Ferrous Iron Colorimeter	Accuracy check at the beginning of each day's use	Return to manufacturer as needed	Measure with standard solution	Upon receipt, successful operation	Check daily before each use	Within range of manufacturer's standard	Service by manufacturer or replace	Field Team Leader	Manufacturer's specifications
Colorimeter (for total residual chlorine)	Accuracy check at the beginning of each day's use	As needed	Measure with standard solution	Upon receipt, successful operation	Check daily before each use	Within range of manufacturer's standard	Service by manufacturer or replace	Field Team Leader	Manufacturer's specifications
Titrator (for total residual chlorine)	Accuracy check at the beginning of each day	As needed	Measure with standard solution	Upon receipt, successful operation	Check daily before each use	With range of manufacturer's standard	Service by manufacturer or replace	Field Team Leader	Manufacturer's specifications
Electron Water Level Meter	Accuracy check annually against a steel tape	Replace as needed	Annual verification	Upon receipt, successful operation	Check daily before each use	Pass/Fail	Service by manufacturer or replace	Field Team Leader	Manufacturer's specifications
Hach flow meter	Calibrate to readings on flume	Quarterly or as needed	Measure against flume	Upon receipt, successful operation	Weekly as needed	Pass/Fail	Service by manufacturer or replace	Field Team Leader	Manufacturer's specifications

QAPP Worksheet #23
Analytical SOP References Table

Reference Number*	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SW-846-8260/ EPA-624			VOA (Unless noted below)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-8011			VOA (1,2-Dibromo-3-chloropropane)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-8270			SVOC	Per SOP	Southwest Research Institute, San Antonio, TX	N
SW-846-9056/ EPA-300			Anions (Unless noted below)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-9214			Anions (Fluoride)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
N/A	RSK175		VOA (Ethene, Ethane, Methane)	Per SOP	GEL Laboratories, Charleston SC	N
EPA-410.4			Miscellaneous (Chemical Oxygen Demand)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-350.3			Miscellaneous (Ammonia as Nitrogen)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-9010			Miscellaneous (Cyanide)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-9040			Miscellaneous (pH—when not as field measurement)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-5210			Miscellaneous (Carbonaceous Biological Oxygen Demand)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-180.1			Miscellaneous (Turbidity—when not as field measurement)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-130.2			Miscellaneous (Hardness)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N

QAPP Worksheet #23 (Continued)
Analytical SOP References Table

Reference Number*	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SW-846-9060			Miscellaneous (Total Organic Carbon)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-345.1			Miscellaneous (Iodide)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-160.1			Miscellaneous (Total Dissolved Solids)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-160.2			Miscellaneous (Total Suspended Solids)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-160.3			Miscellaneous (Total Solids)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-365.3			Miscellaneous (Total Phosphorous)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-9020			Miscellaneous (Total Organic Halides)	Per SOP	TestAmerica Laboratories, Earth City, MO	N
EPA-370.1			Miscellaneous (Silica)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-376.1			Miscellaneous (Sulfide)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-377.1			Miscellaneous (Sulfite)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-9222			Miscellaneous (Total Coliform)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-310.1			Miscellaneous (Alkalinity)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
EPA-1664			Miscellaneous (Oil and Grease)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-6010/6020/EPA-200.8			Metals (Unless noted below)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N

QAPP Worksheet #23 (Continued)
Analytical SOP References Table

Reference Number*	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SW-846-7470			Metals (Mercury)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
SW-846-8082/ SW-846-8081 (Heptachlor)			PCBs and Heptachlor	Per SOP	USEC Analytical Laboratories, Paducah, KY Southwest Research Institute, San Antonio, TX	N
SW-846-9310/ EPA-900			Radionuclides (Gross Alpha and Gross Beta)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
Gamma Spec	RL-7124		Radionuclides (Cesium-137)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
Gas Flow Proportional	RL-7140		Radionuclides (Strontium-90)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
Liquid Scintillation	RL-7100		Radionuclides (Technetium-99)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N
Alpha Spec	RL-7128		Radionuclides (Thorium-230, Uranium-234, Uranium-235, Uranium-238, Neptunium-237, Plutonium-238, Plutonium-239/240)	Per SOP	USEC Analytical Laboratories, Paducah, KY	N

*Information will be based on laboratory used.

