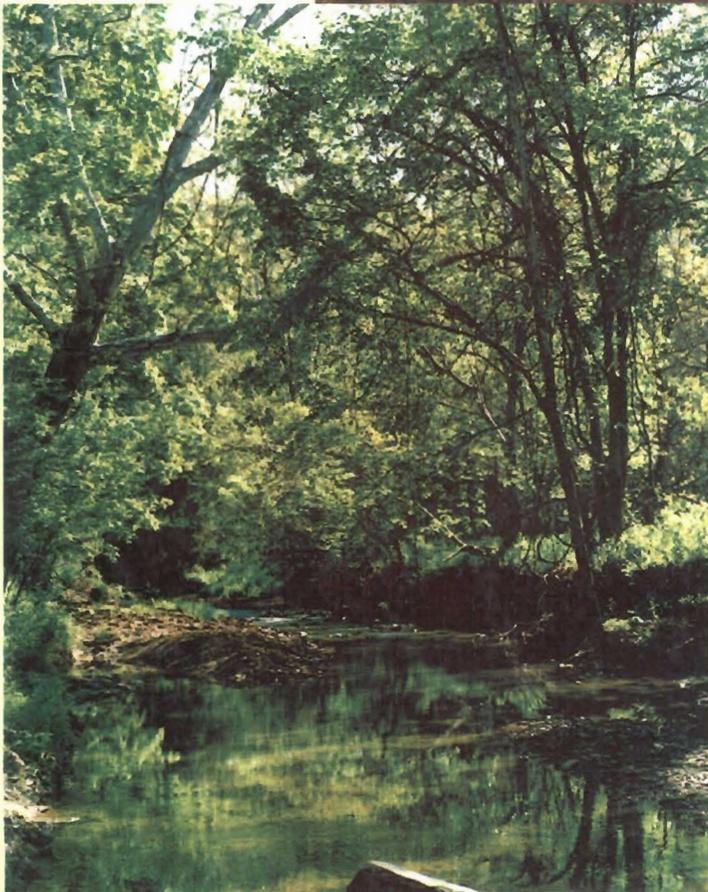
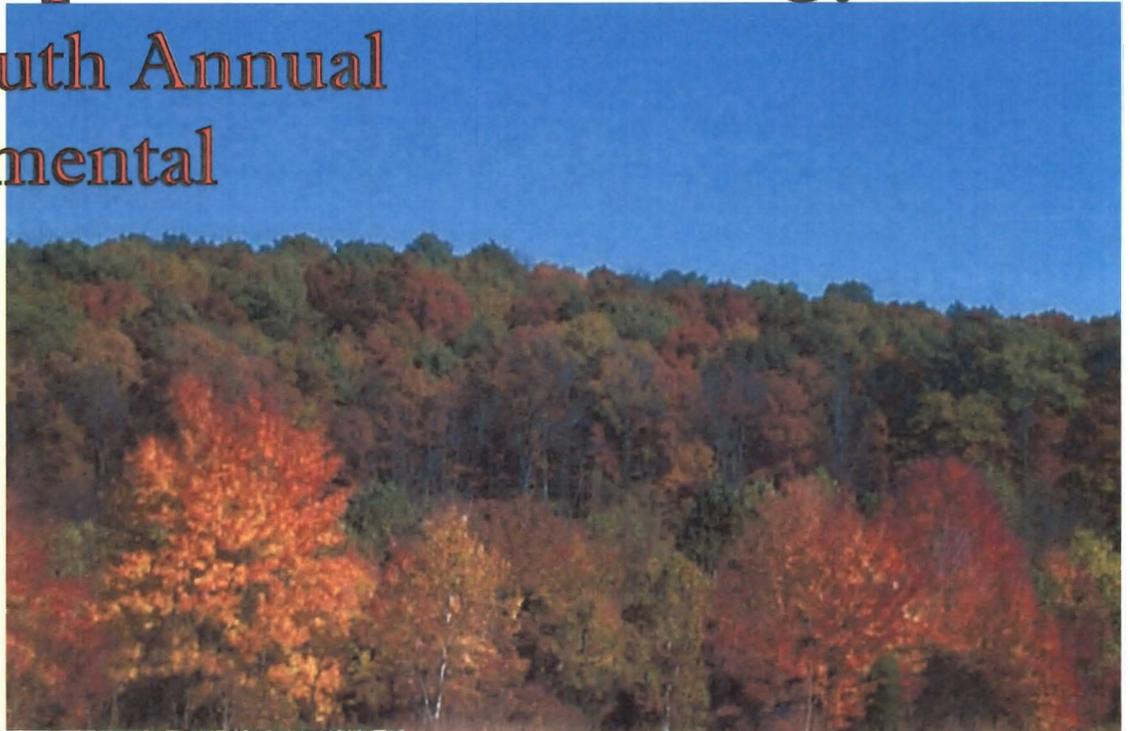


