PAD-ENM-0055/R2

Environmental Monitoring Plan
Fiscal Year 2013
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

This document is approved for public release per review by:

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LATA Kentucky Classification Support

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Environmental Monitoring Plan
Fiscal Year 2013
Paducah Gaseous Diffusion Plant,
Paducah, Kentucky

Date Issued—December 2012

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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CONTENTS

FIGURES

TABLES

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ACRONYMS

AEC	Atomic Energy Commission
AIP	Agreement in Principle
ASER	Annual Site Environmental Report
CAP-88	Clean Air Act Assessment Package-88
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
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
MDC	minimum detectable concentration
MDL	method detection level
MW	monitoring well
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
OU	operable unit
PGDP	Paducah Gaseous Diffusion Plant
PQL	practical quantification limit
QA	quality assurance
RADCON	radiological control
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SPCC	spill prevention control and countermeasure
SARA	Superfund Amendments Reauthorization Act
TED	total effective dose
TLD	thermoluminescent dosimeter
UE	uranium enrichment
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) 2013 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, soil, 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 and parameter lists; and Appendix D is a quality assurance project plan 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 2013. If changes are deemed appropriate based on trending analyses, they will be proposed via a permit modification or decision document change and implemented immediately after approval by the regulatory agencies. These changes will be incorporated in the FY 2014 EMP.

Changes to the sampling programs reflected in the FY 2013 EMP include, but are not limited to, the following actions.

- C-746-S&T and C-746-U Landfills: Elimination of iodine-131 (I-131) from the C-746-S&T and C-746-U Landfills groundwater monitoring programs. This parameter was eliminated as a permit requirement as part of a permit modification during FY 2012. Sampling for I-131 was eliminated during the 2012 period in order to meet permit requirements; however, its elimination is being documented in this EMP. Sampling requirements for the C-746-S&T and C-746-U Landfills are outlined in the solid waste landfill permits issued by the Kentucky Division of Waste Management (KDWM).

- C-746-S&T Landfills: Changed quarterly sampling for polychlorinated biphenyls (PCBs) to an annual event for the C-746-S&T Landfills groundwater monitoring program. The frequency of annual sampling is allowed by the permit.

- Northwest Plume: Sampling frequency decreased from quarterly to semiannually for 22 of the 33 monitoring wells (MWs). This reduction in frequency was allowed after 2 years of quarterly sampling following the Northwest Plume Optimization project, which was completed in August 2010.

- C-400: Addition of screened regions of five MWs (as designated by Ports 1 and 2). The parameter list also was modified for FY 2013; alpha and beta activity analyses, along with and uranium analysis, were eliminated. Sampling requirements for C-400 are a result of CERCLA decision documents and are documented in 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, and the 2009 letter, "Response to Letter from Kentucky Division of Waste Management Regarding Baseline Groundwater Sample Collection at the Northwest Corner of the C-400 Building."

- Water Policy Boundary Monitoring Program: A new program was added to the EMP. The residential well monitoring program was replaced by a new and modified program that captures the residential wells as a result of defining objectives related to monitoring the boundaries of the Water Policy Box. This program is divided into two parts: sampling to monitor plume migration to the (1) northwest and (2) northeast of the site. Water Policy Boundary Monitoring sampling requirements are driven by the CERCLA decision document *Action Memorandum for the Water Policy at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky.*

- Environmental Surveillance: Elimination of gross alpha and beta from 135 MWs and elimination of dissolved PCBs from 3 MWs.

- Geochemical: Elimination of mercury analysis from 44 MWs.

- Geochemical: Elimination of five MWs from the program.

- Environmental Radiation Protection Program: DOE Order (O) 5400.5 has been replaced by DOE O 458.1. Full implementation of DOE O 458.1 at the Paducah Site is January 2, 2013. Surface water, effluent water, and sediment monitoring programs are impacted by this implementation. For these programs, modifications to the program to reflect the sampling strategy change that will occur during the FY are noted in full detail in the applicable sections of Appendix C. Sampling location changes include the addition of sampling surface water near the Kentucky Pollutant Discharge Elimination System outfall locations. Sample parameter changes include the addition of radionuclide analysis at some surface water and sediment locations.

- External Gamma Monitoring: Thermoluminescent dosimeter (TLD) locations will increase beginning in January 2013 due to combining two programs that were monitoring with similar objectives. With this addition of the 11 TLD sites, the other gamma monitoring program that had been managed by the radiation protection organization can be eliminated.

- Ambient Air Monitoring: The ambient air monitoring program had been operated and managed by Kentucky Cabinet for Health and Family Services. The EM Program began managing the program July 1, 2012. The addition of this new program is noted in this FY 2013 EMP.

1. INTRODUCTION

1.1 PURPOSE

This Paducah Site Environmental Monitoring Plan (EMP) for fiscal year (FY) 2013 is intended to document the rationale, sampling frequency, parameters, and analytical methods for environmental monitoring (EM) activities at the Paducah Site and provides information on site characteristics, environmental pathways, dose assessment methodologies, and quality assurance (QA) management. Guidance for EM is included in U.S. Department of Energy (DOE) Order (O) 450.1A, *Environmental Protection Program*; DOE O 5400.5 (and replacement order 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 purpose of DOE O 450.1A is to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations, through which DOE cost-effectively meets or exceeds compliance with applicable environmental, public health, and resource protection requirements. DOE O 5400.5 (and replacement Order 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.

The Radiological Guide establishes the "elements of a radiological effluent monitoring and environmental surveillance program considered acceptable to DOE, in support of DOE Order 5400.5 (and replacement order DOE O 458.1) and DOE O 450.1A," described above.

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

1.2 SCOPE

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

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

In order for DOE and its primary remediation contractor to meet or exceed compliance with applicable environmental, public health, and resource protection requirements cost-effectively, the EMP is evaluated and modified, as appropriate. These modifications may include adjusting the number of monitoring wells

(MWs), 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.

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. 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 sampling activity mandated by a permit is required to be conducted on a quarterly basis.

1.3 RATIONALE

The rationale for EM activities at the Paducah Site for FY 2013 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 2013. 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 2013, 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 2014 EMP.

Changes to the sampling programs reflected in the FY 2013 EMP include, but are not limited to, the following actions.

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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)]. PGDP is an active uranium enrichment facility consisting of a diffusion cascade and extensive support facilities. The cascade, including product and tails withdrawal, is housed in six large process buildings. 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).

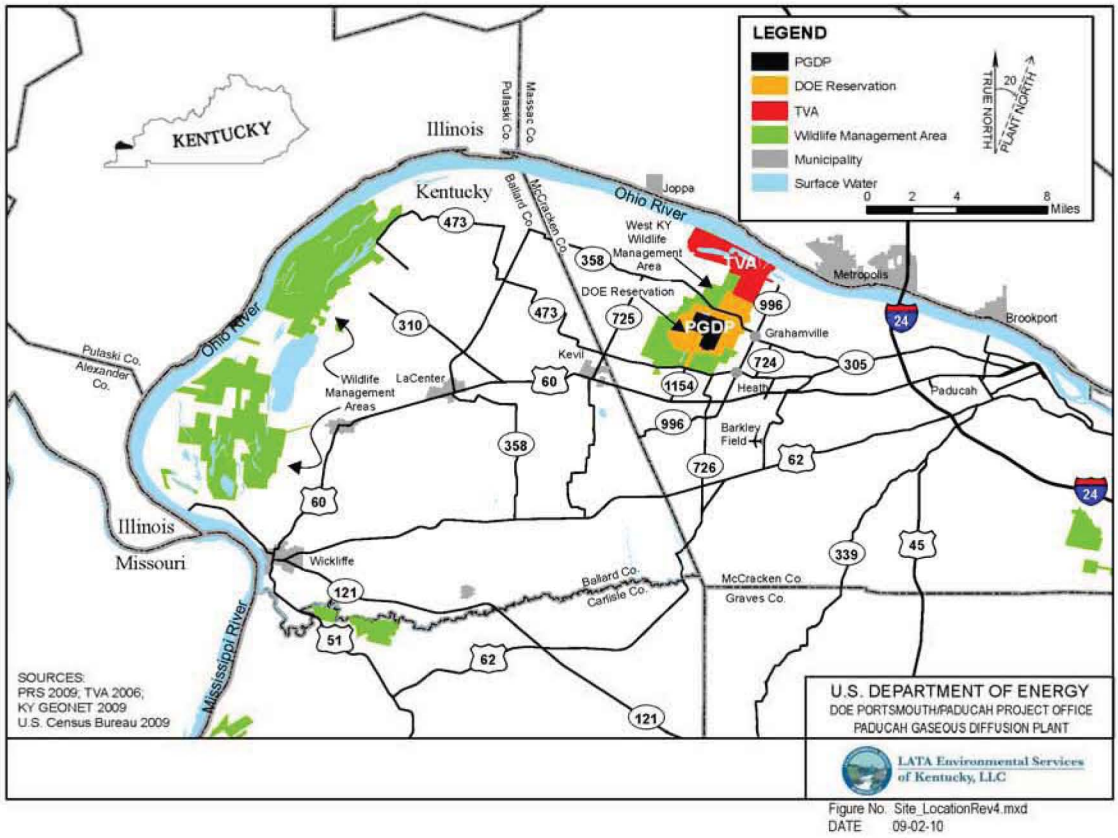

Figure 1. Location of the Paducah Site

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 (UE)

operations and formally requested the Department of the Army to transfer the site from GSA to AEC. Of the 7,566 acres acquired by the AEC, 1,361 acres subsequently were transferred to the Tennessee Valley Authority (Shawnee Fossil Plant Site), and approximately, 2,700 acres were conveyed to the Commonwealth of Kentucky for wildlife conservation and for recreational purposes [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 technetium-99 (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.

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

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.

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. A summary of permits and compliance agreements is included in Appendix A.

Table 1. Routine 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 KPDES Outfalls	5	Monthly
KPDES		
Chemical/Radiological (K001)	1	Weekly
Chemical/Radiological (K015, K017, K019, K020)	4	Monthly
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.

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.

Sampling and analytical methods meet the requirements described in 40 *CFR* § 136 or the KPDES permit (KY0004049). In addition, DOE O 5400.5 (and the replacement order 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.

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:

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

- 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 by analyte required for each extraction (continuous monitoring and/or sampling) location;

- Method detection level (MDL)/minimum detectable concentration (MDC) and accuracy by analyte; and

- QA components.

The preceding requirements are addressed as follows.

- Appendix C of this document lists all effluent monitoring locations. Appendix C specifies sampling and field measurements. Appendix C also lists the sampling frequency at each location and the required analytical parameters by each method type (i.e., volatiles, radionuclides, etc.). 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 is the EM QA Project Plan. All QA components are outlined within this plan. Appendix D lists all procedures associated with sample extraction and field measurements.

- Each contracted laboratory receives a statement of work for all sampling activities. In cases where reporting limits are specified under a given permit, the statement of work specifies these reporting limits as a requirement for the bid for work. In cases where there are no regulatory drivers, laboratories are directed to use the lowest routinely achievable reporting limit for nonradionuclide analyses. (Note: The reporting limits for nonradionuclide analyses [or practical quantification limits (PQL)] referenced in this bullet are limits that are multiples of the MDL. For example, the laboratory

may have an MDL of 1.2 milligram per liter (mg/L) for arsenic; however, the laboratory may use 5.0 mg/L as the reporting limit or PQL.) For radionuclide analyses, laboratories are directed to use the lowest MDC values.

- 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 by the Environmental Compliance support personnel (see Appendix D) for regulatory compliance. Additionally, data are reviewed according to the ERPP organization and the environmental radiological protection program for evaluation and trending purposes 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 species, 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 are required by DOE O 5400.5 (or replacement DOE O 458.1). The KPDES permit requires monthly radiological analyses at the outfall locations (Figure C.12).

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 farther 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. DOE operations at the Paducah Site do not emit enough pollutants to be considered harmful; consequently, DOE operations do not require a permit.

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

In support of DOE O 450.1A, the Paducah Site performs environmental surveillance. Environmental surveillance is the collection and analysis of samples or direct measurements of air, water, soil, and other media from DOE sites and their environment for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposures of members of the public, and assessing the effects, if any, on the local environment.

DOE O 458.1 DOE radiological activities, including remedial actions and activities using technologically enhanced naturally occurring radioactive material, must be conducted so that exposure of members of the public to ionizing radiation will not cause 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).

Table 2. Routine Environmental Surveillance

Program	Number of Locations	Sampling Frequency	Sample Type	Parameters
Groundwater				
Surveillance	28	Annually	Grab	See Appendix C
Surveillance	101	Biennially (Scheduled FY 2013)	Grab	See Appendix C
Surveillance Geochemical	39	Every 3 years (Scheduled FY 2013)	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	22	Quarterly	Grab	See Appendix C
Water Policy Boundary-NE	11	Annually	Grab	See Appendix C
Residential Carbon Filter System	1	Semiannually	Grab	See Appendix C
Surface Water and Seeps				
Surface Water and Seeps	20	Quarterly	Grab	See Appendix C
Surface Water—ERPP	4/1	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

Table 2. Routine Environmental Surveillance (Continued)

Program	Number of Locations	Sampling Frequency	Sample Type	Parameters
Environmental TLDs	57[c]	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 two 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.
[c] Forty-six locations until January 2013.

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. DOE O 450.1A does not require specific groundwater sampling frequencies or parameters; however, "Sample collection programs shall reflect specific facility needs. Type and frequency of sampling shall be adequate to characterize effluent streams." The order requires that DOE identify existing and potential groundwater contamination sources and maintain surveillance of these sources via groundwater monitoring. Monitoring verifies that releases are sustainable without causing environmental harm. The EMP was written to include effluent monitoring and environmental surveillance at the Paducah Site. Background wells are monitored biennially for several parameters, including organics, inorganics, and radionuclides.

Commonwealth of Kentucky Regulation. Preparation of a Groundwater Protection Plan that addresses requirements to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution is required by 401 *KAR* 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 2010. It will be revised on a three-year basis.

Agreement in Principle Sampling. The Agreement in Principle (AIP) supports groundwater program activities by providing oversight of the groundwater program. The oversight includes inspections (including monitoring well 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 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.

FFA Requirement and Operation and Maintenance Plan for the Northwest and Northeast Plume Programs. In order to monitor the nature and extent of groundwater contamination and to evaluate any cyclic trends in water quality that may affect contaminant migration, 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 Operation and Maintenance 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.

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 2 landfills (Figure C.2). Of these 25, 23 are used for collection of samples to analyze organic, inorganic, and radiological parameters identified in Appendix C. The remaining 2 are used for water level measurements. I-131 was removed as a permit requirement during FY 2012 and is documented in this EMP.

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 parameters, as listed in Appendix C. I-131 was removed as a permit requirement during FY 2012 and is documented in this EMP.

C-404 Landfill. The C-404 Hazardous Waste Landfill is closed and monitored under EPA Hazardous Waste Permit KY8-890-008-982. The C-404 Hazardous Waste Landfill currently is being monitored under detection monitoring (semiannual sampling) according to permit requirements. The groundwater is monitored utilizing nine MWs (Figure C.3). There are six downgradient and three upgradient compliance point wells. Parameters specified to be analyzed are provided in Appendix C.

C-746-K Landfill. Sampling of four MWs (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 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, as well as DOE O 450.1A, according to the Paducah FFA.

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 27 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 450.1A. 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 27 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.

Background Monitoring Program. Four background wells are sampled biennially and one annually to monitor the background water chemistry of wells located upgradient of the plant to compare with MWs potentially impacted from plant activities. These MWs will be sampled in this FY.

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.

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, and the 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*, last issued in August 2010, addresses the following specific requirements listed in Section 3(3) of 401 *KAR* 5:037:

(a) General information regarding the facility and its operation;

(b) Identification of activities associated with the facility, as identified in Section 2 of the regulation;

(c) Identification of all practices chosen for the plan to protect groundwater from pollution;

(d) Implementation schedules for the protection practices;

(e) Description of and implementation schedule for employee training necessary to ensure implementation of the plan;

(f) Schedule of required inspections, as applicable; and

(g) Certification of the plan by the appropriate PGDP representative.

These plans and the EMP provide the framework of the Groundwater Monitoring Program.

4.2 SURFACE WATER/SEDIMENT ENVIRONMENT

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 at 20 locations (including 1 seep) upstream and downstream from Paducah Site operations (Figure C.15). Four locations plus a background location are sampled for radiological parameters to evaluate all potential radiological effluents leaving the site and to evaluate the effectiveness of the outfall sampling program. Samples collected at upstream locations are considered background locations. Samples are collected quarterly. Frequency, field measurements parameters, and analytical parameters are listed in Appendix C.

4.2.2.2 Sediment program

Sediment samples are collected semiannually from 14 locations, 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. Sampling frequency, field measurement parameters, and analytical parameters are listed in Appendix C.

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 WKWMA sponsors field hunting trials for dogs.

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

4.3.1.2 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 are considered unlikely as irrigation near the plant has ceased. 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.

4.3.1.1 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 are considered unlikely because irrigation near the plant has ceased. 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.

4.3.1.2 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 are considered unlikely because irrigation near the plant has ceased. 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.

4.3.1.3 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 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.

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. Historically, the radiological control (RADCON) organization also utilized TLDs on or near the site to monitor occupied break areas, cylinder yards, storage facilities, and areas with elevated dose rates. The RADCON and EM programs combined the programs in efforts to more efficiently monitor the site. The increase of 11 locations beginning in January 2013 is a result of the combining of the two programs.

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.

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 operation and management of the air monitoring program. The network is comprised of 9 air monitoring stations, including one background station (Figure C.18). Air monitoring data are reviewed and included in the NESHAP and ASER reports.

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 are considered unlikely because irrigation near the plant has ceased. 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.

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. Exposure factors will be based on information contained in the Risk Methods Document or in consultation with project teams for site-specific parameters.

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 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.

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

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.

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.

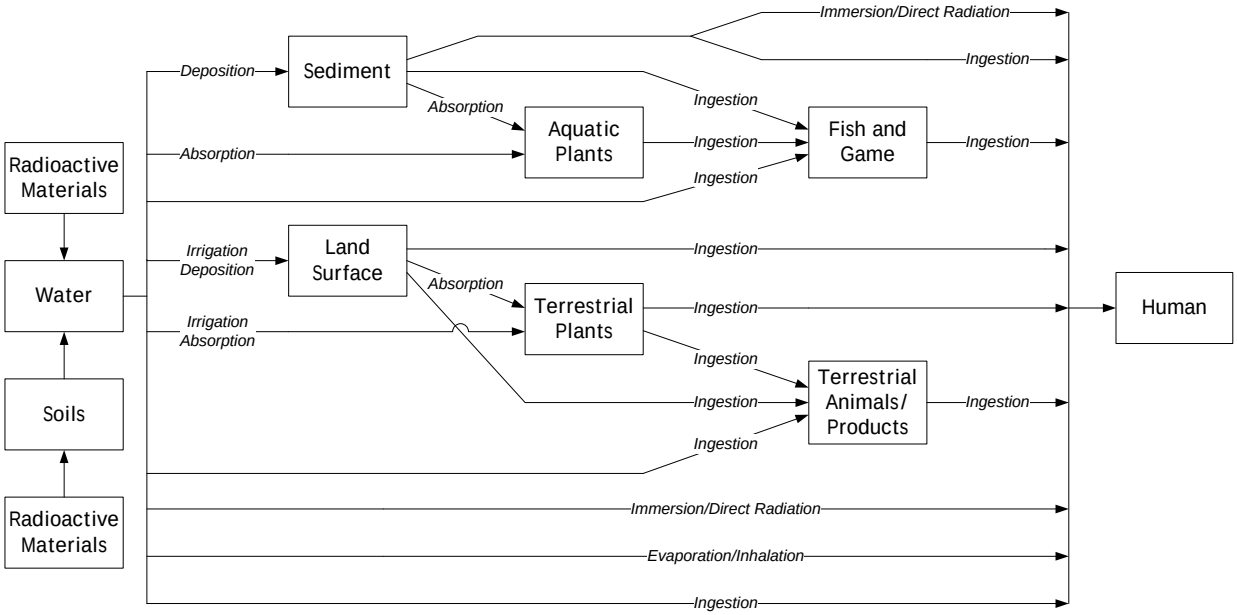

Figure 2. Possible Pathways between Radioactive Material Released to the Soil and/or Water and Humans

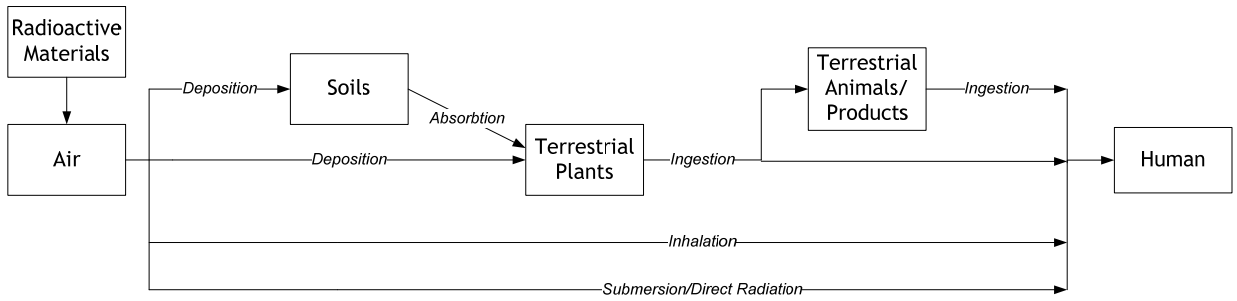

Figure 3. Possible Pathways between Radioactive Materials Released to the Air and Humans

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 contaminate on. 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.

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 site EM data. If site environmental surveillance data is insufficient to meet the requirements of 40 *CFR* § 141, a sample may be taken at the water intake of the drinking water system.