QAPP Worksheet #24
Analytical Instrument Calibration Information

All laboratory equipment and instruments used for quantitative measurements are calibrated in accordance with the laboratory's formal calibration program. Whenever possible, the laboratory uses recognized procedures for calibration such as those published by EPA or American Society for Testing and Materials. If established procedures are not available, the laboratory develops a calibration procedure based on the type of equipment, stability, characteristics of the equipment, required accuracy, and the effect of operation error on the quantities measured. Whenever possible, physical reference standards associated with periodic calibrations, such as weights or certified thermometers with known relationships to nationally recognized standards, are used. Where national reference standards are not available, the basis for the reference standard is documented. Equipment or instruments that fail calibration or become inoperable during use are tagged to indicate they are out of calibration. Such instruments or equipment are repaired and successfully recalibrated prior to reuse. All high resolution mass spectrometer instruments undergo extensive tuning and calibration prior to running each sample set. The calibrations and ongoing instrument performance parameters are recorded and reported as part of the analytical data package.

The laboratory is responsible for maintaining instrument calibration information per their QA Plan including control charts established for all instrumentation. This information is audited annually by DOECAP. Laboratory(s) contracted will be DOECAP audited.

QAPP Worksheet #25

Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference*
GC-MS	Replace/clean ion source; clean injector, replace injector liner, replace/clip capillary column, flush/replace tubing on purge and trap; replace trap	QC standards	Ion source, injector liner, column, column flow, purge lines, purge flow, trap	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Laboratory Section Manager	See Worksheet #23
GC	ECD maintenance; replace/clip capillary column	QC standards	ECD, FID, injector, injector liner, column, column flow	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Laboratory Section Manager	See Worksheet #23
ICP-MS and ICP-AES	Clean plasma torch; clean filters; clean spray and nebulizer chambers; replace pump tubing	QC standards	Torch, filters, nebulizer chamber, pump, pump tubing	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Laboratory Area Supervisor	See Worksheet #23
pH meter	Clean probe	QC standards	Probe	As needed	The value for each of the certified buffer solutions must be within ± 0.05 pH units of the expected value	Repeat maintenance activity or remove from service	Laboratory Manager	See Worksheet #23
Spectrophotometer	Flush/replace tubing	QC standards	Tubing	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity of remove from service	Laboratory Manager	See Worksheet #23
TOC Analyzer (NDIRD)	Replace sample tubing, clean sample boat, replace syringe	QC standards	Tubing, sample boat, syringe	As needed	Must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Laboratory Manager	See Worksheet #23

*The laboratory is responsible for maintaining instrument and equipment maintenance, testing, and inspection information per their QA Plan. This information is audited annually by DOECAP. Laboratory(s) contracted will be DOECAP audited. Field survey/sampling instrumentation will be maintained, tested, and inspected according to manufacturer's instructions.

ECD = electron capture detector
GC = gas chromatography
GC-MS = gas chromatography mass spectrometer
ICP-AES = inductively coupled plasma atomic emission spectroscopy
ICP-MS = inductively coupled plasma mass spectrometer
NDIRD = nondispersive infrared detector
QC = quality control
TOC = total organic carbon

