Environmental Monitoring Plan
for the
Portsmouth Gaseous Diffusion Plant
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0009&D4

February 2013

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for the
Portsmouth Gaseous Diffusion Plant
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February 2013

By
Fluor-B&W Portsmouth LLC, under Contract DE-AC30-10CC40017

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ACRONYMS

ACP	American Centrifuge Plant
ALARA	as low as reasonably achievable
ASME	American Society of Mechanical Engineers
BWCS	Babcock and Wilcox Conversion Services, LLC
CAS	cleanup alternatives study
CFR	Code of Federal Regulations
CMS	corrective measures study
D&D	decontamination and decommissioning
DCG	derived concentration guide
DCS	derived concentration standard
DOE	Department of Energy
DUF_6	depleted uranium hexafluoride
EMP	Environmental Monitoring Plan
EMS	Environmental Management System
FBP	Fluor-B&W Portsmouth LLC
FIPS	Federal Information Processing Standard
ft/d	feet per day
IGWMP	Integrated Groundwater Monitoring Plan
ISMS	Integrated Safety Management System
µg/kg	microgram per kilogram
µg/L	microgram per liter
mg/kg	milligram per kilogram
mg/L	milligram per liter
mrem	millirem
NAD83	North American Datum 83
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
OREIS	Oak Ridge Environmental Information System
PCB	polychlorinated biphenyl
pCi/g	picocurie per gram
pCi/L	picocurie per liter
PEMS	Project Environmental Measurements System
PORTS	Portsmouth Gaseous Diffusion Plant
QA	quality assurance
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SAP	Sampling and Analysis Plan
SIU	standard international unit
SOW	statement of work
TPU	total propagated uncertainty
WEMS	Wastren-EnergX Mission Support, LLC
U.S. EPA	U.S. Environmental Protection Agency
USEC	United States Enrichment Corporation

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1. INTRODUCTION

1.1 PURPOSE

This Environmental Monitoring Plan (EMP) defines and documents the requirements for environmental monitoring at the Portsmouth Gaseous Diffusion Plant (PORTS). The EMP is prepared to comply with U.S. Department of Energy (DOE) Order 458.1, *Radiation Protection of the Public and the Environment*, which replaces DOE Order 5400.5, and DOE Order 436.1, *Departmental Sustainability*, which replaces DOE Order 450.1, *Environmental Protection Program*. Although DOE Orders 5400.5 and 450.1 have been replaced, they are contract requirements for Fluor-B&W Portsmouth LLC (FBP); therefore, this EMP is prepared to comply with each of these DOE Orders.

Guidance documents used to prepare the EMP include the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (hereafter referred to as the *Regulatory Guide*) (DOE/EH-0173T), dated January 1991, which is referenced by DOE Orders 458.1 and 5400.5, and the *Implementation Guide for Use with DOE Order 450.1, Environmental Protection Program* (DOE G 450.1-1). As stated in this implementation guide, DOE guides are not requirements documents and may not be construed as requirements in any audit or assessment of compliance with the associated Policy, Order, Notice, or Manual.

The PORTS EMP is designed to:

- Conduct environmental monitoring, as appropriate, to support the site's ISMS, to detect and characterize releases from DOE activities; assess impacts; estimate the dispersal patterns in the environment; characterize the pathways of exposure to members of the public; and characterize the exposures and doses to individuals, and the population; and to evaluate the potential impacts to the biota in the vicinity of the DOE activity.

- Ensure the analytical work supporting environmental monitoring is implemented using:

  - a consistent system for collecting, assessing, and documenting environmental data of known and documented quality;

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

  - an integrated sampling approach to avoid duplicative data collection.

- Ensure the early identification of and appropriate response to potential adverse environmental impacts associated with DOE operations, including (as appropriate) preoperational characterization and assessment and effluent and surveillance monitoring.

Three companies are responsible for environmental monitoring at PORTS: FBP, Babcock and Wilcox Conversion Services, LLC (BWCS), and USEC, Inc.. FBP and BWCS are DOE contractors. USEC, Inc. is a private company responsible for the American Centrifuge Plant (ACP) and is regulated by the Nuclear Regulatory Commission. This EMP, and most of the environmental monitoring at PORTS is the responsibility of FBP. Chapter 2 discusses BWCS and USEC, Inc. environmental monitoring at National Pollutant Discharge Elimination System (NPDES) outfalls and cylinder storage yards. However, the remaining chapters of this EMP apply to FBP only. BWCS and USEC, Inc. are responsible for collection, reporting, management, and quality assurance of their environmental monitoring data.

1.2 SITE DESCRIPTION

PORTS is located in a rural area of Pike County in south central Ohio, approximately 80 miles south of Columbus, 20 miles north of Portsmouth, and 1 mile east of U.S. Route 23, near Piketon (Figure 1.1). The terrain surrounding the plant, except for the Scioto River floodplain, consists of marginal farmland and densely forested hills. The Scioto River floodplain is farmed extensively, particularly with grain crops.

PORTS is one of only three uranium enrichment facilities that have been operated in the United States (the other two are gaseous diffusion plants at Oak Ridge, Tennessee, and Paducah, Kentucky). The gaseous diffusion uranium enrichment facilities at PORTS operated from 1954 through 2001 supplying enriched uranium for government and commercial use. Initially, PORTS provided uranium-235 for national security at assays above those of the other production facilities at Oak Ridge, Tennessee, and Paducah, Kentucky. In 1991, DOE suspended the production of highly enriched uranium at PORTS. In 1993, DOE leased the uranium production facilities at PORTS to the United States Enrichment Corporation (USEC), which was established by the Energy Policy Act of 1992. USEC enriched uranium at PORTS for use in commercial nuclear power reactors until May 2001. At that time, USEC placed the production facilities at PORTS into a cold standby mode under a contract with DOE. DOE terminated the cold standby program as of September 30, 2005, and replaced it with the cold-shutdown program. In 2010, USEC began the process of returning the gaseous diffusion uranium enrichment facilities and other associated support buildings and areas at PORTS to DOE. This process was completed on September 30, 2011.

DOE is responsible for decontamination and decommissioning (D&D) of the gaseous diffusion process buildings and associated facilities and areas, environmental restoration, waste disposal, and uranium management (including the depleted uranium hexafluoride [DUF_6] Conversion Facility). FBP, Wastren-EnergX Mission Support, LLC (WEMS), and BWCS are the contractors responsible for DOE activities at PORTS.

FBP is responsible for the following activities: 1) D&D of the gaseous diffusion process buildings and associated facilities and areas, 2) environmental restoration of contaminated areas; 3) monitoring and reporting on environmental compliance; 4) disposition of legacy radioactive waste; 5) disposition of highly enriched uranium; and 6) operation of the site's waste storage facilities.

WEMS provides facility support services including the following: 1) maintenance of facilities, grounds, and roadways; 2) janitorial services; 3) security access for DOE facilities; 4) training; 5) records and fleet management; and 6) information technology/network support for DOE operations.

BWCS is responsible for operation of the DUF_6 Conversion Facility at PORTS, surveillance and maintenance of DUF_6 cylinders, and environmental compliance and monitoring activities associated with operation of the DUF_6 Conversion Facility. DUF_6, which is a product of the uranium enrichment process, is stored in cylinders on site. The DUF_6 Conversion Facility converts DUF_6 into uranium oxide and hydrogen fluoride, which are shipped off site. The uranium oxide is made available for beneficial reuse, storage, or disposal, and the hydrogen fluoride is sold for reuse. BWCS is responsible for sampling required by the BWCS NPDES permit and environmental sampling associated with the X-745C, X-745E, and X-745G cylinder storage yards.

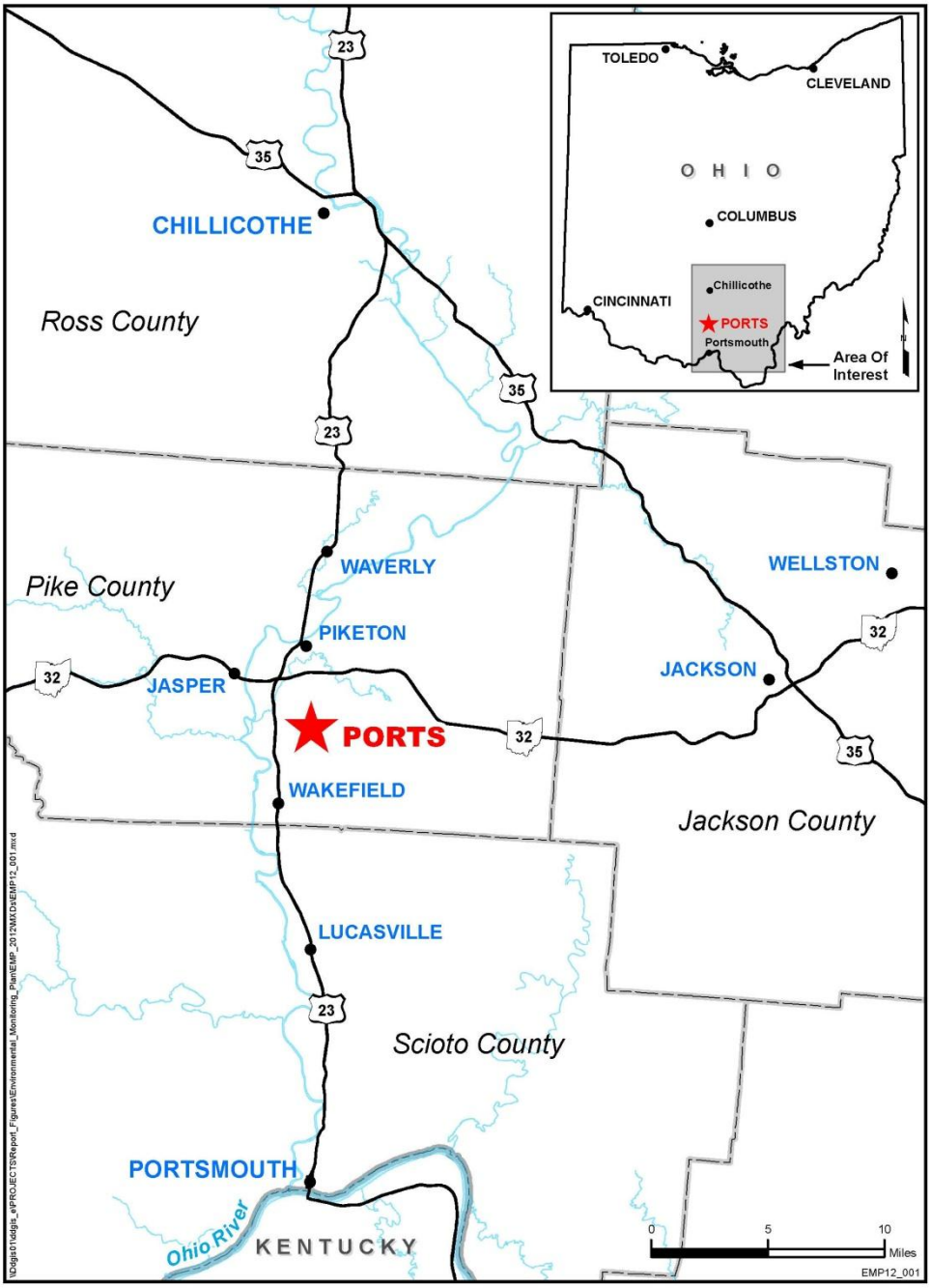

Figure 1.1. PORTS site location

USEC, Inc. (the parent company of USEC), which is a private company regulated by the Nuclear Regulatory Commission, is currently developing gaseous centrifuge uranium enrichment technology at PORTS including construction of both a small scale demonstration facility (the Lead Cascade) and a commercial scale uranium enrichment facility (the ACP). The Lead Cascade has been operating since 2006. The commercial scale ACP is under development. Both of these facilities (the Lead Cascade and the ACP) are housed in existing buildings at PORTS that were constructed for DOE's Gaseous Centrifuge Enrichment Plant, which was cancelled in 1985. USEC, Inc. is responsible for sampling required by the USEC, Inc. NPDES permit. DOE obtains results of this sampling from USEC, Inc. for annual reporting purposes.

Effluent streams from PORTS containing primarily stormwater runoff and water used for once-through cooling purposes discharge into Little Beaver Creek, which flows to Big Beaver Creek, Big Run Creek, the West Drainage Ditch, and the Southwestern Drainage Ditch, all of which ultimately flow into the Scioto River. Two pipelines discharge effluent from the sewage treatment plant and treated blowdown from the recirculating cooling water system to the Scioto River. Sludge from the wastewater treatment plant is discharged into drying beds, and after drying, the sludge is placed in storage containers for disposition.

1.3 OBJECTIVES

Environmental monitoring is completed to determine one or more of the following:

- compliance with applicable environmental quality standards and public exposure limits; federal, state, and local regulations; DOE Orders; and other environmental commitments;
- background levels and site contributions of radioactive and chemical materials in the environment;
- effectiveness of effluent treatment and controls in reducing effluents and emissions;
- validity and effectiveness of models to predict the concentrations or activities of pollutants in the environment;
- long-term buildup of radionuclides and chemicals released from PORTS and direction of environmental trends;
- presence and quantity of unplanned releases; and
- potential environmental problems and the need for remedial actions or mitigation measures.

Environmental monitoring may also:

- provide information to the public on potential impacts of site operations to the public and the environment;
- distinguish site pollutant contributions from other local sources, and;
- provide ancillary data that may be required to assess the consequences of an accident.

Environmental monitoring is conducted in support of the Integrated Safety Management System (ISMS) and Environmental Management System (EMS). The methods and protocols described in this plan meet the intent of the following FBP documents:

- *Integrated Safety Management System Plan* (FBP 2012c, or latest revision)
- *Environmental Management System Program Description* (FBP 2012a, or latest revision)
- *Integrated Safety Management System Description and Environmental Management System Description for the Portsmouth Former Uranium Enrichment Facilities* (FBP 2011, or latest revision).

This EMP also indicates, for each sampled medium, whether each major program element meets the performance criteria (designated in bold text and with the label "*should**") described in the *Regulatory Guide*. The criteria state the actions that must be taken (indicated by "*should**") to comply with the *Regulatory Guide*. Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria. This information is provided at the end of each appropriate chapter or section as a convenience to the reader and as a way to document compliance. Only performance criteria that are relevant to the particular EMP section or chapter are listed. Performance criteria are stated as in the *Regulatory Guide*, including the letter designation.

1.4 SCOPE

The EMP sets forth the requirements for the routine environmental monitoring programs established by PORTS that 1) measure and monitor effluents from site operations; and 2) maintain surveillance through measurement, monitoring, and calculation of the effects of those operations on the environment and public health.

Environmental monitoring consists of two components: effluent monitoring and environmental surveillance. As defined in DOE Order 458.1 (and similarly in DOE Order 5400.5), effluent monitoring is the collection and analysis of samples of liquid and gaseous effluents or measurements of liquid and gaseous effluents performed to characterize and quantify radiological contaminants and process stream characteristics, assess radiation exposures of members of the public, and demonstrate compliance with applicable standards. Environmental surveillance is the collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media at the DOE site and surrounding environs and the measurement of external radiation to demonstrate compliance with applicable standards, assess radiation exposure of members of the public, and assess effects, if any, on the environment.

The following PORTS monitoring programs are discussed in this EMP in Chapter 2, Effluent Monitoring, or Chapter 4, Environmental Surveillance:

- Effluent Monitoring (Chapter 2)
  - NPDES locations
  - Cylinder storage yards (surface water and sediment)
  - Settleable solids
  - Air
- Environmental Surveillance (Chapter 4)
  - Ambient air
  - External radiation
  - Groundwater (including exit pathway and water supply [drinking water wells])
  - Surface water required by the Integrated Groundwater Monitoring Program
  - Local surface water
  - Sediment

- Soil and vegetation
- Biota (crops, fish, deer, and dairy products)

Table 1.1 provides a summary of the environmental monitoring programs, including number of monitoring locations, parameters, and monitoring frequency, as practical. The *Integrated Groundwater Monitoring Plan* (IGWMP) (DOE 2012, or latest revision) provides the requirements for groundwater monitoring, associated surface water monitoring, and water supply monitoring at PORTS. The EMP provides only a brief summary of these programs. FBP, BWCS, and USEC, Inc. NPDES permits provide the requirements for monitoring at NPDES monitoring locations and should be consulted for specific monitoring requirements for each NPDES monitoring location. Monitoring at the cylinder storage yards is conducted in accordance with agreements between DOE and the U.S. Environmental Protection Agency (U.S. EPA) or the Ohio Environmental Protection Agency (Ohio EPA).

The remaining chapters of the EMP describe the elements that support the PORTS environmental monitoring programs. Chapter 3 describes the meteorological monitoring program and its role in dispersion modeling and dose calculation. Chapter 5 describes laboratory procedures. Chapter 6 describes dose calculations. Chapter 7 provides information on data management, analysis, and statistical treatment. Chapter 8 discusses reporting requirements. Chapter 9 is a quality assurance plan (QAP) that describes quality assurance (QA) and quality control (QC) elements applicable to environmental monitoring.

Monitoring required by the EMP may also be used to assess the environmental impacts associated with an unplanned release. In general, unplanned releases may be quantified via existing monitoring, if possible, or by mass balance. Predictions of environmental impacts associated with unplanned releases may be initially estimated by dispersion and transport modeling and confirmed by special environmental sampling as appropriate to the release. In general, procedures for monitoring associated with an unplanned release will be the same as those for routine environmental surveillance, as appropriate to the release.

The EMP is reviewed annually and updated at least once every three years.

1.5 *REGULATORY GUIDE* PERFORMANCE CRITERIA, GENERAL COMMENTS

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. **Operators of DOE-controlled facilities *should** provide the capabilities to detect and quantify planned and unplanned releases of radionuclides, consistent with the potential for offsite impacts, and to support consequence assessments as necessary.**

   In preparing this EMP, the operators of PORTS identified media (e.g., surface water, groundwater, and air) that could be affected by DOE or USEC, Inc. operations and thereby impact offsite environment/populations. This plan provides the existing monitoring for each medium appropriate to its potential for offsite impact. It also describes the site's capabilities to detect and quantify planned and unplanned releases of chemicals and radionuclides.

Table 1.1 EMP summary

Program	No. of locations	Parameters	Frequency
DOE (FBP) NPDES	18	chemicals or other parameters: see FBP NPDES permit	see NPDES permit
	12	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly
	12	radionuclides: Tc-99, U, U-233/234, U-235/236, U-238	monthly
DOE (BWCS) NPDES	1	parameters: see BWCS NPDES permit	see NPDES permit
USEC, Inc. NPDES	3	chemicals: see USEC, Inc. NPDES permit	see NPDES permit
	2	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly[a]
	2	radionuclides: Tc-99, U	weekly[a]
Cylinder yards (FBP) surface water	7	U, alpha activity, beta activity	monthly[b]
Cylinder yards (BWCS) surface water	7	U, alpha activity, beta activity	monthly[b]
surface water	4	polychlorinated biphenyls (PCBs)	quarterly[b]
sediment	4	PCBs	quarterly[b]
Settleable solids	12	Settleable solids Alpha activity and beta activity in the settleable solids portion of the sample (only if settleable solids are detected)	semiannual
Air (FBP process vents)	9	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly
	9	radionuclides: Tc-99, U, U-233/234, U-235/236, U-238	weekly[c]
	2	radionuclides: Th-228, Th-230, Th-232	weekly[c]
Ambient air	15	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly
	15	radionuclides: Tc-99, U, U-233/234, U-235/236, U-238	monthly
	15	chemicals: Fl	weekly
External radiation	24	deep dose, eye dose, shallow dose	quarterly

Table 1.1 EMP summary (continued)

Program	No. of locations	Parameters	Frequency
Groundwater	-	see IGWMP	see IGWMP
Exit pathway groundwater	10	see Section 4.3 and IGWMP	see IGWMP (minimum biennial)
Water supply	-	see IGWMP	see IGWMP
IGWMP surface water	-	see IGWMP	see IGWMP
Local surface water	14	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	semiannual
Sediment	17	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual
	17	PCBs, Al, Sb, As, Ba, Be, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Hg, Ni, Se, Si, Ag, Tl, Zn	annual
Soil	15	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual
Vegetation	15	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual
Biota			
crops	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)
fish	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)
		PCBs	annual (as available)
deer	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)
dairy	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)

[a]Monitoring for radionuclides at USEC, Inc. NPDES outfalls is conducted in accordance with the USEC, Inc. Safety Analysis Report. Current monitoring parameters and frequencies are included in this EMP as information only. Any changes to this monitoring are automatically included in this EMP.
[b]Monitoring at cylinder yards is conducted in accordance with agreements between DOE and U.S EPA or Ohio EPA. Current monitoring parameters and frequencies are included in this EMP as information only. Any changes to this monitoring are automatically included in this EMP.
[c]Samples are normally collected weekly; however, the sampling period may be extended provided that the sampler is operating at all times that the vent is operating.

b. **The recommendations found in this guide *should** be incorporated into the design and operation of effluent monitoring and environmental surveillance systems.**

This plan presents the technical rationale for the existing effluent monitoring and environmental surveillance systems. Proposed changes and/or additions to those systems will incorporate, as necessary, recommendations found in the *Regulatory Guide*.

c. **Documentation of the decisions made concerning incorporation of the specific guidance statements, including a description of any alternative methods selected, *should** be included in the site EMP.**

Discussions of the technical rationale for monitoring system designs, which constitute an integral part of this plan, document decisions on incorporation of specific guidance statements.

d. **The potential for airborne or liquid release of radioactive material (including accidental releases) *should** be evaluated and documented in the EMP. Based on this documentation, those effluent streams that do not have the potential for releasing radioactive material are not subject to selected provisions of this guide. Heads of Operations Offices, in consultation with the appropriate Program Office and EH-1, may approve specific requests for exceptions.**

The potential for airborne or liquid releases has been evaluated in the DOE Environmental Survey for PORTS and is incorporated by reference in this EMP. These evaluations form the basis for environmental monitoring at PORTS.

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2. EFFLUENT MONITORING

As defined in DOE Order 458.1 (and similarly in DOE Order 5400.5), effluent monitoring is the collection and analysis of samples of liquid and gaseous effluents, or measurements of liquid and gaseous effluents, performed to characterize and quantify radiological contaminants and process stream characteristics, assess radiation exposures of members of the public, and demonstrate compliance with applicable standards.

Effluent monitoring at PORTS includes surface water, sediment, groundwater, and air. The following monitoring programs are discussed in this chapter:

- NPDES locations
- Cylinder storage yards (surface water and sediment)
- Settleable solids monitoring
- Air

Groundwater monitoring at PORTS include elements of both effluent monitoring and environmental surveillance and is discussed in Chapter 4, Environmental Surveillance.

2.1 SURFACE WATER/SEDIMENT

Surface waters leaving PORTS consist of treated process wastewater, treated groundwater, groundwater discharge, non-contact once-through cooling water, sewage treatment plant effluent, and stormwater runoff. Surface waters are monitored to assess the effect of facility operations on the quality of the environment and to show compliance with state and federal regulations and DOE Orders. Surface water/sediment monitoring includes:

- NPDES locations
- Cylinder storage yards (surface water and sediment)
- settleable solids
- surface water monitoring required by the IGWMP
- local surface water monitoring

This chapter discusses NPDES sampling, monitoring of the cylinder storage yards (surface water and sediment), and settleable solids monitoring. Chapter 4, Environmental Surveillance, discusses surface water monitoring required by the IGWMP and local surface water monitoring.

Surface water monitoring at NPDES outfalls is mandated by permits issued to current DOE contractors (FBP and BWCS) and USEC, Inc. (referred to as USEC in the remainder of this EMP for simplicity). The permits identify monitoring parameters (e.g., pH, trichloroethene, chromium, and/or oil and grease, etc.), monitoring frequency (daily, weekly, etc.), and discharge limits for each monitoring parameter (as applicable). The permits also require biotoxicity monitoring at two FBP NPDES outfalls and at one monitoring station in the Scioto River. Radiological monitoring data from FBP NPDES outfalls collected in accordance with the EMP are also provided to Ohio EPA. Radiological monitoring is not required at the BWCS NPDES outfall. USEC provides radiological monitoring data to Ohio EPA that are collected in accordance with the Safety Analysis Report.

As required by Ohio EPA, BWCS collects monthly surface water samples from seven locations at the X-745C, X-745E, and X-745G Cylinder Storage Yards. FBP collects monthly surface water samples at seven locations that monitor the X-745B, X-745D, and X-745F Cylinder Storage Yards. These samples collected by FBP or BWCS are analyzed for uranium, alpha activity, and beta activity.

In addition, U.S. EPA requires quarterly sampling of surface water and sediment for PCBs at four locations downstream from the cylinder yards. BWCS is responsible for this sampling. The surface water runoff from the cylinder storage yards flows through NPDES outfalls prior to discharge from PORTS.

FBP collects samples at 12 locations to determine the activity of radioactive material that is present in the sediment suspended in the water samples (settleable solids monitoring). The data from this sampling are used to determine compliance with DOE Orders 458.1 and 5400.5, *Radiation Protection of the Public and the Environment.*

2.1.1 Rationale and Design Criteria

Effluent monitoring program objectives include:

- verifying compliance with applicable federal, state, and local regulations, and DOE Orders;
- evaluating the effectiveness of effluent treatment and control;
- identifying potential environmental problems and evaluating the need for remedial actions or mitigation measures;
- supporting permit revision and/or reissuance;
- detecting, characterizing, and reporting unplanned releases; and
- reviewing radiological data and conducting environmental assessments per the As Low As Reasonably Achievable (ALARA) policy.

In addition, the *Regulatory Guide* recommends that this plan document:

- effluent monitoring (sampling or in situ measurement) extraction locations used for providing quantitative effluent release data for each outfall;
- procedures and equipment used to perform the extraction and measurement;
- frequency and analyses required for each extraction (continuous monitoring and/or sampling) location;
- minimum detection level and accuracy;
- QA components; and
- effluent outfall alarm settings and bases.

2.1.1.1 Regulations

The Clean Water Act, which requires the issuance of NPDES permits, governs the monitoring of effluents to surface water. Monitoring and reporting requirements for NPDES outfalls are outlined in the most recent permits issued by Ohio EPA.

In addition, DOE Orders 436.1, 450.1, 458.1, and 5400.5, as well as the *Regulatory Guide*, provide general and detailed guidance regarding the establishment of effluent monitoring programs for both

chemical and radiological parameters. Routine radiological sampling conducted at FBP and USEC NPDES outfalls meets the effluent monitoring requirements described in DOE Orders 458.1 and 5400.5.

Effluent monitoring at the cylinder storage yards is completed in accordance with agreements between DOE and Ohio EPA or U.S. EPA. Ohio EPA requires monthly collection of surface water samples from locations within the cylinder yards. U.S. EPA requires quarterly sampling of surface water and sediment within the storm water drainage system associated with the cylinder yards.

DOE Order 458.1, *Radiation Protection of the Public and the Environment*, Section 4, paragraph g(4), states that operators of DOE facilities discharging or releasing liquids containing radionuclides from DOE activities must ensure that the discharges do not exceed an annual average (at the point of discharge) of either of the following:

- 5 picocuries per gram (pCi/g) above background of settleable solids for alpha-emitting radionuclides, and
- 50 pCi/g above background of settleable solids for beta-emitting radionuclides.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, Chapter II, paragraph 3a(4), requires sampling of liquid process waste streams to determine the concentration of radioactive material that is present in the sediment suspended in the water sample. This paragraph states:

> *To prevent the buildup of radionuclide concentrations in sediments, liquid process waste streams containing radioactive material in the form of settleable solids may be released to natural waterways if the concentration of radioactive material in the solids present in the waste stream does not exceed 5 pCi (0.2 becquerel) per gram above background level, of settleable solids for alpha-emitting radionuclides or 50 pCi (2 becquerels) per gram above background level, of settleable solids for beta-gamma-emitting radionuclides.*

The settleable solids monitoring program is designed to demonstrate compliance with both DOE Order 458.1, which applies to liquid discharges containing radionuclides from DOE activities and DOE Order 5400.5, which applies to liquid process waste steams containing radioactive material.

2.1.1.2 Evaluation of effluent discharges

Specific radionuclides monitored at PORTS are selected based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and/or isotopic uranium because of the uranium enrichment process. Samples may be analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium during the Cold War.

PCBs are monitored in surface water and sediment at locations downstream from the cylinder storage yards because paint on the cylinders may contain PCBs.

Site investigations have also identified chemicals and radionuclides that are included in PORTS monitoring programs. These investigations include the Groundwater Quality Assessment, Quadrants I-IV Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFIs), Quadrants I-IV Cleanup Alternatives Studies/Corrective Measures Studies (CAS/CMSs), the existing groundwater monitoring program, the Radionuclide Verification Investigation, and other unit-specific studies. Monitoring requirements in the plant NPDES permits reflect the results of these investigations and incorporate knowledge of historic and current PORTS processes.

2.1.1.3 Performance standards

NPDES. Any device or process meeting Ohio EPA-approved standards may be used to determine the instantaneous flow rate, to take automatic samples, or to continuously monitor conditions (i.e. flow or pH) at NPDES locations. NPDES samples are collected in accordance with PORTS procedures.

Operating manual instructions and requirements for automatic samplers are incorporated into the contractor QAPs for NPDES sampling. Automatic samplers have been installed at all permitted outfalls requiring 24-hour composite samples.

Many of the NPDES outfalls (except Outfall 005) are equipped with continuous flow monitors. FBP Outfalls 001, 010, and 011 have continuous pH monitors with alarms tied to the Plant Shift Superintendent's office.

Radiological. Effluent samples for radiological analyses are collected using the same types of sampling equipment accepted for the NPDES program. There are no continuous monitors for radiological parameters.

2.1.1.4 Design criteria

NPDES. Automatic samplers have been installed following manufacturer guidelines for proper operation. All sampler parts that contact the water sample (e.g., sample lines, sample bottles) are compatible with the expected composition of the sample.

Continuous monitors have been installed following manufacturer guidelines for proper operation. All monitor parts that contact the effluent water (e.g., monitor electrodes, electrical cables) are compatible with the expected composition of the sample.