Dose calculations are made for the drinking water pathway if measurable concentrations of radionuclides are found in water samples collected from drinking water systems. Members of the public are assumed to ingest 730 liters of drinking water per year. Based on this criterion, the dose of the maximally exposed individual was calculated for drinking well water contaminated with Tc-99 to be 4 mrem per year.[2]

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.

[2] The value derived by EPA from the 4 mrem/yr MCL for Tc-99 is 900 pCi/L, (see http://www.epa.gov/ogwdw/radionuclides/pdfs/guide_radionuclides_smallsystems_compliance.pdf). An alternate value derived by EPA from the 4 mrem/yr MCL is 3,790 pCi/L and was proposed in the July 18, 1991, *Federal Register*.

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 have 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 is documented in this 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. The TCE and Tc-99 Plume Map updates also utilize data generated under the 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
Annual Site Environmental Report	October 1	DOE O 231.1A DOE O 458.1	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 Reports	Monthly and Quarterly	Clean Water Act	Discharge Monitoring Reports are required for compliance with KPDES permit KY0004049.
Toxicity Report	Quarterly	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.

Table 4. Applicable Reporting Requirements (Continued)

Reporting	Due Date	Source of Requirement	Requirement
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.
Watershed Monitoring Report	April 28 Annually	Clean Water Act	Watershed monitoring is required by KPDES permit KY0004049.
Environmental Monitoring Plan	October 1 Annually	DOE O 450.1A DOE O 458.1	Conduct monitoring as appropriate to support the site's ISMS; detect, characterize, and respond to releases from DOE activities; assess impacts; estimate dispersal patterns in the environment; characterize the pathways of exposure to members of the public; characterize the exposures and doses to individuals and to the population; and evaluate the potential impacts to the biota in the vicinity of DOE activity.
Groundwater Protection Plan	Three Years August 2013	401 *KAR* Section 5:037	This regulation establishes the requirement to prepare and to implement groundwater protection plans to ensure protection for all current and future uses of groundwater and to prevent groundwater pollution.
Best Management Practices Plan	Review Annually; Last Updated September 2011		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 5400.5	This report estimates the external gamma dose on an annual basis; it also is included in the ASER.
FFA Semiannual Report	April 30 October 30	Paducah FFA	This report is required by the FFA document. Data generated in sampling programs referenced in Appendix C are reported in this report.

7. REFERENCES

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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

[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
EW	extraction well
FYR	inspection coordinated with the submittal of the CERCLA Five-Year Review
GC	geochemical surveillance well
GWESA	environmental surveillance annual sampling
GWESBA	environmental surveillance biennial sampling
GWNEQ	groundwater Northeast quarterly
GWNESA	groundwater Northeast Plume semiannual well
GWNWQ	groundwater Northwest Plume O&M Quarterly
GWNWSA	groundwater Northwest Plume O&M semiannually
GWRESM	groundwater residential monthly well
GWRESA	groundwater residential annual well
KG	C-746-K Landfill groundwater well
LRGA	Lower Regional Gravel Aquifer
MW	monitoring well
NA	not applicable; monitoring well or piezometer abandoned; EW, not sampled under EMP Program
NI	not inspected
NR	not required
NS	not sampled
PTZ	PTZ Project multiport well
PZ	piezometer
Q	In the Water Level column, "Q" indicates water levels are collected quarterly
RGA	Regional Gravel Aquifer
SG	C-746-S&T Landfills groundwater well
UCRS	Upper Continental Recharge System
UG	C-746-U Landfill groundwater well
Unknown	information is unknown, cannot be confirmed, or is unavailable
URGA	Upper Regional Gravel Aquifer
W	A well with physical characteristics not considered typical of a monitoring well
WPB-NW	Water Policy Boundary Monitoring Program—Northwest
WPB-NE	Water Policy Boundary Monitoring Program—Northeast

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Table B.1. Well Program Inventory

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW1	RGA	AB 94	NA	NA	NA
MW2	Unknown	AB 88	NA	NA	NA
MW3	Unknown	AB 88	NA	NA	NA
MW4	Unknown	AB 88	NA	NA	NA
MW5	Unknown	AB 88	NA	NA	NA
MW6	Unknown	AB 88	NA	NA	NA
MW7	UCRS	AB 94	NA	NA	NA
MW8	RGA	AB 94	NA	NA	NA
MW9	RGA	AB 94	NA	NA	NA
MW10	RGA	AB	NA	NA	NA
MW11	UCRS	AB 94	NA	NA	NA
MW12	RGA	AB 94	NA	NA	NA
MW13	UCRS	AB 94	NA	NA	NA
MW14	UCRS	AB 94	NA	NA	NA
MW15	RGA	AB 94	NA	NA	NA
MW16	UCRS	AB 94	NA	NA	NA
MW17	RGA	AB 94	NA	NA	NA
MW18	UCRS	AB 94	NA	NA	NA
MW19	RGA	AB 94	NA	NA	NA
MW20	RGA	Current	NA	A	A
MW21	RGA	AB 94	NA	NA	NA
MW22	RGA	AB 94	NA	NA	NA
MW23	Porters Creek Clay Well	AB 94	NA	NA	NA
MW24	Porters Creek Clay Well	AB 94	NA	NA	NA
MW25	Porters Creek Clay Well	AB 94	NA	NA	NA
MW26	Porters Creek Clay Well	AB 94	NA	NA	NA
MW27	Porters Creek Clay Well	AB 94	NA	NA	NA
MW28	UCRS	AB 94	NA	NA	NA
MW29	UCRS	AB 94	NA	NA	NA
MW30	UCRS	AB 94	NA	NA	NA
MW31	UCRS	AB 94	NA	NA	NA
MW32	UCRS	AB 94	NA	NA	NA
MW33	UCRS	AB	NA	NA	NA
MW34	UCRS	AB 94	NA	NA	NA
MW35	UCRS	AB 94	NA	NA	NA
MW36	UCRS	AB 94	NA	NA	NA
MW37	UCRS	AB 94	NA	NA	NA
MW38	RGA	AB 94	NA	NA	NA
MW39	RGA	AB 94	NA	NA	NA
MW40	RGA	AB 94	NA	NA	NA
MW41	RGA	AB 94	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW42	RGA	AB 94	NA	NA	NA
MW43	RGA	AB 94	NA	NA	NA
MW44	RGA	AB 94	NA	NA	NA
MW45	RGA	AB 87	NA	NA	NA
MW46	RGA	AB 94	NA	NA	NA
MW47	UCRS	AB 94	NA	NA	NA
MW48	RGA	AB 94	NA	NA	NA
MW49	UCRS	AB 94	NA	NA	NA
MW50	RGA	AB 94	NA	NA	NA
MW51	RGA	AB 94	NA	NA	NA
MW52	RGA	AB 94	NA	NA	NA
MW53	RGA	AB 94	NA	NA	NA
MW54	RGA	AB 94	NA	NA	NA
MW55	RGA	AB 87	NA	NA	NA
MW56	UCRS	AB 87	NA	NA	NA
MW57	UCRS	AB 94	NA	NA	NA
MW58	UCRS	AB 90	NA	NA	NA
MW59	RGA	AB	NA	NA	NA
MW60	UCRS	AB	NA	NA	NA
MW61	RGA	AB	NA	NA	NA
MW62	RGA	AB	NA	NA	NA
MW63	RGA	Current	GWNWSA	A	A
MW64	UCRS	Current	NS	A	A
MW65	RGA	Current	GWNWSA	A	A
MW66	RGA	Current	GWNWSA	A	A
MW67	RGA	Current	GWESBA, 404G	Q	A
MW68	RGA	Current	NS	A	A
MW69	UCRS	Current	NS	A	A
MW70	RGA	AB 94	NA	NA	NA
MW71	RGA	Current	NS	A	A
MW72	RGA	Current	NS	A	A
MW73	RGA	Current	NS	A	A
PZ74	UCRS	Current	NS	A	A
MW75	UCRS	Current	NS	A	A
MW76	RGA	Current	GWESBA, 404G	Q	A
MW77	RGA	Current	NS	A	A
MW78	RGA	Current	NS	A	A
MW79	RGA	Current	NS	A	A
MW80	RGA	Current	NS	A	A
MW81	RGA	Current	NS	A	A
MW82	UCRS	Current	NS	A	A
MW83	UCRS	Current	NS	A	A
MW84	RGA	Current	404G	Q	A
MW85	UCRS	Current	404G	Q	A
MW86	RGA	Current	GWESBA, 404G	Q	A
MW87	RGA	Current	404G	Q	A
MW88	UCRS	Current	404G	Q	A
MW89	RGA	Current	GWESBA, 404G	Q	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW90	RGA	AB 2001	NA	NA	NA
MW90A	RGA	Current	404G	Q	A
MW91	UCRS	Current	404G	Q	A
MW92	RGA	Current	GWESBA, 404G	Q	A
MW93	RGA	Current	404G	Q	A
MW94	UCRS	Current	404G	Q	A
MW95	RGA	AB 2001	NA	NA	NA
MW95A	RGA	Current	GWESBA, 404G	Q	A
MW96	UCRS	Current	NS	Q	A
MW97	RGA	AB 97	NA	NA	NA
MW98	RGA	Current	GWESA	A	A
MW99	RGA	Current	GWESA,GC	A	A
MW100	RGA	Current	GWESA,GC	A	A
PZ101	Terrace	Current	NS	A	A
MW102	McNairy	Current	NS	A	A
MW103	RGA	Current	GWESBA	A	A
MW104	UCRS	AB 96	NA	NA	NA
MW105	RGA	AB	NA	NA	NA
MW106	RGA	Current	GWESBA, WPB-NW	A	A
PZ107	RGA	Current	NS	A	A
W108	RGA	Current	NS	A	A
PZ109	RGA	Current	NS	A	A
PZ110	RGA	Current	NS	A	A
PZ111	UCRS	Current	NS	A	A
PZ112	UCRS	Current	NS	A	A
PZ113	RGA	Current	NS	A	A-TS
PZ114	McNairy	Current	NS	A	A
PZ115	McNairy	Current	NS	A	A
PZ116	RGA	Current	NS	A	A
PZ117	RGA	Current	NS	A	A
PZ118	RGA	Current	NS	A	A
MW119	RGA	AB	NA	NA	NA
MW120	McNairy	Current	NS	A	A
MW121	McNairy	Current	NS	A	A
MW122	McNairy	Current	NS	A	A
MW123	RGA	Current	NS	A	A
MW124	RGA	Current	GWNESA	A	A
MW125	RGA	Current	GWESBA, GC	A	A
MW126	RGA	Current	GWNESA	A	A
MW127	UCRS	AB-IP	NA	NA	NA
MW128	UCRS	AB-IP	NA	NA	NA
MW129	Terrace Gravels	AB-IP	NA	NA	NA
MW130	Terrace Gravels	AB-IP	NA	NA	NA
MW131	Terrace Gravels	AB-IP	NA	NA	NA
MW132	RGA	Current	NS	A	A
MW133	McNairy	Current	NS	A	A
MW134	RGA	Current	GWESBA, GC, WPB-NW	A	A
MW135	RGA	Current	GWESBA	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW136	UCRS	AB	NA	NA	NA
MW137	RGA	Current	NS	A	A
MW138	UCRS	Current	NS	A	A
MW139	RGA	Current	GWESBA	A	A
MW140	McNairy	AB	NA	NA	NA
MW141	RGA	AB 98	NA	NA	NA
MW142	RGA	AB 98	NA	NA	NA
MW143	UCRS	AB 98	NA	NA	NA
MW144	RGA	Current	NS	A	A
MW145	RGA	Current	GWNESA, GC	A	A
MW146	RGA	Current	GWESBA, WPB-NW	A	A
MW147	RGA	Current	NS	A	A
MW148	RGA	Current	GWESBA	A	A
MW149	UCRS	Current	GWESBA	A	A
MW150	RGA	Current	GWESA	A	A
MW151	Terrace Gravels	Current	NS	A	A
MW152	RGA	Current	GWESA, GC	A	A
MW153	UCRS	Current	NS	A	A
MW154	UCRS	Current	NS	A	A
MW155	RGA	Current	400GQ	A	A
MW156	RGA	Current	400GQ	A	A
MW157	UCRS	Current	NS	A	A
MW158	RGA	AB 99	NA	NA	NA
MW159	RGA	AB 99	NA	NA	NA
MW160	UCRS	AB 99	NA	NA	NA
MW161	RGA	Current	GWESA, GC	A	A
MW162	UCRS	Current	NS	A	A
MW163	RGA	Current	GWESBA, GC	A	A
MW164	UCRS	Current	NS	A	A
MW165	RGA	Current	GWNWSA	A	A
MW166	UCRS	Current	NS	A	A
MW167	UCRS	Current	NS	A	A
MW168	RGA	Current	GWESBA	A	A
MW169	RGA	Current	GWESBA	A	A
MW170	UCRS	Current	NS	A	A
MW171	UCRS	Current	NS	A	A
MW172	UCRS	Current	NS	A	A
MW173	RGA	Current	GWNWSA	A	A
MW174	UCRS	Current	GWESBA	A	A
MW175	RGA	Current	400GSA	A	A
MW176	UCRS	Current	NS	A	A
MW177	UCRS	Current	NS	A	A
MW178	RGA	Current	NS	A	A
MW179	RGA	AB 2003	NA	NA	NA
MW180	UCRS	Current	NS	A	A
MW181	RGA	AB 2000	NA	NA	NA
MW182	UCRS	Current	GWESA	A	A
MW183	RGA	AB	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW184	UCRS	AB 98	NA	NA	NA
MW185	RGA	Current	NS	A	A
MW186	UCRS	Current	GWESBA	A	A
MW187	UCRS	Current	GWESBA	A	A
MW188	RGA	Current	GC	A	A
MW189	UCRS	Current	NS	A	A
MW190	UCRS	Current	NS	A	A
MW191	RGA	Current	GWESA	A	A
MW192	UCRS	Current	NS	A	A
MW193	RGA	Current	GWESBA, GC	A	A
MW194	RGA	Current	GWESBA, WPB-NW	A	A
MW195	UCRS	AB 94	NA	NA	NA
MW196	Terrace Gravels	Current	NS	A	A
MW197	RGA	Current	GWESBA	A	A
MW198	UCRS	Current	NS	A	A
MW199	RGA	Current	GWESBA, WPB-NW	A	A
MW200	RGA	Current	GWESBA	A	A
MW201	RGA	Current	GWESBA, GC, WPB-NW	A	A
MW202	RGA	Current	GWESBA, WPB-NW	A	A
MW203	RGA	Current	GWESA	A	A
MW204	UCRS	Current	NS	A	A
MW205	RGA	Current	GWESBA	A	A
MW206	RGA	Current	GWESA, GC	A	A
MW207	UCRS	Current	NS	A	A
MW208	UCRS	AB2012	NA	NA	NA
MW209	UCRS	Current	NS	A	A
MW210	UCRS	Current	NS	A	A
MW211	UCRS	Current	NS	A	A
MW212	UCRS	Current	NS	A	A
MW213	UCRS	Current	NS	A	A
MW214	UCRS	Current	NS	A	A
MW215	UCRS	Current	NS	A	A
MW216	UCRS	Current	NS	A	A
MW217	UCRS	Current	NS	A	A
MW218	UCRS	Current	NS	A	A
MW219	UCRS	Current	NS	A	A
MW220	RGA	Current	SG	Q	A
MW221	RGA	Current	SG	Q	A
MW222	RGA	Current	SG	Q	A
MW223	RGA	Current	SG	Q	A
MW224	RGA	Current	SG	Q	A
MW225	RGA	Current	NS	A	A
MW226	RGA	Current	GWESBA, 404G	Q	A
MW227	RGA	Current	GWESBA, 404G	Q	A
EW228	RGA	Current	NA	NA	NR
EW229	RGA	Current	NA	NA	NR
EW230	RGA	Current	NA	NA	NR
EW231	RGA	Current	NA	NA	NR

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
EW232	RGA	Current	NA	NA	NR
EW233	RGA	Current	NA	NA	NR
232, Not Installed	NA	NA	NA	NA	NA
MW233	RGA	Current	GWESA	A	A
MW234	RGA	AB 2002	NA	NA	NA
MW235	RGA	AB 2002	NA	NA	NA
MW236	RGA	Current	GWESA	A	A
MW237	UCRS	Current	NS	A	A
MW238	RGA	Current	NS	A	A
MW239	McNairy	Current	NS	A	A
MW240	RGA	Current	GWESA	A	A
MW241	RGA	AB 2003	NA	NA	NA
MW241A	RGA	Current	NS	A	A
MW242	RGA	Current	GWNWQ, GC	A	A
MW243	RGA	Current	GWNWQ	A	A
MW244	RGA	Current	GWNWQ	A	A
MW245	RGA	Current	GWNWQ	A	A
MW246	UCRS	Current	NS	A	A
MW247	McNairy	Current	NS	A	A
MW248	RGA	Current	GWNWQ	A	A
MW249	RGA	Current	NS	A	A
MW250	RGA	Current	GWNWQ	A	A
PZ251	UCRS	Current	NS	A	A
MW252	RGA	Current	GWESA	A	A
MW253	RGA	Current	GWESA	A	A
254, Not Installed	NA	NA	NA	NA	NA
MW255	RGA	Current	GWNEQ	A	A
MW256	RGA	Current	GWNEQ, GC	A	A
MW257	RGA	Current	GC	A	A
MW258	RGA	Current	GWNEQ, GC	A	A
259, Not Installed	NA	NA	NA	NA	NA
MW260	RGA	Current	GWESBA, GC	A	A
MW261	RGA	Current	GWESA, GC	A	A
MW262	RGA	Current	GWESBA	A	A
MW263	RGA	AB 2003	NA	NA	NA
MW264	RGA	AB 2003	NA	NA	NA
MW265	RGA	AB 2000	NA	NA	NA
MW266	RGA	AB 2003	NA	NA	NA
MW267	RGA	AB 2003	NA	NA	NA
MW268	RGA	AB 2002	NA	NA	NA
MW269	RGA	AB 2002	NA	NA	NA
MW270	RGA	AB 2000	NA	NA	NA
MW271	RGA	AB 2002	NA	NA	NA
MW272	RGA	AB 2002	NA	NA	NA
MW273	RGA	AB 2002	NA	NA	NA
MW274	RGA	AB 2002	NA	NA	NA
MW275	RGA	AB 2002	NA	NA	NA
MW276	RGA	AB 2002	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW277	RGA	AB 2000	NA	NA	NA
PZ278	UCRS	AB 97	NA	NA	NA
PZ279	UCRS	AB 97	NA	NA	NA
PZ280	UCRS	AB 97	NA	NA	NA
PZ281	UCRS	AB 97	NA	NA	NA
PZ282	UCRS	AB 97	NA	NA	NA
MW283	RGA	Current	GWNESA	A	A
MW284	RGA	Current	NS	A	A
285, Not Installed	NA	NA	NA	NA	NA
286, Not Installed	NA	NA	NA	NA	NA
PZ287	RGA	Current	NS	A	A
MW288	RGA	Current	GWNEQ, GC	A	A
PZ289	RGA	Current	NS	A	A
PZ290	RGA	Current	NS	A	A
MW291	RGA	Current	GWNESA	A	A
MW292	RGA	Current	GWNEQ, GC	A	A
MW293	RGA	AB 2003	NA	NA	NA
MW293A	RGA	Current	GWNESA	A	A
MW294	RGA	AB 2003	NA	NA	NA
MW294A	RGA	Current	NS	A	A
295, Not Installed	NA	NA	NA	NA	NA
296, Not Installed	NA	NA	NA	NA	NA
297, Not Installed	NA	NA	NA	NA	NA
298, Not Installed	NA	NA	NA	NA	NA
299, Not Installed	NA	NA	NA	NA	NA
MW300	Terrace Gravels	Current	KG	A	A
MW301	Terrace Gravels	Current	KG	A	A
MW302	Terrace Gravels	Current	KG	A	A
MW303	Terrace Gravels	AB 94	NA	NA	NA
MW304	Terrace Gravels	Current	NS	A	A
MW305	Eocene	Current	GWESBA	A	A
MW306	Eocene	Current	NS	A	A
MW307	Eocene	Current	NS	A	A
MW308	Eocene	Current	NS	A	A
MW309	Terrace Gravels	Current	NS	A	A
MW310	Terrace Gravels	Current	NS	A	A
MW311	Terrace Gravels	Current	NS	A	A
MW312	UCRS	Current	NS	A	A
MW313	UCRS	Current	NS	A	A
MW314	UCRS	Current	NS	A	A
MW315	UCRS	Current	NS	A	A
MW316	UCRS	Current	NS	A	A
MW317	Terrace Gravels	Current	NS	A	A
MW318	Terrace Gravels	Current	NS	A	A
319, Not Installed	NA	NA	NA	NA	NA
320, Not Installed	NA	NA	NA	NA	NA
321, Not Installed	NA	NA	NA	NA	NA
322, Not Installed	NA	NA	NA	NA	NA