U.S. Department of Energy Portsmouth Annual Environmental Report for 2007



*Through the seasons at the
Portsmouth Gaseous Diffusion Plant*



**U.S. Department of Energy
Portsmouth Annual Environmental Report
for 2007
Piketon, Ohio**

Date Issued—May 2009

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Environmental Remediation Activities at the
Portsmouth Gaseous Diffusion Plant
under contract DE-AC24-05OH20192
for the
U.S. DEPARTMENT OF ENERGY

This document is approved for public release
per review by:

Henry H. Thomas

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Date

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ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
EMS	Environmental Management System
EPA	Environmental Protection Agency
LPP	LATA/Parallax Portsmouth, LLC
mg/kg	milligram per kilogram (equivalent to part per million)
mg/L	milligram per liter (equivalent to part per million)
$\mu\text{g}/\text{kg}$	microgram per kilogram (equivalent to part per billion)
$\mu\text{g}/\text{L}$	microgram per liter (equivalent to part per billion)
$\mu\text{g}/\text{m}^3$	microgram per cubic meter
mrem	millirem
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/m ³	picocurie per cubic meter
PK	Peter Kiewit
PORTS	Portsmouth Gaseous Diffusion Plant
ppb	part per billion
ppm	part per million
RCRA	Resource Conservation and Recovery Act
TPMC	Theta Pro2Serve Management Company, LLC
TSCA	Toxic Substances Control Act
UDS	Uranium Disposition Services, LLC
USEC	United States Enrichment Corporation

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DEFINITIONS

absorption – Taking up of energy from radiation by the medium through which the radiation is passing.

activity – See “radioactivity.”

air stripper – Equipment that bubbles air through water to remove volatile organic compounds from the water.

alpha activity – The rate of emission of alpha particles from a given material.

alpha particle – A positively charged particle consisting of two protons and two neutrons, identical with the nucleus of a helium atom; emitted by several radioactive substances.

ambient air – The atmosphere around people, plants, and structures. Ambient air usually means outdoor air (as opposed to indoor air).

analyte – The specific component that is being measured in a chemical analysis.

aquifer – A permeable body of rock below the ground surface that is capable of yielding quantities of groundwater to wells and springs. A subsurface zone that yields economically important amounts of water to wells.

atom –Smallest particle of an element capable of entering into a chemical reaction.

background radiation – The radiation in humans’ natural environment, including cosmic rays and radiation from the naturally radioactive elements.

beta activity – The rate of emission of beta particles from a given material.

beta particle – A negatively charged particle emitted from the nucleus of an atom during radioactive decay. It has a mass and charge equal to those of an electron.

biota – Animal and plant life characterizing a given region.

categorical exclusion – A class of actions that either individually or cumulatively do not have a significant effect on the human environment and therefore do not require preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act.

chain-of-custody – A process that documents custody and control of a sample through sample collection, transportation and analysis.

closure – Formal shutdown of a hazardous waste management facility under Resource Conservation and Recovery Act requirements.

compliance – Fulfillment of applicable regulations or requirements of a plan or schedule ordered or approved by a government authority.

concentration – The amount of a substance contained in a unit volume or mass of a sample.

contaminant – Any substance that enters a system (the environment, food, the human body, etc.) where it is not normally found. Contaminants include substances that spoil food, pollute the environment, or cause other adverse effects.

cosmic radiation – Ionizing radiation with very high energies that originates outside the earth's atmosphere. Cosmic radiation is one contributor to natural background radiation.

critical habitat – Specific geographic areas, whether occupied by a species listed under the Endangered Species Act or not, that are essential for conservation of the species and that have been formally designated by a rule published in the Federal Register.

curie (Ci) – A unit of radioactivity, defined as that quantity of any radioactive nuclide which has 3.7×10^{10} (37 billion) disintegrations per second. Several fractions and multiples of the curie are commonly used:

kilocurie (kCi) – 10^3 Ci, one thousand curies; 3.7×10^{13} disintegrations per second.

millicurie (mCi) – 10^{-3} Ci, one-thousandth of a curie; 3.7×10^7 disintegrations per second.

microcurie (μ Ci) – 10^{-6} Ci, one-millionth of a curie, 3.7×10^4 disintegrations per second.

picrocurie (pCi) – 10^{-12} Ci, one-trillionth of a curie; 0.037 disintegration per second.

decontamination and decommissioning – Removing equipment, demolishing buildings, disposing of wastes, and investigating potential contamination in areas of PORTS that are no longer part of current operations.

deferred unit – An area at PORTS that is in or adjacent to current production and operational areas such that remedial activities would interrupt operations, or an area that could become recontaminated from ongoing operations.

derived concentration guide – The concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation) would result in either an effective dose equivalent of 0.1 rem or a dose equivalent of 5 rem to any tissue, including skin and the lens of the eye. The guidelines for radionuclides in air and water are provided in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

dose – The energy imparted to matter by ionizing radiation. The unit of adsorbed dose is the rad, equal to 0.01 joule per kilogram in any medium.