Radiological. Effluent samples for radiological analyses are collected using the same types of sampling equipment used for the NPDES program. There are no continuous monitors for radiological parameters.

2.1.1.5 Alarm levels

NPDES. The pH monitors at FBP Outfalls 001, 010, and 011 trigger alarms at a pH of 6.7 and 8.8 in order to assure compliance with current NPDES limits of 6.5 and 9.0 for these outfalls. No alarms are associated with the flow monitors.

Radiological. No alarms are associated with radiological monitoring at effluent sampling locations.

2.1.2 Monitoring Locations

This section discusses the monitoring locations for the following monitoring programs: NPDES, cylinder storage yards, and settleable solids.

2.1.2.1 NPDES

PORTS has a total of 22 NPDES monitoring locations regulated by the site NPDES permits (Figure 2.1). Of these, FBP has 18 monitoring locations. Nine outfalls discharge directly to surface water and six outfalls discharge to another outfall before leaving the site. FBP also monitors three additional locations that are not discharge points. BWCS has one outfall that flows to the X-230J5 Northwest Holding Pond (FBP NPDES Outfall 010) prior to discharge from the site. USEC is responsible for three NPDES outfalls. Two outfalls discharge directly to surface water, and one discharges to another outfall before leaving the site. The outfalls/sampling locations are shown on Figure 2.1, and all are described briefly below.

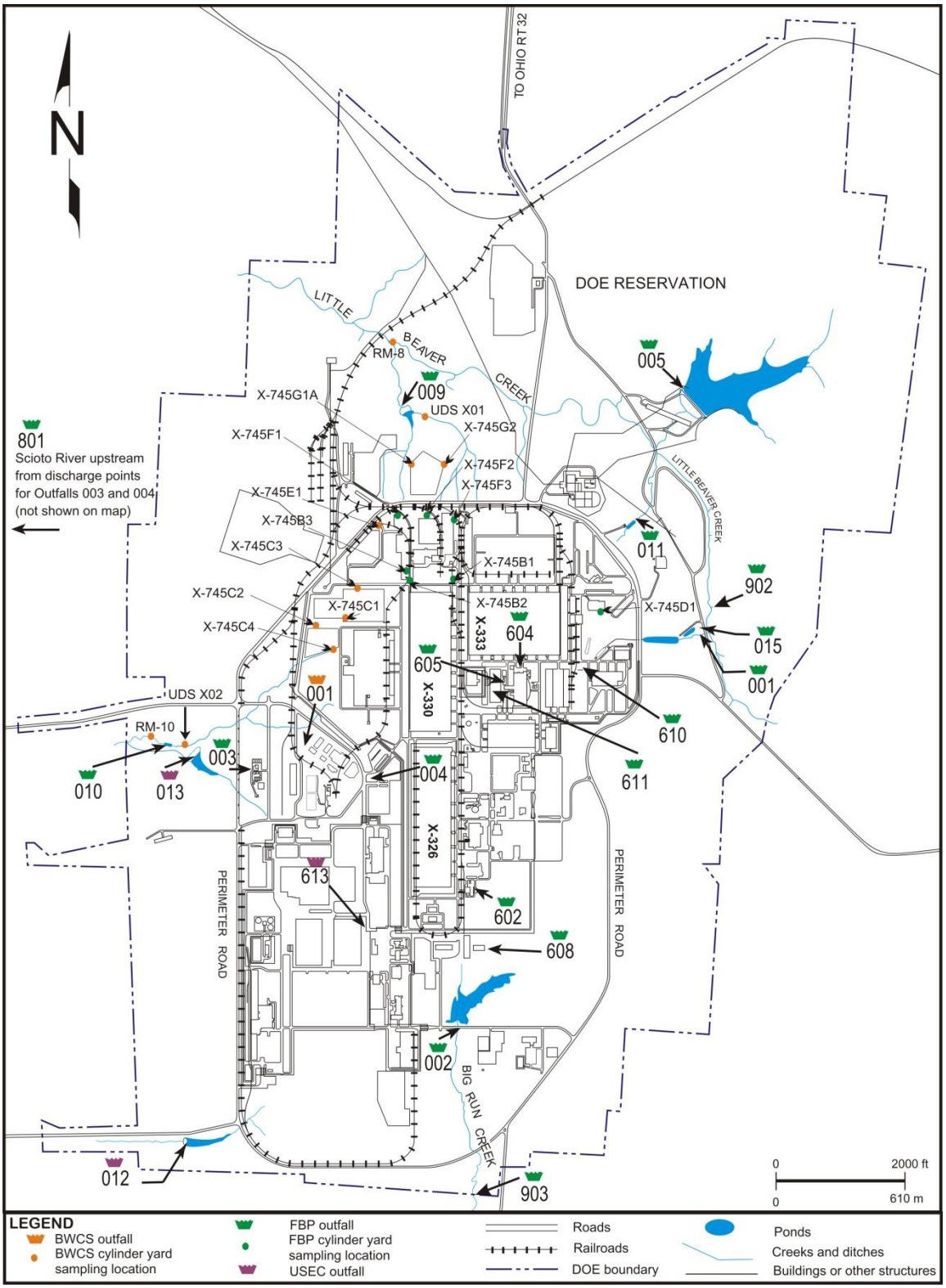

Figure 2.1. PORTS NPDES outfalls/monitoring points and cylinder storage yards monitoring locations

BWCS NPDES Outfall 001 – This outfall is located northwest of the DUF_6 facility. The outfall is permitted for liquid effluents generated by the deionized water system, and boiler and cooling tower blowdown from the DUF_6 Conversion Facility; however, the outfall currently discharges only precipitation run-off. Discharges flow to the West Drainage Ditch and the X-230J5 Northwest Holding Pond (FBP Outfall 010), which ultimately flows to the Scioto River.

FBP NPDES Outfall 001 (X-230J7 East Holding Pond) – The X-230J7 East Holding Pond may receive non-contact cooling water, steam condensate, foundation drainage, storm runoff, hydro-testing water from cylinders, groundwater infiltration, fire suppression system water, sanitary water for eyewash/shower station testing and flushing, residual byproducts from the X-701B groundwater remedy, and effluent from the X-624 Groundwater Treatment Facility. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, and oil can be diverted and contained. Water from this holding pond is discharged to a ditch that flows to Little Beaver Creek.

FBP NPDES Outfall 002 (X-230K South Holding Pond) – The X-230K South Holding Pond may receive non-contact cooling water, steam condensate, foundation drainage, storm runoff, fire-fighting training and fire suppression system water, ash wash water, boiler blowdown, water softener regeneration, groundwater infiltration, sanitary water for eyewash/shower station testing and flushing, and treated coal pile runoff. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, oil can be contained, and pH can be adjusted. Water from this holding pond is discharged to Big Run Creek.

FBP NPDES Outfall 003 (X-6619 Sewage Treatment Plant) – The X-6619 Sewage Treatment Plant treats stormwater, PORTS sewage, sewage from the Ohio Valley Electric Corporation, and water discharged from X-622, X-623 and X-627 groundwater treatment facilities (FBP NPDES Outfalls 608, 610, and 611), the X-700 Biodenitrification Facility (FBP NPDES Outfall 604), the X-705 Decontamination Microfiltration System (FBP NPDES Outfall 605), and the X-6002 Particulate Separator (USEC NPDES Outfall 613). The X-6619 Sewage Treatment Plant uses screening, aeration, clarification, and filtering followed by chlorination to treat wastewater prior to release to the Scioto River.

FBP NPDES Outfall 004 (Cooling Tower Blowdown) – This outfall is located at the junction of Pike Avenue and 15th Street at PORTS. It monitors blowdown water from various on-site cooling towers prior to discharge to the Scioto River. The outfall is also permitted to receive discharges from the X-622, X-623, and X-627 Groundwater Treatment Facilities (FBP NPDES Outfalls 608, 610, and 611).

FBP NPDES Outfall 005 (X-611B Lime Sludge Lagoon) – The X-611B Lime Sludge Lagoon is used to settle lime sludge used in a water-softening process. The X-611B also receives storm runoff. The lagoon only discharges during periods of excess rainfall.

FBP NPDES Outfall 009 (X-230L North Holding Pond) – The X-230L North Holding Pond may receive non-contact cooling water, storm runoff, steam condensate, fire suppression system water, groundwater infiltration, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, and oil can be contained. Water from this holding pond is discharged to the North Drainage Ditch that flows to Little Beaver Creek.

FBP NPDES Outfall 010 (X-230J5 Northwest Holding Pond) – The X-230J5 Northwest Holding Pond may receive non-contact cooling water, storm runoff, steam condensate, sanitary water for eyewash/shower station testing and flushing, fire-fighting training and fire suppression system water, and groundwater infiltration. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, and oil can be diverted and contained. Water from this holding pond is discharged to the West Drainage Ditch, which flows to the Scioto River.

FBP NPDES Outfall 011 (X-230J6 Northeast Holding Pond) – The X-230J6 Northeast Holding Pond may receive non-contact cooling water, storm runoff, steam condensate, fire suppression system water, groundwater infiltration, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, and oil can be diverted and contained. Water from this holding pond is discharged to the Northeast Drainage Ditch that flows to Little Beaver Creek.

USEC NPDES Outfall 012 (X-2230M Southwest Holding Pond) – The X-2230M Southwest Holding Pond may receive precipitation runoff, non-contact cooling water, foundation drainage, groundwater infiltration, steam condensate, firefighting training and fire suppression system water, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where solids can settle, chlorine can dissipate, and oil can be separated from the water prior to its release to an unnamed stream that flows to the Scioto River.

USEC NPDES Outfall 013 (X-2230N West Holding Pond) – The X-2230N West Holding Pond may receive precipitation runoff, non-contact cooling water, groundwater infiltration, foundation drainage, steam condensate, firefighting training and fire suppression system water, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where solids can settle, chlorine can dissipate, and oil can be separated from the water prior to its release to the West Drainage Ditch, which flows to the Scioto River.

FBP NPDES Outfall 015 (X-624 Groundwater Treatment Facility) – This facility removes volatile organic compounds from contaminated groundwater originating from the X-701B plume interceptor trenches. These groundwater interceptor trenches were constructed to control the migration of volatile organic compound-contaminated groundwater toward Little Beaver Creek. Treated water is released to the East Drainage Ditch that flows to Little Beaver Creek.

FBP NPDES Outfall 602 (X-621 Coal Pile Runoff Treatment Facility) – The X-621 Coal Pile Runoff Treatment Facility treats storm water runoff from the coal pile at the X-600 Steam Plant. The treated water is discharged to the X-230K South Holding Pond (FBP NPDES Outfall 002).

FBP NPDES Outfall 604 (X-700 Biodenitrification Facility) – The X-700 Biodenitrification Facility receives solutions from plant operations that are high in nitrate. At the X-700, these solutions are diluted and treated biologically using bacteria prior to being discharged to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

FBP NPDES Outfall 605 (X-705 Decontamination Microfiltration System) – The X-705 Decontamination Microfiltration System treats process wastewater using microfiltration and pressure filtration technology. The treated water is discharged to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

FBP NPDES Outfall 608 (X-622 Groundwater Treatment Facility) – This facility removes volatile organic compounds from contaminated groundwater originating from site remediation activities in the southern portion of the site, which is Quadrant I in the RCRA Corrective Action Program. Treated water is discharged to the sanitary sewer to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

FBP NPDES Outfall 610 (X-623 Groundwater Treatment Facility) – This facility removes volatile organic compounds from contaminated groundwater originating from site remediation activities in the X-701B Holding Pond area in Quadrant II and from miscellaneous well development and purge waters. Treated water is discharged to the sanitary sewer to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

FBP NPDES Outfall 611 (X-627 Groundwater Treatment Facility) – This facility removes volatile organic compounds from groundwater collecting in sumps located in the basements of the X-705 and X-700 buildings, which are part of Quadrant II. Treated water is discharged to the sanitary sewer to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

USEC NPDES Outfall 613 (X-6002 Particulate Separator) – This unit removes suspended solids from water used in the X-6002 Recirculating Hot Water Plant, which provides heat to the X-7725 and other buildings at PORTS, and may occasionally treat discharges of heating water for maintenance activities. Treated water is discharged to the sanitary sewer to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

FBP Station 801 – This location is a monitoring site in the Scioto River, upstream from the discharge point of Outfalls 003 and 004 and outside the zone of effluent and receiving water interaction.

FBP Station 902 – This location is a monitoring site in Little Beaver Creek, downstream from FBP NPDES Outfall 001 and outside the mixing zone.

FBP Station 903 – This location is a monitoring site in Big Run Creek, downstream from FBP NPDES Outfall 002 and outside the mixing zone.

2.1.2.2 Cylinder storage yards

Figure 2.1 shows the surface water runoff locations monitored at the X-745B, X-745C, X-745D, X-745E, X-745F, and X-745G cylinder storage yards and the downstream surface water and sediment monitoring locations for the cylinder yards. A description and the DOE contractor responsible for each location are provided below.

BWCS monitoring locations:

- Locations X-745C1, X-745C2, X-745C3, and X-745C4 monitor surface water runoff from the X-745C cylinder storage yard.
- Location X-745E1 monitors surface water runoff from the X-745E cylinder storage yard.
- Location X-745G1A and X-745G2 monitor surface water runoff from the X-745G cylinder storage yard.
- Location UDS X01 monitors surface water and sediment within the storm water drainage system prior to the outfall associated with the X-230L North Holding Pond.
- Location RM-8 monitors surface water and sediment in the North Drainage Ditch downstream from the X-230L North Holding Pond.
- Location UDS X02 monitors surface water and sediment within the storm water drainage system prior to the outfall associated with the X-230J5 Northwest Holding Pond.
- Location RM-10 monitors surface water and sediment in the West Drainage Ditch downstream from the X-230J5 Northwest Holding Pond.

FBP monitoring locations:

- Locations X-745B1, X-745B2, and X-745B3 monitor surface water runoff from the X-745B cylinder storage yard.

- Location X-745D1 monitors surface water runoff from the X-745D cylinder storage yard.

- Locations X-745F1, X-745F2, and X-745F3 monitor surface water runoff from the X-745F cylinder storage yard.

2.1.2.3 Settleable solids

Samples are collected from seven NPDES outfalls, two IGWMP surface water monitoring locations, and three background locations as listed below:

- FBP NPDES Outfall 002, which discharges to Big Run Creek;

- FBP NPDES Outfall 003, which discharges to the Scioto River;

- FBP NPDES Outfall 004, which discharges to the Scioto River;

- FBP NPDES Outfall 005, which discharges to the Little Beaver Creek;

- FBP NPDES Outfall 009, which discharges to the Little Beaver Creek;

- FBP NPDES Outfall 011, which discharges to the Little Beaver Creek;

- USEC NPDES Outfall 012, which discharges to the Southwestern Drainage Ditch (and then to the Scioto River;

- EDD-SW01, which monitors discharges from FBP NPDES Outfalls 001 and 015;

- WDD-SW03, which monitors discharges from FBP NPDES Outfall 010 and USEC NPDES Outfall 013;

- Background location RW-6, a local surface water monitoring point on the Scioto River in Piketon;

- Background location RW-5, a local surface water monitoring point on the Big Beaver Creek north of PORTS; and

- Background location LBC-SW12, a monitoring point on Little Beaver Creek upstream from PORTS NPDES discharges and potential groundwater discharges.

These locations were selected because they meet the definition of a “liquid discharge containing radionuclides from DOE activities” as stated in the DOE Order 458.1 requirement for settleable solids monitoring (see Section 2.1.1.1). Figure 2.2 shows the settleable solids monitoring locations.

2.1.3 Monitoring Parameters and Frequency

The current FBP, BWCS, and USEC NPDES permits list the non-radiological monitoring parameters and sampling frequencies for each monitoring location. Sampling frequencies for non-radiological parameters vary from daily to quarterly. Table 2.1 lists examples of the non-radiological monitoring parameters for the PORTS NPDES outfalls. Table 2.1 does not include all monitoring parameters for all NPDES outfalls; the current FBP, BWCS, and USEC NPDES permits should be consulted for all monitoring parameters for each monitoring location.

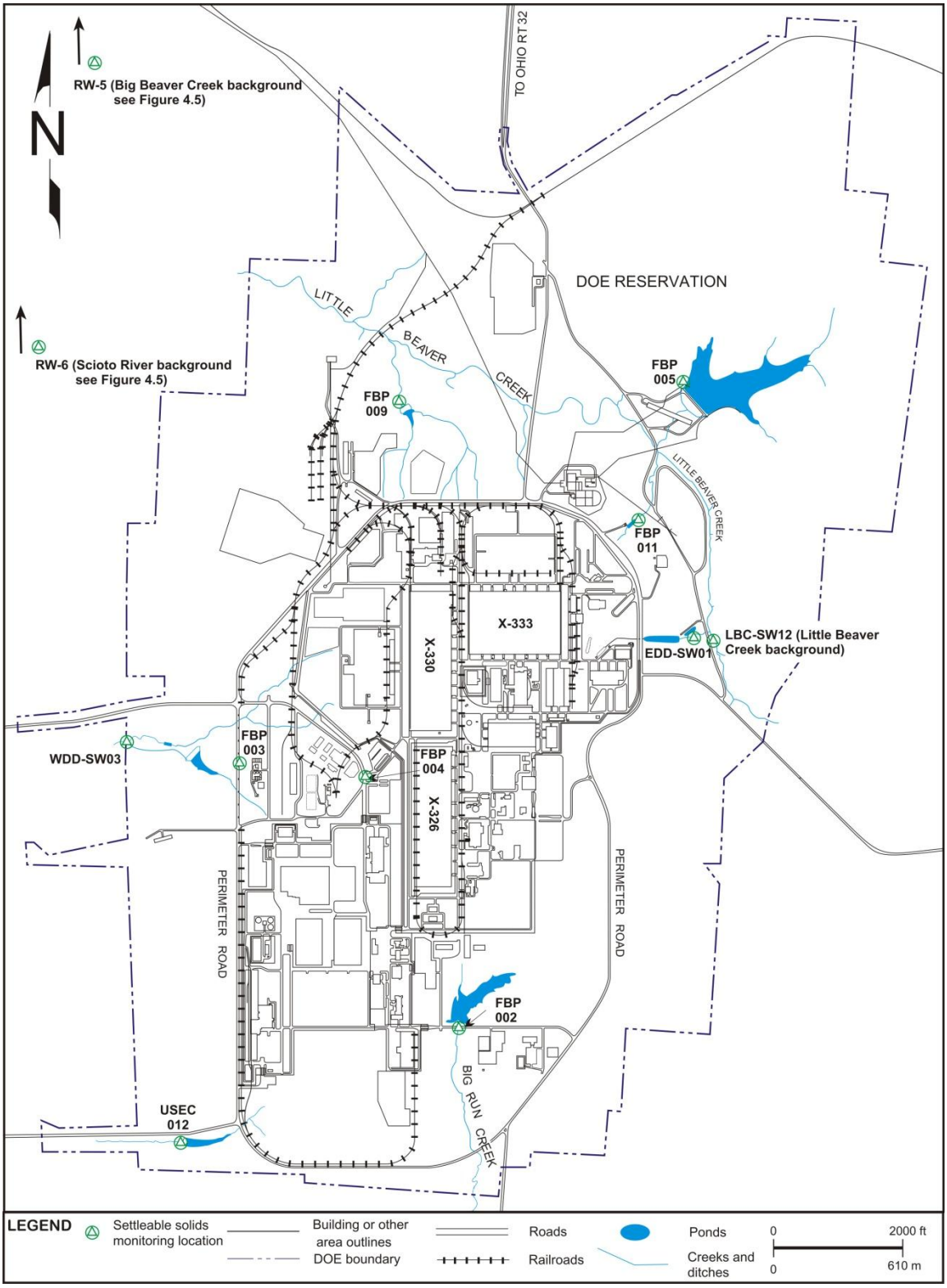

Figure 2.2 Settleable solids monitoring locations

Table 2.1. NPDES non-radiological parameters[a]

Acute Toxicity (*Pimephales promelas*)	Nitrogen Kjeldahl, total
Acute Toxicity (*Ceriodaphnia dubia*)	Nitrogen, ammonia (NH_3)
Carbonaceous Biochemical Oxygen Demand	Nitrogen, nitrate (NO_3)
Cadmium, total recoverable	Nitrogen, nitrite (NO_2)
Chlorine, total residual	Nitrogen, nitrite + nitrate
Chromium, hexavalent	Oil and Grease
Chromium, total	PCBs
Copper, total	pH
Copper, total recoverable	Phosphorus
1,2-trans-dichloroethylene	Silver, total recoverable
Fecal coliform	Solids, dissolved-sum of
Flow rate	Sulfate
Fluoride, total	Trichloroethene
Iron, total	Thallium, total recoverable
Iron, total recoverable	Total precipitation
Manganese, total	Total suspended solids
Mercury, total	Water temperature
Nickel, total	Zinc, total
Nickel, total recoverable	Zinc, total recoverable

[a]See NPDES permits for applicable outfalls and sampling frequencies.

FBP NPDES outfalls are sampled monthly for technetium-99, uranium, and isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238), and quarterly for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Samples are collected from FBP Outfall 005 only when the outfall is in use. Radiological monitoring is not required at the BWCS NPDES outfall.

USEC NPDES Outfalls 012 and 013 are sampled weekly for uranium and technetium-99, and quarterly for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Radiological monitoring is not required at the USEC NPDES Outfall 613. This sampling is conducted in accordance with the USEC Safety Analysis Report. Current monitoring parameters and frequencies are included in this EMP as information only. Any changes to USEC NPDES monitoring required by the Safety Analysis Report are included automatically in this EMP.

BWCS collects monthly surface water samples from monitoring locations at the X-745C, X-745E, and X-745G cylinder storage yards (X-745C1, X-745C2, X-745C3, X-745C4, X-745E1, X-745G1A, and X-745G2) for alpha activity, beta activity, and uranium, when water is available. BWCS collects quarterly surface water (both filtered and unfiltered) and sediment samples from four locations downstream from the cylinder yards (UDS X01, RM-8, UDS X02, and RM-10) for PCBs.

FBP collects monthly surface water samples from monitoring locations at the X-745B, X-745D, and X-745F cylinder storage yards (X-745B1, X-745B2, X-745B3, X-745D1, X-745F1, X-745F2, and X-745F3) for alpha activity, beta activity, and uranium, when water is available.

Settleable solids samples are collected semiannually, with the possible exception of FBP Outfall 005. Because FBP NPDES Outfall 005 only discharges during periods of excessive rain, this outfall is only sampled when in use, and only once in each six month period (i.e., once in January through June, if the outfall is in use, and once in July through December, if in use). Samples are analyzed for settleable solids. If settleable solids are detected in the sample, the settleable solids portion of the sample is analyzed for alpha activity and beta activity.

2.1.4 Field Sampling Procedures

Sampling procedures for each outfall vary from using a dipper for grab samples to collecting samples from an automated composite sampler. Samples are collected in accordance with PORTS procedures.

2.1.5 Procedures for Laboratory Analyses

The NPDES permits reference methods for laboratory analyses. Analytical detection limits are as stipulated in contractual agreements with analytical laboratories. Chapter 5 provides additional information about QA/QC procedures used in laboratory analyses of NPDES samples.

2.1.6 QA/QC Requirements

Chapter 9 includes guidelines for QA/QC procedures for surface water or NPDES sampling. QA/QC procedures specific to the surface water or NPDES programs are identified in the applicable Sampling and Analysis Plan (SAP) for PORTS.

2.1.7 Data Analysis and Statistical Treatment

Sample results for surface water effluent programs are transferred into the Project Environmental Measurements System (PEMS) by the laboratory.

2.1.7.1 NPDES

As data become available from field measurements or contracted laboratories, all NPDES parameters are reviewed in a timely manner for compliance with the limits and requirements specified in the NPDES permits by the assigned environmental staff. For some parameters, limits are provided for individual measurements and for a monthly average (calendar month). Compliance with both limits is reviewed frequently enough to ensure that Ohio EPA exceedence reporting requirements are met.

An annual summary of all NPDES parameters is prepared for the Annual Site Environmental Report following the end of the calendar year. This summary includes for each outfall and parameter:

- the number of values collected over the previous year,
- the annual maximum and minimum values, and
- the overall percent compliance for each DOE outfall.

The overall percent compliance with the current NPDES permits is also calculated. Percent compliance is calculated separately for FBP, BWCS, and USEC NPDES permits.

NPDES radionuclide data are periodically reviewed by assigned personnel for trends and compliance with the following regulatory standards (as applicable):

- DOE derived concentration guides (DCGs) provided in DOE Order 5400.5
- DOE derived concentration standards (DCSs) in the *Derived Concentration Technical Standard* (DOE-STD-1196-2011) as referenced in DOE Order 458.1, which replace the DCGs
- Ohio EPA drinking water standards.

An annual radionuclide summary is prepared for the Annual Site Environmental Report. This summary includes for each outfall and parameter:

- the number of values collected over the previous year,
- the annual maximum and minimum values, and

- the total annual discharge in curies for external DOE and USEC outfalls (calculated separately for DOE and USEC).

Radionuclide data collected at NPDES outfalls may also be used in dose calculations as described in Chapter 6.

2.1.7.2 Cylinder storage yards

Cylinder yards data are periodically reviewed by assigned FBP or BWCS personnel for trends and compliance with U.S. EPA requirements for concentrations of PCBs in surface water and sediment.

2.1.7.3 Settleable solids

When a low concentration of settleable solids is detected in a water sample, accurate measurement of the alpha and beta activity in the settleable solids portion of the sample is not practical due to the small sample size. A DOE memo (DOE 1995) states that settleable solids of less than 40 mg/L are in *de facto* compliance with the DOE Order 5400.5 limits (5 pCi/g above background for alpha activity and 50 pCi/g above background for beta activity – see Section 2.1.1.1). Based on this memo, a reporting limit of 40 mg/L is used for settleable solids in the surface water samples collected for the settleable solids monitoring program. If settleable solids are not detected in the sample at a concentration of 40 mg/L or more, the sample is considered in compliance with the DOE Order limits, and the settleable solids portion of the sample is not analyzed for alpha and beta activity.

If settleable solids are detected in the sample at a concentration of 40 mg/L or more, the settleable solids portion of the sample is analyzed for alpha and beta activity. The background activity, if any, is then subtracted from the result. Results for each location and each sampling event are compared to the limits set in DOE Order 5400.5. After the second semiannual sampling event, the results for each sampling location are averaged and compared to the limits set in DOE Order 458.1. Analytical results reported as undetected are assumed to be zero.

2.1.8 Reports and Records

Chapter 8 summarizes reporting requirements applicable to environmental monitoring data collected under the EMP. Chapter 9 includes recordkeeping requirements.

The following reports must be completed for the surface water effluent monitoring programs discussed in this section.

NPDES. The NPDES permits require submission of a Monthly Operating Report to Ohio EPA by the 15th day of the month following the month-of-interest if submitted in hardcopy and by the 20th day of the month following the month-of-interest if submitted electronically. These reports must be completed on the forms designated by the Ohio EPA and include the following information:

- NPDES permit number and holder, plant mailing address, the month and year of the information, and the outfall, parameters, and units being reported;

- a listing of the individual parameter values or explanatory codes for any required values not available;

- a summary of each parameter, consisting of the sum of the individual values, the arithmetic average, the monthly maximum value and the monthly minimum value; and

- any additional information requested by Ohio EPA.

Radiological Discharge Monitoring Reports that include results for radionuclides monitored at FBP outfalls and USEC NPDES outfalls (external outfalls only) are submitted quarterly to Ohio EPA.

In addition, Ohio NPDES regulations require reporting of any exceedence of a permit limitation to the Ohio EPA hotline within 24 hours, followed by a written report to the Ohio EPA within five days. Other specified noncompliances with the NPDES permit (such as a spill or release to surface waters not included on the permit) must be reported, in writing, to the District Office of the Ohio EPA within five working days of the discovery of the exceedence or noncompliance. For parameters requiring laboratory analysis, this time limit starts when the analysis is completed. The reporting mechanism for NPDES exceedences for off-site laboratories is specified in the laboratories' contracts.

The exceedence report to Ohio EPA must include the plant's NPDES permit number, unique identifier for the occurrence, the date of the occurrence, the outfall involved, the NPDES limit exceeded (if applicable), and the actual value of the parameter or nature of the noncompliance. In addition, a brief description of the cause of the occurrence and any measures taken to prevent a recurrence must be included.

If required, an Occurrence Report as described in DOE Order M 231.1-2 must be submitted to DOE for an NPDES exceedence or other noncompliance.

Data from NPDES monitoring locations are reported in the Annual Site Environmental Report.

Cylinder storage yards. The Annual Site Environmental Report includes a calendar year summary of cylinder yards surface water and sediment sampling data. An annual report of surface water and sediment PCB data is submitted to U.S. EPA.

Settleable solids. The Annual Site Environmental Report includes a calendar year summary of the results of the settleable solids monitoring program.

2.1.9 *Regulatory Guide* Performance Criteria

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. **All liquid effluent streams *should** be evaluated and their potential for release of radioactive material assessed. Based on this assessment, decisions *should** be made regarding necessary effluent monitoring systems and the rationale *should** be documented in the EMP.**

   Historical and continuing evaluations of effluents have shaped the existing monitoring programs. Program modifications are proposed, evaluated, and implemented as continuing evaluations warrant. Monitoring programs have been established and documented in this EMP.

b. **Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination *should** be monitored in accordance with the requirements of DOE Order 5400.1 and DOE Order 5400.5.**

   Liquid effluents from DOE-controlled facilities are monitored in accordance with DOE Orders. Monitoring programs have been established and documented in this EMP.

c. **Facility operators *should** provide monitoring of liquid waste streams adequate to 1) demonstrate compliance with the requirements of DOE Order 5400.5, Chapter II,**

paragraphs 1a, 1d, 2a, and 3, 2) quantify radionuclides released from each discharge point, and 3) alert affected process supervisors of accidents in processes and emission controls.