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
323, Not Installed	NA	NA	NA	NA	NA
324, Not Installed	NA	NA	NA	NA	NA
MW325	RGA	Current	NS	A	A
MW326	RGA	Current	NS	A	A
MW327	RGA	Current	NS	A	A
MW328	RGA	Current	GWESBA, GC	A	A
MW329	RGA	Current	GWESBA, GC	A	A
MW330	RGA	Current	NS	A	A
EW331	RGA	Current	NA	NA	NR
EW332	RGA	Current	NA	NA	NR
MW333	RGA	Current	GWESBA, 404G	Q	A
PZ334	UCRS	Current	NS	A	A
PZ335	UCRS	Current	NS	A	A
PZ336	UCRS	Current	NS	A	A
MW337	RGA	Current	GWESBA, 404G	Q	A
MW338	RGA	Current	GWESBA, 404G	Q	A
MW339	RGA	Current	GWNWSA, GC	A	A
MW340	RGA	Current	GWNWSA	A	A
MW341	RGA	Current	GWESBA	A	A
MW342	RGA	Current	400GSA	A	A
MW343	RGA	Current	GWESBA, 400GSA, GC	A	A
MW344	Terrace Gravels	Current	KG	A	A
MW345	Rubble Zone	Current	GWESA	A	A
MW346	Rubble Zone	Current	NS	A	A
MW347	Rubble Zone	Current	NS	A	A
PZ348	UCRS	Current	NS	A	A
PZ349	RGA	Current	NS	A	A
PZ350	UCRS	Current	NS	A	A
PZ351	RGA	Current	NS	A	A
MW352	RGA	AB 2002	NA	NA	NA
MW353	RGA	Current	NS	A	A
MW354	RGA	Current	GWESBA	A	A
MW355	RGA	Current	GWNWSA	A	A
MW356	RGA	Current	GWESBA	A	A
MW357	URGA	Current	UG	Q	A
MW358	LRGA	Current	UG	Q	A
MW359	UCRS	Current	UG	Q	A
MW360	URGA	Current	UG	Q	A
MW361	LRGA	Current	UG	Q	A
MW362	UCRS	Current	UG	Q	A
MW363	URGA	Current	UG	Q	A
MW364	LRGA	Current	UG	Q	A
MW365	UCRS	Current	UG	Q	A
MW366	URGA	Current	UG	Q	A
MW367	LRGA	Current	UG	Q	A
MW368	UCRS	Current	UG	Q	A
MW369	URGA	Current	UG/SG	Q	A
MW370	LRGA	Current	UG/SG	Q	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW371	UCRS	Current	UG	Q	A
MW372	URGA	Current	UG/SG	Q	A
MW373	LRGA	Current	UG/SG	Q	A
MW374	UCRS	Current	UG	Q	A
MW375	UCRS	Current	UG	Q	A
MW376	LRGA	Current	UG	Q	A
MW377	UCRS	Current	UG	Q	A
378, Not Installed	NA	NA	NA	NA	NA
379, Not Installed	NA	NA	NA	NA	NA
MW380	RGA	Current	NS	Q	A
MW381	RGA	Current	GC	Q	A
382, Not Installed	NA	NA	NA	NA	NA
383, Not Installed	NA	NA	NA	NA	NA
MW384	URGA	Current	SG	Q	A
MW385	LRGA	Current	SG	Q	A
MW386	UCRS	Current	SG	Q	A
MW387	URGA	Current	SG	Q	A
MW388	LRGA	Current	SG	Q	A
MW389	UCRS	Current	SG	Q	A
MW390	UCRS	Current	SG	Q	A
MW391	URGA	Current	SG	Q	A
MW392	LRGA	Current	SG	Q	A
MW393	UCRS	Current	SG	Q	A
MW394	URGA	Current	SG	Q	A
MW395	LRGA	Current	SG	Q	A
MW396	UCRS	Current	SG	Q	A
MW397	LRGA	Current	SG	Q	A
398, Not Installed	NA	NA	NA	NA	NA
399, Not Installed	NA	NA	NA	NA	NA
400, Not Installed	NA	NA	NA	NA	NA
MW401	RGA	Current	NS	A	A
MW402	RGA	Current	NS	A	A
MW403	RGA	Current	GWESBA, GC	A	A
MW404	RGA	Current	GWESBA, GC	A	A
MW405	RGA	Current	GWESBA, 400GQ	A	A
MW406	RGA	Current	GWESBA, 400GQ	A	A
MW407	RGA	Current	GWESBA, 400GQ	A	A
MW408	RGA	Current	GWESBA, 400GQ	A	A
MW409	RGA	Current	GWESA, GC	A	A
MW410	RGA	Current	GWESA	A	A
MW411	RGA	Current	GWESA	A	A
412, Not Installed	NA	NA	NA	NA	NA
413, Not Installed	NA	NA	NA	NA	NA
MW414	RGA	Current	GWESBA, GC	A	A
MW415	RGA	Current	GWESBA	A	A
MW416	RGA	Current	GWESBA	A	A
MW417	RGA	Current	GWESBA	A	A
MW418	RGA	Current	GWESA	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW419	RGA	Current	GWESA	A	A
MW420	URGA	Current	404G	Q	A
MW421	RGA	Current	400GSA	A	A
MW422	RGA	Current	400GSA	A	A
MW423	RGA	Current	400GSA	A	A
MW424	RGA	Current	400GSA	A	A
MW425	RGA	Current	400GSA	A	A
MW426	RGA	Current	GWESBA, GC, WPB-NW	A	A
MW427	RGA	Current	GWESBA, GC, WPB-NW	A	A
MW428	RGA	Current	GWNWSA	A	A
MW429	RGA	AB 2009	NA	NA	NA
MW429 A	RGA	Current	GWNWSA	A	A
MW430	RGA	Current	GWNWSA	A	A
MW431	RGA	Current	GWESBA	A	A
MW432	RGA	Current	GWESBA, WPB-NW	A	A
MW433	RGA	Current	GWESBA, WPB-NW	A	A
434, Not Installed	NA	NA	NA	NA	NA
MW435	RGA	Current	GWESBA, WPB-NW	A	A
436, Not Installed	NA	NA	NA	NA	NA
437, Not Installed	NA	NA	NA	NA	NA
438, Not Installed	NA	NA	NA	NA	NA
MW439	RGA	Current	GWESBA, GC	A	A
MW440	RGA	Current	GWESBA	A	A
MW441	RGA	Current	GWESBA, GC, WPB-NW	A	A
MW442	RGA	Current	GWESBA	A	A
MW443	RGA	Current	GWESBA	A	A
MW444	RGA	Current	GWESBA	A	A
MW445	RGA	Current	GWESBA	A	A
446, Not Installed	NA	NA	NA	NA	NA
MW447	RGA	Current	GWESBA, GC	A	A
MW448	RGA	Current	GWESBA	A	A
449, Not Installed	NA	NA	NA	NA	NA
MW450	RGA	Current	GWESBA	A	A
MW451	RGA	Current	GWESBA	A	A
MW452	RGA	Current	GWESBA, WPB-NW	A	A
MW453	RGA	Current	GWESBA	A	A
MW454	RGA	Current	GWESBA	A	A
MW455	RGA	Current	GWNWQ	A	A
MW456	RGA	Current	GWNWQ	A	A
MW457	RGA	Current	GWNWQ	A	A
MW458	RGA	Current	GWNWQ	A	A
MW459	RGA	Current	GWNWQ	A	A
MW460	RGA	Current	GWNWQ	A	A
MW461	RGA	Current	GWNWQ	A	A
MW462	RGA	Current	GWNWQ	A	A
MW463	RGA	Current	GWESBA	A	A
MW464	RGA	Current	GWESBA	A	A
MW465	RGA	Current	GWESA	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
MW466	RGA	Current	GWESA	A	A
MW467	RGA	Current	GWESBA	A	A
MW468	RGA	Current	GWESBA, GC	A	A
MW469	RGA	Current	GWESA	A	A
MW470	RGA	Current	GWESA	A	A
MW471	RGA	Current	GWESA	A	A
MW472	RGA	Current	GWESA	A	A
MW473	RGA	Current	GWESBA, GC	A	A
MW474	RGA	Current	GWESBA, GC	A	A
MW475	RGA	Current	GWESBA	A	A
MW476	RGA	Current	GWESBA	A	A
MW477	RGA	Current	GWESBA	A	A
MW478	RGA	Current	GWESBA	A	A
MW479	RGA	Current	GWESBA	A	A
MW480	RGA	Current	GWESBA	A	A
MW481	RGA	Current	GWESBA	A	A
MW482	RGA	Current	GWESBA	A	A
MW483	RGA	Current	GWESBA	A	A
MW484	RGA	Current	GWESBA	A	A
MW485	RGA	Current	GWESBA	A	A
MW486	RGA	Current	GWESBA	A	A
MW487	RGA	Current	GWESBA	A	A
MW488	RGA	Current	GWESBA	A	A
MW489	RGA	Current	GWESBA	A	A
MW490	RGA	Current	GWESBA	A	A
MW491	RGA	Current	GWESBA	A	A
MW492	RGA	Current	GWESBA	A	A
MW493	RGA	Current	GWESBA	A	A
MW494	RGA	Current	GWESBA	A	A
MW495	RGA	Current	GWESBA	A	A
MW496	RGA	Current	GWESBA	A	A
MW497	URGA	Current	GWNWQ	A	A
MW498	LRGA	Current	GWNWQ	A	A
MW499	URGA	Current	GWNWQ	A	A
MW500	LRGA	Current	GWNWQ	A	A
MW501	URGA	Current	GWNWQ	A	A
MW502	LRGA	Current	GWNWQ	A	A
MW503	URGA	Current	GWNWQ	A	A
MW504	LRGA	Current	GWNWQ	A	A
MW505	RGA	Current	400GQ	A	A
MW506	RGA	Current	400GQ	A	A
MW507	RGA	Current	400GQ	A	A
PZ-1 (WAG 27)	Unknown	Current	NS	A	A
PZ-2 (WAG 27)	Unknown	Current	NS	A	A
PZ-3 (WAG 27)	Unknown	Current	NS	A	A
PZ-4 (WAG 27)	Unknown	Current	NS	A	A
PZ-5 (WAG 27)	Unknown	Current	NS	A	A
PZ5G	Unknown	Current	NS	A	A

Table B.1. Well Program Inventory (Continued)

Well Number	Screened Zone	Status	Sampled	Water Level	Inspection
PZ5S	Unknown	Current	NS	A	A
Z12	Does not access an aquifer	Current	NS	NA	NA
Z16	Does not access an aquifer	Current	NS	NA	NA
CM01	PTZ Project	Current	NS	A	A
CM02	PTZ Project	Current	NS	A	A
CM03	PTZ Project	Current	NS	A	A
CM04	PTZ Project	Current	NS	A	A
CM05	PTZ Project	Current	NS	A	A
CM06	PTZ Project	Current	NS	A	A
CM07	PTZ Project	Current	NS	A	A
CM08	PTZ Project	Current	NS	A	A
CM09	PTZ Project	Current	NS	A	A
CM10	PTZ Project	Current	NS	A	A
CM11	PTZ Project	Current	NS	A	A
CM12	PTZ Project	Current	NS	A	A
R2	Unknown	Current	WPB-NW	A	FYR
R9	Unknown	Current	WPB-NE	A	FYR
R12	Unknown	Current	WPB-NW	A	FYR
R13	Unknown	Current	WPB-NW	A	FYR
R14	Unknown	Current	WPB-NW	A	FYR
R19	Unknown	Current	WPB-NW	A	FYR
R20	RGA	Current	WPB-NE	A	FYR
R21	Unknown	Current	WPB-NE	A	FYR
R26	Unknown	Current	WPB-NW	A	FYR
R53	Unknown	Current	WPB-NW	A	FYR
R83	Unknown	Current	WPB-NE	A	FYR
R90	Unknown	Current	WPB-NE	A	Outside Water Policy
R114	Unknown	Current	WPB-NE	A	Outside Water Policy
R245	Unknown	Current	WPB-NW	A	FYR
R294	RGA	Current	WPB-NE	A	FYR
R302	RGA	Current	WPB-NE	A	FYR
R384	RGA	Current	WPB-NE	A	Outside Water Policy
R387	RGA	Current	WPB-NE	A	Outside Water Policy
R392	RGA	Current	WPB-NE	A	FYR
R424	RGA	Current	CARB	NS	FYR

Note: Residential wells inside of the water policy box will be inspected during a CERCLA 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, and may be accessed by the landowner.

WATER LEVEL SUITES AT LANDFILLS

Quarterly water levels are collected in support of the quarterly landfill groundwater monitoring program for reporting groundwater flow rate and direction. Wells at the following landfills are sampled in a suite within as short a time period as possible. Noncommitment wells are those wells that also are measured within that time period, but the data is for information purposes only. All other wells are measured on an annual basis between August 1 and September 30.

C-404 Landfill Quarterly Water Levels (9) Permitted Wells
MW84
MW87
MW90A
MW85
MW88
MW91
MW93
MW420
MW94
Commitment Wells (7)[a]
MW67
MW76
MW227
MW333
MW337
MW414
MW416
Noncommitment Wells (6)
MW86
MW89
MW92
MW95A
MW226
MW338

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 (2)
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, as well as in 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.

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APPENDIX C

ENVIRONMENTAL SAMPLING FREQUENCY AND PARAMETERS

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CONTENTS

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FIGURES

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TABLES

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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 sixty-three monitoring wells (MWs) and piezometers are active and monitored as part of the Environmental Monitoring (EM) Program. Active wells are included in either an analytical sampling program or may be evaluated for water level measurements only. 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 and parameters, 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. 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 objective of the Groundwater Protection Plan, 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) 2012 to the FY 2013 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 2013. 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.

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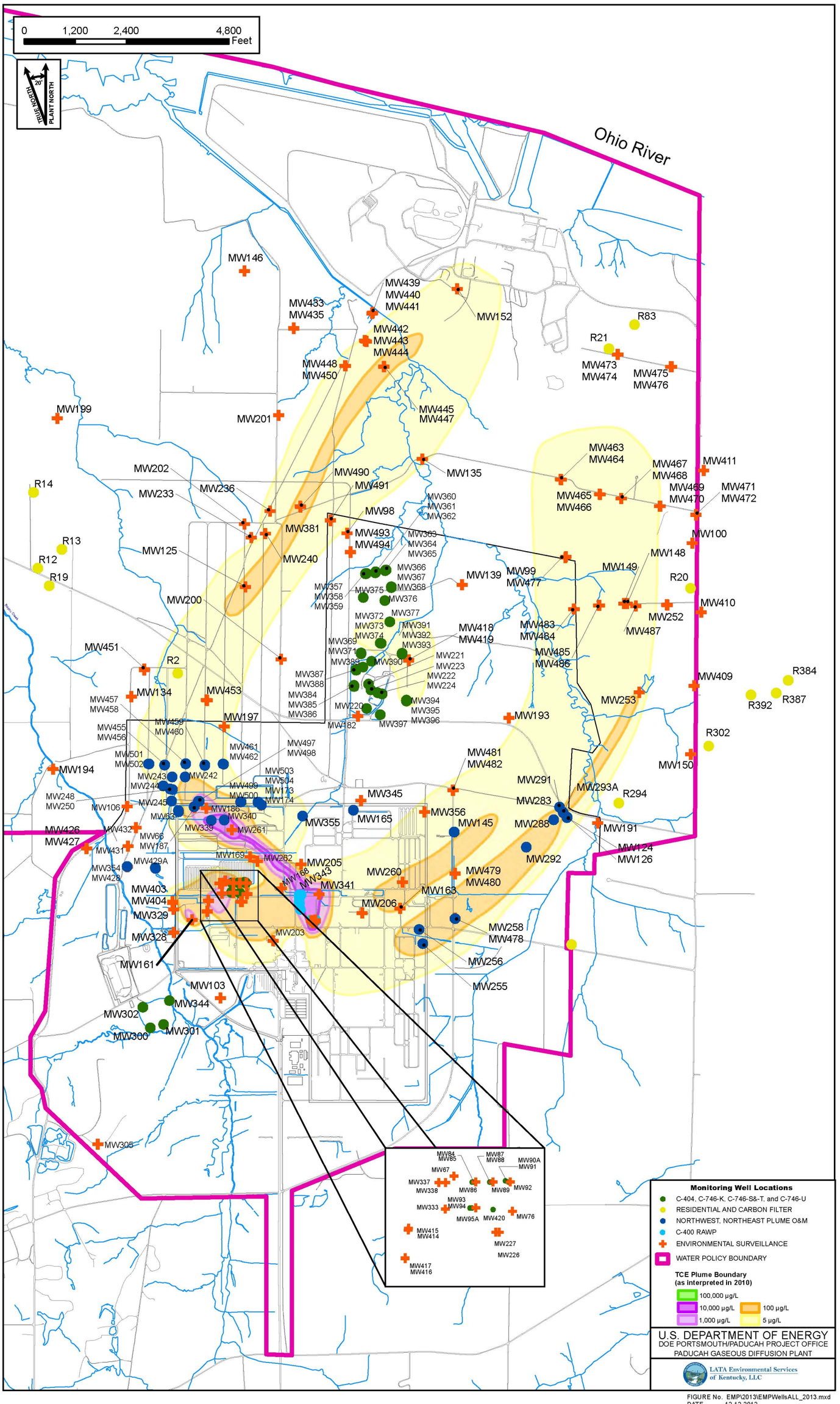

Figure C.1. Monitoring Wells Sampled Under the EMP

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C.2. GROUNDWATER MONITORING

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

(1) Construction requirements, as outlined in either the statement of work, field sampling plan, or work plan for the project;

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

(3) Requirements for pump and packer placement; and

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

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

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

C.2.1 GROUNDWATER MONITORING PROGRAM FOR LANDFILL OPERATIONS

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

Frequency: Quarterly

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

Reported: Quarterly Compliance Monitoring Reports, as required by the 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.

Sampling frequencies and locations were not modified for this sampling program in FY 2012. Iodine-131 (I-131) was removed as a permit requirement during FY 2012. As noted within this plan, modifications to the sampling scheme are implemented as permit modifications come into effect; therefore, I-131 was removed as a parameter during the last FY and is documented within this FY 2013 plan.

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 2013 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. Locations are shown on Figure C.2.

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

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

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

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

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

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

[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.

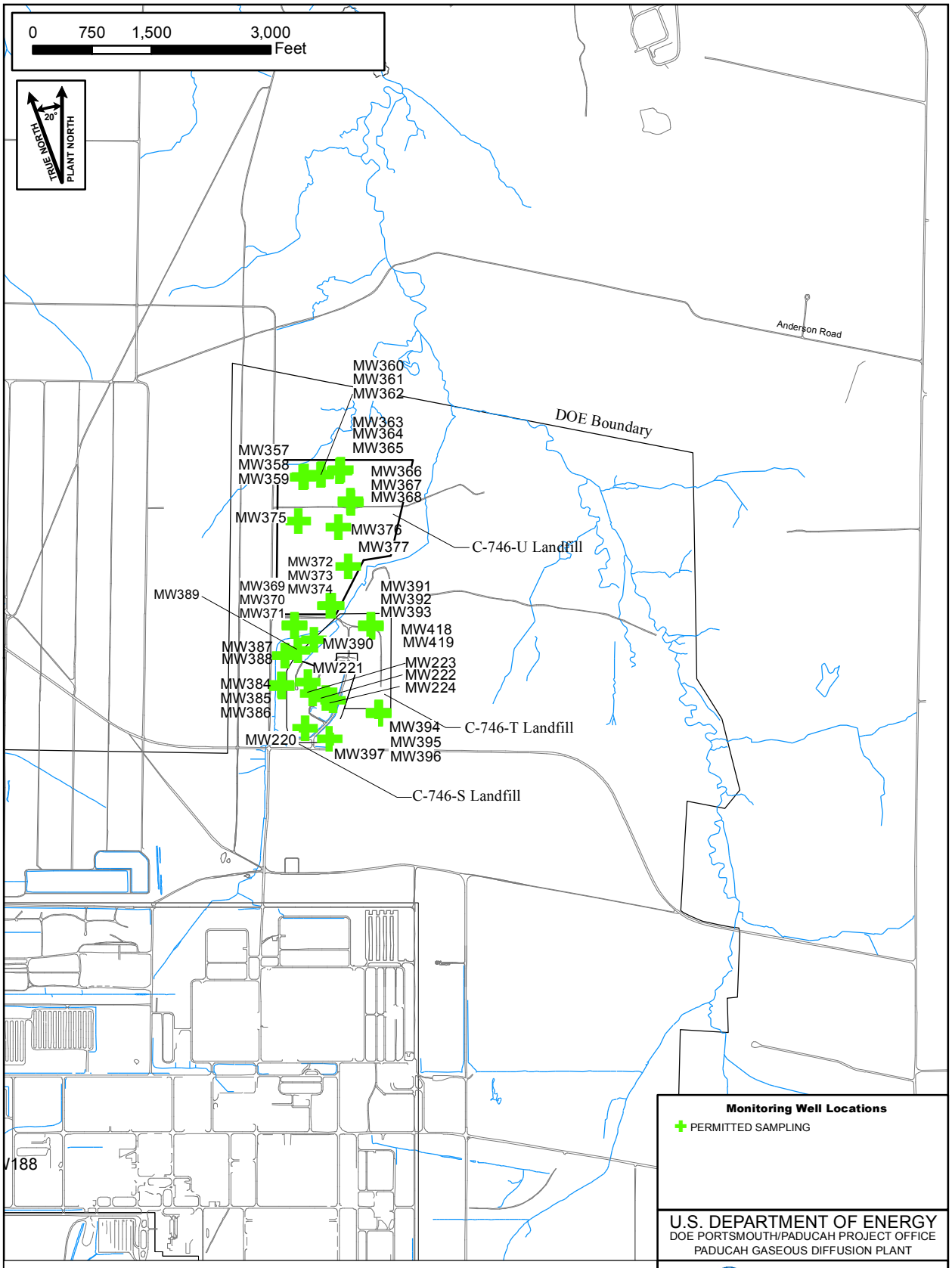

Figure C.2. Groundwater Monitoring Wells Near the C-746-S, T, and U Landfills

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

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 laboratory.

Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2013. 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.