- **absorbed dose** – The quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. Absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 gray).
- **dose equivalent** – The product of the absorbed dose (rad) in tissue and a quality factor. Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).
- **committed dose equivalent** – The calculated total dose equivalent to a tissue or organ over a 50-year period after known intake of a radionuclide into the body. Contributions from external dose are not included. Committed dose equivalent is expressed in units of rem (or sievert).
- **committed effective dose equivalent** – The sum of the committed dose equivalents to various tissues in the body, each multiplied by an appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

- **effective dose equivalent** – The sum of the dose equivalents received by all organs or tissues of the body after each one has been multiplied by the appropriate weighting factor. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent attributable to sources external to the body.
- **collective dose equivalent/collective effective dose equivalent** – The sums of the dose equivalents or effective dose equivalents of all individuals in an exposed population within a 50-mile (80-km) radius, expressed in units of person-rem (or person-sievert). When the collective dose equivalent of interest is for a specific organ, the units would be organ-rem (or organ-sievert). The 50-mile distance is measured from a point located centrally with respect to major facilities or DOE program activities.

downgradient – the direction that groundwater flows; similar to downstream for surface water.

downgradient well – A well installed downgradient of a site that may be capable of detecting migration of contaminants from a site.

effluent – A liquid or gaseous waste discharge to the environment.

effluent monitoring – The collection and analysis of samples or measurement of liquid and gaseous effluents to characterize and quantify the release of contaminants, assess radiation exposures to the public, and demonstrate compliance with applicable standards.

Environmental Restoration – A DOE program that directs the assessment and cleanup of its sites (remediation) and facilities (decontamination and decommissioning) contaminated with waste as a result of nuclear-related activities.

exposure (radiation) – The incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is exposure to ionizing radiation that takes place at a person's workplace. Population exposure is the exposure to the total number of persons who inhabit an area.

external radiation – The exposure to ionizing radiation when the radiation source is located outside the body.

gamma ray – High-energy short-wavelength electromagnetic radiation emitted from the nucleus of an excited atom. Gamma rays are identical to X-rays except for the source of the emission.

glove box – An enclosure with built-in sleeves and gloves used by a person to manipulate hazardous materials such as highly enriched uranium without directly exposing the person to the material.

groundwater – Any water found below the land surface.

half-life, radiological – The time required for half of a given number of atoms of a specific radionuclide to decay. Each nuclide has a unique half-life; half-lives can range in duration from less than a second to many millions of years.

industrial solid waste landfill – A type of landfill that exclusively disposes of solid waste generated by manufacturing or industrial operations.

in situ – In its original place; field measurements taken without removing the sample from its original location; remediation performed while the contaminated media (e.g., groundwater or soil) remains below the surface or in place.

interim remedial measure – Cleanup activities initiated after it has been determined that contamination or waste disposal practices pose an immediate threat to human health and/or the environment. These measures are implemented until a more permanent solution can be made.

internal radiation – Occurs when natural radionuclides enter the body by ingestion of food or liquids or by inhalation. Radon is the major contributor to the annual dose equivalent for internal radionuclides.

irradiation – Exposure to radiation.

isotopes – Forms of an element having the same number of protons but differing numbers of neutrons in their nuclei.

maximally exposed individual – A hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

maximum contaminant level (MCL) – The maximum permissible level of a contaminant in drinking water provided by a public water system.

migration – The transfer or movement of a material through air, soil, or groundwater.

millirem (mrem) – the dose equivalent that is one-thousandth of a rem.

monitoring – Process whereby the quantity and quality of factors that can affect the environment or human health are measured periodically to regulate and control potential impacts.

natural radiation – Radiation from cosmic and other naturally occurring radionuclide sources (such as radon) in the environment.

nuclide – An atom specified by atomic weight, atomic number, and energy state. A radionuclide is a radioactive nuclide.

outfall – The point of conveyance (e.g., drain or pipe) of wastewater or other effluents into a ditch, pond, or river.

part per billion – A unit measure of concentration equivalent to the weight to volume ratio expressed as microgram per liter ($\mu\text{g/L}$) or the weight to weight ratio of microgram per kilogram ($\mu\text{g/kg}$).

part per million – A unit measure of concentration equivalent to the weight to volume ratio expressed as milligram per liter (mg/L), the weight to weight ratio expressed as milligram per kilogram (mg/kg), or the weight to weight ratio of microgram per gram ($\mu\text{g/g}$).

person-rem – Collective dose to a population group. For example, a dose of 1 rem to 10 individuals results in a collective dose of 10 person-rem.

pH – A measure of the hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH from 0 to 7, neutral solutions have a pH equal to 7, and basic solutions have a pH from 7 to 14.

polychlorinated biphenyls (PCBs) – Man-made chemicals that range from oily liquids to waxy solids. PCBs were used in hundreds of industrial and commercial applications due to their chemical properties until

production in the United States ceased in 1977. PCBs have been demonstrated to cause a variety of adverse health effects in animals and possibly cause cancer and other adverse health effects in humans.

preliminary remediation goal – The maximum concentration of a constituent in environmental media (soil, groundwater, etc.) that is considered protective of human health and the environment.