The historical and continuing evaluations of effluents, combined with the requirements of NPDES monitoring, serve to demonstrate compliance and provide the basis for release quantification. Timely reporting of sampling results serves to provide warning of accidents. Accidents in non-radionuclide emission controls are aided by real-time alarms at selected outfalls. NPDES monitoring results are presented in the Annual Site Environmental Report.

d. **When continuous monitoring or continuous sampling is provided, the overall accuracy of the results *should** be determined (±% accuracy and the % confidence level) and documented in the EMP.**

There are no continuous monitors for radionuclides at surface water/sediment monitoring locations. Continuous samplers used in the NPDES program provide samples for radiological analyses. The overall accuracy of the samplers is documented in the manufacturer's specifications.

e. **Provisions for monitoring of liquid effluents during an emergency *should** be considered when determining routine liquid effluent monitoring program needs.**

Provisions for manually sampling effluent points in the event of a power failure or other emergency have been considered.

f. **The selection or modification of a liquid effluent monitoring system *should** be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.**

The historical and continuing evaluations of effluent emissions have been and continue to be used in design and modification of the monitoring system.

g. **For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of the monitoring or surveillance systems, a pre-operational assessment *should** be made and documented in the EMP to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.**

New facilities or major modifications to existing facilities that could affect effluent release quality or quantity are reviewed for environmental compliance. These reviews are documented in project files.

h. **The performance of the effluent monitoring systems *should** be sufficient for determining whether effluent releases of radioactive material are within the DCGs specified in DOE Order 5400.5 and to comply with the reporting requirements of Chapter II, paragraph 7, of that Order.**

Compliance with quality control procedures in the field and in the laboratory analyses ensures the reliability of the effluent monitoring system and its ability to determine activities of radionuclides within the DCGs and DCSs. Minimum detectable activities used in the analytical methodologies for radionuclides are lower than the DCGs and DCSs, which ensures that the performance of the effluent monitoring system is sufficient for determining if effluent releases of radioactive material are within DCGs and DCSs.

i. **The required detection levels of the analysis and monitoring systems *should** be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.**

The use of standard laboratory procedures and adherence to laboratory QA/QC protocols ensures analytical detection levels sufficient to demonstrate compliance. Minimum detectable activities used in the analytical methodologies for radionuclides are lower than the DCGs and DCSs, which ensures that the performance of the effluent monitoring system is sufficient for determining if effluent releases of radioactive material are within DCGs and DCSs.

j. **Sampling systems *should** be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.**

Use of standard collection equipment and procedures ensures collection of representative samples.

k. **Continuous monitoring and sampling systems *should** be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration.**

Scheduled calibration and maintenance of field sampling systems are addressed in specific procedures and applicable QAPs.

l. **Sampling and monitoring systems *should** be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.**

The regular maintenance program for sampling and monitoring systems includes calibration.

m. **Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) *should** be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.**

Effluent monitoring systems are installed according to manufacturers' specifications to ensure proper operation of the system.

n. **Off-line liquid transport lines *should** be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.**

Sampling and monitoring equipment is included in a regular maintenance program.

o. **If continuous monitoring/sampling and recording of the effluent quantity (stream flow) is not feasible for a specific effluent stream, the extenuating circumstances *should** be documented in the EMP.**

Continuous monitoring/sampling (grab and biased samples) is conducted on all effluent streams covered by NPDES permits.

p. **Sampling/monitoring lines and components should* be designed to be compatible with the chemical and biological nature of the liquid effluent.**

Historical and ongoing evaluations of the effluents, combined with manufacturers' specifications, ensure that sampling/monitoring lines are compatible with the effluent composition.

q. **The output signal instrumentation, monitoring system recorders, and alarms *should** be in a location that is continuously occupied by operations or security personnel.**

The output signal from the continuous pH monitor is directed to the office of the Plant Shift Superintendent or the subject facilities operations personnel.

r. **To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE Order 5400.5, when continuous monitoring systems are required, they *should** have alarms set to provide timely warnings.**

No continuous monitoring systems are required for compliance with DOE Order 5400.5; therefore, this criterion does not apply.

s. **As they apply to the monitoring/sampling of liquid effluents, the general QA program provisions described in Chapter 10 of this guide should* be followed.**

Chapter 9 provides a QAP applicable to monitoring and sampling of liquid effluents.

2.2 GROUNDWATER

Effluent monitoring, as applied to groundwater, is monitoring initiated to achieve compliance with one or more federal or state regulations, permit conditions, or environmental commitments made in Environmental Impact Statements, Environmental Assessments, or other official documents; whereas environmental surveillance monitoring is defined as perimeter exit pathway monitoring and off-site water supply monitoring. Because groundwater effluent monitoring and surveillance monitoring at PORTS are both governed by procedures and criteria specified in the IGWMP, these two components of the PORTS groundwater monitoring program are addressed together in Chapter 4, Section 4.3 (Groundwater).

2.3 AIR

A monitoring system provides data to characterize an emission, determine the performance of equipment, establish trends, support environmental management decisions, and demonstrate compliance with existing legal and regulatory requirements. A monitoring system may also alert personnel to excessive emissions during an abnormal occurrence.

This section discusses requirements for monitoring systems installed at sources of emissions that are designed to measure contaminants from those sources. The PORTS ambient air monitoring program measures ambient concentrations or activities of radionuclides and fluoride at on-site and off-site locations. Because these ambient air monitors are not associated with a specific source of air emissions, the ambient air monitoring program is discussed in Chapter 4, Section 4.1.

This section documents the rationale, design, frequency, quality controls, and analytical procedures for airborne effluent monitoring of PORTS operations and is designed to satisfy the criteria in applicable state and federal regulations and DOE Orders. Radionuclide and nonradionuclide emission sources are addressed separately.

2.3.1 Definitions

- **Continuous monitoring** – the real-time measurement of contaminants in liquid, gaseous, and/or airborne effluents using in situ measurement systems.

- **Continuous sampling** – the continuous collection of a liquid, gaseous, and/or airborne effluent for analysis at a later time.

- **Effective dose** – the weighted sum of dose equivalents to specific organs. The standard measure of radiation exposure.

- **Effluent** – any treated or untreated air emission from the PORTS site.

- **Effluent monitoring** – the collection and analysis of samples, or measurements of gaseous effluents, to characterize and qualify contaminants, assess radiation or chemical exposures to members of the public, provide a means to control effluents at or near the point of discharge, and demonstrate compliance with applicable standards and permit conditions.

- **Environmental occurrence –** any sudden or sustained deviation from a regulated or planned performance at a PORTS operation that has significance for environmental protection and compliance.

- **Member of the public** – any person that resides or abides off-site; or, abides on DOE property where DOE no longer maintains a physical barrier with entry only through badged access controlled gates or guarded portals.

- **National Emission Standards for Hazardous Air Pollutants (NESHAP)** – a set of U.S. EPA standards that set regulatory limits for the airborne release of hazardous air pollutants, including radionuclides.

- **Off-line monitoring** – sampling is withdrawn on a short-term basis from the effluent stream for collection or conveyance to a detector or assembly.

- **Off-site** – a location that is not on DOE property.

- **Ohio EPA, U.S. EPA Region V, and U.S. EPA Headquarters** – regulatory agencies responsible for enforcing the Clean Air Act.

2.3.2 Site Operations

PORTS currently has specific sources of air emissions that have operating permits and registrations (a sub-permit for small sources). Emissions from these sources include standard industrial pollutants such as particulates from fossil fuel combustion activities, sulfur dioxide, gaseous fluorides, water treatment chemicals, gasoline and diesel fuel vapors, cleaning solvent vapors, process coolants, and small amounts of radionuclides.

Airborne radionuclides are the main source of potential radiation dose to the public from plant operations. The predominant radionuclides emitted from PORTS operations are uranium, technetium-99 and small amounts of transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Based on the current U.S. EPA dose assessment model, CAP88-PC Version 3.0, and its predecessors, the effective dose to the most exposed individual in proximity to PORTS has consistently been significantly less than the U.S. EPA standard of 10 millirems (mrem)/year.

PORTS maintains and uses gaseous emission controls, as appropriate, to maintain releases of radioactive material in gaseous emissions to unrestricted areas below the limits specified in NESHAP (Title 40 of the Code of Federal Regulations [CFR] Part 61 Subpart H), and in accordance with the plant's ALARA policy. Unrestricted areas are those areas beyond the DOE reservation boundary and to which any member of the public has unrestricted access.

2.3.3 Rationale

For purposes of compliance, a major source is a release point that has the potential to emit, during one year, radionuclides that can cause an individual member of the public offsite, or who abides on DOE property where DOE no longer maintains a physical access control barrier, to receive an annual effective dose of 0.1 mrem or more. A minor source is a release point or group of release points that have the potential to emit radionuclides that produce a dose less than 0.1 mrem/year. Potential to emit is calculated using either stack sampling data or other estimation methods. When calculating "potential emissions," it is assumed that pollution abatement equipment does not exist, but the facility or process operations are otherwise normal, which is consistent with 40 CFR Part 61.93 (b)(4)(ii). Equipment integral to the proper operation of the process is not considered abatement even though radionuclides may be removed by this equipment. In other words, if the process could not function as intended without the equipment, it is considered integral to the process and is not considered abatement equipment. NESHAP regulations and the *Regulatory Guide* criteria require continuous sampling of all emission points with potential doses of 0.1 mrem/year or more.

The development of an airborne effluent monitoring program for airborne emissions of radionuclides has been established under guidelines set by the U.S. EPA and DOE. Specifically, standards established by U.S. EPA for radionuclides are found in NESHAP regulations at 40 CFR Part 61, Subpart H. The guidelines set by DOE are noted in DOE Orders 458.1 and 5400.5, and in the *Regulatory Guide*. In addition to following regulatory and DOE guidelines, air pollutant sources may require stack monitoring if they are:

- sources with air pollution permits that have specific conditional emission restrictions (e.g., opacity limits, mass limits) with which compliance cannot be verified through current means (i.e., engineering calculations, mass balance determinations, published emission factors, or other accepted means); or

- unmonitored air pollutant sources recommended to be monitored.

A stack and vent survey, source inventory, or other equivalent emissions study for all airborne pollutants has been completed at PORTS. NESHAP requires an assessment of radiological airborne effluents to the offsite environment and/or to a member of the public.

The following steps are taken to document compliance with opacity limits:

- Under normal process operation, visible emission readings or continuous opacity monitoring will be conducted at selected emission points. The frequency of the reading will depend on the variability of the process.

- When possible, visible emission readings will be taken during unusual occurrences and/or malfunctions in process equipment that may affect opacity.

2.3.4 Design Criteria

All radiological or non-radiological continuous effluent monitor designs used for demonstration of compliance are based on approved methodologies. The following paragraphs specify sampling and monitoring methodologies and operating procedures.

2.3.4.1 Radiological

The design criteria for an acceptable radionuclide effluent monitor follow documented methodologies in the *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* or other U.S. EPA approved methods. The compliance plan also addresses many of the guidelines stated in the *Regulatory Guide* and DOE Orders. A preoperational radionuclide emissions assessment is made for any new source or when source modifications will alter emissions. If any new sources requiring continuous sampling are installed, they will be sampled according to the radionuclide portion of NESHAP. An acceptable monitor design, location, and operation will meet the performance requirements specified in 40 CFR Part 61, Subpart H, the compliance plan, or other U.S. EPA-approved criteria.

Total radiological activity measurement and gamma spectroscopy will be performed on each sample as required for determining emissions from a source.

2.3.4.2 Non-radiological

The design criteria for an acceptable nonradionuclide effluent monitor meets specifications identified in applicable U.S. EPA, DOE, or Ohio regulations and permits. A preoperational assessment will be made for any new or modified source of nonradionuclide emissions. If the assessment identifies a continuous sampling or monitoring requirement, it will be in accordance with applicable regulatory and permit requirements.

2.3.5 Extent and Frequency of Monitoring

All release points that have the potential to emit, during one year, radionuclides that can cause an individual member of the public at any offsite point where there is a residence, school, business, or office, or who abides on DOE property where DOE no longer maintains a physical access control barrier, to receive an annual dose of 0.1 mrem or more are continuously monitored. All systems meet the continuous sampling requirements specified in 40 CFR Part 61, Subpart H.

Continuously sampled emission points meet all applicable design criteria and sampling frequency requirements as specified for each source by regulation or permit condition. All release points that require periodic grab sampling follow sampling frequencies as specified by regulation or permit requirements. Any release point that requires periodic opacity monitoring will follow the frequency specifications of the applicable regulation or permit condition.

The following vents are continuously monitored (when in use):

- X-330 cold recovery after jet sampler (Vent #1)
- X-330 SE3 seal exhaust sampler (Vent #13)
- X-326 SE4 seal exhaust sampler (Vent #14)
- X-326 SE5 seal exhaust sampler (Vent #15)
- X-326 SE6 seal exhaust sampler (Vent #16)
- X-326 top purge after-jet sampler (Vent #6)
- X-326 EJET after-jet sampler (Vent #7)
- X-344A cold trap sampler (Vent #18)
- X-344A gulper sampler (Vent #8)

Samples from the primary sample traps are normally collected weekly; however, the sampling period may be extended provided that the sampler is operating at all times that the vent is operating. Samples are analyzed for the following radionuclides:

- uranium (total)
- uranium isotopes (uranium-233/234, uranium-235, uranium-238)
- technetium-99
- thorium isotopes (thorium-228, thorium-230, and thorium-232) (Vent #8 and Vent #18 only)

The X-344A vents (Vent #8 and Vent #18) are sampled for thorium isotopes because thorium was occasionally detected in uranium from the Paducah Gaseous Diffusion Plant, which was processed at the X-344A facility.

Samples from the secondary sample traps are collected quarterly and analyzed for selected transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), as well as the weekly sampling parameters listed above (uranium, uranium isotopes, technetium-99, and thorium isotopes [Vent #8 and Vent # 18 only]).

2.3.6 Procedures for Laboratory Analyses

Samples collected for compliance with NESHAP for radionuclide emissions meet requirements specified in 40 CFR Part 61. For each radionuclide identified in a preoperational emission evaluation, a minimum detectable activity is specified that meets the data objectives identified for the release point. Procedures require laboratory results to include the minimum detectable activity, the resulting activity, and the uncertainty.

Nonradionuclide analytical procedures meet regulatory or permit requirements as specified for the individual source. Chapter 5 provides general guidelines for laboratory analyses.

2.3.7 QA/QC Requirements

Chapter 9 provides general QA/QC requirements. QA/QC requirements for radiological sources subject to NESHAP 40 CFR Part 61, Subpart H requirements follow QA criteria stated in 40 CFR Part 61, Appendix B, Method 114. Additional QA/QC requirements may be addressed in source-specific documentation.

All non-radiological monitors are operated in accordance with the QA/QC procedures noted in 40 CFR Part 60 Appendix F or as specified in regulatory or permit requirements for the individual source.

2.3.8 Data Analysis and Statistical Treatment

Overall data analysis and statistical treatment of radiological and non-radiological airborne effluent data for PORTS follow guidelines stated in Chapter 7 of this plan.

2.3.9 Reports and Records

DOE Orders 436.1, *Departmental Sustainability*, and DOE M 231.1-1A, *Environment, Safety and Health Reporting Manual*, establish guidelines and procedures for reporting to DOE on matters of significance to environmental protection, safety, and health protection, and identify an Annual Site Environmental Report. DOE Order M 231.1-2 also describes reporting requirements for unusual occurrences.

DOE Orders 458.1 and 5400.5 provide policy on notification of significant, actual, or potential exposures of the public to radionuclides. The *Regulatory Guide* addresses timely notification of occurrences in environmental surveillance and effluent monitoring.

NESHAP (40 CFR Part 61, Subpart H) establishes the following reports:

- A report to U.S. EPA Headquarters and U.S. EPA Region V or to the delegated state technical administrator is required by June 30 of each year (40 CFR 61.94[a]). This report pertains to monitoring results and dose calculations and must follow 40 CFR 61.94(b).

- If the facility exceeds emission limits, it will report remediation progress monthly to the Administrator until the Administrator has determined that reports are no longer necessary.

Reporting requirements for non-radiological emissions are identified in source-specific conditions for operation or permit requirements.

Chapter 9 documents general recordkeeping procedures. Specific recordkeeping responsibilities will be assigned and documented at PORTS to ensure that records are organized, complete, and accurate. The following recordkeeping guidelines apply to PORTS.

DOE Orders 458.1, 5400.5, and the *Regulatory Guide* include the following recordkeeping requirements:

- Information and data that identify and characterize releases of radioactive material (effluent) to the environment, its fate in the environment, and its probable contribution to radiation doses to the public are retained by the appropriate personnel consistent with the guidelines in DOE Orders, as well as any other applicable requirements.

- A permanent record is documented and filed concerning applications of ALARA policy.

- Auditable records relating to environmental surveillance and effluent monitoring are maintained by the appropriate personnel. These include, but are not limited to, calculations, computer programs, and other forms of data.

- Reports or data from studies conducted to evaluate the operational performance or real or suspected deficiencies of the systems are provided at the operating facility.

- Records documenting QA/QC are maintained in auditable condition. (40 CFR Part 61, Subpart H).

- Documentation of all calculations, measurements, methods, input parameters, and procedures used to estimate dose from PORTS radiological sources are maintained on site by the appropriate personnel for a minimum of five years. These records will be sufficient to enable an independent audit to verify compliance. Records will be made available for inspection at the request of U.S. EPA or Ohio EPA.

Additional recordkeeping requirements for non-radiological emissions are identified in source-specific conditions for operation or permit requirements.

2.3.10 *Regulatory Guide* Performance Criteria

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. All airborne emissions from each facility (DOE site) *should be evaluated and their potential for release of radionuclides assessed. Based on this assessment decisions *should** be made regarding necessary effluent monitoring systems and the rationale *should** be documented in**

the site EMP. The potential for emissions *should include consideration of the loss of emission controls while otherwise operating normally.**

PORTS radiological emission sources are reviewed annually.

b. Airborne emissions from DOE-controlled facilities that have the potential for causing effective dose equivalents exceeding 0.1 mrem to a member of the public under realistic exposure conditions from emissions in a year *should be monitored in accordance with the requirements of DOE Order 5400.1 and DOE Order 5400.5.**

PORTS radiological sources are reviewed annually. Additional monitoring will be conducted based on preoperational evaluation showing the potential for causing doses exceeding 0.1 mrem/year to a member of the public.

c. The criteria for monitoring listed in Chapter 3 of this guide *should be used to establish the airborne emission monitoring programs for DOE-controlled sites.**

All sources at PORTS that have the potential to contribute at least 0.1 mrem in a year are continuously sampled. Radionuclides that contribute 10% or more of the dose will be identified, assessed, documented, and verified annually. For sources with potential emissions less than 0.1 mrem/year, measurements, including engineering calculations, will be conducted periodically. The frequency of periodic measurements will depend upon variability in the sources' emissions. The specific methodology for assessing the potential dose from point sources that emit radionuclides is identified in the PORTS Radiological NESHAP Report.

d. For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a preoperational assessment *should be made and documented in the site EMP to determine the types and quantities of airborne emissions to be expected from the facility, and to establish the associated airborne emission monitoring needs of the facility.**

New facilities or major modifications to existing facilities that could be sources of airborne emissions are reviewed for environmental compliance. These reviews are documented in project files.

e. The performance of the airborne emissions monitoring system *should be sufficient for determining whether the releases of radioactive materials are within the limits or requirements specified in DOE Order 5400.5.**

The *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* lists the detection limits for samples collected from the continuously monitored vents in the X-326, X-330 and X-344A buildings. These detection limits are sufficient to demonstrate compliance with limits set in DOE Orders 5400.5 and 458.1.

f. Sampling and monitoring systems *should be calibrated before use and recalibrated any time they are subject to maintenance or modification that may affect equipment calibration.**

All equipment is calibrated prior to on-line operation and after maintenance or modification that may affect calibration.

g. Sampling and monitoring systems *should be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.**

At a minimum, all applicable sampling and monitoring systems at PORTS are calibrated or checked to a calibration standard at least annually or, if more frequent, as required by regulation or permit condition.

h. Provisions for monitoring of airborne emissions during accident situations *should be considered when determining routine airborne emission monitoring program needs.**

All airborne radionuclide emissions monitoring programs for sources that emit radionuclides that could cause a dose of more than 0.1 mrem/year are designed to operate continuously with periodic collection of sampling media. In the event of an accident, the sampling media of an affected area will be sampled upon notification and analyzed if it is determined that sample data may help quantify the effects of the accident. These results will be included in the annual dose assessment report of PORTS radiological emissions.

i. Diffuse sources (i.e., area sources or multiple point sources in a limited area) *should be identified and assessed for their potential to contribute to public dose and *should** be considered in designing the site emissions monitoring and environmental surveillance program. Diffuse sources that may contribute a significant fraction (e.g., 10%) of the dose to members of the public resulting from site operations *should** be identified, assessed, documented, and verified annually.**

The PORTS ambient air surveillance program is designed as a confirmatory measurement of low emissions from all sources, point or diffuse. In development of this program, PORTS has identified and assessed diffuse sources for their potential to contribute to public dose, including diffuse sources that could contribute more than 10% of the offsite dose. The ambient air monitoring program periodically identifies, assesses, and verifies point and diffuse sources of radionuclides emissions. The frequency of verification is contingent upon the magnitude of dose and potential for change in radionuclide emissions.

j. Airborne emission sampling and monitoring systems *should demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.**

All PORTS activities requiring sampling or monitoring systems include procedures and data quality objectives to ensure that results are a quantification of emissions, are timely, representative, and adequately sensitive.

k. To the extent practicable, samples *should be extracted from the effluents from a location and in a manner that provides a representative sample, using multiport probes if necessary.**

All PORTS sampling follows approved design criteria for an acceptable radionuclide effluent monitor and follows probe siting and sampling methodologies identified in 40 CFR Part 61, Subpart H or other U.S. EPA approved methods.

l. Where a significant potential (greater than once a year) exists for approaching or exceeding a large fraction of the emission standard (e.g., 20%), continuous monitoring *should be required.**

Chapter 3.0 of the *Regulatory Guide* indicates that "the potential for emissions ***should**** include consideration of the loss of emission controls while otherwise operating normally." To ensure

consistent interpretation of this requirement, a decision to install a continuous (real-time) monitoring system is based on the following:

Any release point that has the potential to emit, during one year, radionuclides that can cause an individual member of the public offsite, or who abides on DOE property where DOE no longer maintains a physical access control barrier, to receive an annual effective dose of 0.1 mrem or more will be continuously monitored. This exceeds the requirement for continuously monitoring emissions resulting in a dose of 20% or more of the standard (2 mrem) identified in the *Regulatory Guide*. The potential dose determination assumes no credit for emission controls. All PORTS systems meet the more stringent continuous sampling requirements specified in 40 CFR 61, Subpart H.

m. The design of radioiodine monitors will be such that replacement of sorbent and filter *should not disturb the geometry between the collector and detectors.**

PORTS does not manage radioiodine and consequently has no radioiodine emissions.

n. To signal the need for corrective actions that may be necessary to prevent public or environmental exposures exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems (as required by the criteria in Table 3-1) are required, they *should have alarms set to provide timely warnings.**

Table 3-1 of the *Regulatory Guide* does not require continuous (real-time) monitoring systems. The criteria for continuous monitoring systems are defined in Section 3.5.8 of the *Regulatory Guide*, and the interpretation of the criteria is provided in item "l" above. When a continuous monitoring system is required by the criteria provided in item "l," an appropriate and methodical review of monitoring systems is followed as identified in specific operating criteria. Any deviations from specified operating criteria will signal the need for corrective action.

o. As they apply to the monitoring of airborne emissions, the general QA program provisions of Chapter 10 of the guide *should be followed.**

Chapter 9 documents QA procedures and guidelines for addressing *Regulatory Guide* Chapter 10 QA provisions.

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3. METEOROLOGICAL MONITORING

3.1 INTRODUCTION

Meteorological monitoring acquires information on atmospheric weather phenomena that can be used to forecast atmospheric dispersion of planned and unplanned releases or of events causing environmental concern. This chapter describes the types of weather information that is acquired to support environmental surveillance activities. It also presents the elements of the meteorological monitoring program at PORTS and explains the purpose and the regulatory basis of these specific program components and activities. USEC is responsible for the meteorological monitoring program at PORTS. DOE obtains the meteorological monitoring data from USEC for reporting purposes.

3.2 RATIONALE AND SITING CRITERIA

The establishment and documentation of a meteorological monitoring program are described in the *Regulatory Guide*. Meteorological information representative of conditions at the facility is essential to assess the transport, diffusion, and deposition of material released to the atmosphere by PORTS. Various air pollutants, as well as airborne radionuclides, are emitted from plant operations. Meteorological data may be used in atmospheric dispersion modeling to determine how discharged radionuclides or chemicals mix with the atmosphere, where they travel, and where they may be deposited. Monitoring data and meteorological data may be used to calculate radiation doses from plant operations received by people living near PORTS and to support other environmental surveillance activities such as air quality monitoring.

A single freestanding meteorological tower is located in the southern portion of PORTS (Figure 3.1). The tower contains instrumentation at 10-m, 30-m, and 60-m heights. The instrumentation packages were selected to provide continuous operation within the normal atmospheric conditions at the plant.

3.3 EXTENT AND FREQUENCY OF MONITORING

Tower instrument packages at heights of 10-m, 30-m, and 60-m measure air temperature, relative humidity, and wind speed and direction. These instrument packages are mounted on booms that are between three and four tower diameters from the tower. The temperature/relative humidity instruments are shielded instruments with forced ventilation to minimize the effects of direct and reflected radiation. Ground-level instruments measure solar radiation, barometric pressure, and precipitation. Soil temperature is measured at 0.30-m and 0.61-m depths. Data from the National Weather Service or other local sources may be used in lieu of on-site data.

A microprocessor located at the foot of the tower receives the analog data from each of the instruments. Data recovery is at least 90% on an annual basis for those meteorological elements required to make dose assessments. Digital summaries are transmitted to the Emergency Operations Center or equivalent designee. The summaries consist of average and maximum wind speed, average and standard deviation of wind direction, averages of all temperatures, solar radiation, and precipitation over last interval. One summary is sent directly to a computer terminal, which also serves as the control terminal of the microprocessor. Another summary is sent to a portable computer that operates independently of the rest of the system. Fifteen minute data summaries are also displayed on video terminals at several locations on site including the X-300 Plant Control Facility. The data can be used to generate hourly averages, daily reports, and annual data summaries.

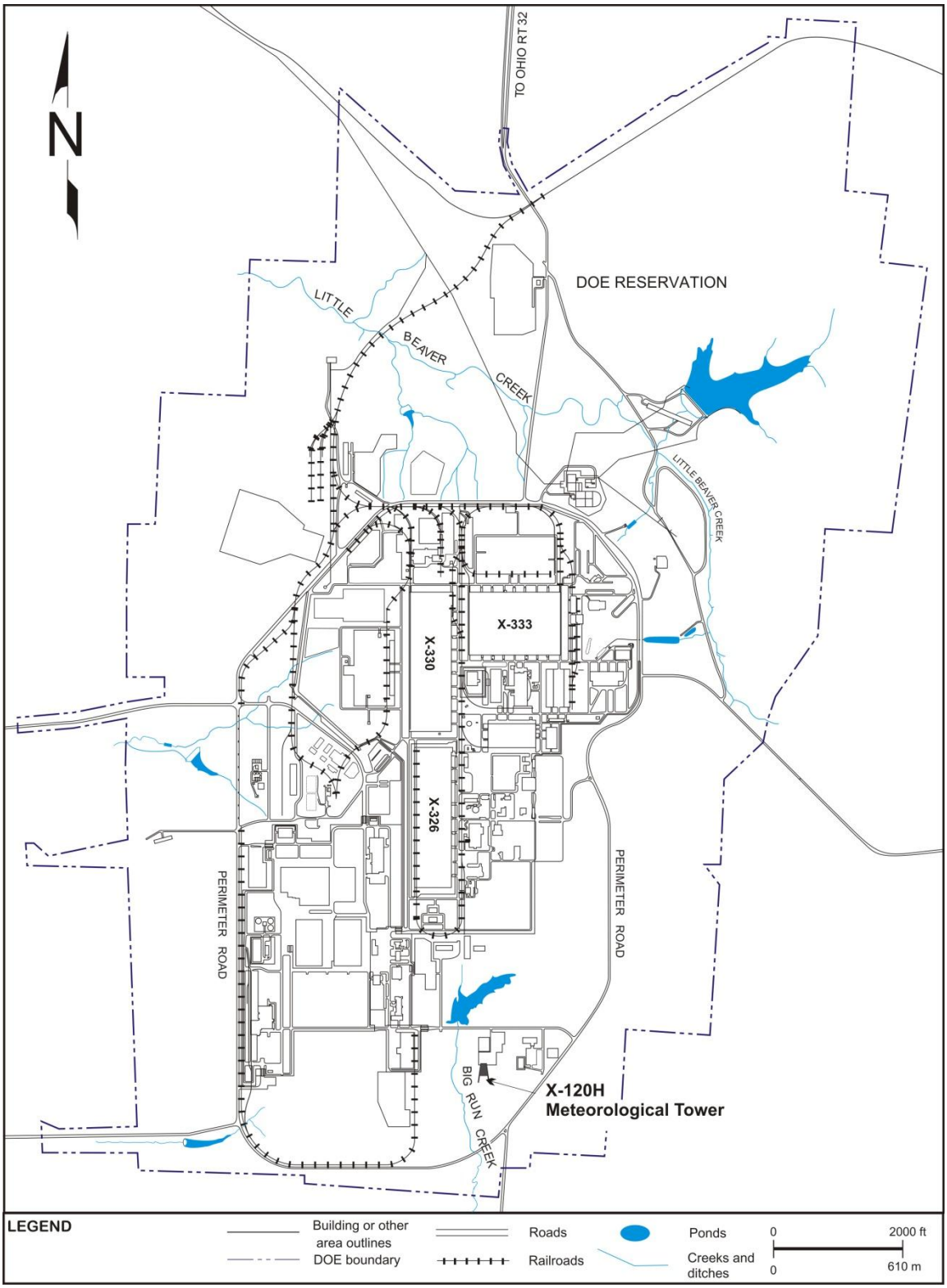

Figure 3.1. Location of meteorological tower at PORTS

3.4 QA/QC REQUIREMENTS

The meteorological monitoring program complies with applicable elements of American Society for Mechanical Engineers (ASME) NQA-1. Personnel who do not have direct responsibility for the meteorological monitoring program perform planned and scheduled audits independently in accordance with written procedures.