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT	
Sample Collection (Personnel/Organization):	Sampling Teams/DOE Prime Contractor and Subcontractors
Sample Packaging (Personnel/Organization):	Sampling Teams/DOE Prime Contractor and Subcontractors
Coordination of Shipment (Personnel/Organization):	Lab Coordinator/DOE Prime Contractor
Type of Shipment/Carrier:	Direct Delivery or Overnight/Federal Express or UPS
SAMPLE RECEIPT AND ANALYSIS	
Sample Receipt (Personnel/Organization):	Sample Management/Contracted Laboratory
Sample Custody and Storage (Personnel/Organization):	Sample Management/Contracted Laboratory
Sample Preparation (Personnel/Organization):	Analysts/Contracted Laboratory
Sample Determinative Analysis (Personnel/Organization):	Analysts/Contracted Laboratory
SAMPLE ARCHIVING	
Field Sample Storage (No. of days from sample collection):	The field laboratory is required to analyze samples within 48 hours of collection and those samples are archived until results are screened unless historical data is sufficient for shipping. The fixed-based laboratory will archive samples for 4 months or less depending on project-specific requirements.
Sample Extract/Digestate Storage (No. of days from extraction/digestion):	120 Days
Biological Sample Storage (No. of days from sample collection):	Not applicable.
SAMPLE DISPOSAL	
Personnel/Organization:	Waste Disposition/Sample and Data Management Manager/DOE Prime Contractor and Subcontractors
Number of Days from Analysis:	6 months

QAPP Worksheet #27
Sample Custody Requirements*

Chain-of-custody procedures are comprised of maintaining sample custody and documentation of samples for evidence. To document chain-of-custody, an accurate record of samples must be maintained in order to trace the possession of each sample from the time of collection to its introduction to the laboratory.

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Field sample custody requirements will be per DOE Prime Contractor procedures PAD-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*; and PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance.*

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Are per the DOECAP-audited laboratory's standard procedures. When the samples are delivered to the laboratory, signatures of the laboratory personnel receiving them and the courier personnel relinquishing them will be completed in the appropriate spaces on the chain-of-custody record, unless the courier is a commercial carrier. This will complete the sample transfer. It will be every laboratory's responsibility to maintain internal logbooks and records that provide custody throughout sample preparation and analysis process.

Sample Identification Procedures:

Sample identification requirements will be specified in work package documents.

Chain-of-custody Procedures:

Chain-of-custody requirements will be per DOE Prime Contractor procedures PAD-ENM-2708, *Chain-of-Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals*; and PAD-ENM-5004, *Sample Tracking, Lab Coordination, and Sample Handling Guidance.*

*It is understood that SOPs are contractor specific.

QAPP Worksheet #28
QC Samples Table

Matrix: Sediment, Water (Groundwater and Surface Water) – excludes air filters and TLDs

Analytical Group/Concentration Level: VOC, SVOCs, Metals, PCBs, Rads

Sampling SOP: See Worksheet #12

Analytical Method/SOP Reference: See Worksheet #23

Sampler's Name/Field Sampling Organization: TBD (information available on contractor organization chart)

Analytical Organization: Environmental Monitoring

No. of Sample Locations: See Appendix C of the EMP

QC Sample	Frequency/Number*	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field blank	Minimum 5%	≤ CRQL**	Verify results; reanalyze	Project manager or designee	Contamination—Accuracy/bias	See procedure PAD-ENM-5003, *Quality Assured Data*
Trip blank	1 per cooler containing VOC samples	≤ CRQL	Verify results; reanalyze		Contamination—Accuracy/bias	See procedure PAD-ENM-5003, *Quality Assured Data*
Equipment blank	Minimum 5%	≤ CRQL	Verify results; reanalyze		Contamination—Accuracy/bias	See procedure PAD-ENM-5003, *Quality Assured Data*
Internal standards, laboratory spiked blanks or spiked field samples	All samples and standards	See data validation procedures PAD-ENM-5105, 5107, 5103, 5102	Check calculations and instrument; reanalyze affected samples	Laboratory analyst	Accuracy	See procedure PAD-ENM-5003, *Quality Assured Data*
Field duplicate	Minimum 5%	None	Data reviewer will place qualifiers on samples affected	Project manager or designee	Homogeneity/ Precision	RPD ≤ 50% sediment, RPD < 25% aqueous
Laboratory duplicate	Per laboratory procedure	See data validation procedures PAD-ENM-5105, 5107, 5103, 5102	Verify results re-prepare and reanalyze	Laboratory analyst	Precision	See procedure PAD-ENM-5003, *Quality Assured Data*

*The number of QC samples is listed on Worksheet #20.
**Unless dictated by project-specific parameters, ≤ CRQL.