quality assurance – Any action in environmental monitoring to demonstrate the reliability of monitoring and measurement data.

quality control – The routine application of procedures within environmental monitoring to obtain the required standards of performance in monitoring and measurement processes.

quality factor – The factor by which an absorbed dose (rad) is multiplied to obtain a quantity that expresses, on a common scale for all ionizing radiation, the biological damage to an exposed person. The quality factor is used because some types of radiation, such as alpha particles, are more biologically damaging than others.

rad – The unit of absorbed dose deposited in a volume of material.

radioactivity – The spontaneous emission of radiation, generally alpha or beta particles or gamma rays, from the nucleus of an unstable isotope.

radionuclide – A radioactive nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accomplished by the emission of photons or particles.

release – Any discharge to the environment. “Environment” is broadly defined as any water, land, or ambient air.

rem – The unit of dose equivalent (absorbed dose in rads multiplied by the radiation quality factor). Dose equivalent is frequently reported in units of millirem (mrem), which is one-thousandth of a rem.

remediation – The correction or cleanup of a site contaminated with waste. See “Environmental Restoration.”

reportable quantity – A release to the environment that exceeds reportable quantities as defined by the Comprehensive Environmental Response, Compensation, and Liability Act.

Resource Conservation and Recovery Act (RCRA) – Federal legislation that regulates the transport, treatment, and disposal of solid and hazardous wastes.

settleable solids – Material settling out of suspension in a liquid within a defined period of time.

source – A point or object from which radiation or contamination emanates.

Superfund – The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act and Superfund Amendments and Reauthorization Act that funds and conducts EPA emergency and long-term removal and remedial actions.

surface water – All water on the surface of the earth, as distinguished from groundwater.

suspended solids – Mixture of fine, nonsettling particles of any solid within a liquid or gas.

terrestrial radiation – Ionizing radiation emitted from radioactive materials in the earth's soils such as potassium-40, thorium, and uranium. Terrestrial radiation contributes to natural background radiation.

transuranics – Elements such as americium, plutonium, and neptunium that have atomic numbers (the number of protons in the nucleus) greater than 92. All transuranics are radioactive.

trichloroethene – A colorless liquid used in many industrial applications as a cleaner and/or solvent. One of many chemicals that is classified as a volatile organic compound. High levels of trichloroethene may cause health effects such as liver and lung damage and abnormal heartbeat; moderate levels may cause dizziness or headache. The International Agency for Research on Cancer considers trichloroethene a probable human carcinogen.

trip blank – A quality control sample of water that accompanies sample containers from the analytical laboratory, to the field sampling location where environmental samples are collected, back to the analytical laboratory to determine whether environmental samples have been contaminated during transport, shipment, and/or site conditions.

turbidity – A measure of the concentration of sediment or suspended particles in a liquid.

upgradient – In the opposite direction of groundwater flow; similar to upstream for surface water.

upgradient well – A well installed hydraulically upgradient of a site to provide data to compare to a downgradient well to determine whether the site is affecting groundwater quality.

volatile organic compounds – Organic (carbon-containing) compounds that evaporate readily at room temperature. These compounds are present in solvents, degreasers, paints, thinners, and fuels. Due to a number of factors including widespread industrial use, they are commonly found in soil and groundwater. Volatile organic compounds found at PORTS include trichloroethene, vinyl chloride, benzene, and dichloroethenes.

weighting factor – A tissue specific number that represents the fraction of the total health risk resulting from uniform, whole body irradiation to the specific organ or tissue (bone marrow, lungs, thyroid, etc.).

wetland – An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, floodplains, fens, and similar areas. A jurisdictional wetland is one that falls under state or federal regulatory authority; a non-jurisdictional wetland does not.

EXECUTIVE SUMMARY

PURPOSE

This Annual Environmental Report is prepared to summarize environmental activities, primarily environmental monitoring, at the Portsmouth Gaseous Diffusion Plant (PORTS) for calendar year 2007. The report fulfills a requirement of the U.S. Department of Energy (DOE) Order 231.1A, *Environment, Safety and Health Reporting*, for preparation of an annual summary of environmental data to characterize environmental management performance.

SITE AND OPERATIONS OVERVIEW

PORTS, which began operation in 1954, is one of three uranium enrichment facilities originally built in the United States; the other two were constructed in Oak Ridge, Tennessee and Paducah, Kentucky, respectively. PORTS is located on 5.9 square miles in Pike County, Ohio. The county has approximately 27,700 residents.

In 1993, the DOE began leasing the uranium enrichment production and operations facilities at PORTS to the United States Enrichment Corporation (USEC). The DOE is responsible for certain environmental restoration and waste management activities, uranium programs, and long-term stewardship of nonleased facilities at PORTS.