Data collection instruments are inspected and maintained by the electronic maintenance staff in accordance with USEC procedures or equivalent guidance. The data are monitored and recorded at the Emergency Operations Center, and the Plant Shift Superintendent's office monitors the weather data visual display. Maintenance and repair documentation are kept and filed with the electronic maintenance staff.

In case of an emergency, replacement instruments of each type for the PORTS meteorological tower are readily available. An adequate supply of replacement parts is available to maintain the tower for meteorological monitoring.

3.5 DATA ANALYSIS

Under the existing system, hourly averages of all measured parameters are calculated and recorded automatically onto a dedicated personal computer. This computer accumulates, records, summarizes, and archives an entire year's data. This computer also provides direct real-time meteorological data to the release modeling system used for emergency management. At the end of each year the accumulated information is backed-up or copied onto a compact disc. These data are used to generate an annual joint frequency distribution of wind direction, speed, stability, average temperature, and total precipitation. Records are compiled by FBP Environmental Protection personnel. The joint frequency distribution and averaged meteorological parameters are used in dispersion modeling and annual dose assessment using U.S. EPA-approved models, such as CAP88 or equivalent.

3.6 REPORTS AND RECORDS

Meteorological data are gathered and recorded throughout the year but are not included in the Annual Site Environmental Report. All essential records are archived by FBP Environmental Protection personnel in accordance with FBP procedures.

3.7 *REGULATORY GUIDE* PERFORMANCE CRITERIA

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. **Each DOE site *should** establish a meteorological monitoring program that is appropriate to the activities at the site, the topographical characteristics of the site, and the distances to critical receptors.**

   The current program is appropriate to site-specific activities, i.e., to those airborne emissions characteristic of operations at PORTS, taking into consideration the physical characteristics of the site and the distance to critical receptors.

b. **The scope of the program *should** be based on an evaluation of the regulatory requirements, the meteorological data needed for impact assessments, environmental surveillance activities, and emergency response, considering the mathematical procedures, models, and input data requirements necessary for computing atmospheric transport and diffusion computations and performing dose assessments.**

The meteorological monitoring program at PORTS has been evaluated in consultation with the National Oceanic and Atmospheric Administration.

c. **The program *should** be documented in a meteorological monitoring section of the EMP in compliance with DOE Order 5400.1.**

This chapter of the EMP documents the meteorological monitoring program in accordance with the *Regulatory Guide*. DOE Order 5400.1 is no longer applicable.

d. **For data from an offsite source to be acceptable, the data *should** be representative of conditions at the DOE facility and provide statistically valid data consistent with onsite monitoring requirements.**

If data from an off-site source are used, the data are as representative of site conditions as possible.

e.,f. **Specific meteorological information requirements for each facility *should** be based on the magnitude of potential source terms, the nature of potential releases from the facility, possible pathways to the atmosphere, distances from release points to critical receptors, and the proximity of the site to other DOE facilities. Meteorological information requirements for facilities *should** be sufficient to support environmental monitoring and surveillance programs.**

Information requirements are sufficient to support air dispersion modeling and dose assessments, as well as air quality monitoring.

g. **The meteorological monitoring program for each DOE site *should** provide the data for use in atmospheric transport and diffusion computations that are appropriate for the site and application.**

The meteorological monitoring program, as discussed in this chapter, supplies the required data for analysis and computations of atmospheric transport and diffusion.

h. **Before any model is deemed appropriate for a specific application, the assumptions upon which the model is based *should** be evaluated and the evaluation results documented.**

When modeling is required, U.S. EPA-approved models are used. The specific model used will be evaluated for appropriateness to the specific application.

i. **Meteorological programs for sites where onsite meteorological measurements are not required *should** include a description of climatology in the vicinity of the site and *should** provide ready access to representative meteorological data.**

PORTS collects on-site meteorological data; therefore, this criterion is not applicable.

j. **Potential release modes, distances from release points to receptors, and meteorological conditions *should** be considered in assessments for DOE facilities required to take onsite measurements.**

Potential release modes and distances from release points to receptors, along with data collected by the meteorological equipment, are considered in assessments at PORTS.

k. **Meteorological measurements *should** be made in locations that, to the extent practicable, provide data representative of the atmospheric conditions into which material will be released and transported.**

The existing tower provides representative measurements of the atmospheric conditions into which PORTS may discharge chemicals and radionuclides.

l. **The instruments used in the monitoring program *should** be capable of continuous operation in the normal range of atmospheric conditions at the facility.**

The monitoring instruments at PORTS provide continuous operation under the normal range of atmospheric conditions at PORTS.

m. **Wind measurements *should** be made at a sufficient number of altitudes to adequately characterize the wind at potential release heights.**

Wind measurements are made at 60-m, 30-m, and 10-m heights at PORTS. The National Oceanic and Atmospheric Administration has determined that this is a sufficient number of altitudes for adequate wind characterization.

n. **If instruments are mounted on booms extending to the side of a tower, the booms *should** be oriented in directions that minimize the potential effects of the tower on the measurements. The instruments *should** be at least two tower diameters from the tower, but *should** be three to four tower diameters from the tower.**

The instrument packages are mounted on booms that are between three and four tower diameters from the tower.

o.,p. **The meteorological monitoring program *should** provide for routine inspection of the data and scheduled maintenance and calibration of the meteorological instrumentation and data-acquisition system at a minimum, based on the calibration frequency recommendations of the manufacturers. Inspections, maintenance, and calibrations *should** be conducted in accordance with written procedures, and logs of the inspections, maintenance, and calibrations *should** be kept and maintained as permanent records.**

Routine data inspection, as well as maintenance and calibration of the data collection instruments at PORTS are addressed in Section 3.4. These activities conform to written procedures, and manufacturers' recommendations are followed for calibration frequency. Logs are maintained as permanent records of inspections, maintenance, and calibrations.

q. **The instrument system *should** provide data recovery of at least 90% on an annual basis for wind direction, wind speed, those parameters necessary to classify atmospheric stability, and other meteorological elements required for dose assessment.**

The instrument system provides at least 90% data recovery on an annual basis for meteorological elements required for dose assessment.

r.,s. **The topographic setting of a facility and the distances from the facility to points of public access *should** be considered when evaluating the need for supplementary instrumentation. If meteorological measurements at a single location cannot adequately represent atmospheric conditions for transport and diffusion computations, supplementary measurements *should** be made.**

The National Oceanic and Atmospheric Administration conducted a meteorological site survey to provide a technical determination of the amount and location of supplementary monitoring needed at PORTS. This survey considered the site's topography and distances from the facility to public access points.

t. **A site-wide meteorological monitoring program *should** be established at each multi-facility site to provide a comprehensive database that can be used for all facilities located within the site.**

PORTS collects on-site meteorological data that are available to be shared by the site contractors.

u. **As they apply to meteorological monitoring, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.**

The general QA program provisions of Chapter 10 of the *Regulatory Guide* have been reviewed, and those elements applicable to the meteorological monitoring program will be followed.

4. ENVIRONMENTAL SURVEILLANCE

As defined in DOE Order 458.1 (and similarly in DOE Order 5400.5), environmental surveillance is the collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media at the DOE site and surrounding environs and the measurement of external radiation to demonstrate compliance with applicable standards, assess radiation exposure of members of the public, and assess effects, if any, on the environment.

PORTS confirms emission-based calculations, limits company liability, and reassures the public and outside regulators by performing routine environmental surveillance. Therefore, PORTS routinely samples and/or monitors various media for contaminants that may be attributable to PORTS operations. Air and surface water are considered the most important media to monitor since contamination could enter these media directly. Environmental radiation, groundwater, soil and vegetation, sediment, and biota are also monitored. The following environmental surveillance monitoring programs at PORTS are discussed in this chapter:

- Ambient air
- Environmental radiation
- Groundwater (including exit pathway and off-site water supplies)
- Surface water (local surface water and IGWMP)
- Sediment
- Soil and vegetation
- Biota (crops, fish, deer, dairy)

DOE Order 458.1 states that DOE radiological activities, including remedial actions, must be conducted so that exposure of members of the public to ionizing radiation will not cause a total effective dose exceeding 100 mrem/year, an equivalent dose to the lens of the eye exceeding 1500 mrem/year, or an equivalent dose to the skin or extremities exceeding 5000 mrem/year, from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose. DOE Order 5400.5 provides similar language with the same total effective dose limit of 100 mrem, but does not include a dose limit for the lens of the eye, skin, or extremities.

DOE Order 458.1 further states that if it is suspected that any of the dose limits specified in the order may be exceeded, or if the total effective dose exceeds 25 mrem/year, the dose to the lens of the eye, skin, and extremities must be evaluated.

Data collected by the effluent monitoring programs and environmental surveillance programs at PORTS are used to assess compliance with these standards. Chapter 6 provides additional information on dose calculations.

4.1 AMBIENT AIR

Because air is a primary exposure pathway to humans from radionuclides released to the atmosphere, ambient air monitoring is conducted to evaluate potential doses to the public and to monitor other pollutants. Additional benefits from the ambient air monitoring program include the following:

- assistance in developing an ALARA policy,
- assistance in the detection of unplanned releases, and
- promotion of public trust by providing additional radiological dose data.

Air monitoring is also conducted to monitor emissions from process vents in the X-326, X-330, and X-344A buildings. Chapter 2, Section 2.3 provides more information about the effluent monitoring program associated with these process vents.

The monitoring program outlined in the following subsections addresses the ambient air surveillance guidelines provided in DOE Orders 458.1 and 5400.5 and in the *Regulatory Guide*. This monitoring is designed to provide ambient air surveillance for all PORTS operations.

4.1.1 Rationale and Design Criteria

Ambient air monitoring for environmental surveillance collects samples to determine activities of radionuclides in ambient air. The activities of radionuclides in air are used to calculate a dose due to the inhalation pathway at the monitoring locations. The program is used to confirm low emissions from radionuclide sources at PORTS including point, diffuse, and fugitive emissions.

Specific radionuclides monitored in ambient air at PORTS are selected based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and/or isotopic uranium because of the uranium enrichment process. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium during the Cold War. Fluoride is sampled in ambient air because it was historically released from the gaseous diffusion process; it may be released during D&D activities and processing of DUF_6 cylinders in the DUF_6 Conversion Facility.

High volume air samplers equipped with a mass-flow controller and a flow totalizer are used to collect particulate radionuclides. This sampling follows criteria specified in 40 CFR Part 50, Appendix G *Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air*. The high volume sampler design meets requirements specified in 40 CFR Part 53 *Ambient Air Monitoring Reference and Equivalent Methods*. The sampler maintains a constant flow rate and indicates the total volume of air sampled. The following criteria also apply.

- The monitoring stations are placed at key receptor locations. Locations are identified using a combination of dispersion modeling, where members of the public reside or abide, the modeled off-site maximum with respect to the annual reported dose for the site, and source-specific airborne emissions.
- The air sampling flow rate should not vary more than 20%.
- The linear flow rate across particulate filters is maintained between 20 and 50 m/min, as specified in the *Regulatory Guide*.
- The total air volume is recorded.
- Filter media are selected to capture at least 99% of di-octyl-phthalate particles with an aerodynamic mean diameter of 0.3 µm, at the operational velocity and pressure drop.
- Sample intake is approximately 2 m above ground level.
- Air sampling devices are designed to minimize the loss of sample during collection.

Low-volume air samplers equipped with a flow controller and a flow totalizer are used to collect gaseous fluorides. The sampler maintains a constant flow rate and indicates total volume of air sampled. The following criteria also apply.

- The air sampling flow rate should not vary more than 20%.
- The filter media is chemically treated for collecting gaseous fluoride.
- The nominal flow rate across particulate filters should be kept between 2 and 12 L/min, unless otherwise specified in the applicable procedure.
- The total air volume is recorded.
- Filter media are selected to capture at least 99% of di-octyl-phthalate particles with an aerodynamic mean diameter of 0.3 µm at the operational velocity and pressure drop.

4.1.2 Monitoring Locations

Ambient air monitoring takes place at 16 stations, 14 of which are equipped to sample both particulate radionuclides and total gaseous fluorides. On-site station A40A is equipped to sample total gaseous fluorides only, and on-site station T7 is equipped to sample radionuclides only. Figure 4.1 shows the ambient air monitoring stations. The stations are described as follows:

On-site stations:

- A8–north-northwest of the plant near railroad right-of-way
- A10–Don Marquis Substation
- A29–west of the plant on the West Access Road near the Ohio Valley Electric Corporation
- A36–X-611 Water Filtration Plant
- A40A–near the northeast corner of the X-749A Landfill Building (fluoride only)
- T7–northwest side of X-734 Landfills near the former X-605 buildings (radionuclides only)

Off-site stations:

- A3–south of the plant on Bailey Chapel Road near Big Run Road
- A6–4 miles north-northwest of the plant inside the village of Piketon
- A9–southwest of the plant on Old US Route 23
- A12–east of the plant on McCorkle Road just north of Dutch Run Road
- A15–east-southeast of the plant on Loop Road south of Dutch Run Road
- A23–northeast of the plant on Taylor Road at McCorkle Road
- A24–north of the plant on the Shyville Road
- A28–6 miles southwest of the plant on Camp Creek Road
- A37–13 miles southwest of the plant approximately 4 miles north of Otway (background station)
- A41A–2.6 miles northeast of the plant at Zahns Corner

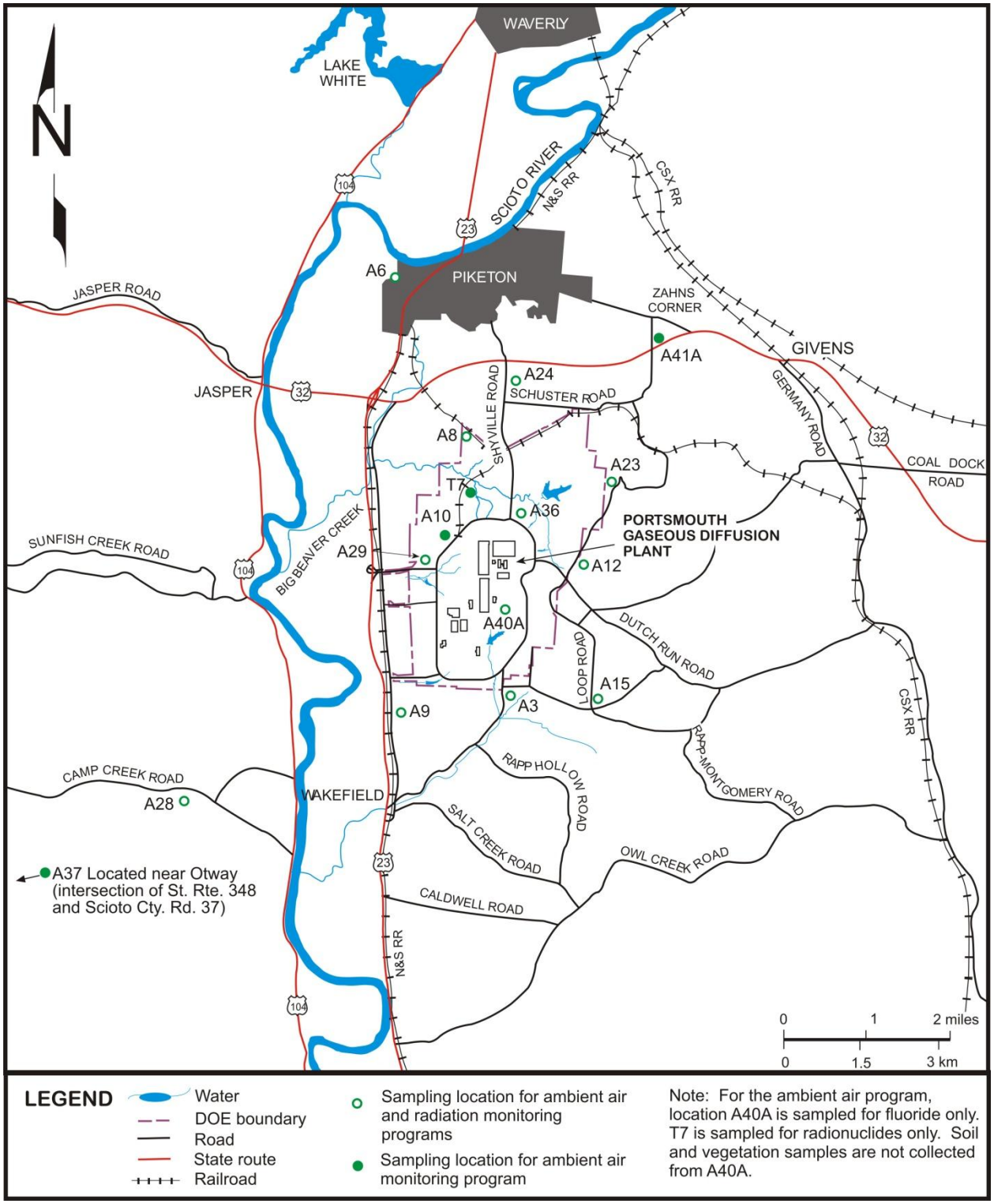

Figure 4.1. Ambient air monitoring locations

The station near Otway (A37) provides an estimate of background or regional levels of radionuclides. Two other locations, Camp Creek Road (A28) and Zahns Corner (A41A), provide backup or supporting information on background and long-range transport levels. The background station near Otway meets *Regulatory Guide* criterion that such stations for large sites be at least 15 km from the site. The remote sampling location in Piketon (A6) serves as a confirmatory measure of a low dose to members of the public within this community.

The current ambient air monitoring locations are based on historic atmospheric dispersion modeling assessments performed by the Oak Ridge National Laboratory. The property-line station locations were the most likely to be affected by releases from PORTS, given typical annual meteorology. Property-line stations at or near these calculated points of maximum impact are in locations that are under the control of PORTS or at residences that are located near the property-line. No residences or businesses are predicted to be affected routinely by radioactive materials released from PORTS without such releases being sampled at one of the selected locations.

Ambient air monitoring locations also comply with the following criteria.

- The location is free from unusual localized effects or other conditions that could result in artificially high or low readings.
- The location is free from excessive large-particle (non-respirable) fugitive dust that may dominate the sample.
- Where applicable, the siting criteria in 40 CFR Part 58, Appendix E, was used as guidance to place the samplers at the various locations.

4.1.3 Monitoring Frequency and Parameters

Samples from high volume radionuclide samplers are collected weekly. Weekly samples are composited into one monthly composite sample. Compositing is completed in accordance with 40 CFR Part 50, Appendix G. Each composite is submitted for radiochemical analysis. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) one month in each quarter. Samples are analyzed monthly for technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238).

Fluoride samples from low volume samplers are collected and submitted to the laboratory weekly.

In the event of unplanned releases of radionuclides that could potentially affect human health or the environment, samples may be collected at appropriate ambient monitoring stations. Appropriate stations would be selected based on meteorological information such as wind speed and direction and the release location.

4.1.4 Procedures for Laboratory Analyses

Chapter 5 includes guidelines for laboratory procedures for analysis of ambient air samples. Laboratory contracts include specific requirements for the analyses including analytical methods, detection limits, and reporting requirements. Laboratory analyses follow the guidelines established in applicable laboratory QAPs.

4.1.5 QA/QC Requirements

Chapter 9 includes guidelines for QA/QC procedures for ambient air sampling. QA/QC procedures specific to the ambient air program are identified in the *Compliance Plan for the National Emission Standards for Hazardous Air Pollutants* or the associated QA/QC Project Plan.

4.1.6 Data Analysis and Statistical Treatment

Sample results are transferred into PEMS by the laboratory. Results are used in conjunction with meter or filter volumes and meteorological data (as needed) to calculate the presence of each radionuclide or fluoride in air (radioisotopes are measured in activity, uranium and fluoride in concentration). As a conservative measure, analytes that are not detected are assumed to be present at the detection limit.

The calculated activity of a radionuclide detected in ambient air is used in conjunction with dose conversion factors generated by the CAP88 model to determine a dose in mrem/year associated with a given activity of a radionuclide in air. For radionuclides that are detected in ambient air, the dose for that radionuclide is calculated by using the maximum activity of each detected radionuclide for the calendar year. For radionuclides that are not detected during the calendar year, the dose is calculated by using half the highest undetected result to calculate the maximum activity of the radionuclide in air. The doses attributable to each radionuclide are then added to obtain the gross dose for each station. The net dose is obtained by subtracting the dose at station A37, the background monitoring station.

4.1.7 Reports and Records

Chapter 8 addresses requirements for reports and records. The following reports include information from the ambient air monitoring program.

- Annual Site Environmental Report includes a summary of 1) ambient air monitoring results for the calendar year and, 2) dose calculations based on the ambient air monitoring results.

- The Annual Report required by 40 CFR Part 61, Subpart H, *National Emission Standards for Emissions of Radionuclides Other than Radon from DOE Facilities*, includes the results of the ambient air monitoring program and associated dose calculations.

4.2 RADIATION

The environmental radiation monitoring program monitors radiation (measured as dose) at on-site and off-site locations around PORTS. The program provides data to confirm that PORTS does not contribute to off-site ambient radiation levels and provides data to assess the potential dose a member of the public may receive visiting or passing through accessible portions of the reservation. Controlled public access is allowed on portions of the main reservation roads outside of the active plant area as a courtesy to the public.

4.2.1 Rationale and Design Criteria

PORTS managed alpha, beta, and gamma-emitting radionuclides as part of the gaseous diffusion uranium enrichment process and sealed radiation sources for testing and calibration. Members of the public could hypothetically be exposed to radiation from the plant itself or from radionuclides released into the environment.

The environmental radiation monitoring program is designed to provide exposure data on radiation from PORTS to members of the public. The primary factor in selecting the monitoring locations was the potential for a member of the public to be exposed to radiation. Secondary factors in selecting the monitoring locations were accessibility by environmental technicians, protection against casual vandalism, and consumption of manpower resources. Historical data collected by the environmental radiation monitoring program indicate that there is no significant difference between radiation levels measured at the PORTS fence line and off-site monitoring locations.

4.2.2 Monitoring Locations

On-site radiation monitoring locations (Figure 4.2) are located along the Perimeter Road and Hewes Street. These locations were selected considering 1) the elevated gamma radiation field in the vicinity of the cylinder storage yards in the northwest corner of the plant, 2) parking areas accessible to the public (where family members of plant workers might wait during shift changes), and 3) intersections of the Perimeter Road and the most commonly used plant access roads (representative of maximum public traffic loads on site).

Additional monitoring locations are co-located with both on-site and off-site ambient air monitoring stations (Figure 4.1). These monitoring locations simplify access for PORTS personnel and quantify off-site radiation levels.

On-site radiation monitoring locations include:

- Power poles #41, #874, #882, #890 (northwest portion of Perimeter Road near cylinder storage yards)
- Ambient air monitoring station A29, power poles #868, #862 (Ohio Valley Electric Corporation, intersection of Principal Access Road/Perimeter Road
- Power pole #1404A (X-7725 Parking Area)
- X230-J2 Building (Hewes Road at south end of X-230K Holding Pond)
- Power pole #518 (south of the former X-746 building)
- Ambient air monitoring station A40A (near the northeast corner of the X-749A Landfill)
- Power pole #933 (intersection of Perimeter Road and Dutch Run Road)
- Ambient air monitoring station A36 (X-611 Water Treatment Plant)
- Power pole #906 (intersection of Perimeter Road and North Access Road)
- Ambient air monitoring station A8 (northern plant boundary)

Off-site radiation monitoring locations include (all located at ambient air monitoring stations):

- A28 (southwest of PORTS on Camp Creek Road)
- A9, A3, A15 (south of PORTS)
- A12, A23 (east of PORTS)
- A24, A6 (north of PORTS)

4.2.3 Monitoring Frequency and Parameters

Radiation is measured by thermoluminescent dosimeters. The dosimeters measure radiation as a dose (in mrem) that is reported in the following components:

- Deep dose: The deep dose equivalent that applies to external whole body exposure; the dose equivalent at a tissue depth of 1 cm. It includes dose for photon energies from approximately 10 kilo-electron volts to 6 mega-electron volts and neutrons.

- Eye dose: The eye dose equivalent applies to the external exposure of the lens of the eye and is the dose equivalent at a tissue depth of 0.3 cm. It includes dose for beta particles, neutrons, and photons.

- Shallow dose: The shallow dose equivalent applies to the external exposure of skin or an extremity and is the dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm^2. It includes dose for beta particles, neutrons, and photons.

Dosimeters are changed and read quarterly per general industry practice.

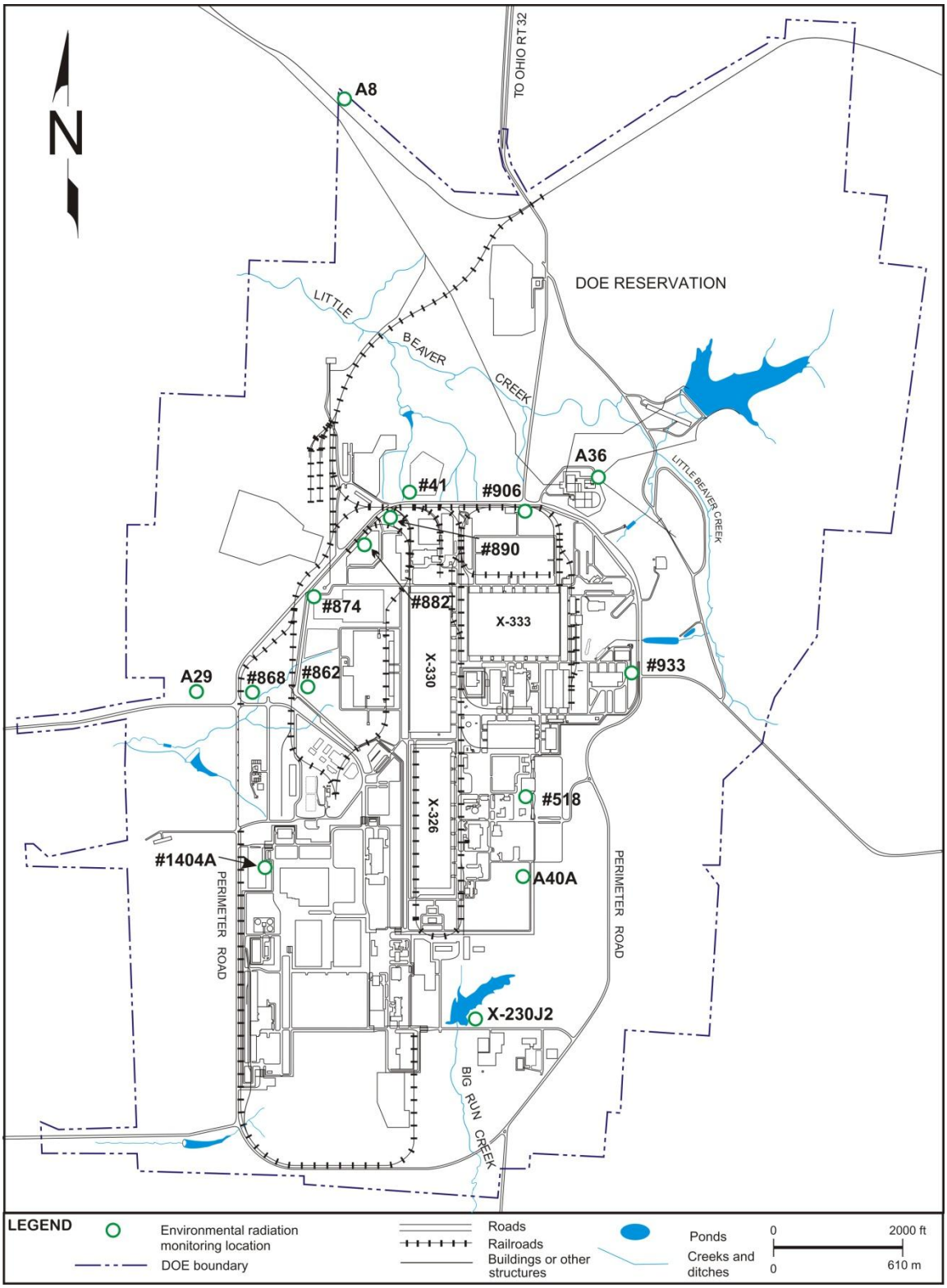

Figure 4.2. On-site radiation monitoring locations

4.2.4 Procedures for Laboratory Analyses

The laboratory that supplies and reads dosimeters for the environmental radiation monitoring program is accredited by the National Voluntary Laboratory Accreditation Program that is part of the National Institute of Standards and Technology.

4.2.5 QA/QC Requirements

QA/QC requirements are provided in the Laboratory QAP. In general, those measures are designed to comply with American National Standards Institute N545-1975, *Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry (Environmental Applications)*.

4.2.6 Data Analysis and Statistical Treatment

Results are provided by the laboratory as specified in the laboratory contract. In general, results are provided quarterly.

4.2.7 Reports and Records

Results for the previous calendar year are summarized in the Annual Site Environmental Report.

Data are maintained in accordance with PORTS reporting guidelines. Calibration worksheets for dosimeters are the responsibility of the supplier.

4.3 GROUNDWATER

Effluent monitoring, as applied to groundwater, is monitoring initiated to achieve compliance with one or more federal or state regulations, permit conditions, or environmental commitments made in Environmental Impact Statements, Environmental Assessments, or other official documents. Included under this heading is groundwater monitoring at RCRA units, monitoring of RCRA 3008(h) facilities, monitoring in conjunction with RCRA Corrective Actions, and monitoring around landfills. In addition, groundwater monitoring in response to an agreed order (e.g., between DOE and U.S. EPA or the State of Ohio) is considered effluent monitoring.

Surveillance monitoring assesses radiation exposures to members of the public, and impacts, if any, on the local environment. Because much of PORTS groundwater monitoring meets both of these criteria, this chapter addresses both groundwater effluent monitoring and groundwater surveillance monitoring.