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)	Opted to Sample—Not Committed to KDWM (11)[a] TCE, Tc-99, and Field Parameters
MW84	MW67
MW85	MW76
MW87	MW86
MW88	MW89
MW90A	MW92
MW91	MW95A
MW93	MW226[b]
MW94	MW227[b]
MW420	MW333[b]
	MW337[b]
	MW338[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	Field Parameters
Trichloroethene	Barometric Pressure
	Conductivity
Metals	Depth to water
Arsenic	Dissolved Oxygen
Cadmium	Redox
Chromium	pH
Iron	Temperature
Lead	Turbidity
Manganese	
Mercury	**Radionuclides**
Selenium	Technetium-99
Uranium	Uranium-234
Arsenic, Dissolved	Uranium-235
Cadmium, Dissolved	Uranium-238
Chromium, Dissolved	
Lead, Dissolved	**Other**
Mercury, Dissolved	Sulfide
Selenium, Dissolved	Sulfite
Uranium, Dissolved	Sulfate
	Total Organic Carbon

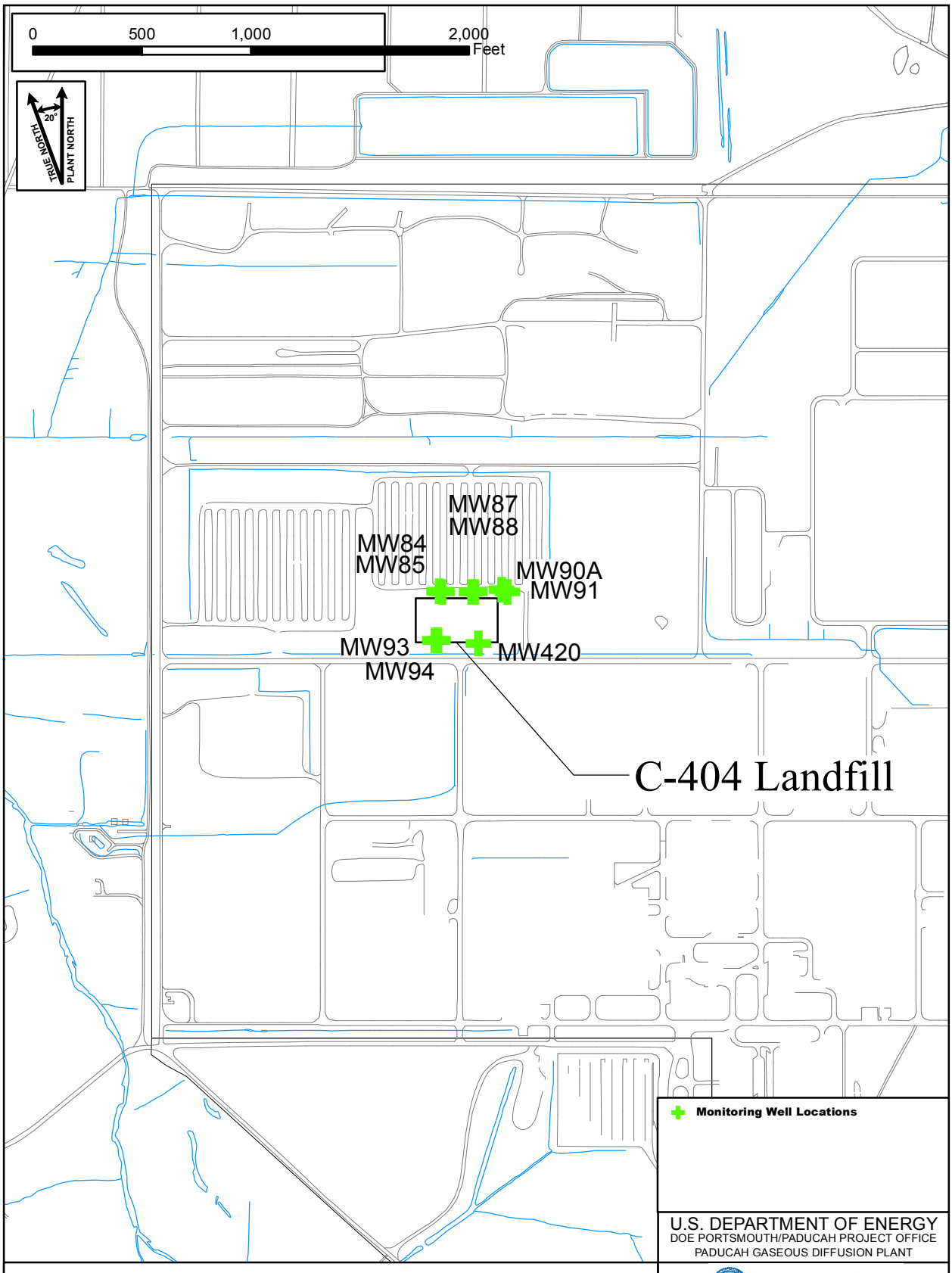

Figure C.3. Groundwater Monitoring Wells Near C-404 Landfill

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 2013.

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

[a] Xylenes

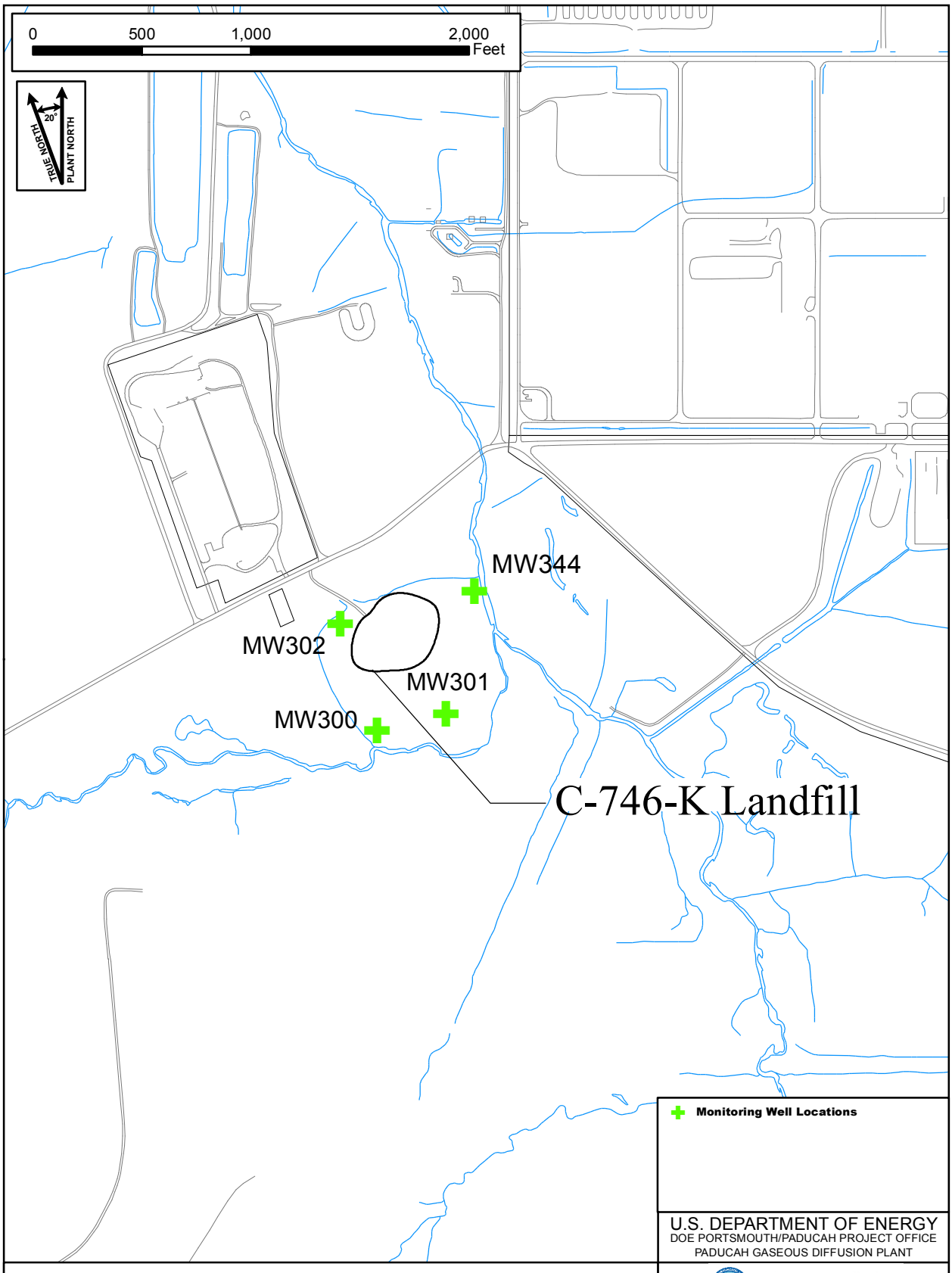

Figure C.4. Groundwater Monitoring Wells Near C-746-K Landfill

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 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 2012.

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.

Additionally, MWs 409, 410, and 411, which are part of the Environmental Surveillance Sampling Program, are to be collected at the same time as the MWs sampled within this program in order to optimize the data set for modeling purposes.

Table C.8. Northeast Plume Semiannual Wells and Parameters

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

[a] Xylenes

Table C.9. Northeast Plume Quarterly Wells and Parameters

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

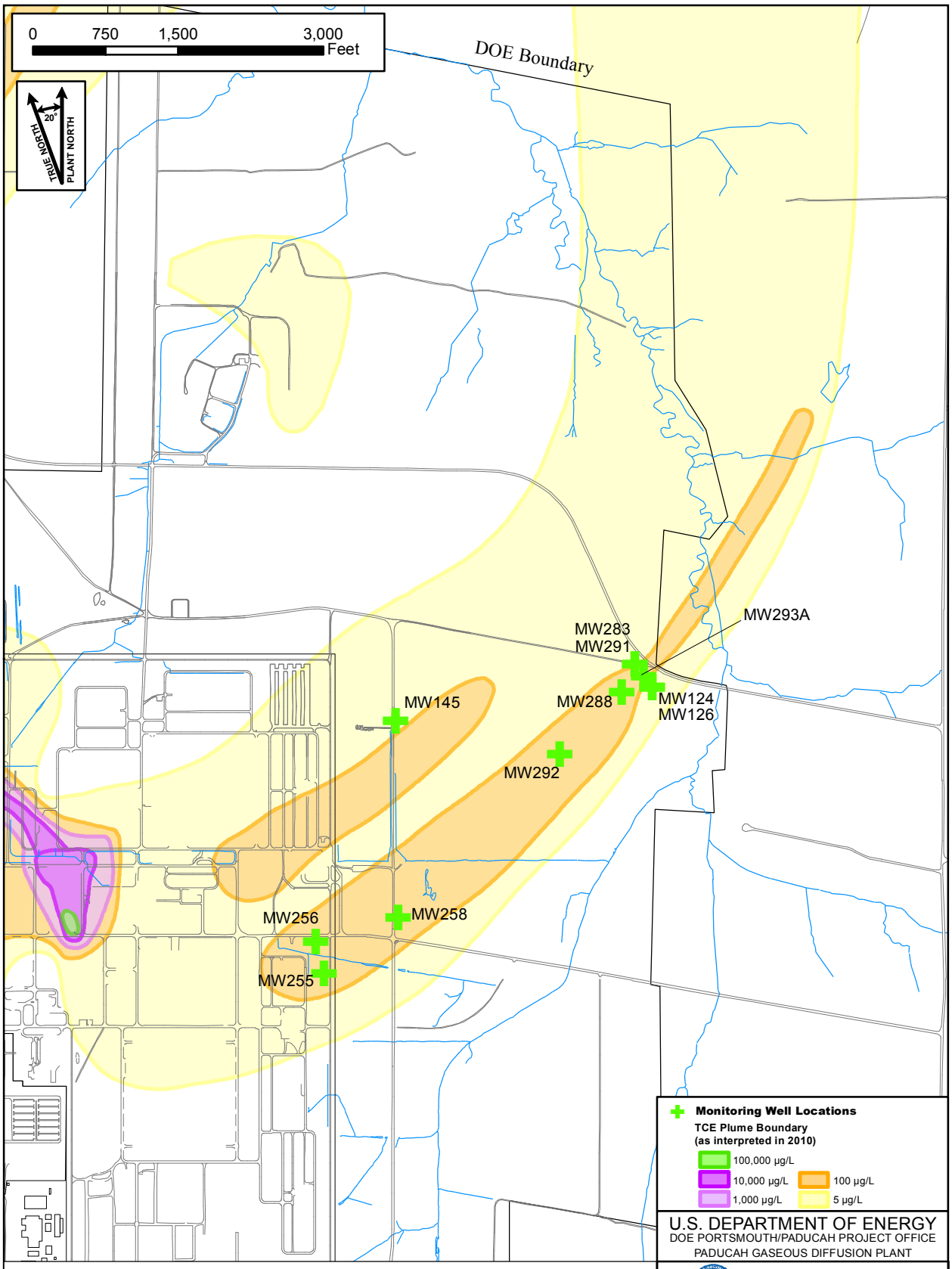

Figure C.5. Northeast Plume Monitoring Wells

FIGURE No. EMP\2013\EMPWellsNEP_2013.mxd
DATE 09-14-2012

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 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 frequency decreased from quarterly to semiannually for 22 of the 33 MWs. This reduction in frequency was allowed after two years of quarterly sampling following the Northwest Plume Optimization project, which was completed in August 2010. There were no changes in analytical parameters for FY 2013.

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

Table C.11. Northwest Plume Analytical Parameters

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

[a] Xylenes

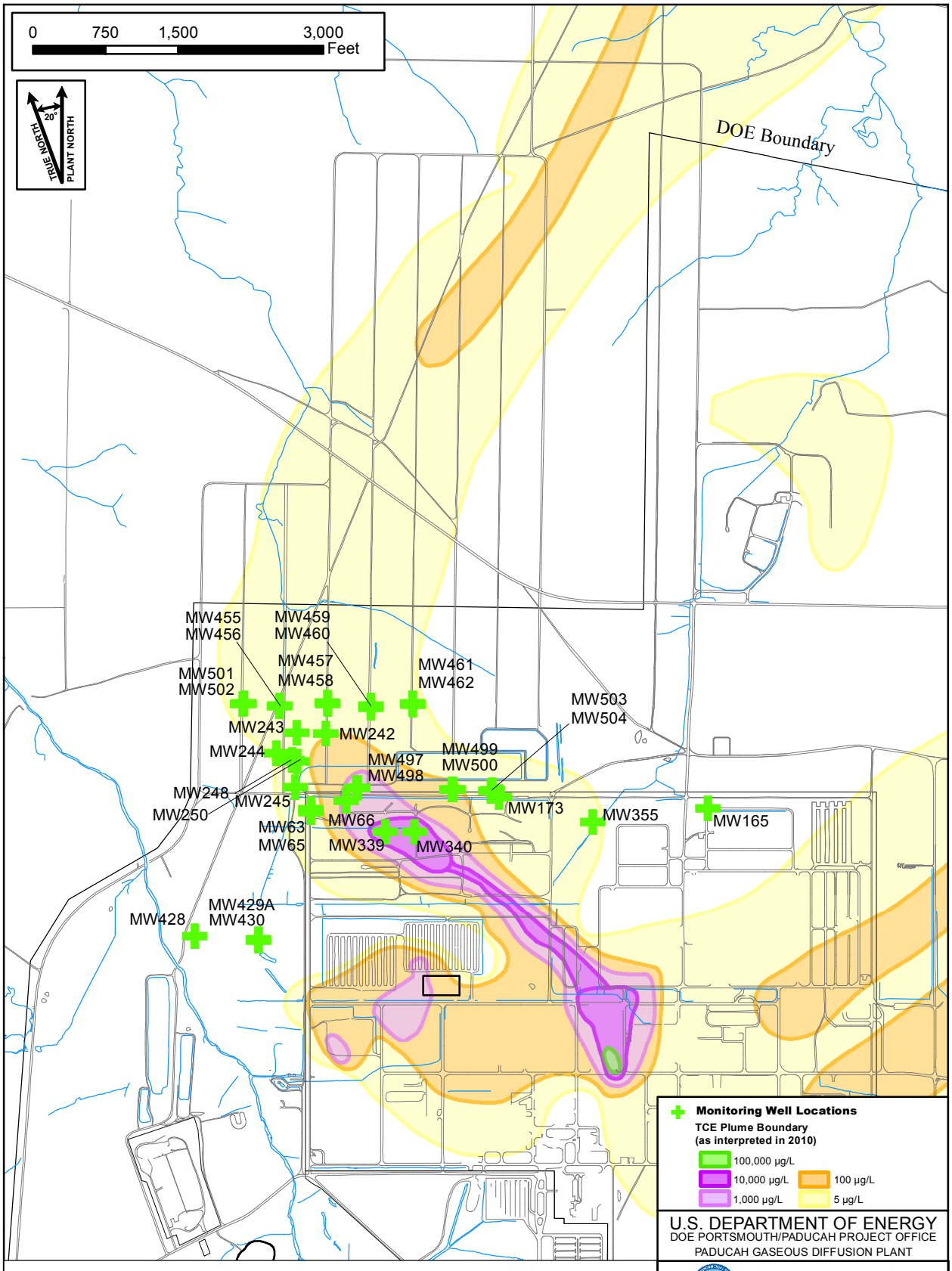

Figure C.6. Northwest Plume Monitoring Wells

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 was modified for this sampling program for FY 2013. Additional screened regions of MWs 421, 422, 423, 424, and 425 were added and are designated by Ports 1 and 2. The parameter list also was modified for FY 2013; alpha and beta activity, along with uranium were removed from the parameter list for FY 2013.

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

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

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

[a] As applicable, depth to water measurements cannot be obtained for multiport wells.

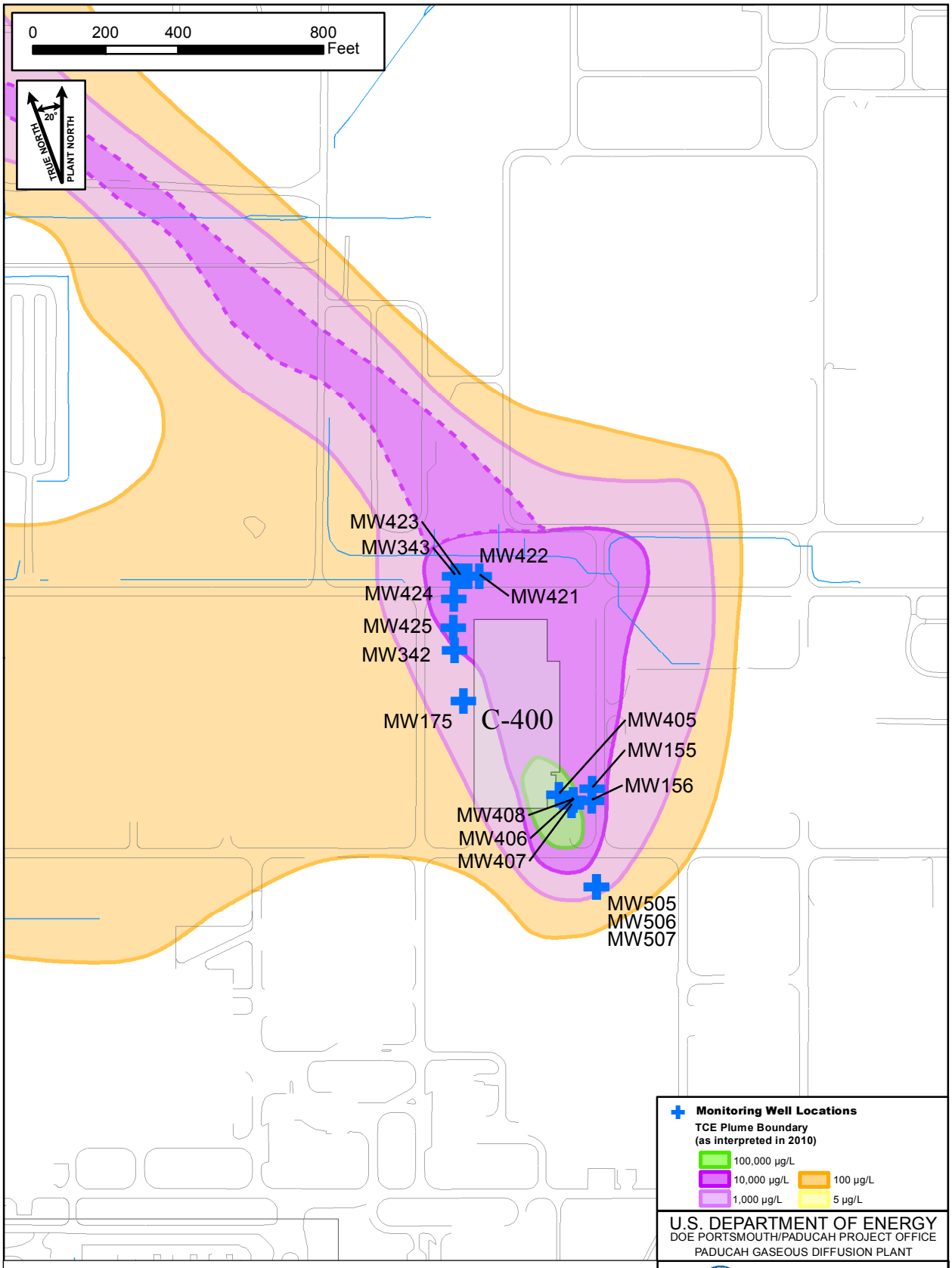

Figure C.7. C-400 Monitoring Wells

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 near the northwestern and northeastern 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 (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 is being introduced under this format in FY 2013. Sampling of the residential wells and MWs stated below were previously a part of other programs contained in this EMP. In order to better capture the objectives stated above, this program was defined as a unique sampling program.

Table C.14. Northwestern Wells

Quarterly (22)	
R2[a]	MW134
R12[a]	MW146
R13[a]	MW194
R14[a]	MW199
R19[a]	MW201
R26	MW202
R53	MW426
R245	MW427
MW106	MW432
	MW433
	MW435
	MW441
	MW452

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

Table C.15. Northeastern Wells

Annually (11)
R9[a]
R20[a]
R21[a]
R83[a]
R90[a]
R114[a]
R294[a]
R302[a]
R384[a]
R387[a]
R392[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
Conductivity
Depth to Water[a]
Dissolved Oxygen
Redox
pH
Temperature
Radionuclides
Alpha Activity
Beta Activity
Technetium-99[b]
Uranium-234[b]
Uranium-235[b]
Uranium-238[b]
Volatiles
Trichloroethene

[a] As applicable.
[b] Laboratory will be directed to analyze uranium and Tc-99 only in cases where alpha or beta activities, respectively, are detected by the laboratory.