QAPP Worksheet #29
Project Documents and Records Table

All project data and information must be documented in a format that is usable by project personnel. The QAPP describes how project data and information shall be documented, tracked, and managed from generation in the field to final use and storage in a manner that ensures data integrity, defensibility, and retrieval.

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records*	Other
Data logbooks (electronic or paper) and associated completed sampling forms; sample chains-of-custody	Laboratory data packages, OREIS database, and associated data packages	OREIS database and associated data packages	PAD-ENM-5003, Att. G, Data Assessment Review Checklist and Comment Form	Form QA-F-0004, Management/ Independent Assessment Report (quarterly assessment on permit driven sampling event is stipulated in the EMP)

*It is understood that SOPs are contractor specific.

OREIS = Oak Ridge Environmental Information System

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ID Numbers	Analytical SOP*	Data Package Turnaround Time	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)**	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
Sediment	PCBs	See Worksheet #18	See Appendix C of the EMP	See Worksheet #23	28-day	USEC Analytical Laboratories, Paducah KY USEC Analytical Laboratories P.O. Box 1410 Paducah, KY 42002-1410: John Price (270) 441-5867	MO00054 TestAmerica Laboratories, Inc. 13715 Rider Trail North Earth City, MO 63045 CONTACT (314) 298-8566
Sediment	Radionuclides	See Worksheet #18		See Worksheet #23	28-day		
Water	PCBs	See Worksheet #18		See Worksheet #23	28-day		
Water	Metals	See Worksheet #18		See Worksheet #23	28-day		
Water	Radionuclides	See Worksheet #18		See Worksheet #23	28-day		
Water	VOCs	See Worksheet #18		See Worksheet #23	28-day		
Water	SVOCs	See Worksheet #18		See Worksheet #23	28-day		
Water	Anions and Miscellaneous	See Worksheet #18		See Worksheet #23	28-day		

*Analytical method SOPs for radiochemistry parameters are laboratory specific.
**These are current laboratories and are subject to change.

ID = identification
PCB = polychlorinated biphenyl
TBD = to be determined
VOC = volatile organic compound
SVOC = semivolatile organic compound

QAPP Worksheet #31
Planned Project Assessments Table

LATA Kentucky will ensure that protocol outlined in the QAPP is implemented adequately. Assessment activities help to ensure that the resultant data quality is adequate for its intended use and that appropriate responses are in place to address nonconformances and deviations from the QAPP. Below is a list of assessments project teams may use.

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Independent Assessment/ Surveillance	A	Internal	Prime Contractor QA	QA Specialists, Contractor, or Independent Assessor	Project Management, Contractor	Project Management, Contractor	QA Specialist, Contractor
Laboratory Audit	Annual	External	DOE Consolidated Audit Program (DOECAP)	Laboratory Assessor	Laboratory	Laboratory	DOECAP
Management Assessments	Annual	Internal	Prime Contractor Project Management	Regulatory Management, Contractor	Regulatory Management, Contractor	Regulatory Management, Contractor	QA Specialist, Contractor
Management by Walking Around (MBWA)*	B	Internal	Project Management	Project Management	Project Management	Project Management	Project Management
MBWA Follow-up surveillances	Quarterly	Internal	Project Management	Project Management or designee, Contractor	Project Management/Designee, Contractor	Project Management, Contractor	Project Management

A = assessment frequency determined by QA Manager and conducted per PAD-QA-1420, *Conduct of Assessments*.
B = assessment frequency determined by regulatory manager and conducted per PAD-QA-1420.
*Reference: PAD-QA-1033 *Management by Walking Around (MBWA) Program*.

QAPP Worksheet #32
Assessment Findings and Corrective Action Responses*

All provisions shall be taken in the field and laboratory to ensure that any problems that may develop shall be dealt with as quickly as possible to ensure the continuity of the project/sampling events. Field modifications to procedures in the QAPP must be approved before the modifications are implemented and then documented. The process controlling procedure modification is PAD-PD-1107, *Development, Approval, and Change Control for LATA Kentucky Performance Documents*. Field modifications are documented through the work control process per PAD-WC-0021. Corrective action in the field may be necessary when the sampling design is changed. For example, a change in the field may include increasing the number or type of samples or analyses, changing sampling locations, and/or modifying sampling protocol. When this occurs, the project team shall identify any suspected technical or QA deficiencies and note them in the field logbook. Listed in Worksheet #32 is how project teams will address assessment findings.