Per legal agreements with the State of Ohio and U.S. EPA, groundwater monitoring at PORTS is completed in accordance with the IGWMP, with the exception of exit pathway monitoring (a component of groundwater environmental surveillance). Although many of the exit pathway groundwater monitoring wells are also part of IGWMP monitoring, the exit pathway monitoring program is not specifically discussed in the IGWMP.

Off-site residential water supply monitoring (drinking water wells) is completed in accordance with the IGWMP to address the public's concern about the potential for off-site groundwater contamination, especially of drinking water sources.

4.3.1 Rationale and Design Criteria

The groundwater flow system at PORTS includes two water-bearing units (the bedrock Berea Sandstone and the unconsolidated Gallia Sand and Gravel [Gallia]) and two aquitards (the Sunbury Shale and the unconsolidated Minford Clay and Silt [Minford]). The basal portion of the Minford is generally grouped with the Gallia to form the uppermost and primary aquifer at the facility (DOE 1998b, DOE 1998c, DOE 1999a, and DOE 1999b). Figure 4.3 is a geological cross-section of the PORTS area.

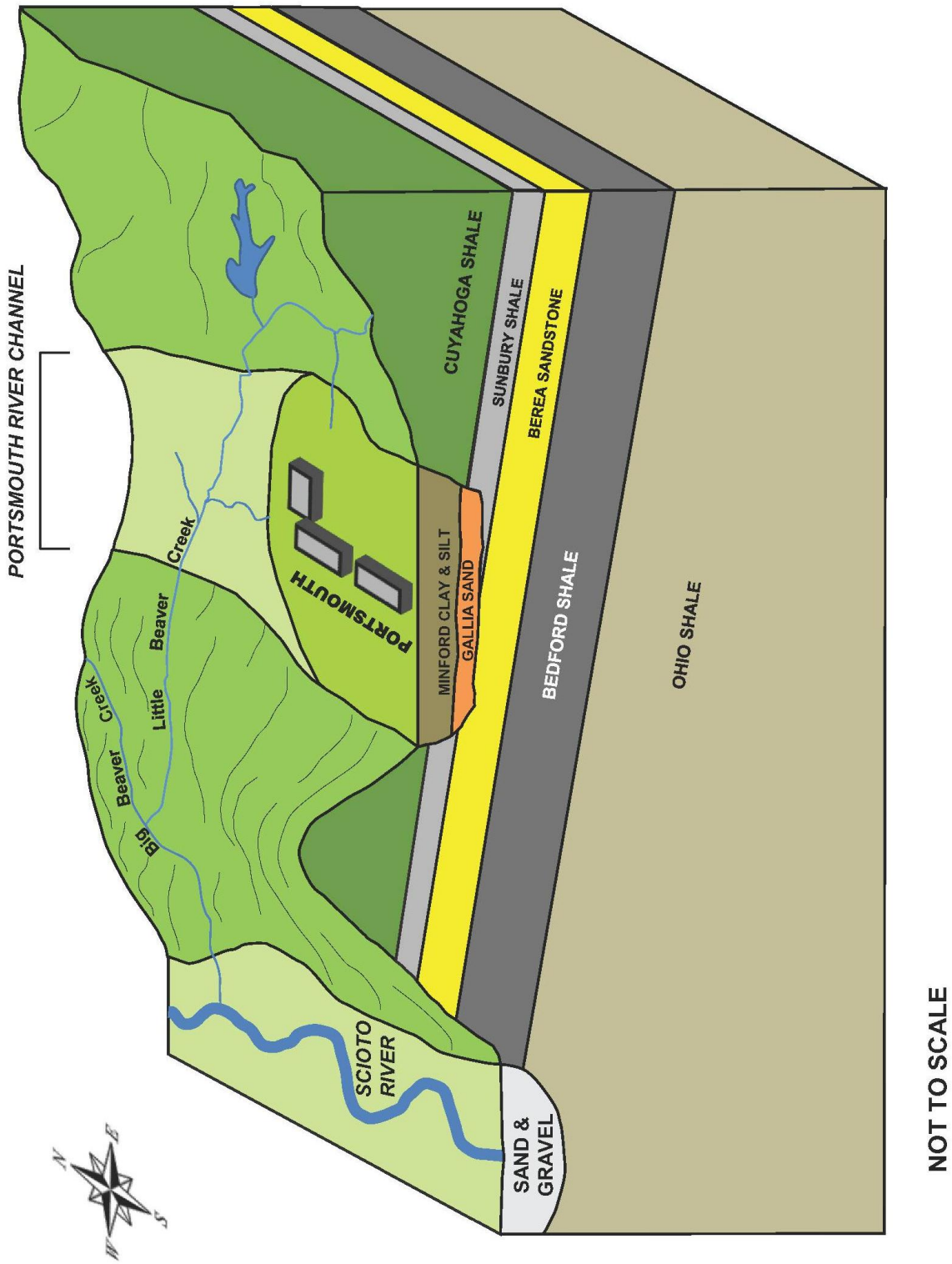

Figure 4.3. Regional structural cross-section

At PORTS, the hydraulic conductivity of all hydrogeologic units is very low. The most conductive unit is the Gallia whose hydraulic conductivity determined from single-well tests across the entire PORTS facility varies from 0.11 to 150 feet per day (ft/d) with an arithmetic mean value of 3.4 ft/d. The hydraulic conductivity of the Gallia is generally higher in thicker areas. The next most permeable formation is the Berea Sandstone with a mean hydraulic conductivity of 0.16 ft/d.

Initial assessments of groundwater contamination at PORTS, conducted in the late 1980s and early 1990s, revealed a number of potential sources of contaminants distributed throughout the site. Hydrogeological evaluations revealed groundwater divides underlying the facility in the Gallia, Minford, and, to a lesser extent, the Berea Sandstone. The Gallia, with its tendency to discharge to surface water features within the reservation boundary, is of primary concern for potential off-site transport. The Berea Sandstone has not exhibited widespread or high levels of contamination on site; however, its regional nature makes it the hydrogeologic unit of concern for potential off-site migration of contaminants. The ultimate discharge areas for most groundwater in both the Gallia and Berea are Little Beaver Creek to the north and east, Big Run Creek to the south, and two drainage channels to the west.

The following documents provide more detailed historical discussions of groundwater contaminants and the geology and hydrogeology of PORTS:

- *Ground Water Quality Assessment of Four RCRA Units for the Portsmouth Gaseous Diffusion Plant* (Martin Marietta Energy Systems 1989)

- *Final Reports for Quadrants I, II, III and IV RFIs* (DOE 1996a, DOE 1996b, DOE 1996c, and DOE 1996d)

- *CAS/CMS Reports for Quadrants I, II, III and IV* (DOE 2000, DOE 2001, DOE 1998a, DOE 1998b)

Monitoring parameters at the groundwater units are based on chemicals and radionuclides identified in Ohio EPA regulations and sampling conducted during the RFI, CAS/CMS, and other investigations. Chemicals may include, but are not limited to, volatile organic compounds (trichloroethene, dichloroethanes, dichloroethenes, vinyl chloride, etc.), metals (cadmium, chromium, nickel, etc.), and other parameters (alkalinity, chloride, sulfate, etc.). Specific radionuclides monitored in groundwater at PORTS are selected based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and/or isotopic uranium because of the uranium enrichment process. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium during the Cold War.

The IGWMP and the *Groundwater Protection Program Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2012b, or latest revision) describe in detail the rationale and criteria used to design groundwater effluent monitoring at PORTS as well as the off-site water supply monitoring program. The IGWMP includes background information and details concerning units or locations that require groundwater monitoring, wells included in the various monitoring programs, analytical parameters and methods for these monitoring programs, the frequency of monitoring at each unit or sampling location, and reporting requirements for each unit or sampling location.

Groundwater exit pathway monitoring at PORTS focuses on the southern portion of the reservation, where the X-749/X-120 groundwater plume is near the site boundary. Wells also monitor the eastern portion of the site near the X-701B groundwater plume.

4.3.2 Monitoring Locations and Frequency

The IGWMP includes maps of well locations, sampling parameters, and monitoring frequencies for the groundwater monitoring areas at PORTS. The IGWMP also provides locations, sampling parameters, and frequencies for the water supply monitoring program (residential drinking water wells and the PORTS water supply).

Figure 4.4 shows the locations of the groundwater exit pathway monitoring wells. Analytical parameters and frequency of sampling for these locations are provided in the IGWMP. At a minimum, exit pathway monitoring wells are sampled biennially and analyzed for volatile organic compounds and radionuclides, which may include uranium, isotopic uranium (uranium-233/234, uranium-235/236, uranium-238), technetium-99, and transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240).

4.3.3 Procedures for Sample Collection and Laboratory Analyses

Sampling procedures are maintained and revised as needed. Laboratory analyses are completed in accordance with established analytical procedures (see Section 5.4) and the applicable laboratory QAPs.

4.3.4 QA/QC Requirements

The IGWMP provides QA/QC requirements applicable to groundwater monitoring at PORTS.

4.3.5 Data Analysis and Statistical Treatment

Sample results are transferred into PEMS by the laboratory. Statistical analyses of groundwater data follow requirements provided in the IGWMP or other requirements provided by Ohio EPA.

4.3.6 Reports and Records

In general, data collected in accordance with the IGWMP is reported to Ohio EPA annually in an Annual Groundwater Report. Additional reporting requirements are included in the IGWMP or provided by Ohio EPA. The PORTS Annual Site Environmental Report includes the results of exit pathway monitoring program and a summary of IGWMP monitoring.

4.4 SURFACE WATER

Surface water surveillance programs include local (off-site) surface water monitoring and surface water monitoring required by the IGWMP. Chapter 3, Effluent Monitoring, describes the NPDES monitoring program and the monitoring program for cylinder storage yards (surface water and sediment).

4.4.1 Rationale and Design Criteria

The local surface water monitoring program is designed to assess levels of radionuclides in local streams at on-site and off-site locations upstream and downstream of PORTS.

Surface water monitoring is also included in the IGWMP because on-site streams and drainage channels can be groundwater discharge areas and may indicate the discharge of groundwater contamination. These locations can also be affected by NPDES discharges or surface water runoff. These locations assess the impact of plant effluent discharges (groundwater and surface water) to local surface water bodies.

Analytes are selected based on contaminants that have been detected at PORTS or that are potentially associated with PORTS activities. The IGWMP provides additional information on parameters selected for IGWMP surface water monitoring. Local surface water samples are analyzed for selected radionuclides based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and isotopic uranium because of the uranium enrichment process.

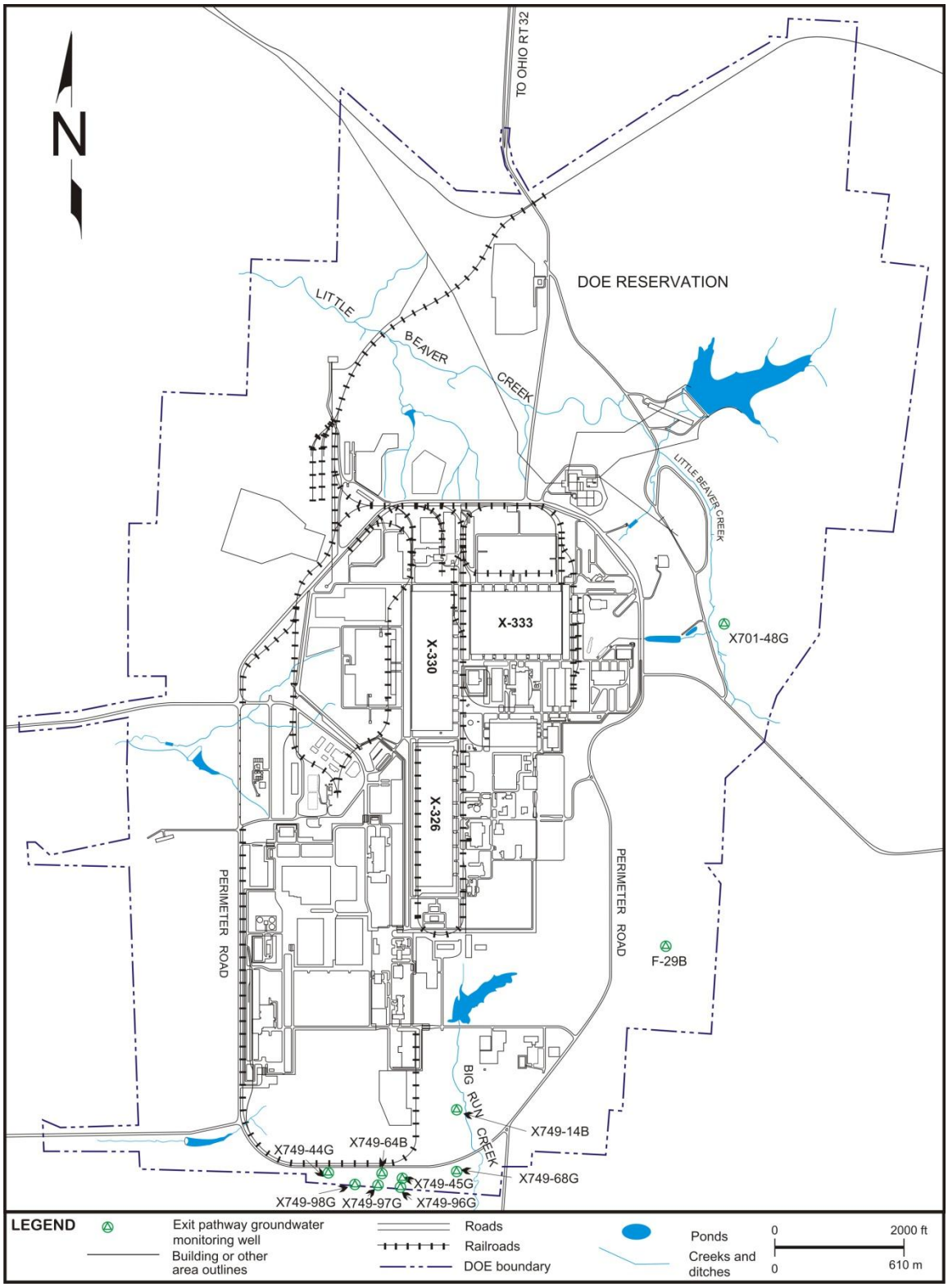

Figure 4.4. Exit pathway groundwater monitoring locations

Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium during the Cold War.

4.4.2 Monitoring Locations

For the local surface water monitoring program, surface water samples are collected at 14 locations on local streams (Little Beaver Creek, Big Beaver Creek, Big Run Creek and the Scioto River) and from background locations located approximately 10 miles from the plant. Figure 4.5 shows the local surface water monitoring points. The purpose for each local surface water monitoring location is listed below:

- Little Beaver Creek: RW-12 is the upstream monitoring point, RW-8 monitors on-site water quality at the North Drainage Ditch from the North Holding Pond, and RW-7 monitors water quality just prior to the confluence with Big Beaver Creek.

- Big Beaver Creek: RW-5 monitors upstream water quality and RW-13 monitors water quality after the confluence with Little Beaver Creek (downstream from PORTS).

- Big Run Creek: RW-33 monitors upstream water quality, RW-2 monitors downstream water quality near Wakefield, and RW-3 monitors water quality at the site boundary.

- Scioto River: RW-6 monitors upstream water quality (in Piketon) and RW-1 monitors downstream water quality (in Wakefield) after PORTS discharges (confluence with Big Beaver Creek, NPDES discharges to the Scioto River, and confluence with Big Run Creek).

- Background creeks: locations 10 miles north, south, east, and west of PORTS (RW-10N [Crooked Creek], RW-10S [creek at State Route 728 and Pleasant Drive], RW-10E [Little Scioto River], and RW-10W [Sunfish Creek]).

Two of the local surface water monitoring locations are also sampled for the settleable solids monitoring program: RW-6, which monitors upstream water quality on the Scioto River in Piketon, and RW-5, which monitors upstream water quality in Big Beaver Creek.

IGWMP surface water samples are collected from 14 locations on Little Beaver Creek, Big Run Creek, Southwestern Drainage Ditch, West Drainage Ditch, North Holding Pond, and the East Drainage Ditch. Figure 4.6 shows the IGWMP surface water sampling locations. The purpose for each IGWMP surface water monitoring location is listed below:

- Little Beaver Creek and East Drainage Ditch sample locations LBC-SW01, LBC-SW02, and EDD-SW01 assess possible X-701B area plume groundwater discharges and surface water discharges from FBP Outfalls 001 and 015.

- Little Beaver Creek sample location LBC-SW03 assesses potential contamination from the X-611A Former Lime Sludge Lagoons and FBP Outfall 011.

- Big Run Creek sample locations BRC-SW01, BRC-SW02, and BRC-SW05 monitor potential groundwater discharges from Quadrant I groundwater plumes and FBP Outfall 002.

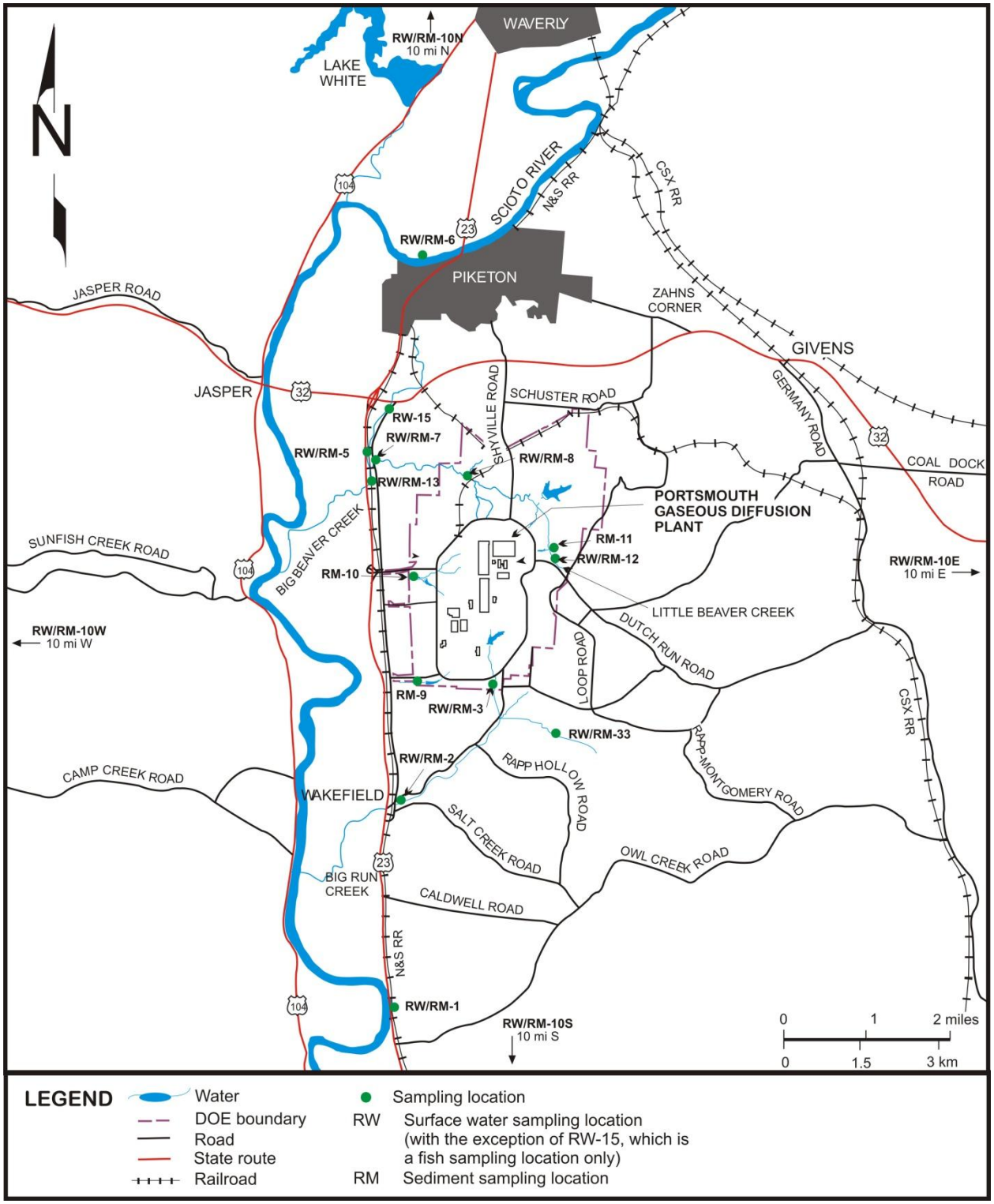

Figure 4.5. Local surface water and sediment monitoring locations

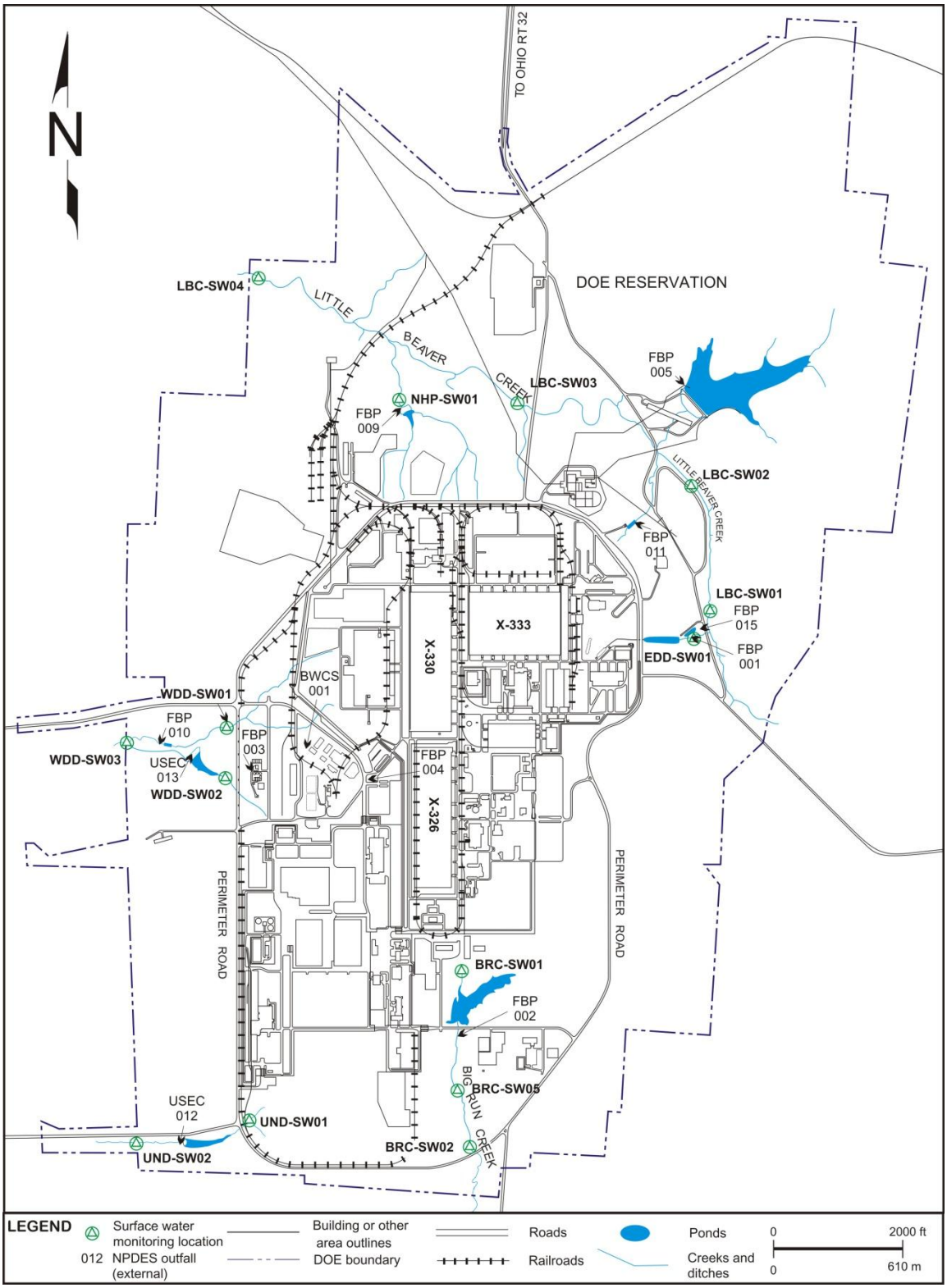

Figure 4.6. IGWMP surface water monitoring locations

- Southwestern Drainage Ditch sample locations UND-SW01 and UND-SW02 assess potential groundwater releases to this creek and the X-2230M Southwest Holding Pond from the western portion of the X-749/X-120 groundwater plume and USEC Outfall 012 (UND-SW02 only).

- North Holding Pond sample location NHP-SW01 and Little Beaver Creek sample location LBC-SW04 assess potential groundwater discharges from the X-734 Landfill and other Quadrant IV sources, FBP Outfall 009, and upstream discharges (see Little Beaver Creek locations LBC-SW01, LBC-SW02 and LBC-SW03).

- Western Drainage Ditch sample locations WDD-SW01, WDD-SW02, and WDD-SW03 assess potential groundwater discharges from the X-616 and X-740 areas to the Western Drainage Ditch and the X-2230N West Holding Pond. FBP Outfall 010, USEC Outfall 013 and BWCS Outfall 001 also affect location WDD-SW03.

Four of the IGWMP surface water monitoring locations also provide exit pathway monitoring: BRC-SW02 (Big Run Creek), LBC-SW04 (Little Beaver Creek), UND-SW02 (Southwestern Drainage Ditch), and WDD-SW03 (Western Drainage Ditch). Two of the IGWMP surface water monitoring locations are also sampled for the settleable solids monitoring program: EDD-SW01 (East Drainage Ditch) and WDD-SW03 (West Drainage Ditch).

4.4.3 Monitoring Frequency and Parameters

Local surface water samples are collected semiannually and analyzed for selected radionuclides including transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238).

IGWMP surface water samples are collected at the frequency provided in the IGWMP (currently quarterly). At a minimum, monitoring parameters include radionuclides and volatile organic compounds. The IGWMP provides the current list of monitoring parameters for the surface water sampling locations.

4.4.4 Procedures for Sample Collection and Laboratory Analyses

Surface water samples are collected in accordance with PORTS procedures. Chapter 5 includes guidelines for laboratory procedures for analysis of surface water samples. Laboratory contracts include specific requirements for the analyses including analytical methods, detection limits, and reporting requirements. Laboratory analyses follow the guidelines established in applicable laboratory QAPs.

4.4.5 QA/QC Requirements

Chapter 9 includes guidelines for QA/QC procedures for local surface water sampling. The IGWMP provides specific QA/QC requirements for IGWMP surface water monitoring.

4.4.6 Data Analysis and Statistical Treatment

Sample results are transferred into PEMS by the laboratory. Data are periodically reviewed by assigned personnel for trends and compliance with regulatory standards such as DOE DCGs/DCSs and drinking water standards, as applicable.

Data collected by the local surface water or IGWMP surface water monitoring programs may be used in dose calculations as described in Chapter 6.

4.4.7 Reports and Records

Chapter 8 summarizes reporting requirements applicable to environmental monitoring data collected under the EMP. The following reports include information from the local surface water and IGWMP surface water monitoring programs.

- Annual Site Environmental Report includes a summary of local surface water and IGWMP surface water monitoring results for the calendar year.

- The Annual Groundwater Report includes IGWMP surface water monitoring data. Additional reporting requirements for IGWMP surface water monitoring data may be provided by Ohio EPA.

Chapter 9 includes recordkeeping requirements.

4.5 SEDIMENT

Sediments can collect, concentrate, and store specific kinds of contaminants. Concentrations of contaminants in sediments, thus, can be integrated measures of aqueous contaminant concentrations over some preceding period of time. Sediments also contain naturally occurring inorganic and organic chemicals. The PORTS sediment monitoring program measures contaminants potentially released by PORTS activities and naturally-occurring constituents.

4.5.1 Rationale and Design Criteria

Sediments are effective at concentrating and storing contaminants that have a high affinity for organic and inorganic surfaces. However, they also contain naturally-occurring inorganic and organic chemicals; thus, analytical measurements generally have higher backgrounds and less sensitivity than aqueous-phase measurements. Analytical parameters measured in sediment samples are restricted to those substances that are accumulated and retained in sediments. Analysis of sediment samples for volatile organic compounds, for example, is not useful because volatile organics would not be found in sediments at concentrations much higher than those in water, and would be rapidly removed from sediments following episodic releases.

Analytes are selected based on contaminants that have been detected at PORTS or that are potentially associated with PORTS activities. Samples are analyzed for metals and PCBs based on historic releases from PORTS. PCBs are a widespread environmental contaminant that were released from PORTS in treated process water prior to 1988 and have been detected in sediment in Little Beaver Creek. Samples are analyzed for metals based on past releases, current or historic NPDES monitoring parameters, and other environmental monitoring data.

Sediment samples are analyzed for selected radionuclides based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and isotopic uranium because of the uranium enrichment process. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium during the Cold War.

Chapter 3, Effluent Monitoring, describes the monitoring program for cylinder storage yards (surface water and sediment).

4.5.2 Monitoring Locations

Sediment samples are collected at monitoring locations for local surface water and at three NPDES discharge points (see Figure 4.5). The purpose for each sediment monitoring location is listed below:

- Little Beaver Creek: RM-12 is the upstream monitoring point, RM-8 monitors the North Drainage Ditch from the North Holding Pond, and RM-7 monitors prior to the confluence with Big Beaver Creek.

- Big Beaver Creek: RM-5 is the upstream monitoring point and RM-13 monitors sediment quality after the confluence with Little Beaver Creek (downstream from PORTS).

- Big Run Creek: RM-33 is the upstream monitoring point, RM-2 monitors downstream near Wakefield, and RM-3 monitors sediment quality at the site boundary.

- Scioto River: RM-6 is the upstream monitoring point (in Piketon) and RM-1 monitors downstream (in Wakefield) after PORTS discharges (confluence with Big Beaver Creek, NPDES discharges to the Scioto River, and confluence with Big Run Creek).

- Background creeks: locations 10 miles north, south, east, and west of PORTS (RW-10N [Crooked Creek], RW-10S [creek at State Route 728 and Pleasant Drive], RW-10E [Little Scioto River], and RW-10W [Sunfish Creek]).