LATA/Parallax Portsmouth, LLC (LPP), Theta Pro2Serve Management Company, LLC (TPMC) and Uranium Disposition Services, LLC (UDS) managed DOE PORTS programs throughout 2007. UDS is responsible for construction of the Depleted Uranium Hexafluoride Conversion Facility at PORTS, the surveillance and maintenance of depleted uranium cylinders, and environmental compliance and monitoring activities associated with UDS operations. Depleted uranium hexafluoride, which was a product of the gaseous diffusion process, is stored in cylinders on site. The Depleted Uranium Hexafluoride Conversion Facility will convert depleted uranium hexafluoride into uranium oxide, which will be shipped off site.

PORTS production facilities that were used for the separation of uranium isotopes by the gaseous diffusion process are currently leased to USEC; however, most activities associated with the gaseous diffusion process of uranium enrichment ceased in 2001. USEC is responsible for cold shutdown operations, removal of uranium deposits from process equipment, and the proposed gas centrifuge uranium enrichment facility. USEC, Inc. (the parent company of USEC) is currently constructing the American Centrifuge Plant at PORTS. The plant is expected to create hundreds of jobs.

In 2007, DOE Headquarters initiated the planning process for decontamination and decommissioning (D&D) of the PORTS gaseous diffusion facilities and associated buildings. D&D includes removing equipment, demolishing buildings, disposing of wastes, and investigating potential contamination beneath the demolished buildings.

With the exception of Chapter 2, Compliance Summary; Chapter 4, Environmental Radiological Program Information; and Chapter 5, Environmental Non-Radiological Program Information, this report does not cover USEC operations at PORTS. USEC data are included in these chapters to provide a more complete picture of the programs in place at PORTS to detect and assess potential impacts to human health and the environment resulting from PORTS activities.

ENVIRONMENTAL COMPLIANCE

DOE PORTS or the responsible DOE contractor has been issued a permit for discharge of water to surface streams, several air emission permits, and a permit for the storage of hazardous waste. The DOE is also responsible for preparing a number of reports for compliance with environmental regulations. These reports include an annual groundwater monitoring report, an annual hazardous waste report, an annual polychlorinated biphenyl (PCB) document log, an annual summary of radionuclide air emissions and the associated dose to the public from these emissions, an annual report of specified non-radiological air emissions, a monthly report of National Pollutant Discharge Elimination System (NPDES) monitoring data, a quarterly radiological discharge monitoring report for NPDES outfalls, an annual hazardous chemical inventory, and an annual toxic chemical release inventory.

USEC is responsible for compliance activities directly associated with its operations, including air emission permits for uranium enrichment facilities, water discharge permits for several holding ponds and water treatment facilities, and management of wastes generated by USEC operations.

DOE PORTS did not receive any Notices of Violation for inspections conducted during 2007.

ENVIRONMENTAL PROGRAMS

Environmental Restoration, Waste Management, and Public Awareness Programs are conducted at PORTS to protect and inform the local population, improve the quality of the environment, and comply with federal and state regulations.

Environmental Restoration Program

Environmental restoration is the process of cleaning up waste sites and facilities to demonstrate that risks to human health and the environment are either eliminated or reduced to safe levels. The DOE established the Environmental Restoration Program to find, analyze, and correct site contamination problems.

The 1989 Ohio Consent Decree and the 1989 U.S. EPA Administrative Consent Order (as amended in 1994 and 1997) require investigation and cleanup of PORTS in accordance with the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. The site is divided into quadrants to facilitate the investigation and cleanup. Corrective actions, also called remedial actions, are underway in each quadrant.

In 2007, DOE installed four new groundwater extraction wells in the southern portion of the X-749/X-120 groundwater plume in Quadrant I. The groundwater extraction wells began operating on June 29, 2007, and are intended to control and remediate the groundwater contamination in this area, which had moved a short distance off site. Groundwater data collected in the last half of 2007 indicate that contaminants have decreased in at least one groundwater monitoring well in this area, due in part to operation of the new groundwater extraction wells. In 2007, contamination was not detected beyond the DOE property boundary at concentrations that exceed the EPA drinking water standard.

In December 2003, the Ohio EPA issued the Decision Document for remedial actions required for the X-701B area in Quadrant II. These remedial actions include construction of landfill caps in the western portion of the area and groundwater treatment through injection of a chemical oxidant followed by phytoremediation, if necessary. Phase I field activities for groundwater remediation were completed during 2005 to determine operating parameters for the oxidant injection system. A work plan for

completion of the groundwater remediation at X-701B was approved by Ohio EPA in September 2006. The first phase of oxidant injections was completed in October 2006, with the second and third phases completed in April 2007 and August 2007, respectively. Results of sampling completed after the injections indicate that the oxidant has been effective in removing trichloroethene from groundwater.

As required by the Ohio EPA, remedial actions in Quadrants III and IV were maintained and monitored in 2007.

Waste Management Program

The DOE PORTS Waste Management Program directs the safe storage, treatment, and disposal of waste generated from past plant operations, ongoing plant maintenance, and ongoing environmental restoration projects. In 2007, more than 9 million pounds of waste from PORTS were recycled, treated, or disposed at off-site facilities.