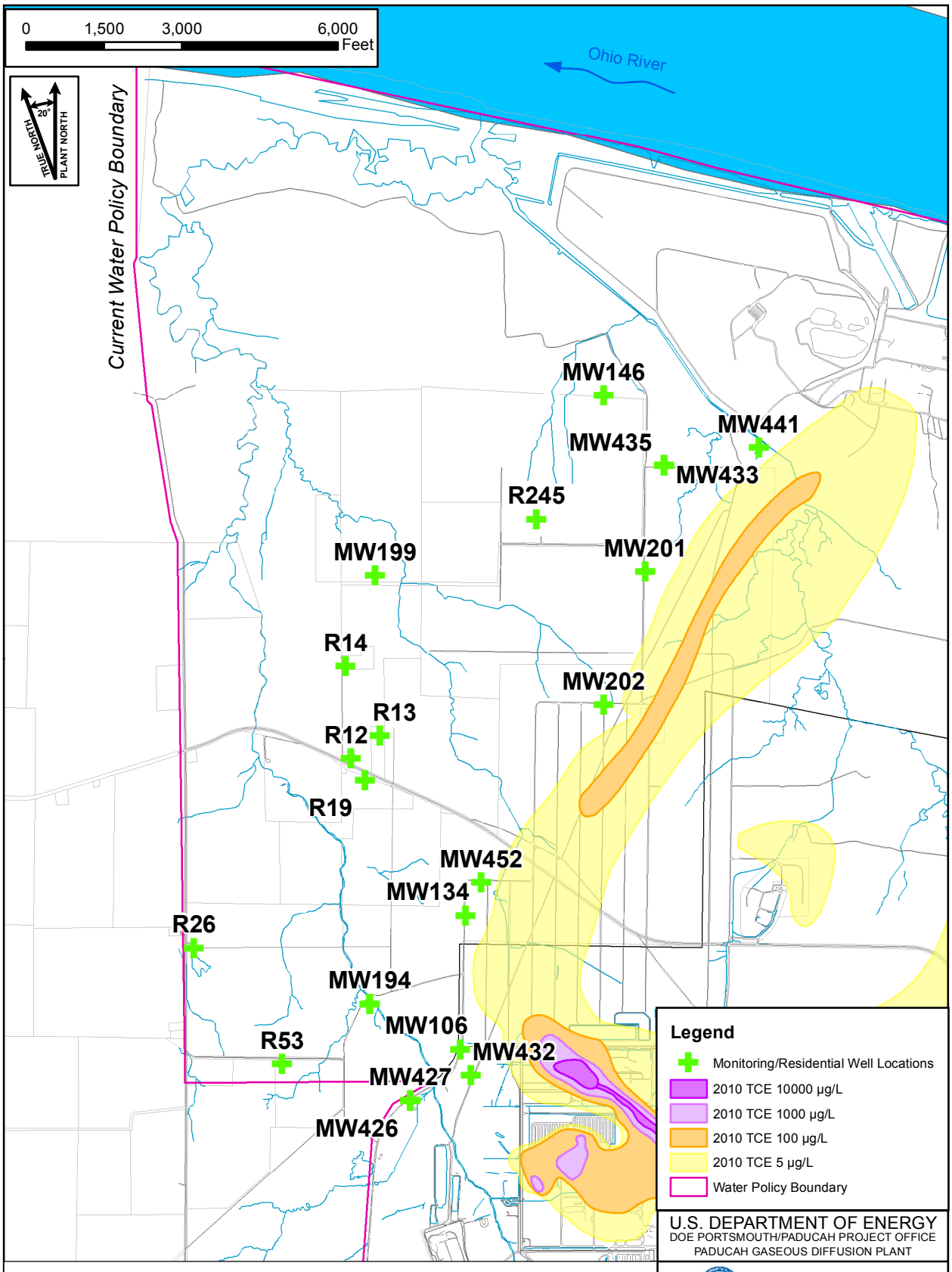

Figure C.8. Water Policy Boundary Monitoring Wells, Northwest

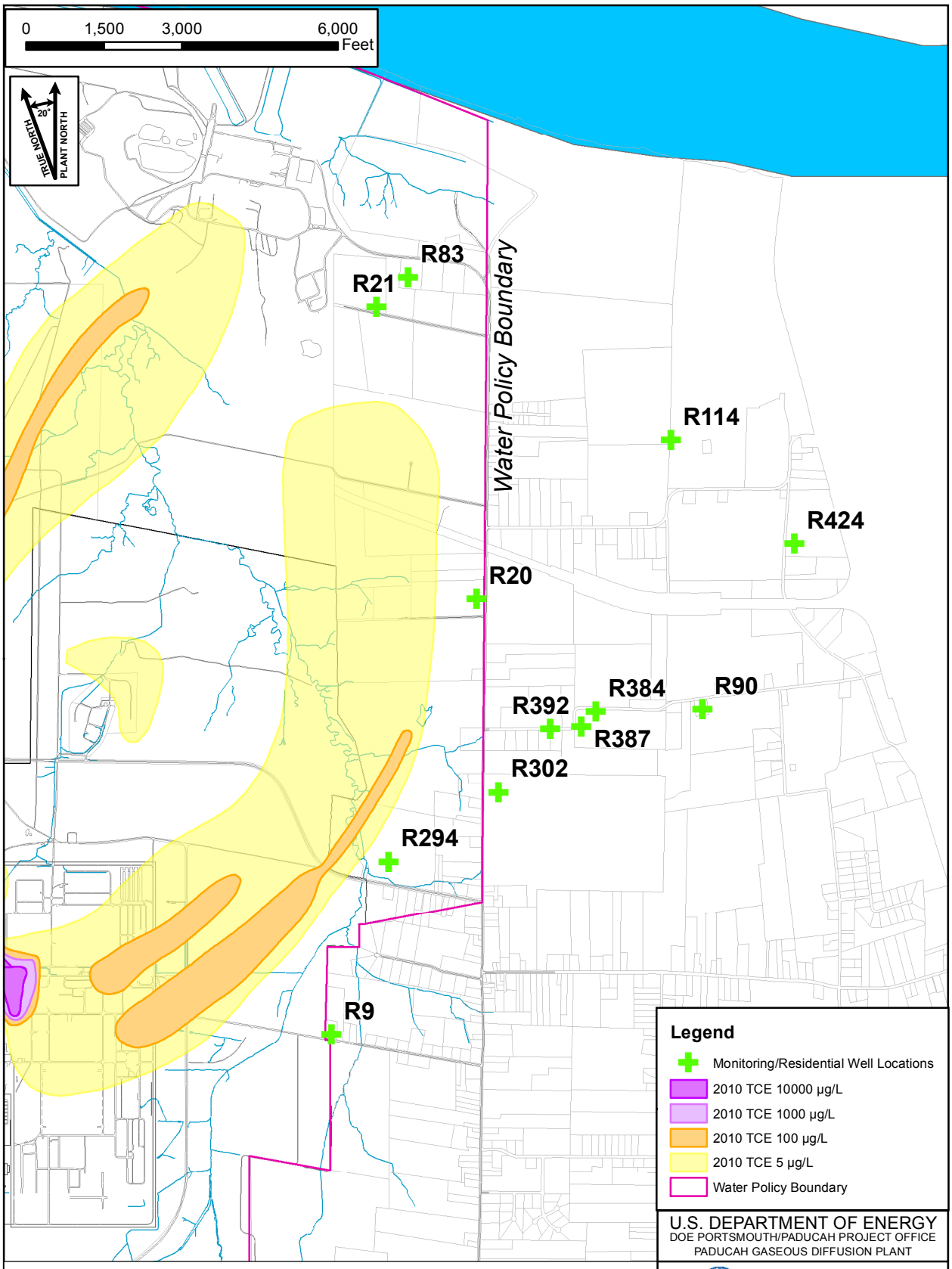

Figure C.9. Water Policy Boundary Monitoring Wells, Northeast

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 and Tc-99 sampling frequency will be reduced from the monthly requirement to semiannual requirement to verify the technetium is below reporting limits. Review of the data may result in an increase in sampling frequencies or parameters during the FY 2013 period. If so, modifications will be made to this program and documented in the FY 2014 EMP.

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 2 after carbon filter
R424 Port 3 after ultraviolet light

Table C.18. Carbon Filtration System Analytical Parameters

Field Parameters
Conductivity
Dissolved Oxygen
Redox
pH
Temperature
Radionuclides
Technetium-99
Volatiles
Trichloroethene
Miscellaneous
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 450.1A.

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. Those changes remained in effect for FY 2012 and continue for FY 2013. The biennial grouping of MWs was not sampled in FY 2012; therefore, they will be sampled in FY 2013.

Parameter modifications for FY 2013 include the elimination of dissolved PCBs for MWs 182, 418 and 419. Alpha activity, beta activity, and uranium analyses were eliminated for both the biennial and annual groupings. Tc-99 remains the only radionuclide.

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.

Three MWs (MW409, MW410, and MW411) are to be sampled quarterly for TCE in order to monitor migration of the Northeast Plume.

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

Table C.19. Surveillance Wells (129)

Biennial (101)[a]			
MW67	MW260	MW440	MW484
MW76	MW262	MW441	MW485
MW86	MW328	MW442	MW486
MW89	MW329	MW443	MW487
MW92	MW333	MW444	MW488
MW95A	MW337	MW445	MW489
MW106	MW338	MW447	MW490
MW125	MW341	MW448	MW491
MW134	MW343	MW450	MW492
MW135	MW354	MW451	MW493
MW139	MW356	MW452	MW494
MW146	MW403 Port 3	MW453	MW495
MW148	MW404 Port 4	MW454	MW496
MW149	MW405 Port 5	MW463	**Background (4)**
MW163	MW406 Port 5	MW464	MW103
MW168	MW407 Port 4	MW467	MW194
MW169	MW408 Port 5	MW468	MW199
MW174	MW414	MW473	MW305
MW186	MW415	MW474	
MW187	MW416	MW475	
MW193	MW417	MW476	
MW197	MW426	MW477	
MW200	MW427	MW478	
MW201	MW431	MW479	
MW202	MW432	MW480	
MW205	MW433	MW481	
MW226	MW435	MW482	
MW227	MW439	MW483	

Annually (28)			
MW98	MW206	MW409[b]	MW470
MW 99	MW233	MW410[b]	MW471
MW 100	MW236	MW411[b]	MW472
MW152	MW240	MW418[a]	
MW161	MW252	MW419[a]	**Background (1)**
MW182[a]	MW253	MW465	MW150
MW191	MW261	MW466	
MW203	MW345	MW469	

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

[b] These wells will be sampled semiannually for TCE to evaluate Northeast Plume migration. Other parameters listed here will be sampled on an annual basis.

Table C.20. Environmental Surveillance Analytical Parameters

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

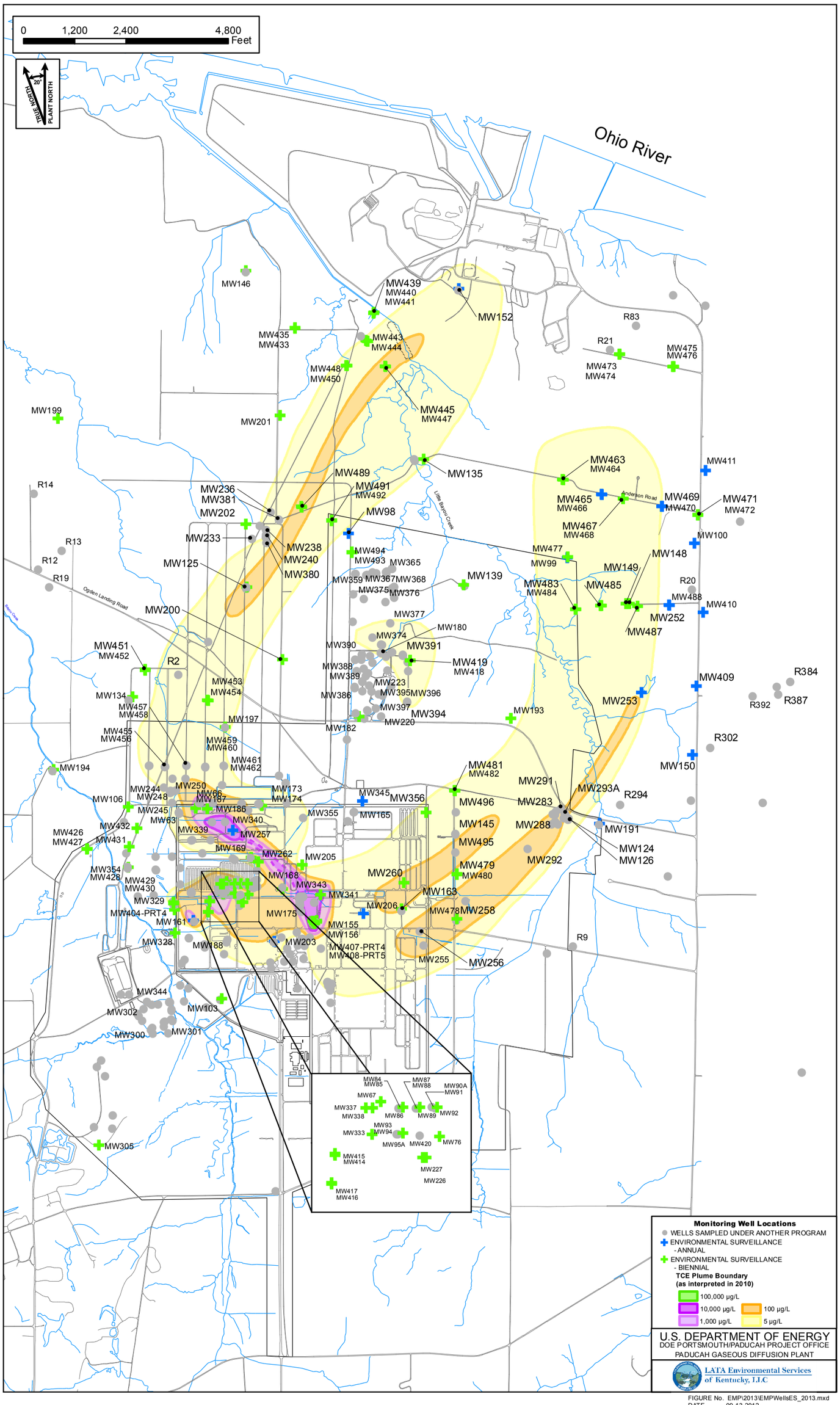

Figure C.10. Environmental Surveillance Groundwater Monitoring Wells

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Geochemical Environmental Surveillance Monitoring

Frequency: Triennially

Driver: DOE Order 450.1A and the Paducah FFA

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 450.1A.

Reported: ASER

Comments: The program was modified in FY 2011 to reduce sampling from an annual basis to a triennial basis. Those changes remained in effect for FY 2012 and continue for FY 2013. The MWs were not sampled in FY 2011 or FY 2012; therefore, they will be sampled in FY 2013.

In FY 2013, mercury was eliminated from the program because it's neither a contaminant of potential concern nor is it a chemical that provides information for geochemical changes.

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

Table C.22. Surveillance Geochemical Annual Analytical Parameters

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

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 as follows: SW07300014 (C-746-S Landfill), SW07300015 (C-746-T Landfill), and SW07300045 (C-746-U Landfill)

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

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

Comments: Sampling frequencies and sampling parameters were not modified for this sampling program in FY 2013, 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	C-746-U
L135	L150
L136	L154[a]
L154[a]	L351

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

Table C.24. Landfill Surface Water Parameters

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

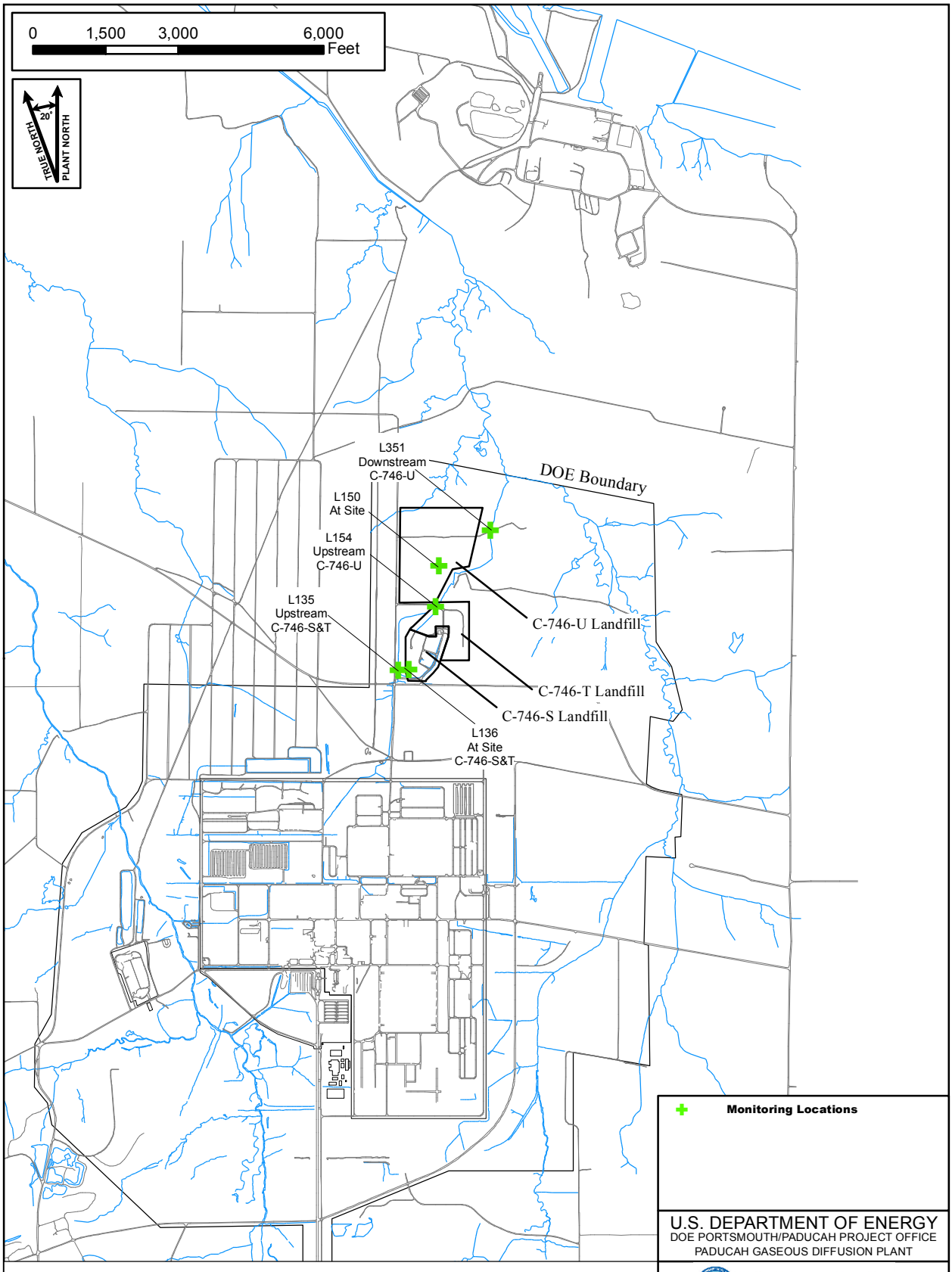

Figure C.11. Landfill Surface Water Locations

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

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

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

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	Frequency of Sampling at KPDES Locations D—Daily; W—Weekly; M—Monthly; Q—Quarterly				
	K001	**K015**	**K017**	**K019**	**K020**
Flow (Mgd)	D	M	M	M	M
Total Suspended Solids (mg/L)	W	M	M	M	M
Oil & Grease (mg/L)	W	M	M	M	M
Total Residual Chlorine (mg/L)	W				
Temperature (°F)	W		M		
PCBs (mg/L)	W	M	M	M	Q
Trichloroethene (mg/L)	W				Q
Total Phosphorus (mg/L)	W				
Alpha Activity (pCi/L)	W	M	M	M	M
Beta Activity (pCi/L)	W	M	M	M	M
Uranium (µg/L)	W	M	M	M	M
Total Recoverable Zinc (µg/L)			M	M	Q
Total Recoverable Arsenic (µg/L)					Q
Total Recoverable Nickel (µg/L)					Q
Nitrates (mg/L N)					Q
1,1,1-Trichloroethane (mg/L)					Q
Chlorides (mg/L)					Q
Acute Toxicity (TU_A)[a]		Q		Q	Q
Chronic Toxicity (TU_c)[b]	Q		M		
Technetium-99 (pCi/L)	Q	Q	Q	Q	Q
Hardness (as mg/L $CaCO_3$)	Q	Q	Q	Q	Q
Phosphorous (mg/L)					Q
CBOD (mg/L)					Q
Dissolved Oxygen (mg/L)					Q
Total Recoverable Iron (µg/L)		Q		Q	Q
Benzo(a)anthracene (µg/L)		Q	Q		
Benzo(k)fluoranthene (µg/L)		Q			
Free Cyanide (µg/L)	Q				
Heptachlor (µg/L)	Q	Q	Q		
Indeno(1,2,3-cd) pyrene (µg/L)	Q				
pH (between 6–9)	W	M	M	W[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 discharging to the outfalls.