- NPDES outfalls: RM-9 monitors USEC Outfall 012, RM-10 monitors FBP Outfall 010 and USEC Outfall 013, and RM-11 monitors FBP Outfall 001.

4.5.3 Monitoring Frequency and Parameters

Sediment samples are collected annually and analyzed for metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silicon, silver, thallium, and zinc), PCBs, transuranic radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238).

4.5.4 Procedures for Sample Collection and Laboratory Analyses

Sediment samples are collected in accordance with PORTS procedures. Chapter 5 includes guidelines for laboratory procedures for analysis of sediment samples. Laboratory contracts include specific requirements for the analyses including analytical methods, detection limits, and reporting requirements. Laboratory analyses follow the guidelines established in applicable laboratory QAPs.

4.5.5 QA/QC Requirements

Chapter 9 includes guidelines for QA/QC procedures for sediment sampling.

4.5.6 Data Analysis and Statistical Treatment

Sample results are transferred into PEMS by the laboratory. Data are periodically reviewed by assigned personnel for trends.

Data collected by the sediment monitoring program may be used in dose calculations as described in Chapter 6.

4.5.7 Reports and Records

Chapter 8 summarizes reporting requirements applicable to environmental monitoring data collected under the EMP. The Annual Site Environmental Report includes a summary of sediment monitoring results for the calendar year.

Chapter 9 includes recordkeeping requirements.

4.6 SOIL/VEGETATION

Contaminants released from PORTS may reach soil and vegetation (feed crops) by deposition of airborne materials and materials contained in irrigation water. Vegetation may also take up contaminants directly from the soil. Through a number of pathways described in Chapter 6 of this plan, these contaminants in

soil and vegetation may reach and affect man. Soil and grass (forage for grazing animals) are sampled to verify that there is no ongoing accumulation of radionuclides.

4.6.1 Rationale and Design Criteria

Because soil provides an integrating medium for contaminants released to the atmosphere as particulates or gases, it is viewed as a long-term accumulator of material and is useful for long-term trend analysis and to quantify spatial distribution of contaminants around plant facilities. Grass is an indicator of contaminants available to grazing animals.

Because the majority of the contaminants in grass and soil are derived from airborne materials, grass and soil samples are collected, when possible, at ambient air monitoring stations that sample radionuclides (see Section 4.1), making correlations with airborne emissions possible. These monitoring stations are sited using dispersion modeling and local meteorological data and include public exposure locations, the DOE site boundary, local communities, and background areas.

Specific radionuclides monitored in soil and vegetation at PORTS are selected based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and isotopic uranium because of the uranium enrichment process. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium during the Cold War.

4.6.2 Monitoring Locations

Soil and vegetation samples are collected at 15 ambient air monitoring stations that sample radionuclides. Figure 4.1 shows the ambient air monitoring stations. The stations are described as follows:

On-site stations:

- A8–north-northwest of the plant near railroad right-of-way
- A10–Don Marquis Substation
- A29–west of the plant on the West Access Road near the Ohio Valley Electric Corporation
- A36–X-611 Water Filtration Plant
- T7–northwest side of X-734 Landfills near the former X-605 buildings

Off-site stations:

- A3–south of the plant on Bailey Chapel Road near Big Run Road
- A6–4 miles north-northwest of the plant inside the village of Piketon
- A9–southwest of the plant on Old US Route 23
- A12–east of the plant on McCorkle Road just north of Dutch Run Road
- A15–east-southeast of the plant on Loop Road south of Dutch Run Road
- A23–northeast of the plant on Taylor Road at McCorkle Road
- A24–north of the plant on the Shyville Road
- A28–6 miles southwest of the plant on Camp Creek Road
- A37–13 miles southwest of the plant approximately 4 miles north of Otway (background station)
- A41A–2.6 miles northeast of the plant at Zahns Corner

4.6.3 Monitoring Frequency and Parameters

Soil samples and samples of wide-blade grass, typical of local cattle forage, are collected annually and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238,

plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). To the extent possible, grass samples consist of an equal mix of standing live and standing dead crop. A mix of live and dead crop provides a more representative estimate of deposition, which is the major pathway, rather than root uptake.

4.6.4 Procedures for Sample Collection and Laboratory Analyses

Grass samples are collected in accordance with PORTS procedures. After removal of vegetation, soil samples are collected in accordance with PORTS procedures. Chapter 5 includes guidelines for laboratory procedures for analysis of soil and vegetation samples. Laboratory contracts include specific requirements for the analyses including analytical methods, detection limits, and reporting requirements. Laboratory analyses follow the guidelines established in applicable laboratory QAPs.

4.6.5 QA/QC Requirements

Chapter 9 includes guidelines for QA/QC procedures for soil and vegetation sampling.

4.6.6 Data Analysis and Statistical Treatment

Sample results are transferred into PEMS by the laboratory. Data are periodically reviewed by assigned personnel for trends.

Data collected by the soil and vegetation monitoring program may be used in dose calculations as described in Chapter 6.

4.6.7 Reports and Records

Chapter 8 summarizes reporting requirements applicable to environmental monitoring data collected under the EMP. The Annual Site Environmental Report includes a summary of soil and vegetation monitoring results for the calendar year.

Chapter 9 includes recordkeeping requirements.

4.7 BIOTA

Biota is defined as the animal and plant life of a region. Biota monitoring at PORTS includes vegetation (grass – discussed in the previous section), crops, fish, deer, and dairy products (milk and eggs).

4.7.1 Rationale and Design Criteria

Contaminants released from PORTS may accumulate in food crops, fish, and animals. The primary exposure pathway for humans is ingestion of crops, fish, meat (deer), and dairy products (milk and eggs).

Each component of the biota monitoring program may accumulate radionuclides released from PORTS via various pathways (ingestion, inhalation, deposition, etc.). Therefore, all biota samples are analyzed for radionuclides. Specific radionuclides monitored in biota at PORTS are selected based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and isotopic uranium because of the uranium enrichment process. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium during the Cold War.

Additionally, fish samples are analyzed for PCBs. PCBs are a widespread environmental contaminant that were released from PORTS in treated process water prior to 1988 and have been detected in sediment in Little Beaver Creek. PCBs are routinely detected in fish sampled throughout the United States and have been detected in fish sampled at PORTS.

Monitoring the bioaccumulation of volatile organic compounds, including trichloroethene, is not recommended because these compounds have low bioconcentration potential.

4.7.2 Monitoring Locations

The fish monitoring program focuses on upstream and downstream locations on Little Beaver Creek, Big Beaver Creek, and the Scioto River. Fish are collected as available and as weather permits. Whenever possible, only fish of a size and species likely to be taken by sport fishermen are sampled.

Samples of locally produced dairy products (milk and eggs) are collected annually as available on a voluntary basis. PORTS annually collects donated samples of food crops from local farmers and gardeners. Because of fluctuations in the types of crops available, selection of crops for analysis varies from year to year.

Deer samples may be collected through two different means. Samples may be collected from road kills that occur on the reservation. Deer samples may also be obtained from hunting when allowed on the DOE reservation. Samples of the liver, kidney and muscle are usually collected. The liver and kidneys are sampled because these organs are expected to concentrate radionuclides ingested by the animal. Muscle samples are collected because this portion of the deer is eaten by humans and provides data for a dose assessment as described in Chapter 6.

4.7.3 Monitoring Frequency and Parameters

Samples are collected annually or as they are available. Each type of biota sample is analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). In addition, fish samples are analyzed for PCBs.

4.7.4 Procedures for Sample Collection and Laboratory Analyses

Biota samples are collected in accordance with PORTS procedures. Chapter 5 includes guidelines for laboratory procedures for analysis of biota samples. Laboratory contracts include specific requirements for the analyses including analytical methods, detection limits, and reporting requirements. Laboratory analyses follow the guidelines established in applicable laboratory QAPs.

4.7.5 QA/QC Requirements

Chapter 9 includes guidelines for QA/QC procedures for biota sampling.

4.7.6 Data Analysis and Statistical Treatment

Sample results are transferred into PEMS by the laboratory. Data are periodically reviewed by assigned personnel for trends.

Data collected by the biota monitoring program may be used in dose calculations as described in Chapter 6.

4.7.7 Reports and Records

Chapter 8 summarizes reporting requirements applicable to environmental monitoring data collected under the EMP. The Annual Site Environmental Report includes a summary of biota monitoring results for the calendar year.

Chapter 9 includes recordkeeping requirements.

4.8 *REGULATORY GUIDE* PERFORMANCE CRITERIA

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

4.8.1 General Criteria

a. **An evaluation *should** be conducted and used as the basis for establishing an environmental surveillance program for all DOE-controlled sites. The purpose of the surveillance program is to characterize the radiological conditions of the offsite environs and, if appropriate, estimate public doses related to these conditions, confirm predictions of public doses based on effluent monitoring data, and, where appropriate, to provide compliance data for all applicable regulations. The results of this evaluation *should** be documented in the site EMP.**

   Sections of this EMP discuss the rationale and design criteria for each environmental surveillance program. Chapter 6 discusses dose calculations.

b. **The environmental surveillance program for DOE-controlled sites *should** be conducted in accordance with the requirements of DOE Order 5400.1 and DOE Order 5400.5.**

   The environmental monitoring programs discussed in this chapter are designed to address the requirements of DOE Orders 458.1 and 5400.5, as well as the *Regulatory Guide* and other regulatory criteria. DOE Order 5400.1 has been replaced and is no longer applicable.

c. **The criteria for environmental surveillance programs listed in Chapter 5 *should** be used for establishing the environmental surveillance program for DOE-controlled sites. Additional site-specific criteria *should** be documented in the site EMP.**

   The (*Regulatory Guide*) Chapter 5 criteria are the basis for the radiological surveillance program described in this EMP. Other criteria, such as legal liability and public relations, were also considered in developing this plan.

d. **The need for environmental sampling and analysis should* be evaluated, by exposure pathway analysis, for each site radionuclide effluent or emission (liquid or airborne). This analysis with appropriate data, references, and site-specific assumptions, along with site-specific criteria for selection of samples, measurements, instrumentation, equipment, and sampling or measurement locations should* be documented in the site EMP.**

   Through years of operating PORTS, DOE and operating contractors have evaluated exposure pathways to the public. Emissions and effluents have been measured and modeled to estimate the effects of these discharges on humans. Direct measurements of media and biota have also been performed to provide further inputs to the pathway models.

   Chapters 2 and 4 discuss the basis for each sampling program, the rationale for selection of locations, and the types of samples collected and the analyses performed. Chapter 6 discusses dose modeling and/or calculations for specific exposure pathways.

e. **A critical pathway analysis (radionuclide/media) *should** be performed, documented, and referenced in the Annual Site Environmental Report.**

Through years of operating PORTS, DOE and operating contractors have evaluated exposure pathways to the public. Emissions and effluents have been measured and modeled to estimate the effects of these discharges on humans. Direct measurements of media and biota have also been performed to provide further inputs to the pathway models.

The Annual Site Environmental Report discusses exposure pathways and documents dose modeling and calculations performed in the given calendar year.

f. **If the projected dose equivalent from inhalation of particulates exceeds the criteria of Chapter 5, particle-size analysis of the emission *should** be conducted at least annually.**

The total estimated dose to the maximally exposed individual does not exceed the criteria in (*Regulatory Guide*) Chapter 5. Consequently, particle-size analysis of particulate emissions is not required.

g. **Further provisions *should** be made, as appropriate, for the detection and quantification of unplanned releases to the environment of radioactive materials, including radionuclides that may be transported by stormwater runoff, flooding, or resuspension of ground-deposited material.**

Unplanned releases from monitored vents will be quantified from vent sampler data if possible. The vent sampler will be changed out immediately and the results of laboratory analysis will be assumed to be due to the unplanned release.

Unplanned releases from unmonitored sources may be estimated from mass balances based on accountability data and the best isotopic data available. It will be assumed that the released material has the same isotopic proportions as the cascade process gas unless isotopic data specific to the released material is available.

Unplanned releases to surface water may be estimated by mass balance or by laboratory analysis of samples from the appropriate point source outfalls (NPDES locations). The water sampling stations are located to assess the total impact of the facilities, including point source outfalls and diffuse sources from historical activities.

Verification of unplanned airborne releases may be possible by immediately collecting samples from ambient air stations. Ambient air monitoring stations are located to monitor the prevailing wind directions and the directions to potential maximally exposed individuals.

h. **For all new or modified facilities coming on-line, a preoperational assessment *should** be made and documented in the site EMP to determine the types and quantities of effluents to be expected from the facility and to establish the associated environmental surveillance program.**

New facilities or major modifications to existing facilities are reviewed for environmental compliance, including impacts to PORTS airborne emissions and liquid effluents. These reviews are documented in project files. If necessary, the EMP will be updated as required during the annual review cycle.

j. **Gross radioactivity analyses *should** be used only as trend indicators, unless documented supporting analyses provide a reliable relationship to specific radionuclide concentrations or doses.**

Radiological analyses completed to support the DOE EMP include specific radionuclides instead of gross radioactivity (i.e., alpha activity or beta activity).

k. **The overall accuracy (±% accuracy) *should** be estimated, and the approximate Environmental Detection Limit at a specified % confidence level for environmental measurements of beta-gammas, alphas, and neutrons, as appropriate, *should** be determined and documented.**

The accuracy of environmental measurements is determined through the use of either matrix spikes or standards. These QC samples are prepared periodically by the laboratories, as are control charts that are developed to examine trends or biases. Analytical data for radionuclides include a result, detection limit, counting error (reported as rad error in PEMS), total propagated uncertainty (TPU), and confidence interval (reported as TPU level in PEMS).

The detection limit is recalculated periodically and is documented by the laboratories as part of their internal QC programs.

l. **Sample preservation methods *should** be consistent with the analytical procedures used.**

Samples are preserved as required by the analytical method and/or analytical laboratory.

m. **All environmental surveillance techniques should* be designed to take a representative sample or measurement of the important radiation exposure pathway media.**

Ambient air samples are collected continuously for analysis of most parameters. These samples are representative of the conditions at each location as they are either flow- or time- proportional. Time-proportional samplers are used where flow is relatively constant, as in ambient air.

Grab samples are collected in water for analysis of volatile organics because continuous samplers would drive off the volatiles, and the results would not be representative of the true concentration in water.

Biota are sampled at locations where there are farms or homes so that the measurements are representative of concentrations to which the public may be exposed.

n. **Sampling or measurement frequencies for each significant radionuclide or environmental medium combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem effective dose equivalent from emissions in a year) *should** take into account the half-life of the radionuclides to be measured and *should** be documented in the site EMP.**

The radionuclides that are managed and need to be accounted for in PORTS emissions are the uranium isotopes ^{234}U, ^{235}U, ^{236}U, and ^{238}U (shortest half-life is 244,500 years); the long-lived fission product ^{99}Tc (half-life of 213,000 years); and transuranic radionuclides (^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}Pu$ – shortest half life is 87.75 years).

o. **"Background" or "control" location measurements *should** be made for every significant radionuclide and pathway combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem effective dose equivalent from emissions in a year) for which environmental measurements are used in the dose calculations.**

The use of background or "control" sampling locations is contained in the program descriptions in this plan.

p. **An annual review of the radionuclide composition of effluents or emissions *should** be made and compared with those used to establish the site EMP. Any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, *should** be documented in an approved revised site EMP.**

Radionuclide data collected in accordance with this plan are reviewed periodically and are discussed and summarized in the Annual Site Environmental Report. The EMP is reviewed annually and is updated at least once every three years.

q. **Any changes in the site-specific or generic factors *should** be noted in the EMP and the retired or replaced values preserved for historical purposes.**

Change control and preservation of retired information is addressed in Chapter 9, Quality Assurance. Additionally, the environmental surveillance program and any changes are described each year in the Annual Site Environmental Report.

r. **As they apply to environmental surveillance activities, the general QA program provisions of Chapter 10 of this guide *should** be followed.**

The activities discussed in this chapter are conducted in accordance with the QA guidelines established in ASME NQA-1 and 10 CFR 830.122, as applicable. Additional information is provided in Chapter 9 of this document.

4.8.2 Air Criteria

s. **The air sampling rate *should** not vary by more than ±20%, and total air flow or total running time *should** be indicated; air sampling systems *should** be leak-tested, flow calibrated, tested, and inspected on a routine basis at a minimum, using the calibration frequency recommendations of the equipment manufacturers.**

The performance goals and maintenance, testing, and calibration requirements are specified and documented in the standard operating procedures or SAPs of the Environmental Monitoring Programs. All of the specifications meet, or are more restrictive than, the *Regulatory Guide* requirements.

t. **When neutron monitoring is required, the method of measurement *should** be based on the anticipated flux and energy spectrum.**

No neutron monitoring equipment is operated for any PORTS DOE programs.

u. **The sample exchange frequency for non-particulate sampling *should** be determined on a site-specific basis and *should** be documented in the environmental surveillance files.**

Information in Sections 2.3 and 4.1 of this EMP addresses the sample exchange frequency for nonparticulate sampling.

4.8.3 Radiation Criteria

v. **Calibration of dosimeters and exposure-rate instruments *should** be based on traceability to National Institute of Standards and Technology (NIST) standards.**

All instruments or dosimeters used to measure radiation are calibrated periodically with standards traceable to NIST.

4.8.4 Groundwater Criteria

w. **DOE Operations Office and contractor staff *should** ensure that groundwater monitoring plans are consistent with State and regional EPA groundwater monitoring requirements under RCRA and CERCLA to avoid unnecessary duplication. DOE Operations Offices and contractor staff *should** consult with State and regional EPA offices, as needed, to ensure that the requirements are incorporated into the Radiological Monitoring Plan.**

The IGWMP is reviewed and approved by Ohio EPA and is therefore deemed to meet state and regional EPA groundwater monitoring requirements under RCRA.

4.8.5 Terrestrial Environment Criteria

x. **State and local game officials *should** be consulted when selecting appropriate protected species to sample.**

Currently there are no sampling programs for protected species. If the program were to be implemented, then local and state game officials would be contacted, and permits for sampling would be obtained.

y. **The analytical procedure to be used *should** be considered when choosing a method for preserving milk samples.**

Milk samples are preserved as required by the analytical laboratory.

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5. LABORATORY PROCEDURES

5.1 INTRODUCTION

Procedures for laboratory analyses comprise, by definition, an integral element of the environmental monitoring program because both effluent monitoring and environmental surveillance are defined, in part, in DOE Orders 458.1 and 5400.5 as "*the collection and analysis of samples*." Those objectives of the EMP concerning compliance with applicable regulations and commitments, identification of facility contributions to ambient contaminant levels, and determination of the effectiveness of effluent treatment/controls would be impossible to measure without a valid and reliable analytical system.

In compliance with the *Regulatory Guide*, each laboratory used by PORTS for analysis of samples collected for the environmental monitoring and surveillance program has written documentation that identifies:

- sample identification systems,
- procedures preventing cross-contamination,
- analytical methods and/or modifications thereof,
- analytical capabilities,
- equipment calibration and reference source practices, and
- other QC procedures.

5.2 ORGANIZATION

The Analytical Project Manager is responsible for coordinating laboratory analytical services for FBP. Based on the data quality objectives in the applicable Sampling and Analysis Plan, the Analytical Project Manager develops the laboratory Statement of Work (SOW) to include the following:

- appropriate analytical protocols to be applied to meet data quality objectives,
- technical and quality standards for requested analytical services, and
- schedules for completion of services to assure project schedules are met.

After data are received from the analytical laboratory, the FBP Sample and Data Management Group is responsible for contract compliance data verification, and the FBP Quality Assurance Data Validation Group is responsible for data validation. Chapter 7, Section 7.4.4, provides more information about data verification and validation.

BWCS is responsible for environmental monitoring data collected by BWCS.

DOE is responsible for conducting audits of laboratories to be used for FBP and BWCS programs.

5.3 GENERAL QUALITY ASSURANCE

A Laboratory QAP is maintained by each analytical laboratory performing analyses of environmental samples. The Laboratory QAP meets standard Ohio EPA, U.S. EPA, and DOE QA requirements and contains the following elements:

- Title page with provision for signatures
- Table of Contents
- Organization and personnel
- Personnel training
- Sample management practices and chain-of-custody (sample log)

- Material procurement and control
- Facilities and equipment
- Equipment maintenance
- Analytical procedures
- Calibration
- Limits of detection
- Analysis of QC samples and documentation
- Out-of-control events and corrective action
- Document control
- Data evaluation
- Holding times and preservatives
- Internal laboratory audits
- QA reports to management
- Accuracy, precision, and completeness

5.4 ANALYTICAL METHODS

Analyses of environmental samples are completed in accordance with established analytical procedures such as *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods*, (SW-846, most recent edition) and/or *Methods for Chemical Analysis of Water and Waste* (EPA-600/4-032, most recent edition). If applicable, analyses are completed in accordance with the methods specified by regulations or permit requirements. Contracts with analytical laboratories used to analyze samples collected in accordance with this EMP specify the analytical method(s), detection limits, reporting criteria, and other information. Detection limits are assigned to satisfy reporting limits, DOE DCGs/DCSs, and/or preliminary remediation goals, as applicable. However, detection limits reported for specific samples may vary depending on the concentration of contaminants in the sample, interferences in the sample matrix, and the media being sampled.

5.5 *REGULATORY GUIDE* PERFORMANCE CRITERIA

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. **Laboratory procedures and practices *should** be documented in the site EMP.**

Those procedures and practices that are fundamental to the analysis of environmental monitoring samples are documented in the Laboratory QAP. Analyses are performed in accordance with established analytical procedures such as *Test Methods for Evaluating Solid Waste - Physical/Chemical Methods*, (SW-846, most recent edition) and/or *Methods for Chemical Analysis of Water and Waste* (EPA-600/4-032, most recent edition). When U.S. EPA methods are not available, other standard methods are used. Specific laboratory procedures are developed and documented by each of the analytical laboratories and included in their Laboratory QAP.

b. **Each monitoring and surveillance organization *should** have a sample identification system that provides positive identification of samples and aliquots of samples throughout the analytical process. The system *should** incorporate a method for tracking all pertinent information obtained in the sampling process.**

When samples are logged into the laboratory, a unique laboratory identification number is assigned. Labels bearing this number are affixed to the sample container. Sample tracking is also accomplished through the direct electronic transfer of analytical data into PEMS.

c. **Each laboratory *should** establish and adhere to written procedures to minimize the possibility of cross-contamination between samples. High-activity samples *should** be kept separate from low-activity samples.**

Written glassware cleaning procedures are followed at each laboratory cleaning facility for this purpose. Single-use disposable lab equipment is used where practical to minimize the need for washing. Some equipment (e.g., gas chromatography and gas chromatography/mass spectrometry) is specified for low-level concentrations only. The analysis of field and preparation blanks gives an indication of contamination levels. Historical data and in-lab screening procedures are used to segregate samples. High-level radioactive samples are sent to a different laboratory from low-level samples.

d. **The integrity of samples *should** be maintained (i.e., minimize degradation of samples by using proper preservation and handling practices that are compatible with analytical methods).**

Samples requiring preservative arrive at the analytical laboratory with the preservative added. This fact is noted on the chain-of-custody form (sample log). Samples that need to be kept at 4°C are stored in ice or in monitored refrigerators. All samples are kept in secure storage.

e. **Specific analytical methods *should** be identified, documented, and used to identify and quantify all radionuclides in the facility inventory or effluent that contributes 10% or more to the public dose or environmental contamination associated with the site.**

Laboratory contracts include analytes and analytical methods for radionuclides. All laboratories provide copies of the Laboratory QAP and procedures for conducting analysis of samples prior to being approved as subcontractors for PORTS.

f. **Standard analytical methods *should** be used for radionuclide analyses (when available). Any modification of standard methods *should** be documented.**

U.S. EPA methods are the methods of choice. Only when such a method is not available are other standard methods used. Any modification of these methods is documented by the laboratories and approved by the responsible sampling organizations. Modifications may be made following procedures outlined in the SAPs, PORTS procedures, or equivalent.

g. **Methods, requirements, and necessary documentation *should** be specified in analytical contracts.**

Laboratory contracts include analytical methods, detection limits, reporting requirements, and other documentation necessary for compliance with this EMP.

h. **All sites that release or could release gamma-emitting radionuclides *should** have the capability (either in-house or outside) of having samples (routine, special, or emergency) analyzed by gamma-ray spectroscopy systems.**

Multiple analyzer capability or backup for all the tests required for inorganic, organic, and radiochemical measurements exist at PORTS. This duplication provides assurance that prompt attention to special or emergency samples is available. Additionally, backup is provided by other laboratories and by qualified commercial laboratories.

i. **Counting equipment *should** be calibrated using, at a minimum, the calibration frequency recommendations of the manufacturers to obtain accurate results.**

All equipment used for NPDES, RCRA, or compliance work is calibrated according to U.S.EPA or Ohio EPA procedures. In the absence of U.S. EPA or Ohio EPA guidelines, the manufacturer's recommendations are used.

j. **Check sources *should** be counted periodically on all counters to verify that the counters are giving correct results.**

Check sources or common standards are used daily with multiple instrumentation to ensure a common basis. Internal and external control and standards from another vendor are used to verify the correctness of the check sources.

k. **Samples that are sent off-site for analysis or for laboratory intercomparison *should** be monitored for contamination and radiation levels and *should** be packaged in a manner that meets applicable transportation regulations and requirements.**

Environmental samples and shipping containers are surveyed for contamination and free-released prior to shipment off site. Samples are packaged to meet applicable Department of Transportation requirements.

l. **As they apply to laboratory procedures, the general QA program provisions of Chapter 10 of this guide (the *Regulatory Guide*) *should** be followed.**

The activities discussed in this chapter are conducted in accordance with the QA guidelines established in the *Regulatory Guide*, ASME NQA-1, and 10 CFR 830.122, as applicable. Additional information is provided in Chapter 9 of this document.

6. DOSE CALCULATIONS

Operations at PORTS emit airborne and waterborne radionuclides and chemicals. After release, these substances disperse throughout the environment by applicable transport mechanisms, where eventually some may reach and affect humans. This chapter describes the methodologies that may be used to characterize dispersion of released radionuclides and to estimate human exposures to and intakes of the dispersed radionuclides. Ohio EPA and U.S. EPA do not currently require modeling of chemicals released from PORTS.

DOE Order 458.1 states that DOE radiological activities, including remedial actions, must be conducted so that exposure of members of the public to ionizing radiation will not cause a total effective dose exceeding 100 mrem/year, an equivalent dose to the lens of the eye exceeding 1500 mrem/year, or an equivalent dose to the skin or extremities exceeding 5000 mrem/year, from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose. DOE Order 5400.5 provides similar language with the same total effective dose limit of 100 mrem, but does not include a dose limit for the lens of the eye, skin, or extremities.

DOE Order 458.1 defines "public dose" as the dose received by members 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 offsite (DOE Order 5400.5 provides nearly identical language). It does not include doses from occupational exposures, doses from naturally occurring "background" radiation, doses received by a patient from medical procedures, or doses from consumer products.

DOE Order 458.1 further states that if it is suspected that any of the dose limits specified in the order may be exceeded, or if the total effective dose exceeds 25 mrem/year, the dose to the lens of the eye, skin, and extremities must be evaluated. From 2000-2010, the worst-case total effective dose to a member of the public from PORTS operations averaged 1.8 mrem/year with the highest dose during 2000-2010 less than 5 mrem. Because the historical dose from PORTS activities is significantly less than the 25 mrem/year threshold, the public doses to the lens of the eye, skin, and extremities are not evaluated.

U.S. EPA regulations establish additional public dose limits for exposures to selected sources or exposure modes. Regulations implementing NESHAP (40 CFR Part 61, Subpart H) establish a dose limit of 10 mrem from airborne emissions. The 10-mrem limit applies where the members of the public reside or abide. Additionally, U.S. EPA has determined that the 10-mrem limit applies to any member of the public that abides on DOE property where DOE no longer maintains a physical barrier with entry only through a badged access controlled gate or guarded portal.

6.1 CONFORMANCE WITH STANDARDS FOR DOSE CALCULATIONS

DOE Order 458.1 requires use of dose evaluation models that are codified or approved for use by DOE. Models selected to assess environmental transport of and human exposures to substances released from PORTS are appropriate for the physical and environmental setting and available data. As required by NESHAP (40 CFR Part 61 Subpart H), dose calculations for radionuclides released to air are modeled using an U.S. EPA-approved version of the CAP88 model.

Dose calculations are completed using standard U.S. EPA factors such as those provided in the *Exposure Factors Handbook* (U.S. EPA 1997) and *Federal Guidance Report No.11 (FGR 11) Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors of Inhalation, Immersion, and Ingestion* (U.S. EPA 1988). Models and dose calculations are documented including results of calculations, a description of exposure factors or models used, and the source of input data. Descriptions

of models and exposure factors may consist of references to published documents and/or regulatory requirements.

Surface and groundwater transport modeling are not routinely required at PORTS by U.S. EPA or Ohio EPA. If necessary, transport modeling is conducted in accordance with the appropriate U.S.EPA, Ohio EPA, or DOE requirements and/or guidance.

6.2 POTENTIAL EXPOSURE PATHWAYS

Members of the public can receive radiation doses from radionuclides released to the atmosphere, surface water, and groundwater. In addition, some members of the public may receive doses from direct external radiation (i.e., radiation emanating from buildings and other objects such as the cylinders located within the reservation boundary).

The radionuclides managed at PORTS are primarily alpha and beta emitters. Consequently, the potential dose from external exposure pathways (immersion and direct irradiation) is generally smaller than the potential dose from internal exposures (ingestion and inhalation). Furthermore, none of the radionuclides managed at PORTS are volatile under normal aqueous conditions; consequently, the inhalation pathway is not a significant contributor. Therefore, ingestion of drinking water is the most significant potential exposure pathway. To the best of current site knowledge, radionuclides have not contaminated any drinking water sources. The Scioto River downstream from PORTS is not a water source for any public drinking water supply. Residential drinking water wells are monitored as described in Chapter 4, Section 4.3.

DOE Orders 458.1 and 5400.5 set a limit of 100 mrem/year for a potential dose to a member of the public via exposure to all radionuclide releases from a DOE facility. To ensure that PORTS meets this standard, dose calculations are completed for radionuclides released from PORTS via air and surface water, for direct radiation, and for radionuclides detected in off-site environmental media (water, soil, etc.), and biota (deer, fish, crops, vegetation, etc.).