Waste management activities are conducted in compliance with DOE Orders, Ohio EPA regulations, and U.S. EPA regulations. Waste management requirements are varied and often complex because of the variety of wastes generated by DOE PORTS activities. The types of waste managed by DOE PORTS include:

- *Low-level radioactive waste* – radioactive waste not classified as high level or transuranic waste.
- *Hazardous (RCRA) waste* – waste listed under RCRA or that exhibits one or more of the four RCRA hazardous characteristics: ignitability, corrosivity, reactivity, and toxicity.
- *PCB wastes* – waste containing PCBs, a class of synthetic organic chemicals. Disposal of PCB materials is regulated under the Toxic Substances Control Act (TSCA).
- *Solid wastes* – Waste that includes construction and demolition debris, industrial waste, and sanitary waste, as defined by Ohio regulations.

Many of the wastes generated by DOE PORTS are a combination of these first three waste types; for example, some wastes are both RCRA hazardous waste and low-level radioactive waste.

Supplemental policies also have been implemented for waste management including: minimizing waste generation; characterizing and certifying wastes before they are stored, processed, treated, or disposed; pursuing volume reduction (such as blending and bulking); on-site storage in preparation for safe and compliant final treatment and/or disposal; and recycling.

Public Awareness Program

The DOE provides a public Environmental Information Center to allow access to all documents used to make decisions on remedial actions being taken at PORTS. The information center is located just north of PORTS at the Ohio State University Endeavor Center (Room 220), 1862 Shyville Road, Piketon, Ohio 45661. The Information Center is open 9 a.m. to noon Monday and Tuesday, noon to 4 p.m. Wednesday and Thursday, or by appointment (call 740-289-8898 or email eic@falcon1.net). Additional information is provided by the DOE Site Office (740-897-5010) and the LPP Office of Public Affairs (740-897-2336). The latest Annual Environmental Report and other information can also be obtained from the PORTS web site at www.lpports.com.

Public update meetings and public workshops on specific topics are also held to keep the public informed and to receive their comments and questions. Periodically, fact sheets about major projects are written for the public. Additionally, the *Portsmouth Environmental Bulletin* is distributed to more than 4,000 recipients, including those on the community relations mailing list, neighbors within 2 miles of the plant, and plant employees and retirees.

ENVIRONMENTAL MONITORING

Environmental monitoring at PORTS includes air, water, soil, and biota (animals, vegetation, and crops) and includes measurement of both radiological and chemical parameters. Environmental monitoring programs may be required by regulations, permit requirements, and DOE Orders, but also may be developed to address public concerns about plant operations. The DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* describes the environmental monitoring programs for DOE PORTS.

In 2007, environmental monitoring information was collected for the following programs:

- Airborne discharges,
- Ambient air,
- Direct radiation,
- Discharges to surface water,
- Local surface water,
- Sediment,
- Soil,
- Vegetation, and
- Biota.

Data collected for these programs in 2007 are consistent with data collected in previous years and indicate that radionuclides and chemicals released by PORTS operations have a minimal effect on human health and the environment. The DOE also collects extensive environmental monitoring information on groundwater at PORTS. Groundwater monitoring is discussed in Chapter 6, Groundwater Programs.

DOSE

Potential impacts on human health from radionuclides released by PORTS operations are calculated based on environmental monitoring data. This impact, commonly called a dose, can be caused by radionuclides released into the air and/or water, or radiation emanating directly from buildings or other objects at PORTS. The U.S. EPA sets a 10 millirem (mrem)/year limit for the dose from radionuclides released to the air, and the DOE sets a 100 mrem/year limit for the dose from radionuclides from all potential pathways (air, water, and direct radiation). A person living in southern Ohio receives a dose of approximately 300 mrem/year from natural sources of radiation (National Council on Radiation Protection 1987). Figure 1 provides a comparison of the doses from various common radiation sources.

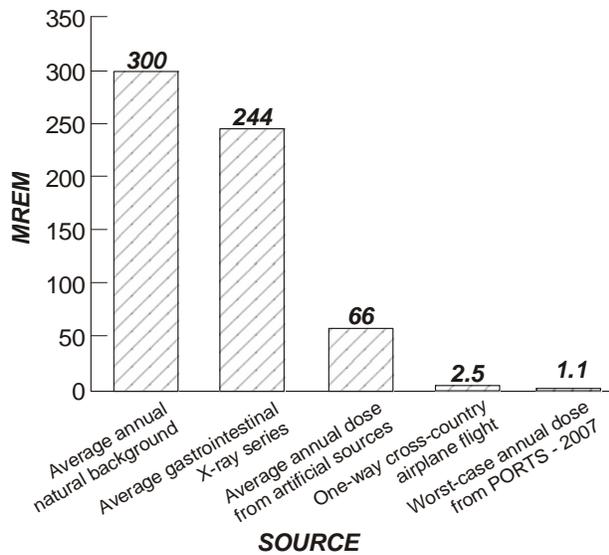


Figure 1. Comparison of dose from various common radiation sources.