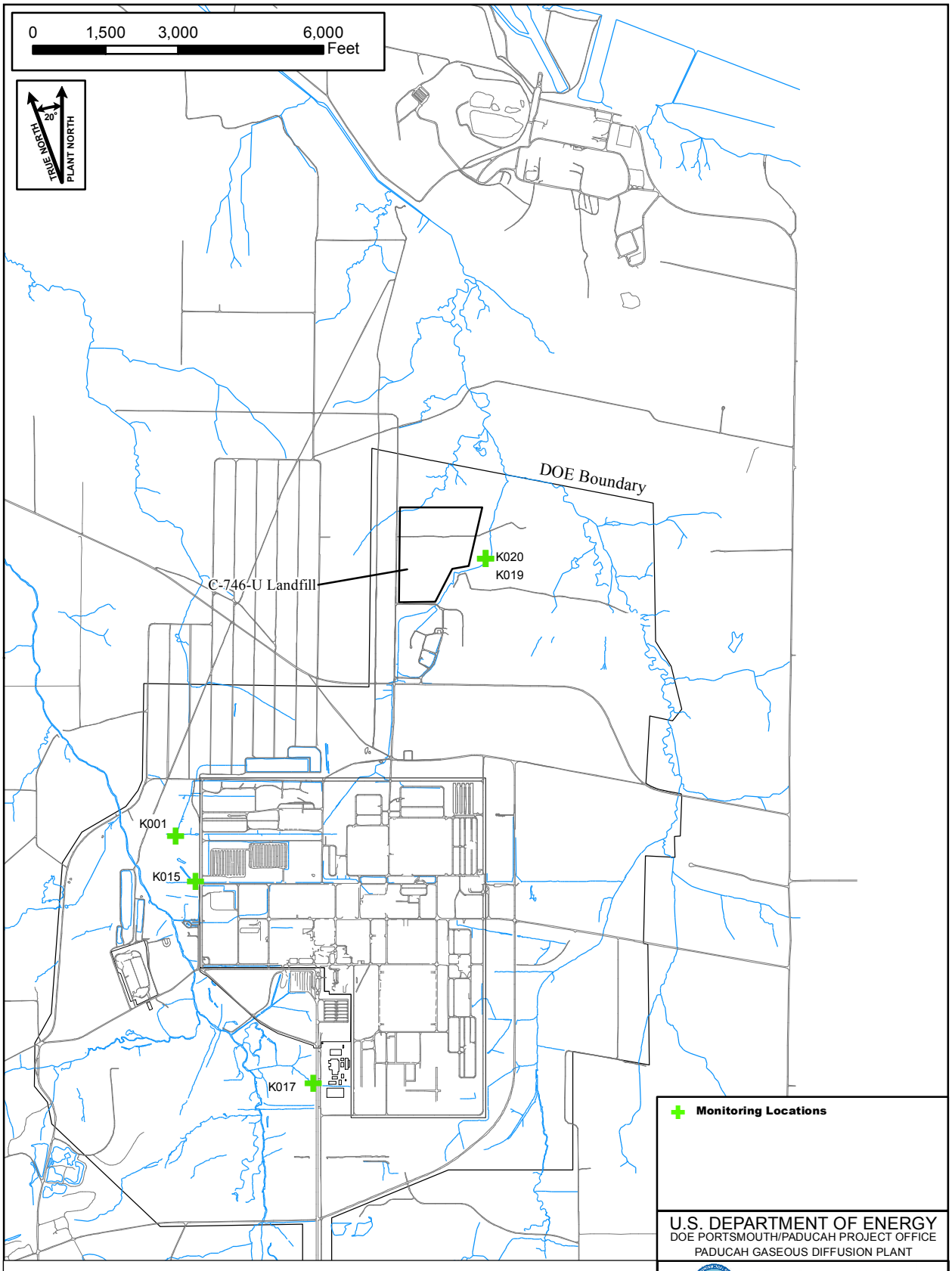

Figure C.12. KPDES Outfall Sampling Locations

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*

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

Reported: ASER

Comments: DOE Order 458.1 will be implemented during FY 2013 with the effective date being January 2, 2013. Once implemented, 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. 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, whereas 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 does is assumed to pose minimal risk to the public or the environment. If, by the end of the 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 an appropriate data point for calculation of dose. These threshold limits may change, if conditions change. Any necessary modifications to the program will be implemented as needed and documented in the FY 2014 EMP. Also, it should be noted, that the sample aliquots collected for the isotopic analysis will be submitted to the laboratory; however, the analysis will be pending the alpha and beta activity results.

The Environmental Radiation Protection Program (ERPP) will be implemented on January 2, 2013; therefore, the sampling detailed in this section will not begin until the second quarter of FY 2013.

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

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

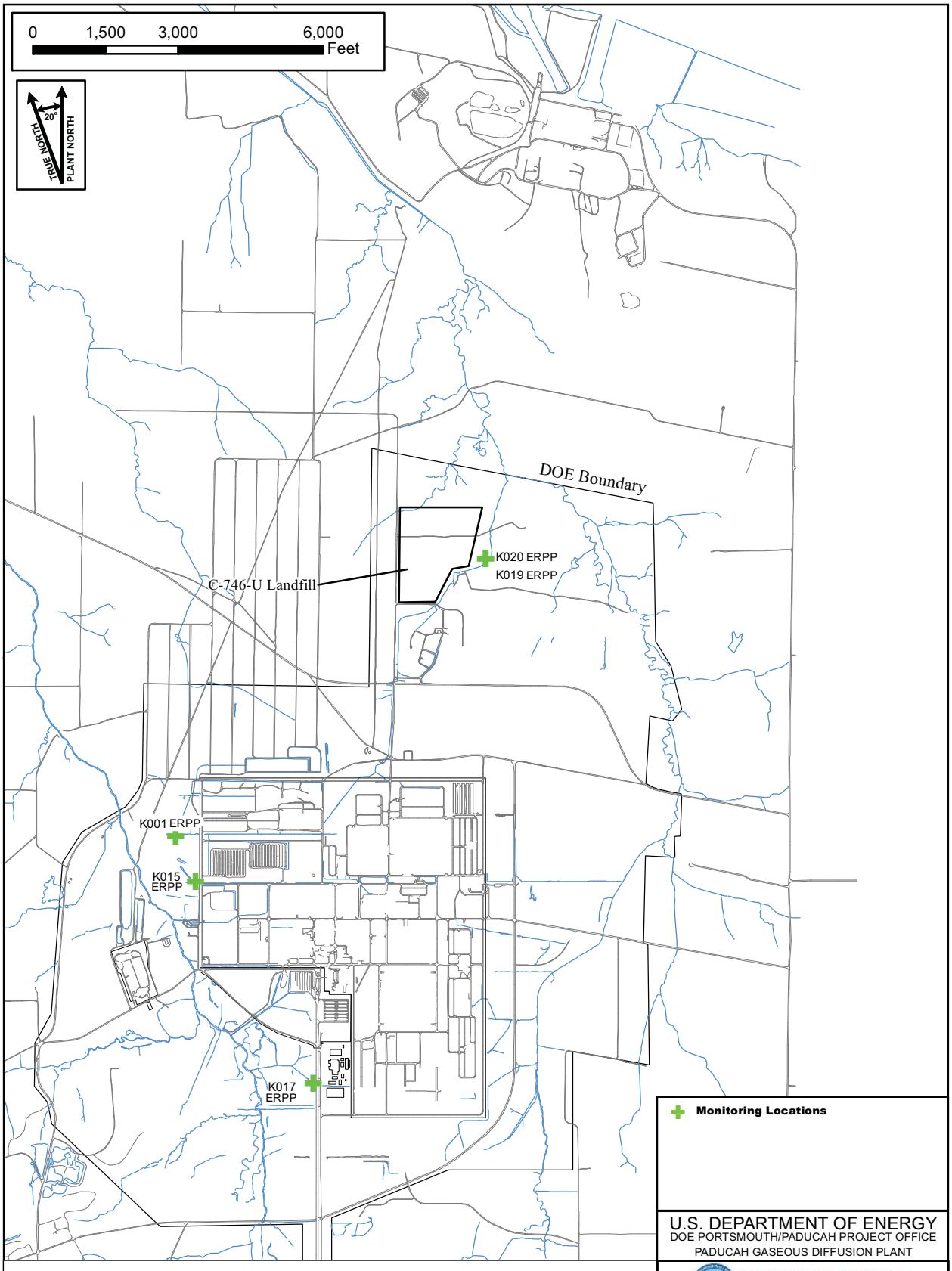

Figure C.13. Surface Water Monitoring Near KPDES Outfalls

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.

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.

Reported: May be reported to KDWM via electronic mail.

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
pH
Total Suspended Solids
Turbidity
Field Parameters
pH
Turbidity

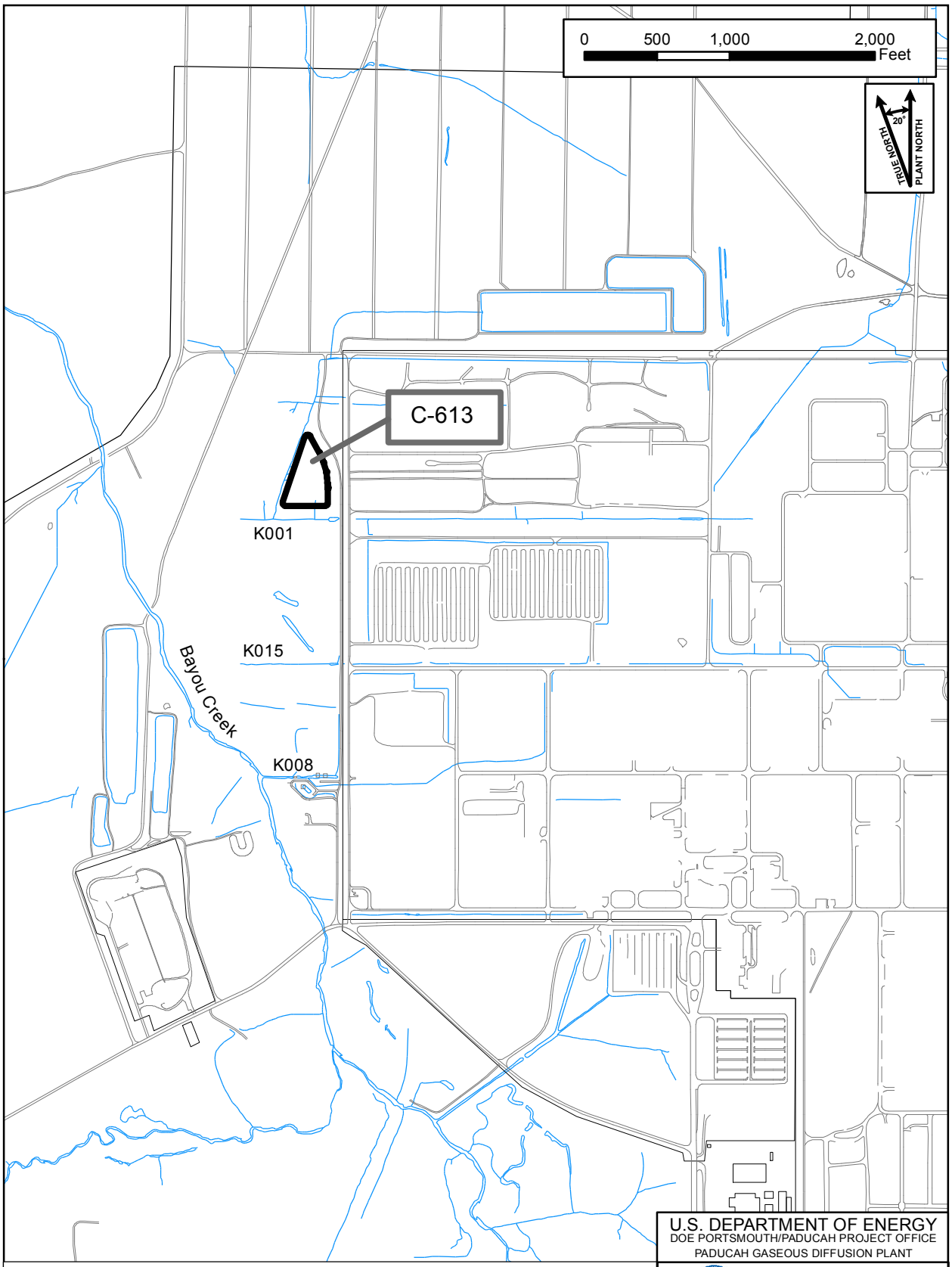

Figure C.14. C-613 Sediment Basin

FIGURE No. EMP\2013\EMP613_2013.mxd
DATE 09-14-2012

C.3.4 ENVIRONMENTAL SURVEILLANCE WATERSHED MONITORING PROGRAM

Surface Water Monitoring

Frequency: Quarterly and Annually (background for ERPP monitoring)

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.

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

Reported: ASER

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, whereas 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 does is assumed to pose minimal risk to the public or the environment. If, by the end of the 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 an appropriate data point for calculation of dose. These threshold limits may change if conditions change. Any necessary modifications to the program will be implemented, as needed, and documented in the FY 2014 EMP. 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.

The ERPP will be implemented on January 2, 2013; therefore, the radiological parameters will not be sampled until the second quarter of FY 2013.

Tables C.28 details surface water and the seep sampling locations. Tables C.29 and C.30 details the surface water and seep sampling locations that are driven by the KPDES permit. Sampling driven by the ERPP is found by grouping in Tables C.31, C.32, C.33, and C.34. Sampling parameters driven by the implementation of the ERPP will start in the second quarter of FY 2013. Once implemented, 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]
C616
C746K-5
C746KTB1A
L1 (BG)
L10
L11
L194
L29A (BG/R)[a]
L291
L30 (R)[a]
L306 (R)[a]
L5
L12
L241
L6
L64(BG)
S31
K001UP
Seep (1)
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	**Field Measurements**
PCB, Total	Alkalinity
PCB-1016	Conductivity
PCB-1221	Dissolved Oxygen
PCB-1232	Flow[a]
PCB-1242	pH
PCB-1248	Temperature
PCB-1254	
PCB-1260	**Volatiles**
PCB-1268	Trichloroethene

[a] See previous page for locations where flow rates are not collected.

Table C.30. Seep Location Quarterly Analytical Parameters

Volatiles
Trichloroethene
Field Measurements
pH
Dissolved Oxygen
Temperature
Conductivity

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

Locations	Radionuclides
L10	Alpha Activity
L241	Beta Activity
	Technetium-99[a]
	Uranium[a]
	Uranium-234[a]
	Uranium-235[a]
	Uranium-238[a]

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

Locations	Radionuclides
L5	Alpha Activity
	Beta Activity
	Neptunium-237[a]
	Plutonium-238[a]
	Plutonium-239/240[a]
	Thorium-234[a]
	Potassium-40[a]
	Cesium-137[a]
	Technetium-99[a]
	Uranium[a]
	Uranium-234[a]
	Uranium-235[a]
	Uranium-238[a]

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

Locations	Radionuclides
L11	Alpha Activity
	Beta Activity
	Thorium-228[a]
	Thorium-230[a]
	Thorium-232[a]
	Technetium-99[a]
	Uranium[a]
	Uranium-234[a]
	Uranium-235[a]
	Uranium-238[a]

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

Locations	Radionuclides
L1	Alpha Activity
	Beta Activity
	Neptunium-237
	Plutonium-238
	Plutonium-239/240
	Thorium-228
	Thorium-230
	Thorium-232
	Thorium-234
	Potassium-40
	Cesium-137
	Technetium-99
	Uranium
	Uranium-234
	Uranium-235
	Uranium-238
	Alpha Activity on the filtered material [Settleable Solids (pCi/g)]
	Beta Activity on the filtered material [Settleable Solids (pCi/g)]

[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.

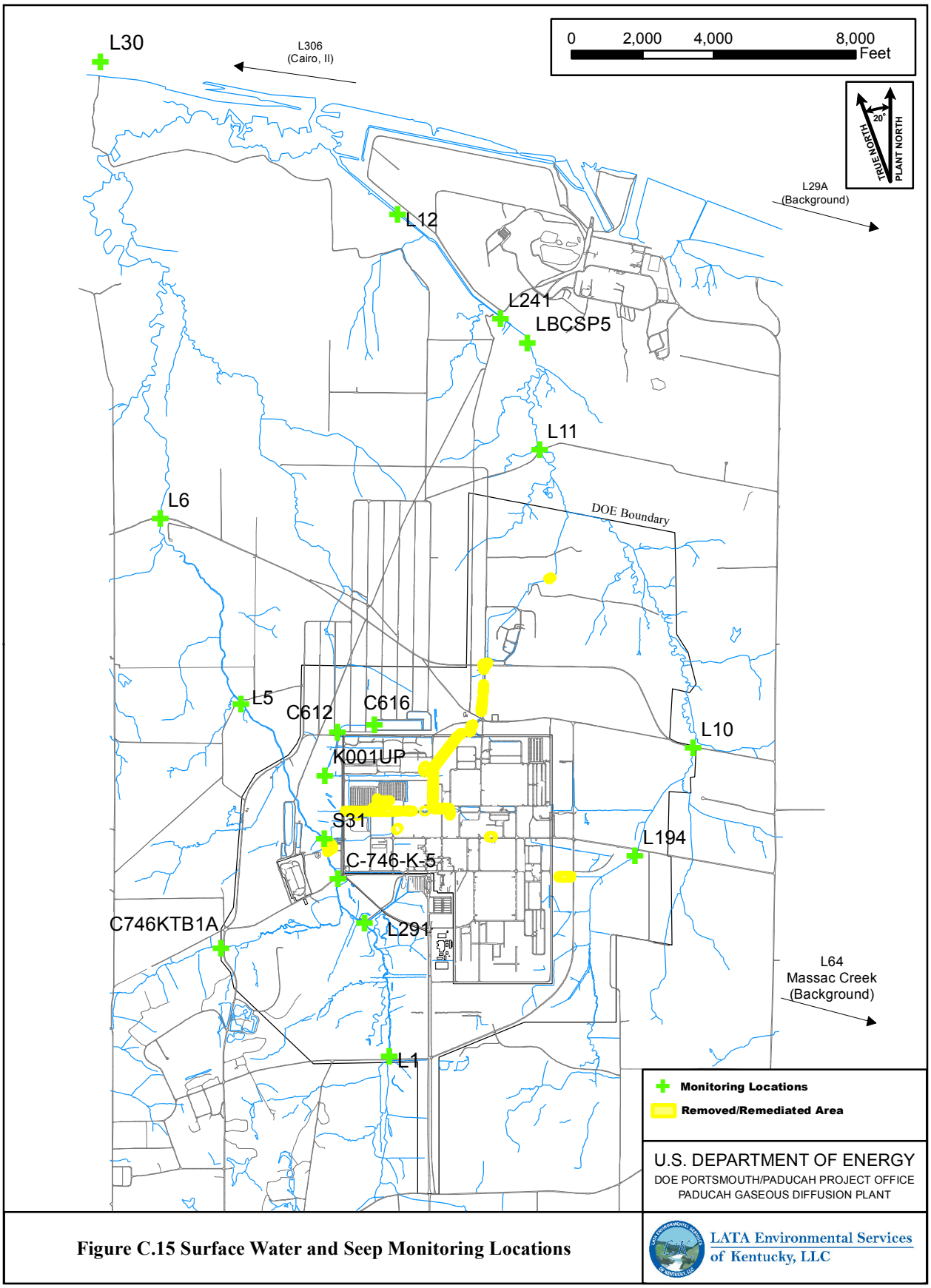

Figure C.15 Surface Water and Seep Monitoring Locations

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.

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

Reported: ASER

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.

The ERPP will be implemented on January 2, 2013; therefore, the radiological parameters will not be sampled until the second quarter of FY 2013.

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. Sampling parameters driven by the implementation of the ERPP will start in the second quarter of FY 2013. Locations are shown on Figure C.16.

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

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

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

Locations	Radionuclides
S1	Alpha Activity
S2	Beta Activity
S20 (BG)	Neptunium-237
S27	Plutonium-238
S33	Plutonium-239/240
S34	Thorium-228
	Thorium-230
	Thorium-232
	Thorium-234
	Potassium-40
	Cesium-137
	Technetium-99
	Uranium
	Uranium-234
	Uranium-235
	Uranium-238

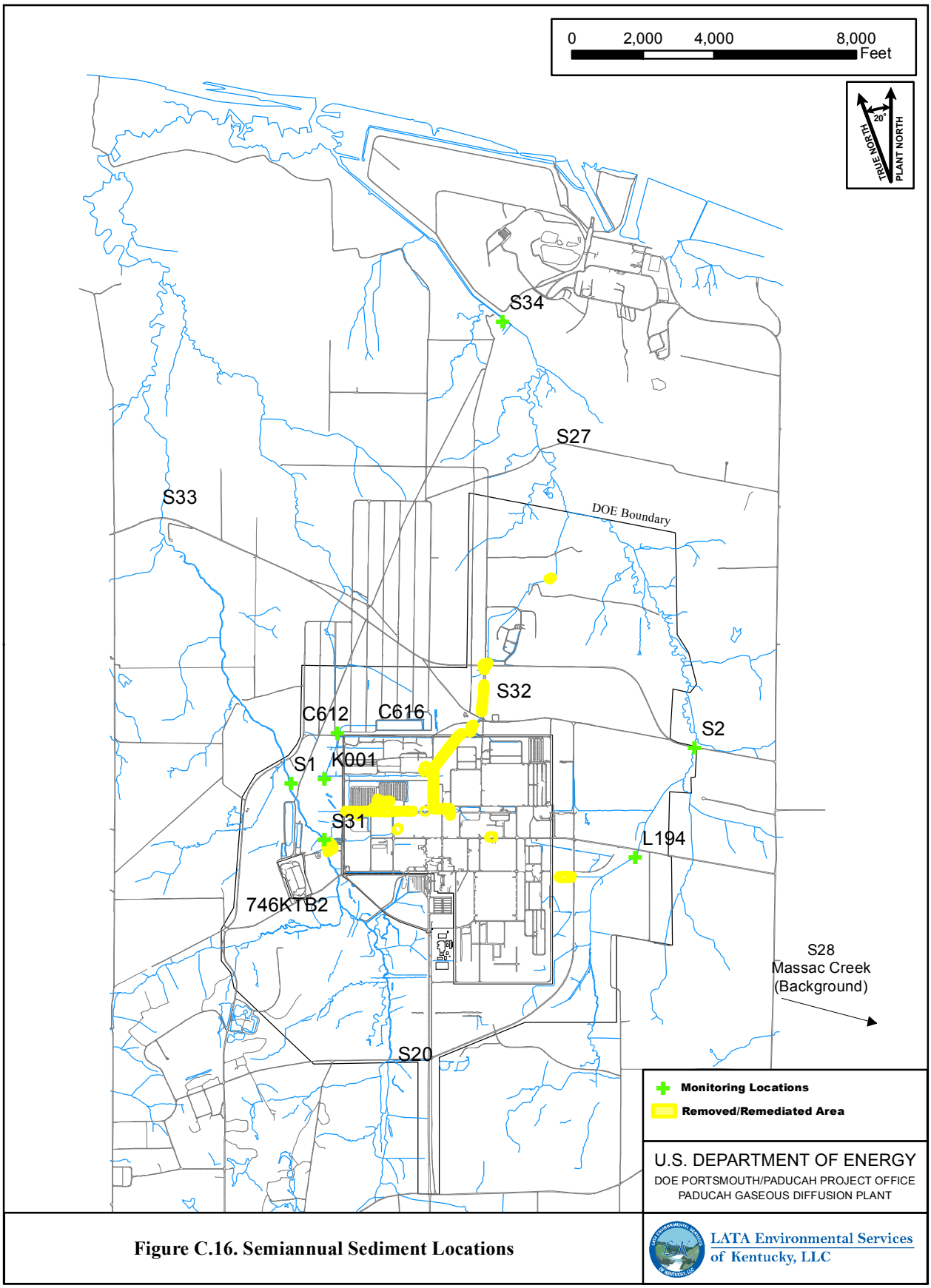

Figure C.16. Semiannual Sediment Locations

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

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

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.