Table 6.1 lists environmental release and transport mechanisms that potentially apply to releases from PORTS. Models and dose calculations evaluate radionuclides dispersed into the environment via these pathways (as applicable). Sections 6.3 and 6.4 provide additional information on modeling and dose calculations.

Models for evaluating public exposures to released radionuclides are selected based on 1) the applicability of the model to the situation being evaluated, 2) the degree to which the model has been documented and verified, and 3) the availability of the data needed to implement the model. Unless required by regulatory or legal requirements, the simplest model needed to evaluate a situation is used. Dose evaluation models are either codified or approved for use by DOE.

6.3 TRANSPORT MODELS

Transport models may be used to predict concentrations of contaminants in environmental media in the absence of direct measurements, or to confirm direct measurements. Transport models may be used to assess releases to air, surface water, or groundwater.

Table 6.1. Environmental transport mechanisms potentially applicable to releases from PORTS

Releases to air	Remain suspended in air Deposit on ground Deposit on vegetation Deposit on water surfaces
Releases to surface water	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Deposit in sediments Infiltrate to groundwater
Releases to groundwater	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Flow into surface water Absorb onto sub-surface soil
Radionuclides in objects	Remain in fixed sources

6.3.1 Atmospheric Transport

Modeling of airborne levels and deposition rates of radionuclides released to the atmosphere by PORTS radionuclide emission points is completed using the CAP88 model approved by U.S. EPA for demonstrating compliance with NESHAP (40 CFR Part 61, Subpart H). The CAP88 model calculates the predicted dose an individual member of the public could receive at selected locations (residences or businesses near PORTS), and the collective population dose received by the entire population within 50 miles of PORTS.

Whenever possible, site-specific values are used for meteorological variables (wind speed and direction, atmospheric stability class, air temperature, rainfall, and mixing layer height).

6.3.2 Surface Water Transport

Quantities of radionuclides released to surface waters are determined by monitoring NPDES outfalls (i.e., liquid effluent). Local receiving streams (Little Beaver Creek, Big Beaver Creek, Big Run Creek, and the Scioto River) are also sampled upstream and downstream of plant discharges to provide direct measurements of contaminant levels in these streams. In the Scioto River, radionuclide discharges from PORTS operations do not cause a significant difference between levels of radionuclides measured upstream and downstream.

Because all NPDES outfalls discharge to the Scioto River either directly or indirectly (from other local streams), the Scioto River represents the most common public exposure point to liquid radionuclide discharges from PORTS. For dose estimates, radionuclide activities in the Scioto River due to PORTS effluents are estimated by a simple dilution calculation.

Pathways assessed in the calculation include ingestion of water and aquatic foods, swimming, boating, and shoreline activities. This dose includes the conservative assumption that the river is a source of drinking water, although the State of Ohio does not classify the lower Scioto River as suitable for a drinking water source and no public or identified private drinking water sources have been identified on the Scioto River downstream of PORTS.

6.3.3 Groundwater Transport

At PORTS, transport models are not routinely required by regulators to predict concentrations of contaminants in groundwater. If required, transport modeling of contaminants in groundwater is performed by an experienced environmental professional using accepted modeling practices. Modeling is completed using local site information as available including aquifer characteristics and meteorological data.

6.4 ENVIRONMENTAL PATHWAY ASSESSMENTS

Environmental pathway models or calculations are used to assess the dose to humans or aquatic or terrestrial organisms based on direct measurement of radionuclide activities in environmental media and biota. In general, models or calculations are completed using conservative data assumptions. For example, maximum contaminant activities are often used instead of average activities. Assumptions are documented for all models or calculations.

At PORTS, these dose calculations may be completed for detections of radionuclides in environmental media (ambient air, surface water, residential drinking water [well water], sediment, and soil), and biota (vegetation, crops, deer, fish, and dairy products) at off-site sampling locations. Detections of radionuclides on the DOE reservation are not used in dose calculations because the public does not have access to the facility at the sampling locations.

Dose calculations for individual media are added to determine compliance with the 100 mrem standard in DOE Orders 458.1 and 5400.5. These calculations are completed annually as dictated by the findings of the sampling program and documented in the Annual Site Environmental Report.

6.4.1 Contaminants in Air

The CAP88 model calculates doses to individuals and the population for compliance with NESHAP regulations as described in Section 6.3.1. Additionally, the calculated activity of a radionuclide detected in ambient air is used in conjunction with dose conversion factors generated by the CAP88 model to determine a dose in mrem/year associated with a given activity of a radionuclide in air. Chapter 4, Section 4.1, describes the ambient air monitoring program that generates these data. However, the NESHAP dose is used when totaling doses from environmental media because it evaluates more exposure pathways and results in a larger dose (i.e., using the NESHAP dose is a more conservative assumption).

6.4.2 Contaminants in Sediment

Discharges from PORTS to surface waters may result in accumulations of radionuclides in sediment. Humans may receive a dose from these radionuclides through direct ingestion or by eating fish that have ingested the sediment.

Sediments from the Scioto River and local creeks are sampled annually to monitor the presence of metals, PCBs and radionuclides (see Chapter 4, Section 4.5). Activities of radionuclides detected at off-site sampling locations are used to calculate a dose for ingestion of sediment based on standard exposure factors for ingestion of soil in children. Section 6.4.6 discusses dose calculations for fish.

6.4.3 Contaminants in Groundwater

Dose calculations are completed for the drinking water pathway if measurable activities of radionuclides (not including naturally-occurring levels of uranium) are found in water samples collected in accordance with the IGWMP from private drinking water systems (see Chapter 4, Section 4.3). A maximally exposed individual is assumed to ingest water containing the measured activities of radionuclides throughout the year.

6.4.4 Contaminants in Soil

Contaminants may reach soil by deposition of airborne radionuclides and radionuclides contained in irrigation water. Soil samples are collected annually at ambient air monitoring stations (see Chapter 4, Section 4.6). Activities of radionuclides detected at off-site sampling locations are used to calculate a dose based on ingestion of soil.

6.4.5 Contaminants in Vegetation or Crops

Contaminants may reach vegetation (food and feed crops) by deposition of airborne materials, uptake from soil, and deposition of materials contained in irrigation water. Vegetation samples (grass) are collected annually at ambient air monitoring stations (see Chapter 4, Section 4.6). Samples of local crops are also collected annually (see Chapter 4, Section 4.7).

The only significant potential direct pathway for human exposure to contaminants in food crops is ingestion. Indirect pathways involve ingestion of feed crops by terrestrial animals. A dose calculation is completed for consumption of beef cattle if radionuclides are detected in off-site vegetation. A dose calculation is completed for consumption of crops if radionuclides are detected in crops.

6.4.6 Contaminants in Terrestrial Animals and Fish

Contaminants may accumulate in terrestrial animals from eating contaminated feed or soil, drinking contaminated water, and breathing contaminated air. Contaminants may accumulate in fish when they eat contaminated foods or sediment and equilibrate with surrounding waters. Potential direct pathways for human exposure to contaminants in terrestrial animals and fish are eating beef, venison, eggs, and fish and drinking milk.

Section 6.4.5 describes the dose calculation for beef cattle. Samples of deer (muscle, kidney, and/or liver), eggs, fish, and milk are collected annually (as available) from on-site or off-site locations (see Chapter 4, Section 4.7). Dose calculations are completed if radionuclides are detected in the samples.

6.4.7 Radionuclides in Objects

The only identified source of potential exposure to the public from radiation emanating from radionuclides contained in structures and other objects is gamma radiation from the cylinder yards near Perimeter Road. The gamma radiation field from this source does not extend to the site boundaries, and public exposure is limited to passing traffic on the plant's Perimeter Road (members of the public that are allowed access to Perimeter Road near the cylinder yards, such as delivery personnel). Public exposure to this source is estimated from measurements taken along the Perimeter Road. A theoretical dose, using these measured exposure rates, is calculated to a hypothetical, maximally exposed individual.

6.5 INTERNAL DOSIMETRY MODELS

Standard dose conversion factors are used in dose calculations and models, including, but not limited to *Federal Guidance Report No.11 (FGR 11) Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors of Inhalation, Immersion, and Ingestion* (U.S. EPA 1988). Dose calculations made with CAP88 use the dose conversion factors included in the model.

6.6 RADIATION DOSE TO AQUATIC AND TERRESTRIAL BIOTA

DOE Order 5400.5 sets an absorbed dose rate limit of 1 rad/day to native aquatic organisms. DOE Order 458.1 sets absorbed dose rate limits for aquatic animals, riparian animals, terrestrial plants, and terrestrial animals and requires evaluation of dose rates by using DOE Technical Standard *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE-STD-1153-2002) or an alternative approach that demonstrates compliance with the limits in the DOE Technical Standard.

Analytical data for radionuclides detected in sediment (for aquatic and riparian animals), soil (for terrestrial plant and animals) and surface water (used for each dose assessment) collected at approximately the same location are used to assess compliance with the dose limits. The maximum values of transuranic radionuclides, technetium-99, and uranium isotopes detected in sediment/soil and surface water samples are entered into the spreadsheet that is part of DOE Technical Standard. The spreadsheet, developed as part of the DOE Technical Standard, is used to evaluate compliance with the dose limits.

6.7 QA/QC REQUIREMENTS

Dose models and calculations meet QA/QC requirements, including, but not limited to, documentation of assumptions and data used in the models or calculations, and recordkeeping. Chapter 9 provides additional QA/QC requirements.

6.8 REPORTS AND RECORDS

Doses based on PORTS air emissions and ambient air monitoring (modeled using CAP88) are provided to U.S. EPA in the NESHAP annual report. These doses, as well as other dose modeling or calculations discussed in this chapter, are published in the Annual Site Environmental Report.

6.9 *REGULATORY GUIDE* PERFORMANCE CRITERIA

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. **Except where mandated otherwise (e.g., compliance with 40 CFR Part 61), the assessment models selected for all environmental dose assessments *should** appropriately characterize the physical and environmental situation encountered. The information used in dose assessments *should** be as accurate and realistic as possible.**

   Models used for dose assessments are appropriate for the physical, chemical, and environmental situation. Data used for dose assessments may be selected to evaluate a worst-case scenario versus a more realistic scenario to demonstrate that the dose associated with a worst-case scenario meets U.S. EPA and/or DOE dose limits.

b. **Complete documentation of models, input data, and computer programs *should** be provided in a manner that supports the annual site environmental report or other application.**

   Models, input data, assumptions and other information used in dose calculations are documented and maintained by PORTS personnel.

c. **Default values used in model applications *should** be documented and evaluated to determine appropriateness to the specific modeling situation.**

   Default values used in modeling applications are documented and evaluated for appropriateness to the modeling situation.

d. **When performing human food chain assessments, a complete set of human exposure pathways *should** be considered, consistent with current methods, and *should** be documented supporting the site EMP.**

   Through the years, human exposure pathways have been considered and evaluated. The primary pathways that contribute to the dose are discussed in detail in this chapter.

e. Surface and groundwater modeling *should be conducted as necessary to conform with the applicable requirements of the state government and the regional office of the EPA.**

Ohio EPA and U.S. EPA Region V currently do not require surface or groundwater modeling. Modeling of contaminant migration is completed as needed in accordance with standard industry practice.

f. **The general QA program provisions of Chapter 10 of this guide *should** be followed as they apply to performing calculations that assess dose impacts.**

PORTS follows the general QA program provisions from Chapter 10 of the *Regulatory Guide* when performing dose modeling and dose calculations.

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7. DATA MANAGEMENT, ANALYSIS, AND STATISTICAL TREATMENT

7.1 INTRODUCTION

This chapter provides a general description of the objectives, roles and responsibilities, and methods to be followed by FBP for management, analysis, and statistical treatment of data generated by the environmental monitoring program. BWCS is responsible for data collected by BWCS.

Data generated by the environmental monitoring program provide a basis for site management decisions. Thus, adequate attention to estimating the accuracy, bias, and precision of the data is necessary to determine whether such management decisions and actions are supported by valid and reliable data.

Groundwater and surface water data are also collected in accordance with the IGWMP (see Chapter 4, Sections 4.3 and 4.4). The IGWMP provides specific requirements for data generated under the IGWMP.

7.2 OBJECTIVES

The objective of an effective data management, analysis, and statistical treatment program is to meet or exceed the required data reporting goals for effluent monitoring and environmental surveillance. The goals for collection of environmental data include:

- estimating chemical and radionuclide concentrations or activities with their associated accuracy and precision at each sampling and/or measurement point for each required sampling and/or measurement time;

- comparing the estimated chemical and radionuclide concentrations or activities at each sampling and/or measurement point to previous estimates at that point to identify changes or inconsistencies in contaminant levels;

- comparing the estimated chemical and radionuclide concentrations or activities at each sampling and/or measurement point to the established limits; and

- comparing the estimated chemical and radionuclide concentrations or activities at single sampling and/or measurement points or groups of points to those at control or other points and evaluating the reliability of those comparisons.

Plans and procedures are developed and implemented to manage, evaluate, and report data collected by site effluent and environmental surveillance monitoring programs. This chapter describes the roles and responsibilities of the FBP Environmental Monitoring and Field Characterization Group and Sample and Data Management Group and methodology for data management, analysis, and statistical treatment activities.

7.3 ROLES AND RESPONSIBILITIES

The FBP Environmental Monitoring and Field Characterization Manager is responsible for the environmental surveillance and effluent monitoring programs that are part of the FBP contract with DOE.

The FBP Environmental Monitoring and Field Characterization Group is responsible for maintenance of the paper copies of all field information (field results, copies of field logbooks, and field notes), until the field information is submitted to Records Management and Document Control. If electronic versions of this information are also required, the FBP Environmental Monitoring and Field Characterization Group will facilitate the electronic transfer of the data.

The analytical laboratory is responsible for transferring environmental data into PEMS or providing data as described in the laboratory contract.

BWCS is responsible for data collected by BWCS.

7.4 METHODS

The following sections describe the processes that take place during collection, management, analysis, and reporting of data for the FBP environmental monitoring program.

7.4.1 Data Collection

The field sampling staff collects environmental samples on a routine basis as detailed in this EMP. Field measurements and samples are collected and samples are sent to the analytical laboratory for analysis. Field data may include information on field conditions, field instrument measurements, and any deviations from prescribed plans or procedures. The FBP Environmental Monitoring and Field Characterization Group generates required information related to sampling (field measurements, copies of field logbooks, and field notes, as applicable) according to a documented schedule.

The contracted analytical laboratory receives the environmental samples and analyzes the samples for the chemical and/or radiological parameters specified in the laboratory contract. Laboratory data include the analytical results for environmental samples, field QA/QC samples, laboratory QA/QC samples, and any data qualifiers placed on the results by the laboratory analysts.

7.4.2 Data Tracking

Data are provided from the analytical laboratory in hard copy and/or are transferred to PEMS by the laboratory, as specified in the laboratory contract. Data packages are reviewed as described in Section 7.4.4.

7.4.3 Data Storage

The FBP Sample and Data Management Group ensures that paper copy data are stored appropriately (i.e., document control, assigned file cabinets, etc.).

The minimum required data that are entered into PEMS include:

- Sample date (time, day, month, year)
- Sample identification number (unique sample identifier)
- Location (example: RM-6, X749-97G, etc.)
- Sampling media (e.g., air, surface water, soil, etc.)
- Sample type (e.g., regular, field blank, duplicate, etc.)
- Parameter (arsenic, trichloroethene, pH, etc.)
- Result (the value of the measurement)
- Unit of measure (e.g., milligram per liter [mg/L], pCi/g, milligram per kilogram [mg/kg], etc.)
- Detection limit

7.4.4 Data Verification and Validation

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, and contractual requirements. Data validation is defined as an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, and contractual compliance to determine the analytical quality of a specific data set.

The FBP Sample and Data Management Group is responsible for contract compliance data verification after data are received from the analytical laboratory. The contract compliance verification process includes screening of electronic and hard copy data deliverables for completeness, compliance with the analytical SOW, and consistency between the hard copy and electronic data deliverables (i.e., the hard copy data match the electronic data loaded into PEMS). All FBP environmental monitoring data collected in accordance with the EMP or IGWMP are verified.

The results of the verification are documented in the contract compliance verification report. For items that can be reconciled prior to data validation, the Analytical Project Manager will request that the laboratory reanalyze samples and/or revise reports to satisfy the SOW. Data verification typically occurs before data validation but can be completed concurrently.

The FBP Quality Assurance Data Validation Group is responsible for data validation. During data validation, analytical performance is evaluated against a set of criteria and limits specific to FBP or the project. In addition to these criteria and limits, the professional judgment of the data validator is also used. This process provides a level of assurance, based on technical evaluation, that an analyte is present or absent, and if present, the level of uncertainty associated with the measurement.

Data validation evaluates quality control samples, the identification and quantitation of analytes, and the effect of deficiencies in quality on analytical results. Based on the findings during data validation, qualifiers may be assigned to individual data points. It is the responsibility of the FBP Quality Assurance Data Validation Group to ensure that the appropriate data qualifiers are entered into PEMS. Data validation (if required) occurs prior to the use of the data by the user for its intended purpose(s) identified by project data quality objectives. The percentage of data that is validated is specific to each project and determined by the project manager.

After data validation is complete, data are ready to be processed and transferred to the Oak Ridge Environmental Information System (OREIS).

7.4.5 Data Analysis and Reporting

The FBP Environmental Monitoring and Field Characterization Group is responsible for analysis and reporting of environmental monitoring and surveillance data. Chapter 8 summarizes reporting requirements for data generated by the EMP. Chapters 2 and 4 describe specific reporting requirements for each effluent monitoring and environmental surveillance monitoring program.

The Annual Site Environmental Report includes a summary of environmental data collected by FBP, BWCS, and USEC during the given calendar year. These data generally include sampling locations, sampling media (e.g., air, water, soil, etc.), parameters, analytical results, and units of measure. Data summaries may include the total number of samples collected, the minimum, maximum, and average concentrations or activities of monitoring parameters, and regulatory limits as defined by the environmental program (i.e. NPDES limits, DOE DCGs/DCSs, etc.), as applicable. Summary parameters such as average concentrations or activities of monitoring parameters are calculated using standard commercial software.

7.5 *REGULATORY GUIDE* PERFORMANCE CRITERIA

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. **The statistical techniques used to support the concentration estimates, to determine their corresponding measures of reliability, and to compare radionuclide data between sampling and/or measurement points and times *should** be designed with consideration of the characteristics of effluent and environmental data.**

Single Value Analysis
Statistical treatment of single sample results is different for reporting radionuclide and nonradionuclide data. Radioactivity results are routinely reported by the contracted analytical laboratory with their counting uncertainties. The estimate of precision, which is based upon Poisson statistics, is used to test whether the sample result is significantly greater than either zero or a regulatory limit. This test of significance includes only the error associated with analytical measurement. Data for organic and inorganic analyses are taken at face value; an estimate of measurement error is not reported by the contracted analytical laboratory.

Monitoring programs that routinely generate and analyze individual sample data are augmented with a quality control program designed to collect duplicate samples at a frequency of at least 5%, where feasible. Under certain sampling conditions, such as isokinetic sampling from stacks, it is not feasible to install a second sampling rake and collect duplicate samples. Other programs, such as water sampling, can be modified to include portable flow proportional or time proportional samplers operating in parallel with the permanent equipment.

Multiple Value Analyses
The statistical treatment of data for the computation of averages or sums is preceded by a determination that the calculation is appropriate for the data. This determination is based upon considerations of the representativeness and completeness of the data and the intended use of the data. Properly addressing these issues often requires input about processes that the data represent, sampling and measurement methods, and the hypothesis that is being tested or the phenomenon that is being characterized.

Due to the individual nature of the evaluation for each environmental monitoring program data summary, it is not feasible to specify rules or guidance to cover all situations. The process is performed on a program-by-program basis and a short statement of the evaluation may be included with the data summary in the Annual Site Environmental Report, if appropriate. For example, summing airborne emissions data by stack to support the calculation of annual off-site dose estimates is a routine calculation and does not need a statement of rationale whereas combining data from several water sampling locations to estimate an average water quality or contaminant loading infers a commonality among the sampling points and is supported by a statement of rationale. Basic summary statistics presented in the Annual Site Environmental Report (average, minimum, and maximum values) are determined using methods available in commercial software systems.

b. **Documented and approved sampling, sample-handling, analysis, and data management techniques *should** be used to reduce the variability of results.**

The techniques for sampling, sample handling, chain-of-custody, instrument maintenance and calibration, laboratory analysis, data management, information analysis, and reporting are documented in the standard operating procedures of the organizations that perform the work. All compliance environmental monitoring is conducted in accordance with the specific regulatory authorities that mandate the activity. Sampling, chain-of-custody, and laboratory analyses are conducted in accordance with requirements and guidance from Ohio EPA and DOE, as available.

c. **The level of confidence in the data due to the radiological analyses *should** be estimated by analyzing blanks and spiked pseudosamples and by comparing the resulting concentration estimates to the known concentrations in those samples.**

Radiological analyses for PORTS environmental monitoring programs are performed by contract laboratories that participate in regular internal and external audit programs. The contracted laboratory is responsible for meeting applicable QA/QC criteria for radiological analyses as specified in the Laboratory QAP. Blanks and pseudosamples are routinely analyzed as part of each laboratory quality control program.

d. **The precision of radionuclide analytical results *should** be reported as a range, a variance, a standard deviation, a standard error, and/or a confidence interval.**

Analytical data for radionuclides include a result, detection limit, counting error (reported as rad error in PEMS), TPU, and confidence interval (reported as TPU level in PEMS).

e. **Data *should** be examined and entered into the database promptly after analysis.**

Environmental data are transferred into PEMS by the analytical laboratory or are provided as stated in the laboratory contract.

f. **Outliers *should** be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. As each data point is collected, it *should** be compared to previous data, because such comparison can help identify unusual measurements that require investigation or further statistical evaluation.**

Analytical results that exceed the expected minimum and maximum values are verified by the FBP Environmental Monitoring and Field Characterization Group with the analytical laboratory. If the laboratory cannot identify a measurement or data management error, field records associated with the sample are checked for any annotations regarding unusual conditions that might affect the results.

Outliers are not generally excluded from information analysis without an identified reason. A questionable value is noted in the data report. If an outlier is identified and a valid measurement is available from another source, the outlier may be replaced.

g. **As they apply to data analysis and statistical treatment activities, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.**

Chapter 9 provides an overview of the QA Program provisions of the *Regulatory Guide.* These provisions are followed, as applicable, in data management, analysis, and statistical treatment.

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8. REPORTS

8.1 INTRODUCTION

This chapter provides an overview of the reports prepared by PORTS that use data collected in whole or in part by the environmental monitoring program. Reporting requirements have been established in regulations, statutes, and orders issued by regulatory agencies of government and by DOE, and they are addressed specifically in the individual sections of the EMP.

Reporting requirements can change as regulations are developed and amended. In addition, the applicability of reporting requirements varies at individual DOE sites or facilities. PORTS is committed to identifying and complying with all applicable reporting requirements.

8.2 REPORTING REQUIREMENTS

Table 8.1 summarizes reports that include environmental monitoring data collected by programs discussed in the EMP. This EMP does not include reports that may be required to address environmental monitoring for the Ohio EPA Consent Decree, U.S. EPA Administrative Consent Order, U.S. EPA/DOE Toxic Substance Control Act Federal Facilities Compliance Agreement, and various other regulatory programs. The Annual Site Environmental Report contains summary data for the given calendar year for the effluent monitoring and environmental surveillance monitoring programs discussed in Chapters 2 and 4. Data collected less frequently than annually may be provided in each year's report until new data are available. The Annual Site Environmental Report also includes the results of dose modeling and calculations as described in Chapter 6.

Table 8.1. Report summary

Report	Deadline	Source of Requirements	Requirement
NPDES Monthly Operating Report	Monthly	Clean Water Act (NPDES Permit)	Required by current FBP, BWCS, and USEC NPDES permits.
NPDES Radiological Discharge Monitoring Report	Quarterly	Ohio EPA request in current FBP and USEC NPDES permits	Submittal of radiological monitoring data for NPDES outfalls collected by USEC in accordance with the Safety Analysis Report and FBP in accordance with the EMP.
Groundwater Monitoring Report	Annual (April 1)	IGWMP (Director's Final Findings and Orders)	Summarizes data collected in accordance with the IGWMP.
NESHAP Annual Report	Annual (June 30)	40 CFR Part 61, Subpart H	Includes dose calculations based on emissions of radionuclides from PORTS and results of ambient air monitoring.
Annual Site Environmental Report	Annual (October 1)	DOE Order 231.1B	Summarizes environmental data to characterize site environmental performance.
Occurrence Report	Determined by categorization	DOE Order 231.1A	Occurrence reports are prepared in accordance with DOE M 231.1-2.

As applicable to the monitoring program, the Annual Site Environmental Report may include comparisons of maximum or average concentrations or activities of contaminants at sampling locations to DOE, U.S. EPA, or Ohio EPA standards, permit limits, background levels, or other criteria. The most recent guidance issued by DOE for preparation of the Annual Site Environmental Report is considered when preparing the report. The guidance may be adapted as needed for applicability to PORTS.

8.3 *REGULATORY GUIDE* PERFORMANCE CRITERIA

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. **DOE officials and DOE Management and Operating Contractors *should** identify and comply with the relevant reporting requirements.**

   PORTS identifies and complies with the relevant reporting requirements for the environmental monitoring program.

b. **Timely notification of occurrences and information involving DOE and its contractors *should** be made to the appropriate DOE officials and to other responsible authorities.**

   PORTS provides notification of occurrences to the appropriate DOE officials and other responsible authorities in accordance with the requirements of DOE Order DOE M 231.1-2 and regulatory agencies.

c. **Auditable records relating to environmental surveillance and effluent monitoring *should** be maintained. Calculations, computer programs, and other data handling *should** be recorded or referenced.**

   PORTS maintains auditable records relating to the environmental monitoring program. Recordkeeping requirements for the environmental monitoring program are addressed throughout this EMP, and in detail in Section 9.15.

d. **As they apply to records and reporting activities, the general quality assurance program provisions of Chapter 10 of this guide *should** be followed.**

   The QA Programs at PORTS follow the QA provisions of Chapter 10 of the *Regulatory Guide* as they apply to records and reporting activities.

9. QUALITY ASSURANCE PLAN

9.1 INTRODUCTION

QA refers to those planned and systematic actions to provide adequate confidence that a site, structure, system, or component will perform satisfactorily and safely in service. This QAP for the FBP environmental monitoring program at PORTS has been developed to ensure the validity of *in situ* measurements, laboratory analysis of samples, and reports. It describes the responsibilities and planned and systematic actions affecting the quality of the information collected by or for the PORTS environmental monitoring program in order to establish a high degree of confidence in the results of the monitoring programs and assure regulatory agencies and the public that results are valid and defensible. BWCS is responsible for data collected by BWCS.

QA requirements and responsibilities apply to all DOE contractors and subcontractors who collect and/or analyze samples, analyze and manage data, and report results for the environmental monitoring program.

This QAP has been developed in compliance with DOE Orders 458.1, and 5400.5, *Radiation Protection of the Public and the Environment*, and in conformity with the guidance of DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. The *Quality Assurance Program Description* (FBP 2012d), and *Quality Assurance Program for the Former Uranium Enrichment Facilities* (FBP 2011), which meet the requirements of DOE Order 414.1C, *Quality Assurance,* and ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities,* also contains requirements applicable to the environmental monitoring program.

9.2 ORGANIZATION

This section describes the organizational structures, functional responsibilities, levels of authority, and lines of communication for activities affecting quality. DOE monitoring and associated activities are conducted by the responsible DOE contractor. The FBP Environmental Monitoring and Field Characterization Manager has primary responsibility for implementing the FBP environmental monitoring program. The BWCS Environmental Program Manager is responsible for data collected by BWCS. USEC is responsible for monitoring of the NPDES outfalls identified in the USEC NPDES permit. FBP obtains results of BWCS and USEC environmental monitoring for reporting in the Annual Site Environmental Report.

The FBP Environmental Monitoring and Field Characterization Manager is responsible for:

- ensuring that the FBP staff and subcontractors properly implement the Quality Assurance Project Plans (QAPPs) applicable to the FBP environmental monitoring program, and

- managing the performance of the Task Managers and environmental monitoring/reporting activities.

The Environmental Monitoring and Reporting Manager and Field Characterization Manager are responsible for:

- ensuring that the environmental monitoring activities are planned and executed in accordance with the EMP,

- ensuring that technical personnel who furnish services are qualified by experience or training to perform the work,

- ensuring that personnel assigned to perform work in support of this program are qualified by experience or training to comply with the technical and QA requirements applicable to the work being performed,

- providing adequate resources to effectively support the execution of the environmental monitoring program,

- maintaining cognizance of QA issues and problems and effecting resolution,

- interfacing with the FBP Environmental Monitoring and Field Characterization Manager, PORTS staff, and subcontractors on administrative matters and technical matters related to environmental monitoring,

- assigning work,

- managing the execution of the environmental monitoring program, and

- interfacing with the FBP Environmental Protection Manager or Environmental Restoration and Waste Management QA Manager on problems and issues encountered in conducting the environmental monitoring program.

The FBP Environmental Restoration and Waste Management QA Manager is responsible for:

- providing QA requirements and directions to the FBP Environmental Monitoring and Field Characterization Group,

- serving as the focal point for environmental monitoring program QA activities and ensuring that the activities are conducted in accordance with applicable plans and procedures, and

- reviewing environmental monitoring program activities through internal audits and/or surveillances.

The FBP Environmental Monitoring and Field Characterization, Environmental Protection, and Environmental Restoration and Waste Management QA Groups are responsible for:

- the technical content and quality of work performed in their individual areas of responsibility,

- coordination with and direction of the Environmental Monitoring and Field Characterization Manager, and

- implementing requirements of this QAP or project specific QAPP within their individual areas of responsibility.

9.3 QA PROGRAM

The QA Program at PORTS includes the *Quality Assurance Program Description* (FBP 2012d, or latest revision), the EMP QAP, project-specific QAPPs, PORTS and subcontractor procedures, and Laboratory QAPs.