This Annual Environmental Report includes radiological dose calculations for the dose to the public from radionuclides released to the environment based on environmental monitoring data collected by both the DOE and USEC. The maximum dose that a member of the public could receive from radiation released by PORTS in 2007 is 1.1 mrem, based on a maximum dose of 0.0051 mrem from airborne radionuclides, 0.022 mrem from radionuclides released to the Scioto River, 0.97 mrem from direct radiation from the PORTS depleted uranium cylinder storage yards, and 0.12 mrem based on exposure to radionuclides detected at off-site monitoring locations in 2007. This dose calculation uses a worst-case approach; that is, the calculation assumes that the same individual is exposed to the most extreme conditions from

each pathway. This dose (1.1 mrem) is significantly less than the 100 mrem/year limit set by DOE for the dose to a member of the public from radionuclides from all potential pathways. The dose to a member of the public from airborne radionuclides released by PORTS (0.0051 mrem) is also significantly less than the 10 mrem/year standard set by U.S. EPA.

GROUNDWATER PROGRAMS

Groundwater monitoring at DOE PORTS is performed at RCRA hazardous waste units, solid waste disposal units, and RCRA Corrective Action Program units. The *Integrated Groundwater Monitoring Plan* describes the groundwater monitoring program for PORTS, which has been reviewed and approved by the Ohio EPA. In general, samples are collected from wells at 11 groundwater monitoring areas and surface water locations that are part of the groundwater monitoring program. Samples are analyzed for metals, volatile organic compounds, and/or radiological constituents. DOE PORTS then evaluates constituents detected in the groundwater to assess the potential for each constituent to affect human health and the environment.

Some groundwater monitoring is conducted in order to meet DOE Order requirements. Exit pathway monitoring assesses the effect of DOE PORTS on regional groundwater quality and quantity.

Five groundwater contamination plumes have been identified on site at PORTS. The primary groundwater contaminant is trichloroethene. Remediation of groundwater is being conducted, in part, under Ohio EPA's RCRA Corrective Action Program. The contaminated groundwater plumes present at PORTS did not change significantly in 2007. Trichloroethene and several other volatile organics continue to be detected at concentrations less than 4 micrograms per liter ($\mu\text{g/L}$ or parts per billion) in an off-site well approximately 45 feet south of the DOE property line that is part of the X-749/X-120 groundwater plume. Trichloroethene and other volatile organics were also detected for the first time in two other off-site monitoring wells at concentrations of 1.2 $\mu\text{g/L}$ or less. In 2007, trichloroethene was not detected in groundwater beyond the DOE property boundary at concentrations that exceed the EPA drinking water standard of 5 $\mu\text{g/L}$.

The groundwater extraction wells installed in the southern portion of the X-749/X-120 groundwater plume in 2007, which began operating on June 29, 2007, are intended to control and remediate the groundwater plume in this area. Concentrations of trichloroethene in at least one on-site groundwater monitoring well had decreased by the end of 2007, due at least in part to operation of the new groundwater extraction wells.

The *Integrated Groundwater Monitoring Plan* also addresses monitoring of residential water supplies near PORTS to verify that site contaminants have not migrated into off-site drinking water wells. Results of this program indicate that PORTS has not affected drinking water wells outside the site boundaries.

QUALITY ASSURANCE AND QUALITY CONTROL

Data reliability is of the utmost importance for monitoring releases and measuring radiation in the environment. To demonstrate that the monitoring and measurement results are accurate, DOE PORTS has implemented a quality assurance and quality control program based on guidelines from the U.S. EPA, the American Society for Testing and Materials, and other federal and state agencies. The DOE PORTS staff administers numerous quality control activities to verify reliability of the data on a day-to-day basis. DOE PORTS also participates actively in quality control programs administered by agencies outside the site such as the U.S. EPA.

1. INTRODUCTION

1.1 SUMMARY

The Portsmouth Gaseous Diffusion Plant (PORTS) is located on a 5.9-square-mile site in a rural area of Pike County, Ohio. U.S. Department of Energy (DOE) activities at PORTS include environmental restoration, waste management, and long-term stewardship of the facilities that are not leased to the United States Enrichment Corporation (USEC). Production facilities for the separation and enrichment of uranium isotopes are leased to USEC, but most activities associated with the gaseous diffusion process of uranium enrichment ceased in 2001. In 2007, USEC, Inc. (the parent company of USEC) continued operation of the small-scale demonstration centrifuge for uranium enrichment at PORTS (the Lead Cascade). USEC, Inc. is also planning the construction of its commercial scale American Centrifuge Plant at PORTS. In general, USEC activities are not covered by this document, with the exception of some environmental compliance information provided in Chapter 2 and radiological and non-radiological environmental monitoring program information discussed in Chapters 4 and 5.

1.2 BACKGROUND INFORMATION

PORTS, which began operation in 1954, is owned by the DOE (see Figure 1.1). Effective July 1, 1993, the DOE leased the uranium production facilities at the site to USEC, which was established by the Energy Policy Act of 1992. The DOE is responsible for certain environmental restoration and waste management activities, uranium programs, and long-term stewardship of nonleased facilities at PORTS.