For the FY 2013 EMP, I-131 was removed as a leachate monitoring requirement as a result of a permit modification.

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

Volatiles	PCBs	Metals	Anions
1,1,1,2-Tetrachloroethane	PCB, Total	Aluminum	Bromide
1,1,1-Trichloroethane	PCB-1016	Antimony	Chloride
1,1,2,2-Tetrachloroethane	PCB-1221	Arsenic	Fluoride
1,1,2-Trichloroethane	PCB-1232	Barium	Nitrate as Nitrogen
1,1-Dichloroethane	PCB-1242	Beryllium	Sulfate
1,1-Dichloroethene	PCB-1248	Boron	
1,2,3-Trichloropropane	PCB-1254	Cadmium	**Field Parameters**
1,2-Dibromo-3-chloropropane	PCB-1260	Calcium	Conductivity
1,2-Dibromoethane	PCB-1268	Chromium	Dissolved Oxygen
1,2-Dichlorobenzene		Cobalt	Redox
1,2-Dichloroethane	**Radionuclides**	Copper	Temperature
1,2-Dichloropropane	Alpha Activity	Iodide	pH
1,4-Dichlorobenzene	Beta activity	Iron	
2-Butanone		Lead	**Miscellaneous**
2-Hexanone	Radium-226	Magnesium	Total Dissolved Solids
4-Methyl-2-pentanone	Strontium-90	Manganese	Chemical Oxygen Demand
Acetone	Technetium-99	Mercury	Cyanide
Acrolein	Thorium-230	Molybdenum	Total Organic Halides
Acrylonitrile	Tritium	Nickel	Total Organic Carbon
Benzene	Cesium-137	Potassium	Oil and Grease
Bromochloromethane	Cobalt-60	Rhodium	Phosphorus
Bromodichloromethane	Thorium-234	Selenium	Hardness—Total as CaCO3
Bromoform	Americium-241	Silver	Carbonaceous Biochemical Oxygen Demand
Bromomethane	Neptunium-237	Sodium	
Carbon Disulfide	Plutonium-239/240	Tantalum	
Carbon Tetrachloride	Activity of Uranium-235	Thallium	
Chlorobenzene	Uranium-234	Uranium	
Chloroethane	Uranium-238	Vanadium	
Chloroform	Dissolved Alpha	Zinc	
Chloromethane	Dissolved Beta	Barium, Dissolved	
cis-1,2-Dichloroethene	Technetium-99, Dissolved	Chromium, Dissolved	
cis-1,3-Dichloropropene	Cesium-137, Dissolved	Uranium, Dissolved	
Dibromochloromethane	Cobalt-60, Dissolved	Antimony, Dissolved	
Dibromomethane	Thorium-234, Dissolved	Arsenic, Dissolved	
Dimethylbenzene, Total[a]	Americium-241, Dissolved	Cadmium, Dissolved	
Ethylbenzene	Neptunium-237, Dissolved	Cobalt, Dissolved	
Iodomethane	Plutonium-239/240, Dissolved	Copper, Dissolved	
Methylene Chloride	Thorium-230, Dissolved	Lead, Dissolved	
Styrene	Activity of Uranium-235, Dissolved	Manganese, Dissolved	
Tetrachloroethene	Uranium-234, Dissolved	Nickel, Dissolved	
Toluene	Uranium-238, Dissolved	Selenium, Dissolved	
trans-1,2-Dichloroethene	Uranium	Silver, Dissolved	
trans-1,3-Dichloropropene	Uranium, Dissolved	Tin	
trans-1,4-Dichloro-2-Butene		Tin, Dissolved	
Trichloroethene		Titanium	
Trichlorofluoromethane		Titanium, Dissolved	
Vinyl Acetate		Uranium, Dissolved	
Vinyl Chloride		Vanadium, Dissolved	
		Zinc, Dissolved	

[a] Xylenes

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

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

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

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

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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 450.1A and DOE Order 458.1

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

Reported: ASER

Comments: Eleven new monitoring locations will be added to the environmental gamma radiological monitoring program beginning January 2, 2013. The additional locations added to the program were the result of combining the Radiation Protection Program and the EM Program, which had been managed by two differing organizations. This will result in an overall cost savings to the site because the environmental TLD program managed through the Radiation Protection Program was eliminated as a result of combining the two programs.

Figure C.17 shows TLD monitoring locations.

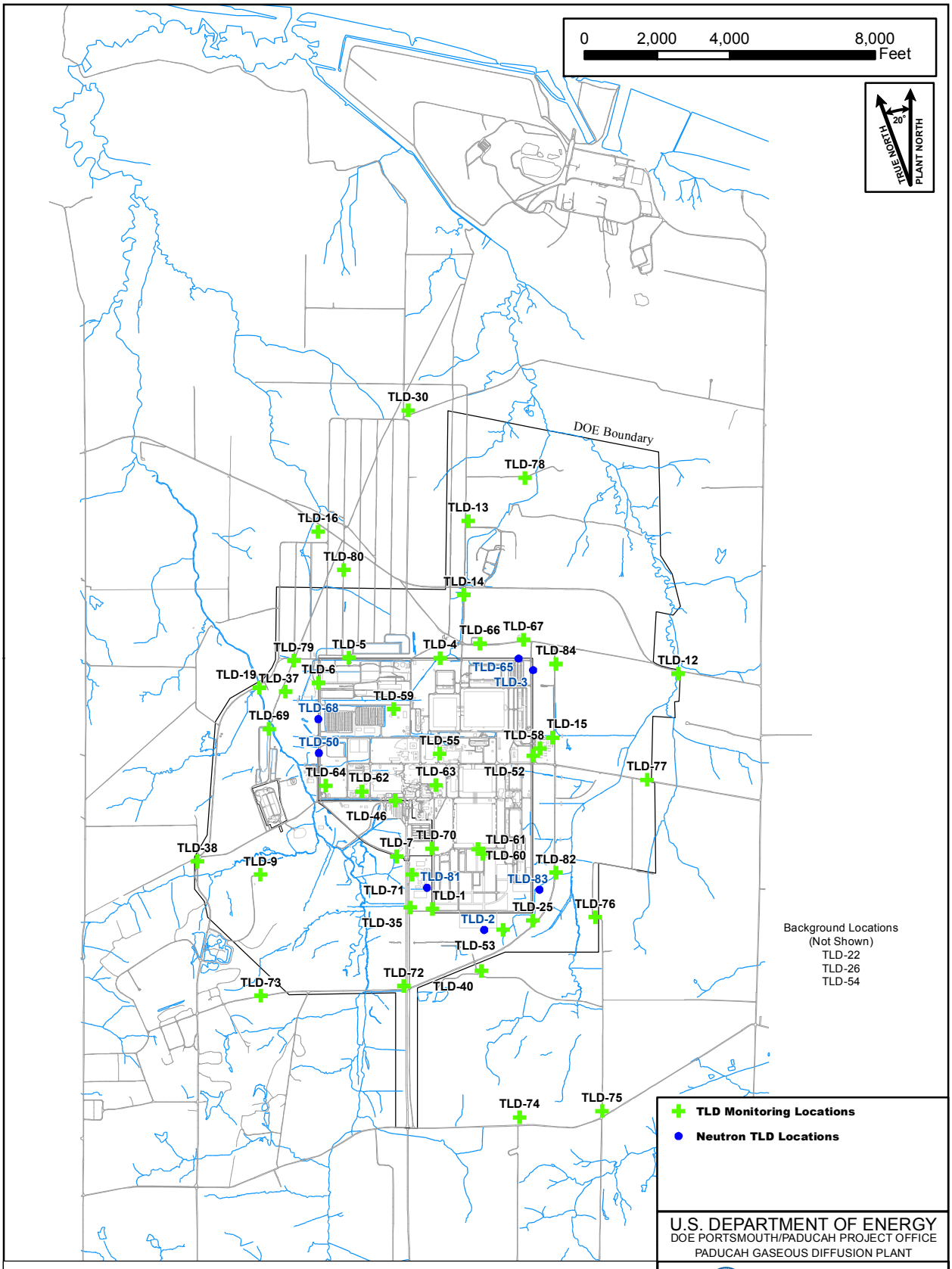

Figure C.17. TLD Monitoring Locations

FIGURE No. EMP\2012\EMP-TLD2012revp1.mxd
DATE 10-02-2012

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

Rationale: Monitor radionuclide emissions from Paducah Site activities

Reported: National Emissions Standards for Hazardous Air Pollutants Annual Report and the ASER

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)
AMD57
AMD012
AMD002
AMDNE
AMD015
AMD612
AMD746S
AMD746U

Table C.40. Ambient Air Monitoring Weekly Analytical Parameters

Radionuclides
Alpha Activity
Beta Activity

Table C.41. Ambient Air Monitoring Quarterly Analytical Parameters

Radionuclides
Americium-241
Neptunium-237/Protactinium-233
Plutonium-238
Plutonium-239/240
Technetium-99
Thorium-234/Uranium-238
Uranium-234
Uranium-235
Uranium-238

BG = Background

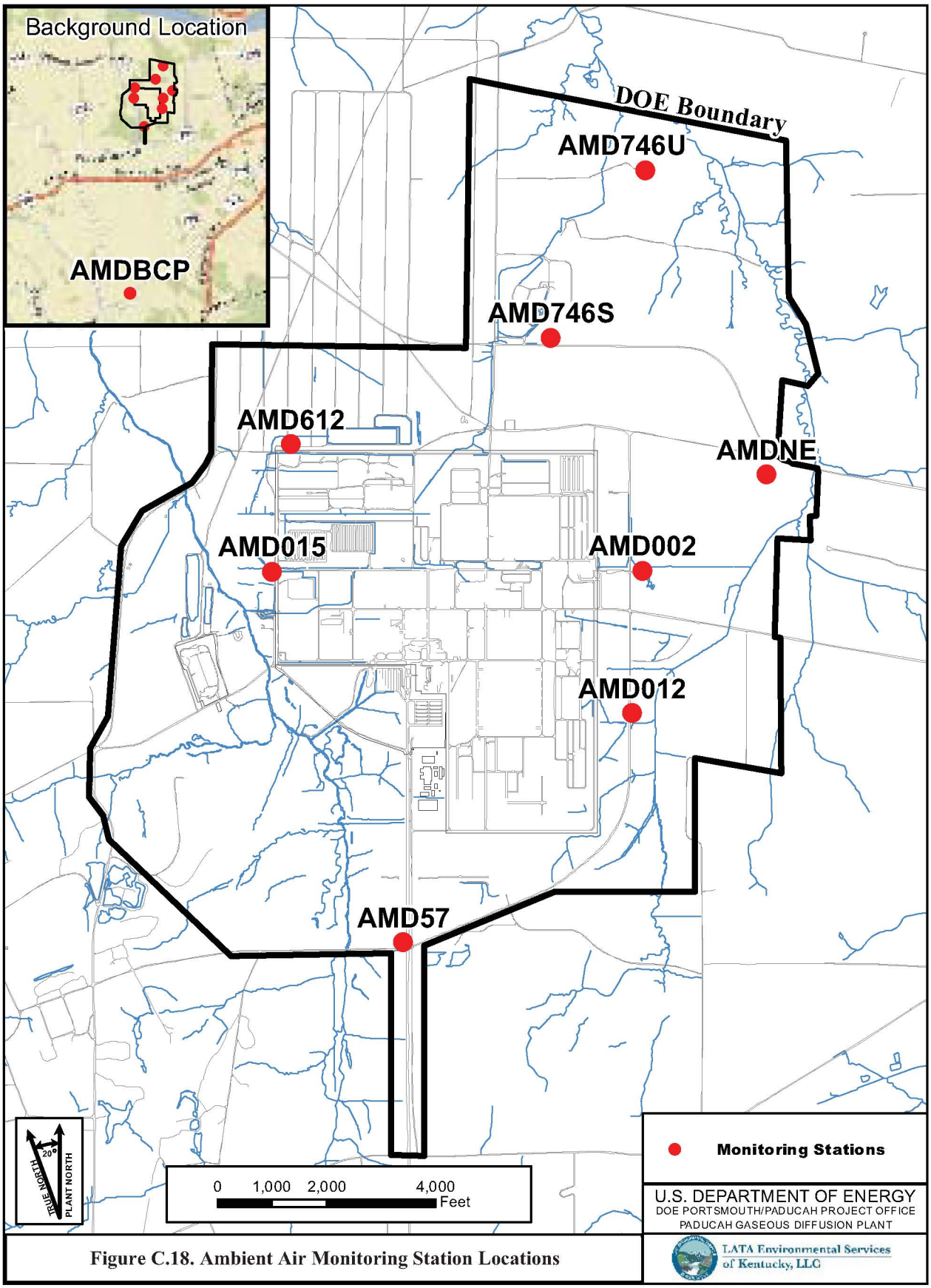

Figure C.18. Ambient Air Monitoring Station Locations

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

APPENDIX D

ENVIRONMENTAL MONITORING QUALITY ASSURANCE PROJECT PLAN

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CONTENTS

TABLES

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ACRONYMS

ACO	Administrative Consent Order
AOC	Areas of Concern
CFR	*Code of Federal Regulations*
COC	chain-of-custody
DMC	Document Management Center
DMR-QA	Discharge Monitoring Report—Quality Assurance
DOE	U.S. Department of Energy
DQO	data quality objective
EDD	electronic data deliverable
EM	Environmental Monitoring
EM QAPP	Environmental Monitoring Quality Assurance Project Plan
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Agency
ES	environmental services
FFA	Federal Facility Agreement
KPDES	Kentucky Pollutant Discharge Elimination System
LATA Kentucky	LATA Environmental Services of Kentucky, LLC
MCL	maximum contaminant level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
Paducah OREIS	Paducah Oak Ridge Environmental Information System
OSHA	Occupational Safety and Health Administration
PARCCS	Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PGDP	Paducah Gaseous Diffusion Plant
QA	Quality Assurance
QAP	Quality Assurance Plan
QAPIP	Quality Assurance Program and Implementation Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
RGA	Regional Gravel Aquifer
RPD	relative percent difference
RSD	relative standard deviation
S&DM	Sample and Data Management
SOW	statement of work
SWMU	solid waste management unit
Tc-99	technetium-99
TCE	trichloroethene
USEC	United States Enrichment Corporation
VOC	volatile organic compound

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D.1. INTRODUCTION TO THE QUALITY PROGRAM

The Environmental Monitoring (EM) Program, managed by LATA Environmental Services of Kentucky, LLC, (LATA Kentucky) and its subcontractors, performs environmental monitoring, effluent monitoring, environmental surveillance, and compliance reporting. The EM Quality Assurance Project Plan (QAPP) describes the responsibilities and activities that affect the quality of the operations, maintenance, and scientific and technical information collected. This EM QAPP supports and is included as an appendix to the *Environmental Monitoring Plan* (EMP), PAD-ENM-0055. The EMP provides overall direction for EM activities. Additionally, the *Paducah Gaseous Diffusion Plant Programmatic Quality Assurance Project Plan*, DOE/LX/07-1269&D2, provides measurement quality objectives for the analytical requirements listed in Appendix C.

The U.S. Department of Energy (DOE) Prime Contractor Quality Assurance Program and Implementation Plan (QAPIP) (PAD-PLA-QM-001) implements the quality assurance (QA) requirements established in 10 *CFR* § 830.120, DOE Order 414.1C, and American Society of Mechanical Engineers Nuclear Quality Assurance-1 and flows those requirements down into all DOE Prime Contractor activities and functions. The EM program is focused on obtaining environmental data and measurements; therefore, the EM QAPP follows the format established in the U.S. Environmental Protection Agency (EPA), *Requirements for Quality Assurance Project Plans* (QA/R-5) (May 2006). This EPA document applies specifically to environmental data collected and used in decision making and provides the structure, content, and guidance for Quality Assurance Plans (QAPs) associated with environmental data collection.

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

Reference Documents

- PAD-ENM-0055, *Environmental Monitoring Plan*
- Kentucky Pollutant Discharge Elimination System (KPDES) Permit, KY0004049
- Solid Waste Residential Landfill (Closed) Permit, KYSW07300014
- Solid Waste Inert Landfill (Closed) Permit, KY SW07300015
- Solid Waste Contained Landfill (Open) Permit, KY SW07300045
- Hazardous Waste Facility Permit, KY8-890-008-982
- 10 *CFR* § 830.120, *Quality Assurance Requirements*
- DOE Order 414.1C, *Quality Assurance*
- EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans*
- SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*
- EPA Test Methods Series

- PAD-PLA-QM-001, *LATA Kentucky Quality Assurance Program and Implementation Plan for the Paducah Environmental Remediation Project*

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

D.2. PROJECT/TASK ORGANIZATION AND RESPONSIBILITY

D.2.1 PROJECT PERSONNEL

The Organizational Chart for Environmental Monitoring is shown in Attachment 1. The Environmental Monitoring and Reporting Manager, who is responsible for implementing all relevant aspects of the EMP, reports to the Manager of Projects. The organization is designed to provide a clear line of functional and program responsibility and authority supported by a management control structure. Overall responsibilities for this project include the following:

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

D.2.2 RESPONSIBILITIES

D.2.2.1 Environmental Monitoring and Reporting Manager

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

D.2.2.2 Environmental Sampling/Well Activities Manager

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

procedures; and ensuring visitor and worker safety and health on the project site. For work performed by a subcontractor, such as well rehabilitation, well abandonment, or EM sampling, the Environmental Sampling/Well Activities Manager is responsible for the oversight of that work scope.

D.2.2.3 Samplers

The samplers report to the Environmental Sampling/Well Activities Manager and are responsible for all groundwater monitoring, KPDES, surface water, and sediment sampling activities, which include the following: maintaining logbook entries; calibrating monitoring equipment; performing field analyses; maintaining sampling equipment; performing well inspections; conducting all routine monthly, quarterly, semiannual, and annual sampling, as well as special, residential, and Commonwealth of Kentucky split sampling; preserving samples; and maintaining quality records of sampling events in written format. The samplers are responsible for overseeing the performance of necessary calibrations; decontaminating sampling equipment; performing laboratory inspections; maintaining an inventory list of reagents and chemicals; managing and reviewing records and logbooks; and working in accordance with applicable Chemical Hygiene Plans.

D.2.2.4 Sample/Data Management Manager

The Sample/Data Management Manager reports to the Environmental Monitoring and Reporting Manager and is responsible for long-term storage of project data and for transmitting data to external agencies according to the *Paducah Site Data Management Plan*, DOE/OR/07-1595&D1, and the Paducah Data Management Policy ("Paducah Environmental Management & Enrichment Facilities Data Management Policy," internal correspondence number, LTR.KY/ER96-0281, from J. C. Massey to D. L. Chumbler et al., Lockheed Martin Energy Systems, Inc., Paducah, KY, November 11, 1996). The Sample/Data Management Manager ensures compliance with policies and procedures relating to data management with respect to the project and ensures that the requirements of PAD-ENM-5003, *Quality Assured Data*, as well as applicable validation procedures are followed. For work performed by a subcontractor, such as laboratory validation, the Sample/Data Management Manager is responsible for the oversight of that work scope.

D.2.2.5 Data Entry Specialist

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

D.2.2.6 Sample/Data Coordinator

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

D.2.2.7 QA Specialist

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

D.2.2.8 Environmental Compliance Support Personnel

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

D.3. PROGRAM DEFINITION/BACKGROUND

D.3.1 PROGRAM STATEMENT

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

- Provides for data that is used to protect human health and the environment.
- Achieve compliance with federal or Commonwealth of Kentucky regulations, permit conditions, or environmental commitments both on and off-site;
- Better understand the effects of DOE operations on the quality of the regional environment;
- Address public concern about off-site contamination; and
- Meet DOE requirements.
- Provides for quality data sets that meet data and measurement quality objectives that can be utilized as historical data sets for future decision making purposes, such as effective treatment remedies under CERCLA or real property transfer.

D.3.2 BACKGROUND

The Paducah Gaseous Diffusion Plant (PGDP) located in Paducah, Kentucky, is an operating uranium enrichment facility owned by DOE. Effective July 1, 1993, DOE leased the plant production facilities at Paducah to the United States Enrichment Corporation (USEC) to provide operations and maintenance services. DOE contracted with LATA Kentucky effective July 26, 2010, to manage and integrate the EM activities for DOE.