This QAP describes and presents applicable QA Program criteria to ensure the quality of the work performed for the PORTS environmental monitoring program. DOE contractors and subcontractors

involved in the environmental monitoring program perform work in accordance with the applicable QAP and/or project-specific QAPPs.

9.3.1 Training

Activities affecting quality include:

- sample collection, handling, and analysis,
- software documentation, data transfer, and software verification and validation,
- preparation and review of technical calculations,
- technical report preparation, and
- technical and document reviews.

Personnel whose activities affect the quality of data collected under the EMP must be trained to perform their assigned responsibilities. Personnel performing or managing sampling, laboratory analyses, data analyses, data interpretation, and reporting are qualified by experience, training, and education to perform the assigned responsibilities and to ensure that suitable quality is achieved and maintained.

9.3.2 Management Assessment of the Program

Self-assessment is an integral part of the overall management process. The key to the self-assessment program is continual, open-ended assessment by the line management responsible for organization performance. This process is supplemented by assessments performed by individuals from the line organization who are independent from the activities being performed. This process also includes results from organizations with oversight responsibilities.

The environmental monitoring program is assessed regularly for adequacy and to ensure the effective implementation of the program. The assessment may be conducted by management or by a designated organization having QA Program assessment expertise. Assessments may consist of interviews and discussions with staff, surveillance, review meetings, and investigations of potential problem areas. Assessments are conducted in a manner consistent with applicable QA requirements or procedures for conducting QA audits. The assessment includes identification of the personnel selected for the assessment and their qualifications.

Surveillance is monitoring or observation to verify that requirements have been specified and that items or activities conform to the specified requirements. Surveillance of the environmental measurements process may consider the following:

- permits and documents approvals,
- availability and use of procedures,
- equipment calibrations,
- sample control and identifications,
- decontamination of sampling equipment,
- calibration standards and reference materials,
- documentation and reporting,
- training and qualifications, and
- quality improvement.

9.3.3 Program Design

The EMP includes regulatory requirements, design and rationale, monitoring locations, monitoring parameters and frequencies, data analyses, and reporting requirements (as applicable) for each monitoring

program. The EMP also includes organizational responsibilities, QA/QC requirements, and required records and reporting.

9.3.4 Quality Objectives

Quality objectives for data and information collected in support of the environmental monitoring program are specified for each phase of the activity. With regard to collection of field samples, the quality objective is to collect the sample according to the specified procedure, and not alter the sample's true nature. Internal field QC checks (see Section 9.18) are used to evaluate the level of sample contamination attributable to collection and handling activities.

Although a large portion of the data collected in the environmental monitoring program is based on laboratory analysis of field-collected samples, some data is obtained directly from field measurements. Section 9.10 discusses selection and control of instrumentation for collecting field measurements and instrument calibration requirements. Field instruments are maintained and calibrated to provide data within the precision and accuracy specifications of the instrument.

For field sampling, completeness is a measure of the number of samples collected at a site compared to the number of samples expected to be collected. For laboratory analysis, completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under correct normal conditions. The completeness objective should be 90% for field sampling and 90% for laboratory analysis for all environmental monitoring programs, unless specified otherwise in program-specific QA plans.

Quality requirements for precision and accuracy of analytical data are specified in analytical methods, laboratory contracts, or Laboratory QAPs.

Analytical results are reported using consistent units of measure. With the exception of radionuclide and radiation dosages, field and laboratory data are expressed in Standard International Units (SIUs), usually mg/L, micrograms per liter (µg/L), mg/kg, or micrograms per kilogram (µg/kg). Radionuclides are reported in picocuries per liter (pCi/L), pCi/g, or comparable units, as opposed to SIUs. Radiation dosages are reported in mrem or comparable units, as opposed to SIUs. Only significant figures are reported.

9.4 DESIGN CONTROL

This section describes the elements used to implement control of environmental monitoring design at PORTS. Design control elements include design documents and change control procedures.

9.4.1 Design Documents

Design refers to any information specifying how a task is to be performed. In this context, the design documents for the environmental monitoring program include the EMP, the IGWMP, specific sampling procedures, and contracts for support services. Design control implicitly covers all activities described in the EMP, including, for example, standard sampling procedures and software configuration management. In the context of this program, control means that 1) the subject information receives review and concurrence, as appropriate; 2) the distribution of the subject information is recorded; and 3) revisions are made in all distributed copies.

This section commits DOE contractors and subcontractors to systematic control over the preparation and maintenance of environmental monitoring design documents and commits to a documented review of all documents and reports.

The Environmental Monitoring and Field Characterization Group, in conjunction with the Environmental Restoration and Waste Management QA Manager, ensures that design activities conducted within their

areas of responsibility are performed in accordance with requirements of the PORTS QA procedures or equivalent for design control.

The Environmental Monitoring and Field Characterization Group, in conjunction with the Environmental Restoration and Waste Management QA Manager, ensures that design changes affecting the quality of items or activities within their areas of responsibility are completed in accordance with the requirements of PORTS or subcontractor procedures or equivalent for document control.

The designated Task Manager identifies document reviewers for each document and report within his or her areas of responsibility.

Reviews are performed by one or more individuals who collectively have the technical expertise at least equivalent to those who performed the original work. Reviews are a documented evaluation of the work. The primary author of the document or report ensures that resolution of reviewer comments is completed and that all issues are addressed and documented. The following are design control elements that apply to the EMP:

- development of the EMP,
- development of procedures identified in the EMP,
- review of procedures referenced in the EMP for technical adequacy and approval by qualified persons other than those who prepared the procedures, and
- review and approval of changes to procedures by qualified persons, familiar with the original procedure and purpose of the program, to ensure that the original purpose is fulfilled.

Each of these design control elements are described below.

The EMP is prepared using the *Regulatory Guide* to comply with DOE Order 458.1, *Radiation Protection of the Public and the Environment*, which replaces DOE Order 5400.5, and DOE Order 436.1, *Departmental Sustainability*, which replaces DOE Order 450.1, *Environmental Protection Program*. Although DOE Orders 5400.5 and 450.1 have been replaced, they are contract requirements for FBP; therefore, this EMP is prepared to comply with each of these DOE Orders. Once prepared, the EMP is internally reviewed by personnel designated by the Environmental Monitoring and Field Characterization Manager. Finally, DOE staff review and approve the plan. The EMP is managed by the designated Task Managers. The EMP is reviewed annually and updated at least once every three years.

The designated Task Managers are responsible for the development and approval of procedures identified in the plan. Changes to existing procedures are approved by qualified people familiar with the environmental monitoring program.

Any internally developed computer software programs (i.e., computer software programs that are not standard commercial software) used to generate, manage, control, process, analyze, or report environmental monitoring data must be verified, validated, and documented by the developer and the user.

9.4.1.1 Internal measurement control program

The design control management system is documented and implemented using procedures generated in conformance with this QAP.

The field and laboratory processes affecting data quality are controlled by internal measurement control programs that define frequency and use of control standards, creation and use of control charts, and documentation.

Field QC samples are collected to evaluate the precision of the sample collection process, to assess the effectiveness of the decontamination of equipment used in the process, and to determine the extent of potential contamination acquired during the sampling event, or from sample preservation, site conditions, or transportation and storage prior to analysis, as applicable.

Analytical activities are supported by the use of reference materials (e.g., materials of known composition that are used in the calibration of instruments, methods standardization, spike additions for recovery tests, and other practices). Certified standards from NIST, U.S. EPA, or other DOE laboratories are used for such work. Analyses are performed using U.S. EPA or other approved procedures. Analytical methods and minimum QA requirements may be dictated by regulatory requirements and/or DOE Orders.

QC is ensured by using standard materials from NIST or other reliable sources for calibration, yield/ efficiency determinations, spike recoveries, isotopic dilution, and other techniques. Backgrounds are measured periodically for corrections, and instruments responses and efficiencies are routinely established.

Radiological, non-radiological, and wet chemical analysis methods are used to analyze environmental samples. Routine calibration and standardization, replicate analyses, spike additions, and analyses of blanks all support the internal QC efforts. These internal QC programs are the mainstay of analytical data and are the basis for ensuring reliable results on a day-to-day and batch-to-batch basis.

QA/QC measurement control programs external to the sample analysis groups (but internal to PORTS) have single, blind control samples submitted to the analytical laboratories to monitor performance. Reliable suppliers such as NIST, U.S. EPA, and DOE are the sources for these standards. The results of such periodic measurement programs are statistically evaluated and reported to the laboratories and their customers. Most reports are issued quarterly, and some laboratories compile annual summary reports. These reports assist in evaluating the adequacy of analytical support programs and procedures. If serious deviations are noted by the QC groups, the operating laboratories are promptly notified so that corrective actions can be initiated, and problems can be resolved. QC data are stored in an easily retrievable manner so that they can be related to the analytical results they support.

9.4.1.2 External measurement control program

In addition to the internal program, all PORTS installations are directed by DOE and expected by regulators to participate in external QC programs. These programs generate data that are readily recognizable as objective packets of results. These packets give participating laboratories and government agencies a periodic view of performance. The sources of these programs are laboratories in the DOE and commercial sector.

All data from each of the laboratories are reported to the supplier. The commercial supplier provides a monthly report of the evaluated data to the Sample and Data Management Group. The report includes a percent recovery of the referenced value, deviation from the mean of all reported data, specific problems in a site lab, and other statistical information. Statistical evaluation is performed by the supplier to determine acceptability of the analytical data.

9.4.2 Change Control

Change control in environmental monitoring program activities and documentation applies to revisions reflecting changes in organization, field or laboratory procedures, media sampled, types of analyses, frequency of analysis, data review, and evaluation. Examples of changes that may be expected to occur in some aspect of the environmental monitoring program are listed below.

- Organization - organizational responsibilities for various activities
- Field or laboratory procedures - revisions to approved sampling and analysis procedures
- Media sampled
- Types of analyses
- Frequency of analysis
- Data review/evaluation changes presented by DOE

9.4.2.1 Minor or permit changes

Minor program changes apply primarily to organization, field, and laboratory procedures. Minor changes include revision of position titles due to organizational changes and any change in a sampling point, such as relocation, caused by natural destruction or obstruction of the original site or changes in regulatory requirements. Because permit modifications are regulatory driven, they do not require prior approval by DOE. Minor or permit changes are incorporated into the program with the approval of the Environmental Monitoring and Field Characterization Manager. An immediate revision or supplement to the EMP may not be required.

9.4.2.2 Major changes

Changes that impact the execution and/or performance of the environmental monitoring program and its related activities require review and approval by the same organization(s) that performed the original review and approval. Examples include a change in action limits for a particular contaminant; non-regulatory, planned elimination of a particular media or station to be sampled; changes in the analyses performed; and changes in the frequency of sampling or analysis. The reviewing organizations will have access to pertinent background data or information on which to base their approval. A revised EMP or supplemental document will be required.

9.5 PROCUREMENT DOCUMENT CONTROL

Purchased items and services that have the potential to affect data quality are controlled to ensure conformity with PORTS procurement requirements. Control is provided through procurement planning, supplier evaluation and selection, and supplier performance evaluation and verification. Applicable design bases or other requirements to ensure high quality must be included or referenced in documents concerning the procurement of items and services. Procurement documents must require suppliers to have a QA program consistent with the requirements of current procurement document control procedures. Inspection, and in some cases, testing, are performed as a condition of acceptance of an item or service.

9.6 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

Work processes affecting quality are prescribed by and performed according to instructions, procedures, or drawings that are documented, controlled, reviewed, and approved. Appropriate sampling and analysis procedures may be prescribed by regulation for compliance monitoring (for example, sampling and analysis requirements to support NPDES permits). The location, frequency, and parameters to be monitored may be identified by permits issued by regulatory agencies for compliance purposes.

The designated Task Managers in conjunction with the Environmental Restoration and Waste Management QA Manager ensure that activities conducted within their areas of responsibility are

performed in accordance with the requirements of PORTS procedures or equivalent for instructions, procedures, and drawings.

9.6.1 Sampling Procedures

Generic references to the field sampling procedures are given in the EMP due to the changes in the PORTS procedure references and titles, and use of subcontractors who may use their own approved equivalent procedures. Any sampling procedures performed in the field that deviate from PORTS or industry standard procedures must be described in detail and reported and approved by the designated Task Manager.

9.6.2 Sample Custody

Sample custody is documented on chain-of-custody forms (called sample logs in PEMS) and tracked to ensure traceability, defensibility, and integrity of samples and data. A sample is considered to be under custody if any of the following conditions are met:

- It is actually in the possession of the person or team responsible for sample collection and chain-of-custody.
- It is visible to the person who has taken possession.
- It is secured by the person or team responsible for possession so that tampering can be detected.
- It is in a secure area.

Samples collected in the field are subject to standard procedures for chain of custody control. Sample custody is maintained through the use of chain-of-custody forms (sample logs). Subcontracted laboratories maintain sample custody in accordance to their approved QAP.

9.6.3 Instrument Calibration Procedures and Preventive Maintenance and Frequency

Calibration and maintenance procedures and frequencies to be used in the field (e.g., daily or prior to each use) are given in the procedures for the operation of the equipment. A logbook of instrument and equipment calibration and maintenance is maintained by the user/operator. The logbook includes instrument type and identification number, along with calibration and maintenance data. The person conducting calibration and maintenance must date and sign or initial each entry.

9.6.4 Analytical Procedures

Chapter 5 discusses analytical procedures.

9.6.5 Data Reduction, Assessment, Analysis, and Reporting

Verification, validation, reduction, analysis, and reporting of field and analytical data collected for environmental monitoring programs is necessary to ensure data conform to applicable regulatory requirements, and to verify that QC requirements are met. Chapter 7 provides an overview of data management, analysis and statistical treatment.

9.7 DOCUMENT CONTROL

This section defines the activities within the environmental monitoring program that ensure the correct documents are used when specifying quality requirements or when prescribing activities that affect the quality of the output of the services of either organization. Some environmental monitoring documents that specify quality requirements, or prescribe activities that have the potential to affect quality, require control in accordance with this section. Controls include, but are not limited to, preparation, review, approval, release, and revision of documents subject to the requirements of this section.

This section commits all DOE contractors and subcontractor personnel to the systematic control of documents that significantly impact the quality of the environmental monitoring program. The Environmental Monitoring and Field Characterization Group and subcontractors, in conjunction with the Environmental Restoration and Waste Management QA Manager, ensure that activities conducted within their areas of responsibility are generated, appropriated, reviewed, used, altered, and distributed in accordance with the requirements of current document control procedures.

A sample tracking/filing system is used to account for each sample and its related documentation. All data collected and documentation generated including logbooks and record books, chain-of-custody documentation (sample logs), laboratory data, QC data, and calculations for the environmental monitoring program is compiled (either the original or a copy) by the designated Task Manager. The designated Task Manager is responsible for placing this information in the PORTS records management system. A copy of each document is maintained at a secure location that is accessible to the Environmental Monitoring and Field Characterization Group and designated authorized parties.

9.8 IDENTIFICATION AND CONTROL OF ITEMS

Quality-related items are controlled as specified in current procedures. Control consists of item identification, secure storage, and distribution. Identification of the items is maintained either on the items themselves or in documentation traceable to the items. These requirements apply to instrumentation, equipment, software, samples, and quality-related information (e.g., logbooks and QA records).

All equipment and instruments used in the environmental monitoring program are logged and correctly identified, and are part of the field logbook or lab record book. Maintenance records are kept in accordance with the procedures describing the operation of the equipment.

9.8.1 Sample Location

All routine environmental monitoring locations are located with respect to the North American Datum 83 (NAD83) Ohio State Plane South Federal Information Processing Standard (FIPS) (in feet) for reference and to physical landmarks for the use of the environmental technicians or subcontractors.

9.8.2 Sample Identification

Each sample collected is assigned a unique sample identification number. In addition to this number, the date of collection is recorded on the container. The date and time of sample collection are also recorded in the logbook and on the chain-of-custody form (sample log). Sample identification is verified by the sampling technician prior to submittal to the analytical laboratory to assure traceability of the samples to the appropriate source, requirement, or use document.

9.8.3 Sample Documentation

Field activities are recorded daily either in dedicated field logbooks or on field log sheets. Field logbooks are turned over to the designated Task Manager or designee upon completion of the book or project. The minimum requirements for the contents of the logbooks are described in PORTS procedures for sample documentation (or equivalent).

9.8.4 Chain-of-Custody

Samples are tracked from the time of collection to the time of receipt in the analytical laboratory following applicable PORTS procedures for chain-of-custody.

9.9 CONTROL OF PROCESSES

This section refers to control of processes affecting quality of items or services by instructions, procedures, drawings, checklists, or other appropriate means. Thus, qualifications of procedures and

equipment and approved criteria and processes are specified or referenced in the program procedures and instructions.

9.10 CONTROL OF FIELD MEASUREMENT EQUIPMENT

Selection of field measurement equipment used for activities affecting quality is controlled by the designated Task Manager, subcontractors or analytical services managers to ensure that such equipment is of proper type, range, accuracy, and tolerance to determine conformance to specified requirements.

Field measurements are documented and evaluated by a responsible authority to assure that requirements have been satisfied. The precision of field measurement equipment is assumed to be that stipulated by the manufacturer. Routine maintenance and calibration checks of field measurement equipment are completed by qualified field personnel. Accuracy is assessed by means of appropriate calibration. Field measurement equipment is calibrated, adjusted, and maintained at prescribed intervals, or prior to each use, against certified equipment having known valid relationships to nationally recognized standards. If no known standards exist, the basis for the calibration is documented.

The method and interval of calibration for each item is defined in procedures and is based on the type of equipment, stability characteristics, required accuracy, intended use, and other conditions affecting measurement control. Additional calibrations are performed when accuracy of field measurement equipment is suspect. Chemical calibrations and standardizations are made using standards traceable to national standards and of known purity. Calibrations and standards obtained externally adhere to the same requirements. Suppliers certify compliance and provide evidence of the quality of the services and materials provided on request.

Field measurement equipment is properly handled and stored to maintain accuracy. Records of the calibration status are maintained as described in the procedures covering the operation of the field measurement equipment. Calibration logs are provided to the designated Task Manager or designee on a regular basis.

9.11 HANDLING, STORAGE, AND SHIPPING

The handling, storing, shipping, cleaning, and preserving of quality-related items and samples are controlled to prevent damage or loss and to minimize deterioration in accordance with standard procedures and practices. The Environmental Restoration and Waste Management QA Manager is responsible for planning and performing verification activities to ensure that applicable procedures are developed and followed.

Sample preservation and holding time requirements comply with appropriate regulatory standards and requirements. The analytical laboratory checks individual sample containers against the accompanying chain-of-custody form (sample log) and analytical requests to ensure correctness and completeness of sample collection.

Waste material may be generated during sampling and analysis activities associated with the environmental monitoring program. These wastes are characterized and properly managed from generation through storage, treatment, and/or final disposition. Wastes are segregated according to waste type. All containers are labeled in accordance with PORTS procedures.

Excess or remaining samples are disposed according to the requirements of PORTS procedures for laboratory waste disposal or by equivalent procedures at subcontractor laboratories.

9.12 INSPECTION, TESTING, AND OPERATING STATUS

Testing may be conducted to determine if an item or service is acceptable to acquire additional information. The status of inspection and test activities is identified either on the items themselves or in documents traceable to the items, where it is necessary to assure that the required inspections are performed, and to ensure that items that have failed the required inspections and tests are not inadvertently installed, used, or operated. Status is maintained through indicators, such as physical location and tags, markings, stamps, inspection records, or other suitable means.

Field and laboratory work conducted in support of the EMP is periodically inspected. Inspections are based on requirements for the given activity as detailed in the EMP and as defined by the terms of regulatory compliance. Data generated by sampling and analysis are subject to verification and validation to ensure resulting data quality is sufficient for its intended use. Internally, QC is maintained through procedures and checks that include the following practices (as applicable).

- Use of procedures for sample collection and analysis
- Use of chain-of-custody forms (sample logs) and sample tracking procedures to ensure traceability, defensibility, and integrity of samples and data
- Instrument standardization, calibration, and verification
- Background measurements representative of the sample source and in the laboratory
- Resolution checks and detector alignment for determination of gamma emitter radionuclides; yield determinations for applicable radiochemical procedures
- Duplicate analyses for precision checks
- Spiked and surrogate sample analysis to determine matrix effects
- Sample preservation, handling, and decontamination
- Use of surveillance procedures

Out-of-service equipment is clearly tagged as such, and its maintenance is recorded. Clear identification of out-of-service equipment ensures that only equipment operating as specified is used. Changing or removal of status indicators is the responsibility of the supervisor of the items.

If audits reveal an item out of conformance with prescribed standards, management initiates the appropriate corrective measures.

9.13 CONTROL OF NONCONFORMING ITEMS

This section commits the Environmental Monitoring and Field Characterization Group to ensure that nonconforming items occurring during the conduct of the environmental monitoring program are controlled in a manner to prevent further use or processing.

The Environmental Monitoring and Field Characterization Group in conjunction with the Environmental Restoration and Waste Management QA Manager ensure that items within their areas of responsibility found to be noncompliant with specified requirements are identified, reported, and resolved in accordance with current procedures.

9.14 CORRECTIVE ACTION

The identification, cause, and corrective action for significant conditions adverse to quality are documented and reported to appropriate levels of management. Significant conditions adverse to quality include failure to implement sampling and analysis programs or QA plans; deficiencies in the use of procedures or instructions; failure to implement corrective actions in response to a nonconformance report; and unexpected damage or loss to documentation.

Significant conditions adverse to the quality of the data produced are identified and corrected by authorized personnel using approved and documented procedures as required by this section. Corrective actions are implemented in a timely manner.

This section commits DOE contractors and subcontractor personnel to a system of corrective action applied in response to significant conditions adverse to quality as described in current procedures.

The designated Task Manager or designee is responsible for documenting on an Incident Report Form, Non-Conformance Report, or equivalent, the significant condition adverse to quality, status evaluation, and specified corrective action(s). These individuals are responsible for the activity investigation, the cause of the conditions, determination of corrective actions, and document cause and corrective action on the Incident Report Form, Non-Conformance Report, or equivalent. The designated individuals must ensure that conditions adverse to quality occurring within its areas of responsibility are reported in writing to the Environmental Restoration and Waste Management QA Manager.

Upon confirmation that a significant condition adverse to quality exists, the Environmental Restoration and Waste Management QA Manager, in conjunction with the designated Task Manager, initiates the corrective action system in accordance with the requirements of PORTS procedures for corrective action or equivalent.

9.15 QA RECORDS

QA records associated with the environmental monitoring program are generated, identified, classified, retained, and maintained in accordance with this section, its implementing procedures, and PORTS procedures for QA records or equivalent. QA records for this program include any documentation of quality or the lack of quality in document preparation, software performance testing, as well as in assessments of the QA Program's effectiveness.

The designated Task Manager is responsible for the specification, preparation, and maintenance of records that furnish documentary evidence of quality. Documents that are designated as records are legible, accurate, and completed appropriate to the work accomplished. Records must be identifiable, retrievable, and protected against damage, deterioration, and loss. The designated Task Manager is responsible for developing and maintaining procedures or instructions for identifying and controlling records within his/her department.

DOE contractors and subcontractors, in conjunction with the Environmental Restoration and Waste Management QA Manager, ensure that QA records generated within their areas of responsibility are processed in accordance with the requirements of PORTS procedures for QA records or equivalent. The designated Task Manager is responsible for placing this information in the PORTS records management system.

9.16 AUDITS AND SURVEILLANCES

Independent audits and surveillances are planned and documented activities performed to determine by investigation, examination, or evaluation of objective evidence the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents and the effectiveness of

implementation. This section describes the audit and surveillance program used to ensure that the QA elements described in this chapter are implemented for the environmental monitoring program.

The Environmental Restoration and Waste Management QA Manager, in conjunction with the designated Task Manager, establishes audit frequencies and schedules based on the activity's complexity, importance, and potential impact on quality. Project staff members and subcontractors may assist their respective Task Manager in scheduling and conducting audits of activities performed in their areas of responsibility, and respond to audit findings by taking the necessary action to correct identified deficiencies.

Project staff members and subcontractors ensure that audit activities conducted in their areas of responsibility reach closure status and that audit activity is documented.

Surveillances are used to verify that requirements have been specified and that items or activities conform to the specified requirements. The Environmental Restoration and Waste Management QA Manager, in conjunction with the designated Task Manager, establishes a surveillance schedule according to the scope of the program activities.

The Environmental Restoration and Waste Management QA Manager assigns a Surveillance Team Leader and team members, and are responsible for ensuring that team personnel are knowledgeable in, but not directly responsible for the activities under surveillance.

A performance audit or surveillance evaluates the effectiveness of the project in fulfilling its objectives. A system audit or surveillance examines project activities to determine whether they comply with procedures and other applicable documents. Surveillances are planned and performed using a checklist that clearly identifies and defines the work elements to be monitored. Surveillance results are documented.

The designated Task Managers provide support and access to surveillance teams operating within his/her areas of responsibility, and respond to issued surveillance reports. Surveillance reports remain active until all deficiencies are closed.

9.17 SOFTWARE QA

To ensure consistent data analysis and summarization across the entire environmental monitoring program, the designated Task Manager is responsible for the development and utilization of computer programs for data analysis, summarization, and reporting. Standard commercial software may be used, or internal programs may be developed and validated prior to use. The designated Task Manager must ensure that all internally developed software has been developed in accordance with written specifications and procedures reflecting the requirements of the user.

The designated Task Manager ensures that access to software used for activities within his/her areas of responsibility is controlled.

9.18 INTERNAL QC CHECKS

This section addresses requirements for field and laboratory QC samples. Laboratory QC measures specified in the analytical method are performed by the analytical laboratory.

Field QC samples include field blanks, equipment blanks, and duplicate samples. These QC samples are collected as appropriate for the specified sampling and are generally collected at a recommended frequency of one QC sample for every 20 environmental samples. Field QC samples are generally analyzed for the same constituents that are analyzed in the associated environmental samples.

Field blanks of ASTM Type II water, deionized ultra-filtered water, or equivalent, preserved according to the sampling protocol are used to evaluate contamination present in the field.

Equipment blanks are only collected in conjunction with samples of air, water, and solids collected with reusable equipment. Equipment blanks are collected by rinsing clean equipment with ASTM Type II water, deionized ultra-filtered water, or equivalent, prior to sample collection, and collecting the rinsate as a sample to assess the decontamination process for reusable equipment. Equipment blanks are collected to assess contamination acquired during equipment storage and handling.

Duplicate samples are collected as a measure of data precision (see Section 9.1.9.1).

9.19 PERFORMANCE REPORTING

Evidence of quality includes at least the following performance measures for field and analytical data.

9.19.1 Field Data

Data precision is defined as a measure of the total variability in the sampling and analysis program. Data precision is calculated by collecting duplicate samples at the same location and time and subjecting them to the same methods and procedures.

Data completeness is a measure of the amount of data planned to be collected for each sampling program compared to the amount that was actually collected.

Contamination is a measure of the amount of contamination from sample handling in the field. This is measured using field blanks. Another measure is the analysis of the decontamination sample collected following decontamination of equipment. This will indicate how effective these procedures were and if contamination was potentially introduced into other samples.

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population. This is a qualitative statement on the sampling design and what it is intended to measure.

9.19.2 Analytical Data

Data precision is measured using split samples (both before and after extraction) to determine variability in the entire method and in the analysis.

Data accuracy is a measure of the agreement between a value and an accepted reference or true value. This is determined through the use of internal or external standards.

Data completeness is a measure of the amount of results planned and actual results obtained.

Contamination is a measure the amount of contamination introduced to the sample from the laboratory and is measured by laboratory blanks.

Percent of holding times met is an indication of the ability of the analytical laboratory to analyze samples within the required holding times. This is the number of samples analyzed within holding times versus the total number of samples analyzed.

9.20 DATA VALIDATION

Data validation is performed by one or more individuals who individually or collectively have technical expertise at least equivalent to those who performed the original effort, but who have no responsibility for the initial effort. A data validator selects representative results for both solid and liquid media. These results are traced through the entire sample collection and analytical process. The validator reviews all

documentation and performs all necessary calculations to confirm the reported results. Written summaries of data validation are provided as needed for a given program. Data validation checklists are used to document the validation process.

9.21 *REGULATORY GUIDE* PERFORMANCE CRITERIA

Performance criteria provided in the *Regulatory Guide* (designated by *should**) that are applicable to this chapter are quoted below (in bold type). Responses provided for each performance criteria address the applicable part of the PORTS environmental monitoring program that meets the criteria.

a. A QA Plan *should be prepared and included as a section of the EMP and *should** cover the monitoring activities at each site, consistent with applicable elements of the 18-element format in ASME NQA-1.**

This chapter of the EMP is the QAP for the environmental monitoring program at PORTS. It is consistent with applicable elements of ASME NQA-1. In addition subcontractors responsible for portions of the environmental monitoring program are required to submit QAPPs that meet ASME NQA-1 as well as other DOE Orders.

b. Periodic audits *should be performed to verify compliance with operational procedures, QC procedures, and all aspects of the QA program.**

Audits are scheduled and conducted periodically to ensure that the QAP is being implemented for the environmental monitoring program.

c. Audits *should be performed independently in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited (i.e., supervisors cannot audit their own facilities).**

Audits are performed independently by personnel knowledgeable of but not directly responsible for the audited activities.

d. Audit results *should be documented and reported to and reviewed by responsible management. Follow-up action *should** be taken where indicated**.

Results of audits are documented and reported to and reviewed by responsible management. Action is taken to correct identified deficiencies in accordance with PORTS or equivalent procedures.

e. The elements of a QA program *should be derived from the 18 criteria in ASME NQA-1 and 10 CFR Part 50.**

The PORTS QA Program meets U.S.EPA, Ohio EPA, and DOE requirements as well as other industry standards such as ASME NQA-1

f. Radiation measuring equipment, including portable instruments, environmental dosimeters, in situ monitoring equipment, and laboratory instruments, *should be calibrated with standards traceable to NIST calibration standards.**

Radiation measuring equipment is calibrated periodically with standards traceable to NIST calibration standards.

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