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Time frame of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Time Frame for Response
Management, Independent, and Surveillances	Form QA-F-004, Management/ Independent Assessment Report, and QA-F-0710, Issue Identification Form	Project management, issue owner, contractor	Upon issuance of Form QA-F-004, Management/ Independent Assessment Report, form QA-F-0710, Issue Identification Form, will be completed and attached to the assessment report	QA-F-0710, Issue Identification Form, documents the issue response and/or corrective actions	Action owner as designated by issue owner, contractor	Fifteen days for initial issue response, corrective action schedule determined by issue owner, per PAD-QA-1210

*It is understood that SOPs are contractor specific.

QAPP Worksheet #33
QA Management Reports Table

Reports to management include project status reports, field and/or laboratory audits, and data quality assessments. These reports will be directed to the QA Manager and Project Manager who have ultimate responsibility for assuring that any corrective action response is completed, verified, and documented.

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Field Change Requests	As needed	Ongoing	Field staff	QAPP recipients
QAPP Addenda	As needed	Not Applicable	Project Manager	QAPP recipients
Field Audit Report	TBD as determined by QA Manager	30 days after completion of audit	QA Manager	LATA Kentucky Project Manager QA Manager
Corrective Action Plan	As needed	Within 3 weeks of request	Project Manager	QA Manager

TBD = to be determined
QA = quality assurance

QAPP Worksheet #34
Verification (Step I) Process Table

This section of the QAPP provides a description of the QA activities that will occur after the data collection phase of the project is completed. Implementation of this section will determine whether the data conforms to the specified criteria satisfying the project objectives.

Verification Input	Description[a]	Internal/ External	Responsible for Verification (Name, Organization)
Field Logbooks	Field logbooks are verified per DOE Prime Contractor procedure, PAD-ENM-2700, *Logbooks and Data Forms*, and PAD-ENM-5003, *Quality Assured Data*.	Internal	Project Management or designee, Contractor
Chains-of-custody	Chains-of-custody are controlled by DOE Prime Contractor procedure, PAD-ENM-5004, *Sample Tracking, Lab Coordination and Sample Handling Guidance*. Chains-of-custody will be included in data assessment packages for review as part of data verification and data assessment.	Internal	Sample and Data Management, Project Management, and QA Personnel, Contractor
Field and Laboratory Data	Field and analytical data are verified and assessed per DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*. Data assessment packages will be created per this procedure. The data assessment packages will include field and analytical data, chains-of-custody, data verification and assessment queries, and other project-specific information needed for personnel to review the package adequately. Data assessment packages will be reviewed to document any issues pertaining to the data and to indicate if data met the data quality objectives of the project.	Internal	Sample and Data Management, Project Management, and QA Personnel,[b] Contractor
Sampling Procedures	Evaluate whether sampling procedures were followed with respect to equipment and proper sampling support using audit and sampling reports, field change requests and field logbooks.	Internal	Sample and Data Management, Project Management, and QA Personnel,[b] Contractor
Laboratory Data	All laboratory data will be verified by the laboratory performing the analysis for completeness and technical accuracy prior to submittal to LATA Kentucky. Subsequently, LATA Kentucky will evaluate the data packages for completeness and compliance.	External/ Internal	Laboratory Manager, LATA Kentucky Sample and Data Management
Electronic Data Deliverables (EDDs)	Determine whether required fields and format were provided.	Internal	Sample and Data Management
QAPP	All planning documents will be available to reviewers to allow reconciliation with planned activities and objectives.	Internal	All data users

[a] It is understood that SOPs are contractor specific.
[b] QA specialist performs general QA review.