During past operations of PGDP, hazardous substances generated as byproducts from the enrichment process were released into the environment. The source areas where releases originally occurred are often referred to as solid waste management units (SWMUs) and areas of concern (AOC). In general, SWMUs

and AOC are typically areas such as burial grounds, spill sites, landfarms, surface impoundments, and underground storage tanks. The releases from these source areas can migrate into the surrounding soils, aquatic and terrestrial biota, and in some cases, the underlying groundwater and adjacent surface waters. In July 1988, groundwater samples collected from residential wells north of PGDP led to the discovery of trichloroethene (TCE) and technetium-99 (Tc-99) contamination in the Regional Gravel Aquifer (RGA). With the participation of the Commonwealth of Kentucky, EPA, and DOE, the Administrative Consent Order (ACO) was entered effective November 23, 1988. The ACO was a legally binding agreement for the participating parties that initiated the investigation into the nature and extent of the contamination in these wells. On May 31, 1994, the PGDP was put on the National Priorities List (NPL) and a Federal Facility Agreement (FFA) was negotiated among DOE, the Commonwealth of Kentucky, and EPA that became effective in February 1998.

D.4. PROJECT/TASK DESCRIPTION

D.4.1 PURPOSE

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

D.4.2 SCOPE

EM performs effluent monitoring and environmental surveillance activities. Table D.4.1 provides a listing of the different tasks under EM.

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

Table D.4.1. Summary of EM Activities

Effluent Monitoring	Groundwater Surface Water—C-746-S&T and C-746-U Landfill Runoff, KPDES Outfalls
Environmental Surveillance	Groundwater Surface Water Sediment External Gamma Radiation Ambient Air Monitoring

Environmental surveillance, which excludes the effluent monitoring previously described, is the collection and analysis of samples or direct measurements of air, water, soil, and other media from DOE

sites and their environment for the purpose of determining compliance with applicable standards and permit requirements, assessing radiation exposure of members of the public, and assessing the effects, if any, on the local environment. Environmental surveillance activities consist of groundwater surveillance monitoring wells, surface water and sediment sampling, and external gamma radiation monitoring.

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

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

D.4.3 REQUIREMENTS

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

D.5. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The QA objectives of EM are to generate quality assured data that ensures the data reported to EPA, Commonwealth of Kentucky, and the public is legally and scientifically defensible. The intended use of the acquired data is to provide regulatory reports and an annual site environmental report that discuss the solid and hazardous waste monitoring and the impact of PGDP operations on the environment.

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

D.5.1 DATA QUALITY REQUIREMENTS AND PARCCS EVALUATION

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

Once data have been reviewed, verified, and/or validated, data assessment personnel will evaluate the finalized data assessment packages against the EM program objectives. The evaluation will be used to determine whether the data meets the program objectives. Quality data is obtained by adherence to the

data quality requirements and the PARCCS parameters outlined in this document because these standards fulfill the mission statements of government agencies, such as the Multi-Agency Radiological Laboratory Analytical Protocols. Laboratories are asked to report at their lowest practical quantitation limits for nonradionuclides and to the lowest level of uncertainty for radionuclides (assuming standard count times, where applicable) for the parameters requested for each program identified in Appendix C.

The following text presents the methods used to evaluate the PARCCS parameters.

D.5.1.1 Accuracy, Precision, and Sensitivity of Analysis

The objective of the analytical QC requirements is to ensure adequate accuracy, precision and sensitivity of analysis. Samples collected for groundwater analysis during the project will be analyzed using EPA SW-846 analytical methods, for which QA/QC procedures have been established. Samples collected for KPDES will be analyzed using the analytical methods specified by the KPDES permit, or, if a method is not specified, the chosen analytical method will be an EPA approved method (e.g., SW-846 Method 8082 or EPA 200.8). Toxicity samples are analyzed in accordance with protocol published in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*, EPA/600/4-89/001 (Second Edition). The precision and accuracy for each parameter/method are provided in the applicable methods.

- **Accuracy**

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

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

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

- **Precision**

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

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

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

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

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

- **Sensitivity**

  The sensitivity of analysis (or the detection limit) is determined by the analytical method and the laboratory analyst and instrumentation. During the development of data quality objective (DQOs), the required detection limit is determined based on regulatory restrictions such as maximum contaminant levels (MCLs) for drinking water standards. The analytical laboratory is requested to meet these requirements. The laboratory reporting limits (i.e., laboratory quantitation limits) are established upon the detection limits and are generally a 5 to 10 times the detection limits, as noted in SW-846, Chapter 1.

D.5.1.2 Field Representativeness, Completeness, and Comparability

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

- **Representativeness**

  Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. See Table D.7.1 for a list of field procedures that contribute to representativeness of the sampled media. The documentation required in this QAP will enable checking that sampling protocols have been followed and sample identification and integrity have been assured. Field planning meetings, field assessments, and oversight by the Environmental Sampling/Well Activities Manager will provide opportunities to check that field procedures are being correctly implemented.

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

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

- **Completeness**

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

  The completeness objective for this project is 90%.

  Percent of completeness is defined as

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

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

- **Comparability**

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

D.6. SPECIAL TRAINING REQUIREMENTS/CERTIFICATIONS

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

Health and Safety-Related Training

- HAZWOPER training, such as 40-hour Occupational Safety and Health Administration (OSHA), 8-hour OSHA refresher, medical monitoring, and respirator training.

- Plant-specific training, such as lockout-tagout, fire watch, etc.

Project-Specific or Job-Specific Training

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

Training files are maintained by the DOE Prime Contractor Training Organization. A training database is utilized to manage and track training. Subcontractors maintain copies of training records at the appropriate satellite temporary record storage area.

D.7. DOCUMENTATION AND RECORDS

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

Applicable and appropriate documents, plans, and procedures utilized for EM activities are listed in D.7.1. (Note: Table D.7.1 is not a comprehensive list of all utilized documents, plans, and procedures.) Documents, plans, and procedures utilized are identified in this section and may be referenced in the appropriate section discussing each project. Procedures are managed by the DMC. The DMC ensures that the most current approved procedures and plans are available for personnel.

D.7.2 RECORDS MANAGEMENT

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

D.7.2.1 Description of the Records Management System

The records management system is defined by PAD-RM-1009, *Records Management, Administrative Record, and Document Control*. This procedure establishes the requirements to ensure consistent management of records maintained by DOE Prime Contractor. The EM records are maintained at the appropriate satellite records storage area; the record copy is located within the DMC at the DOE Prime Contractor Kevil building and records that are in-use are located at the field office (C-743-T-03).

D.7.2.2 Personnel Responsible for Records

The Environmental Monitoring and Reporting Manager has direct responsibility for ensuring the requirements are adhered to as stated in this plan. The Sample/Data Management Manager is responsible for the daily activities associated with records management and implementing the requirements stated in this plan.

D.7.2.3 Identification of EM Records

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

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

Number	Title
DOE/OR/07-1707	Federal Facility Agreement for the Paducah Gaseous Diffusion Plant
DOE/OR/07-1595&D2	Data and Documents Management and Quality Assurance Plan
PAD-ENM-0811	Pesticide and PCB Data Verification and Validation
PAD-ENM-5007	Data Management Coordination
PAD-ENM-0021	Temperature Control for Sample Storage
KY0004049	KPDES Permit
KY073-00014	C-746-S Residential Landfill Permit
KY073-00015	C-746-T Inert Landfill Permit
KY073-00045	C-746-U Residential Landfill Permit
KY8-890-008-982	Hazardous Waste Facility Permit
PAD-ENM-0016	Maintenance and Use of ASTM Type II Water System
PAD-ENM-0023	Composite Sampling
PAD-ENM-0018	Sampling Containerized Waste
PAD-ENM-0025	Paducah Environmental Monitoring Waste Management Plan
PAD-ENM-0026	Wet Chemistry and Miscellaneous Analyses Data Verification and Validation
PAD-ENM-0055	Environmental Monitoring Plan
PAD-ENM-1001	Transmitting Data to the Paducah Oak Ridge Environmental Information System
PAD-ENM-1002	Submitting, Reviewing, and Dispositioning Changes to the Environmental Databases (OREIS and PEMS)
PAD-ENM-1003	Developing, Implementing, and Maintaining Data Management Implementat Plans
PAD-ENM-2100	Groundwater Level Measurement
PAD-ENM-2101	Groundwater Sampling
PAD-ENM-2203	Surface Water Sampling
PAD-ENM-2300	Collection of Soil Samples
PAD-ENM-2302	Collection of Sediment Samples Associated with Surface Water
PAD-ENM-2303	Borehole Logging
PAD-ENM-2700	Logbooks and Data Forms
PAD-ENM-2702	Decontamination of Sampling Equipment and Devices
PAD-ENM-2704	Trip, Equipment, and Field Blank Preparation
PAD-ENM-2708	Chain of Custody Forms, Field Sample Logs, Sample Labels, and Custody Seals
PAD-ENM-5003	Quality Assured Data
PAD-ENM-5004	Sample Tracking, Laboratory Coordination, and Sample Handling Guidance
PAD-ENM-5007	Data Management Coordination
PAD-ENM-5102	Radiochemical Data Verification and Validation
PAD-ENM-5103	Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans Data Verification and Validation
PAD-ENM-5105	Volatile and Semivolatile Data Verification and Validation
PAD-ENM-5107	Inorganic Data Verification and Validation
PAD-PROJ-0025	Monitoring Well Maintenance Implementation Plan
PAD-PROJ-0061	Site Specific HASP for the Environmental Monitoring Project
PAD-QA-1210	Issues Management
PAD-QA-1220	Occurrence Notification and Reporting
PAD-QA-1420	Conduct of Assessment
PAD-RM-1009	Records Management, Administrative Record, and Document Control

D.7.2.4 Storage of EM Records

EM files are maintained as field operating records and are considered the project record copy.

D.7.2.5 Transfer of Records to the DMC

Documents, plans, procedures, and records to be submitted to the DMC are provided as specified in Table D.7.2.

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

D.7.2.6 Retention of Records

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

Table D.7.2. Transfer of Records to the DMC

Record Type	Comments
Assessment records (i.e., audits, surveillances, and self-assessment reports)	Assessment records will be managed by the QA organization.
Maintenance Records	Records generated as a result of large maintenance tasks that are performed by the maintenance organization will be managed by that organization. Small maintenance tasks that involve technical expertise by the sampling crew will be documented, and any generated records will be managed by the EM organization.
Corrective action plans and evidence	Corrective action records will be managed by the QA organization.
Procedures and work control documents	Procedures, work instructions, and operator aids were initially submitted as required; changes will be submitted, as necessary, to the DMC.
Regulatory inspection records	Inspection records will be submitted to the DMC.
Logbooks	Logbooks will be submitted to the DMC.
Chain-of-custody	Each COC is sent to Sample/Data Management.
Data Assessment Packages	Data assessment packages will be submitted to the DMC.
Laboratory Data Packages	Laboratory data packages will be submitted to the DMC.

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

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

D.9. DATA COLLECTION DESIGN

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

D.9.1 SAMPLE INFORMATION

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

D.9.2 FIELD MEASUREMENTS

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

Field measurements are taken and recorded on appropriate field forms or in logbooks and input into ES PEMS. If field forms are used, they are input and QC checked against the field logbook by appropriate data personnel. Criteria for field measurements are provided in Table D.9.1.

For the collection of depth to water and quarterly water level measurements, the tape measure must be checked against a source on an annual basis.

D.9.3 DEFINITIVE DATA

Definitive data is defined as the analytical and biological monitoring data generated by the fixed-base laboratory. Analyses are specified in Appendix C of the EMP Definitive data generated by the fixed-base laboratory is required to undergo a laboratory data review for consistency and completeness in accordance with the fixed-base laboratory QA plan. The primary data outputs include data packages and EDDs.

All data packages received from the fixed-base laboratory are tracked, reviewed, and maintained in a secure environment. The primary individual responsible for these tasks is the Sample/Data Coordinator.

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

Table D.9.1. Field Measurement Criteria

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

[a] Field measurements are identified on a project basis. Appendix C of the PAD-ENM-0055, *Environmental Monitoring Plan*, lists the project-specific measurements.

[b] If attempts to achieve stabilized field measurement readings have failed, a decision to proceed with sampling efforts may be made by the Environmental Sampling/Well Activities Manager or designee. Documentation in the field log book of such an occurrence will be noted.

D.10. SAMPLING METHODS REQUIREMENTS

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

- Generates COC records and sample labels;
- Tracks sample collection and shipment;
- Manages field-generated data;
- Imports laboratory-generated data;
- Updates field and laboratory data based on integrated data verification and validation;

- Reports data for project use; and
- Formats data for transfer to Paducah OREIS.

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

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

D.11. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Samples are uniquely identified by a sample identification number. Sample identification numbers for EM are identified in ES PEMS and are assigned by the Sample/Data Management Manager according to the project, sample type, and location. Examples of sample numbering schemes are found in the Data Management Implementation Plan.

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

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

Documentation from the sample collection process is in the form of logbooks, COC forms, and other records. Prior to the shipment of samples to fixed-base laboratories, a copy of the COC is to be provided to the S&DM coordinator. S&DM assists with the coordination of sample shipments to a fixed-base laboratory. Shipping COCs will be provided prior to sample shipments for off-site, fixed-base laboratory services.

D.12. ANALYTICAL METHOD REQUIREMENTS

When available and appropriate for the sample matrix, SW-846 methods or EPA methods are used. When not available, other nationally recognized methods such as those of DOE, EPA, and the American Society for Testing and Materials will be used. Analytical methods, analytical parameters, and reporting limits are

identified in the analytical SOWs in ES PEMS. (Note: If no specific reporting limit is required by a specific project, a reporting limit will not be provided in the SOW. In these cases, the laboratory will report its applicable and appropriate reporting limit for the method.)

D.13. QUALITY CONTROL REQUIREMENTS

D.13.1 FIELD QUALITY CONTROL SAMPLES

Table D.13.1 provides a summary of the field QC samples that are taken for the EM samples. Field QC samples include field blanks, equipment blanks, field duplicates, and trip blanks. QC samples for EM activities are collected 1 per every 20 samples, as defined by SW-846, *Test Methods for Evaluating Solid Waste.* These samples will be analyzed in the same manner as the field samples.

- Field Duplicates (or Replicates)

  Field duplicate samples are collected and analyzed to assess the overall precision of the field and laboratory effort. Field duplicate samples, of a similar matrix, will be collected at a rate of 5% or one per 20 samples or fewer. Field duplicate samples in a soil matrix are homogenized and split in the hole.

- Trip Blanks

  Trip blanks are used to determine whether on-site atmospheric contaminants are seeping into the sample vials, or if any cross-contamination of samples is occurring during shipment or storage of sample containers. A trip blank consists of demonstrated analyte-free water sealed in 40-mL Teflon septum vials with no headspace (or bubbles) in the vials. Trip blanks are to be kept in close proximity to the samples being collected and will be maintained at 4^{o}C and handled in the same manner as the other volatile organic compounds (VOCs) aqueous samples. Trip blanks are collected when VOCs are collected at a frequency of one per 20 environmental samples or one per cooler per day, whichever is more frequent. Trip blanks will be analyzed for volatile organics only.

- Field Blanks

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

- Equipment Blanks (or Rinseates)

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

Table D.13.1. Field QC Samples

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

D.13.2 INTERNAL QC CHECKS AND FREQUENCY FOR LABORATORY ANALYSIS

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

Independent Quality Control

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

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

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

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

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

D.15. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

D.15.1 FIELD EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

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

D.15.2 LABORATORY EQUIPMENT CALIBRATION PROCEDURES AND FREQUENCY

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

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

Inspection/acceptance requirements for supplies and consumables are managed in accordance with the LATA Kentucky Quality Program and QA procedures.

D.17. DATA ACQUISITION REQUIREMENTS (NONDIRECT MEASUREMENT)

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

D.18. DATA MANAGEMENT

LATA Kentucky utilizes ES PEMS for sample scheduling, collection, and tracking each sample and associated data from the point of collection through final data reporting. ES PEMS tracking includes field forms, COCs, data packages, and EDDs. Data are entered as the project progresses. All field measurement data, analytical data, sampling information, and other pertinent information are entered into ES PEMS.

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

D.19. ASSESSMENT/OVERSIGHT

D.19.1 ASSESSMENTS AND RESPONSE ACTIONS

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

Independent assessment activities include reviewing documents and monitoring work activities to provide an effective real-time means of evaluating the adequacy and effectiveness of methods for achieving quality.

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

Corrective actions of internal audit/surveillance findings and nonconformances are managed in accordance with the LATA Kentucky quality program and applicable procedures.

D.19.2 REPORTS TO MANAGEMENT

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

D.20. DATA VALIDATION AND USABILITY

D.20.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

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

D.20.2 INITIAL DATA REVIEWS

Initial data reviews are conducted by a technical reviewer, prior to submitting documents, plans, data, etc., to the project manager for review and approval.

D.20.3 FINAL DATA REVIEW AND DATA USAGE

Final data reviews are performed prior to release of data to external agencies to ensure accuracy in reported results. The final data review steps are performed by the Environmental Monitoring and Reporting Manager, Sample/Data Management Manager, and other EM team members, as appropriate.

D.20.4 VALIDATION AND VERIFICATION METHODS

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

- PAD-ENM-5105, *Volatile and Semivolatile Data Verification and Validation*
- PAD-ENM-5107, *Inorganic Data Verification and Validation*
- PAD-ENM-5103, *Polychlorinated Dibenzodioxins/Polychlorinated Dibenzofurans Verification and Validation*
- PAD-ENM-5102, *Radiochemical Data Verification and Validation*
- PAD-ENM-0026, *Wet Chemistry and Miscellaneous Analyses Data Verification and Validation*
- PAD-ENM-0811, *Pesticide and PCB Data Verification and Validation*

D.20.5 RECONCILIATION WITH USER REQUIREMENTS

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

ATTACHMENT

ENVIRONMENTAL MONITORING ORGANIZATIONAL CHART

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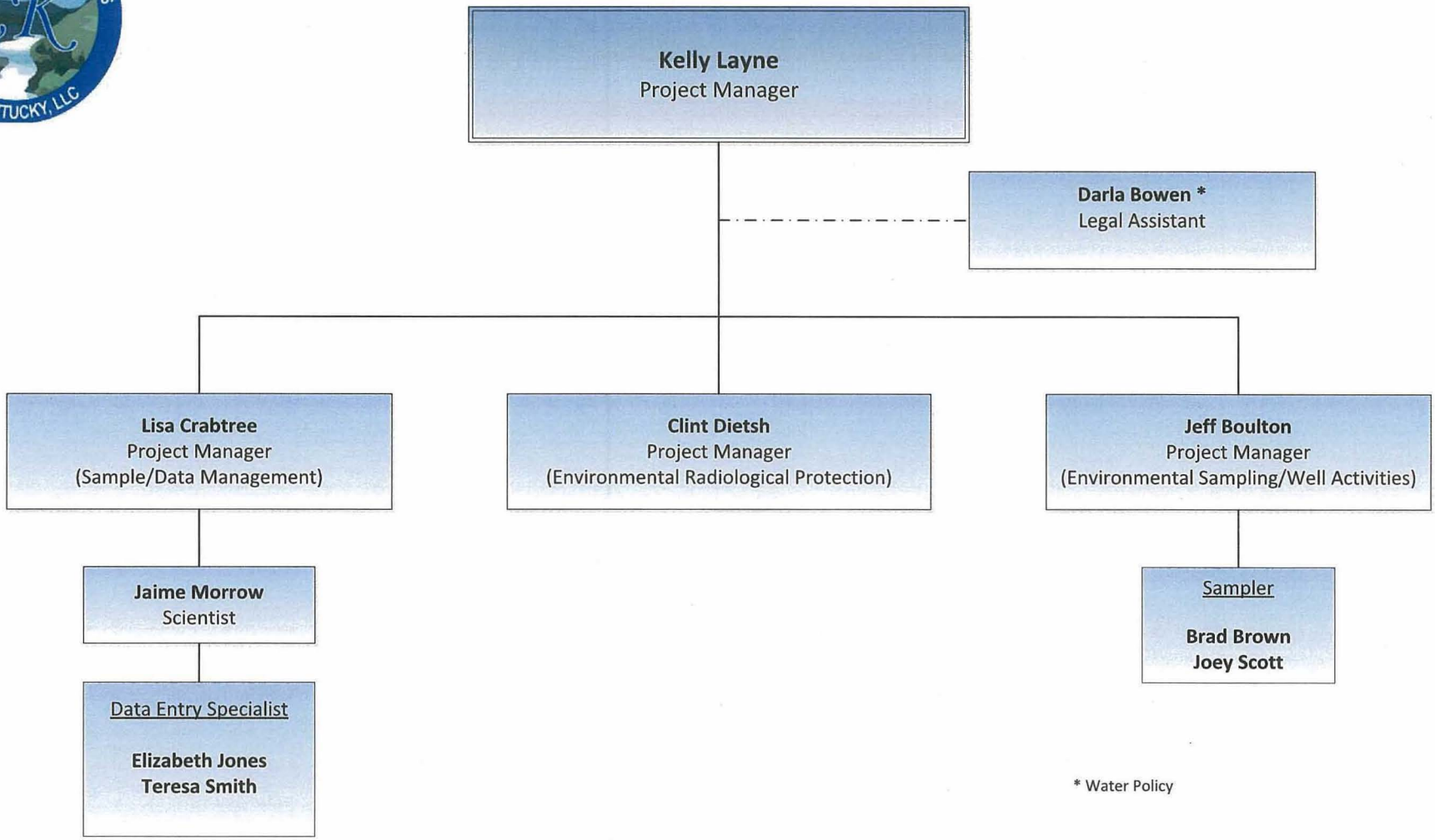
Environmental Monitoring



* Water Policy

Lisa Crabtree for Kelly Layne
Manager's Signature

3/5/12
Date

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