QAPP Worksheet #35
Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description[a]	Responsible for Validation (Name, Organization)
IIa	Data Deliverables, Analytes, and Holding Times	The documentation from the contractual screening will be included in the data assessment packages, per DOE Prime Contractor procedure PAD-ENM-5003, *Quality Assured Data*.	Sample and Data Management Personnel, Contractor
IIa	Chain-of-Custody, Sample Handling, Sampling Methods and Procedures, and Field Transcription	These items will be validated during the data assessment process as required by DOE Prime Contractor procedure, PAD-ENM-5003, *Quality Assured Data*, and PAD-ENM-1003, *Developing, Implementing, and Maintaining Data Management Implementation Plans.* The documentation of this validation will be included in the data assessment packages.	Sample and Data Management Personnel, Contractor
IIa	Analytical Methods and Procedures, Laboratory Data Qualifiers, and Standards	These items will be reviewed during the data validation process as required by DOE Prime Contractor data validation procedures. Data validation will be performed in parallel with data assessment. The data validation report and data validation qualifiers will be considered when the data assessment process is being finalized.	Data Validation Subcontractor, and Sample and Data Management, Project, Contractor
IIa	Audits	The audit reports and accreditation and certification records for the laboratory supporting the projects will be considered in the bidding process.	QA Personnel
IIb	Deviations and qualifiers from Step IIa	Any deviations and qualifiers resulting from Step IIa process will be documented in the data assessment packages.	Sample and Data Management, Project, and QA Personnel, Contractor
IIb	Sampling Plan, Sampling Procedures, Co-located Field Duplicates, Project Quantitation Limits, Confirmatory Analyses, Performance Criteria	These items will be evaluated as part of the data verification and data assessment process per DOE Prime Contractor procedure, PAD-ENM-5003, Quality Assured Data. These items will be considered when evaluating whether the project met their Data Quality Objectives.	Sample and Data Management, Project, and QA Personnel, Contractor

[a] It is understood that SOPs are contractor specific.

QAPP Worksheet #36
Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
Step IIa/IIb	Sediments	All	All	National Functional Guidelines; Worksheets #12, #15, and #28; and PAD-ENM-0026, PAD-ENM-0811, PAD-ENM-5102, PAD-ENM-5105, PAD-ENM-5003, and PAD-ENM-5107	Data Validator[a]
Step IIa/IIb	Water	All	All		Data Validator[a]

[a] Validation is to be conducted by a qualified individual, independent from sampling, laboratory, project management, or other decision making personnel for the task. This could be an outside party or someone within LATA Kentucky who is not involved in the project.

QAPP Worksheet #37
Usability Assessment*

LATA Kentucky shall determine the adequacy of data based on the results of validation and verification. The usability step involves assessing whether the process execution and resulting data meet project quality objectives documented in the QAPP.

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: Field and analytical data are verified and assessed per procedure PAD-ENM-5003, *Quality Assured Data*. Data assessment packages will be created per this procedure. Data assessment packages will include field and analytical data, chains-of-custody, data verification and assessment queries, and other project-specific information needed for personnel to review the package adequately. Data assessment packages will be reviewed to document any issues pertaining to the data and to indicate if data quality objectives of the project were met. For data selected for validation, the following procedures are used: PAD-ENM-0026, PAD-ENM-0811, PAD-ENM-5102, PAD-ENM-5105, and PAD-ENM-5107.

Describe the evaluative procedures used to assess overall measurement error associated with the project: PARCCS parameters (precision, accuracy, representativeness, comparability, completeness, and sensitivity) will be evaluated per procedure PAD-ENM-5003, *Quality Assured Data*. This information will be included in the data assessment packages for review by project personnel. Data assessment also will include documentation of QC exceedances, trends, and/or bias in the data set. Data assessment will document any statistics used.

Identify the personnel responsible for performing the usability assessment: Project personnel, as verified by QA personnel.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies: Data assessment packages will be created, which will include data assessment comments/questions and laboratory comments. Data verification and assessment queries indicating any historical outliers will be included in the data assessment packages.

*It is understood that SOPs are contractor specific.

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