Figure 1.1 The Portsmouth Gaseous Diffusion Plant.

LATA/Parallax Portsmouth, LLC (LPP), Theta Pro2Serve Management Company, LLC (TPMC), and Uranium Disposition Services, LLC (UDS) managed DOE PORTS programs throughout 2007. LPP is responsible for the following activities: 1) environmental restoration of contaminated areas; 2) monitoring and reporting on environmental compliance; 3) disposition of legacy radioactive waste; 4) decontamination and decommissioning of inactive facilities; 5) disposition of highly enriched uranium; and 6) operation of the site's waste storage facilities. TPMC provides infrastructure services including the following: 1) maintenance of facilities, grounds, and roadways; 2) janitorial services; 3) operation and maintenance of the boiler system that provides heat to DOE facilities; 4) security access for DOE facilities; and 5) information technology/network support for DOE operations.

UDS is responsible for construction of the Depleted Uranium Hexafluoride Conversion Facility at PORTS, surveillance and maintenance of depleted uranium cylinders, and environmental compliance and monitoring activities associated with UDS operations. Depleted uranium hexafluoride, which is a product of the gaseous diffusion process, is stored in cylinders on site. The Depleted Uranium Hexafluoride Conversion Facility will convert depleted uranium hexafluoride into uranium oxide, which will be shipped off site. Operation of the facility is expected to begin in 2010.

USEC, which became a privately-held company in 1998, enriched uranium at PORTS via the gaseous diffusion process for use in commercial nuclear power reactors until May 2001, at which time USEC ceased production at PORTS. USEC is transitioning the gaseous diffusion production facilities at PORTS to a cold shutdown mode under a contract with the DOE. Cold shutdown activities include removing lube oils and oil contaminated with polychlorinated biphenyls (PCBs) from equipment and removing uranium hexafluoride deposits within the gaseous diffusion process equipment. USEC is also processing uranium to remove technetium-99.

In 2002, USEC, Inc. decided to site the Lead Cascade at PORTS, which is a small-scale demonstration centrifuge for uranium enrichment. In January 2004, USEC, Inc. announced that its commercial scale American Centrifuge Plant would be built at PORTS. In October 2006, USEC, Inc. introduced uranium hexafluoride feedstock to the Lead Cascade. The Lead Cascade will operate for up to five years on total recycle to generate process operating and economic data. Both of these facilities (the Lead Cascade and the American Centrifuge Plant) are housed in existing buildings at PORTS that were constructed for DOE's Gaseous Centrifuge Enrichment Plant, which was cancelled in 1985.

The gas centrifuge uranium enrichment process requires much less electricity than the gaseous diffusion process. Gas centrifuge uranium enrichment uses a rotor that spins at a high speed within a casing to separate uranium-235 from uranium-238 (resulting in enriched uranium). Gaseous diffusion uranium enrichment uses a porous barrier to separate uranium-235 molecules from uranium-238 molecules.

In 2007, DOE Headquarters initiated the planning process for the decontamination and decommissioning (D&D) of the PORTS gaseous diffusion facilities and associated buildings. D&D includes removing equipment, demolishing buildings, disposing of wastes, and investigating potential contamination beneath the demolished buildings.

This report is intended to fulfill the requirements of DOE Order 231.1A, *Environment, Safety and Health Reporting*. This DOE Order requires development of an annual site environmental report that includes information on regulatory compliance, environmental programs, radiological and non-radiological monitoring programs, groundwater programs, and quality assurance. This report is not intended to present all of the monitoring data at PORTS. Additional data collected for other site purposes, such as environmental restoration and waste management, are presented in other documents that have been prepared in accordance with applicable laws and regulations. These data are presented in

other reports, such as the 2007 *Groundwater Monitoring Report* and the 2007 *Annual Hazardous Waste Report*, which are available at the DOE PORTS Environmental Information Center.

1.3 DESCRIPTION OF SITE LOCALE

DOE PORTS is located in a rural area of Pike County, Ohio, on a 5.9-square-mile site (see Figure 1.2). The site is 2 miles east of the Scioto River in a small valley running parallel to and approximately 120 feet above the Scioto River floodplain. Figure 1.3 depicts the plant site and its immediate environs.

Pike County has approximately 27,700 residents. Scattered rural development is typical; however, the county contains a number of small villages such as Piketon and Beaver that lie within a few miles of the plant. The county's largest community, Waverly, is about 10 miles north of the plant and has a population of about 4,400 residents. The nearest residential center in this area is Piketon, which is about 5 miles north of the plant on U.S. Route 23 with a population of about 1,900. Several residences are adjacent to the southern half of the eastern boundary and along Wakefield Mound Road (old U.S. 23), directly west of the plant.

Additional cities within 50 miles of the plant are Portsmouth (population 20,909), 22 miles south; Chillicothe (population 21,796), 27 miles north; and Jackson (population 6,184), 18 miles east (U.S. Census 2000). The total population within 50 miles of the plant is approximately 600,000 persons.

1.4 DESCRIPTION OF SITE OPERATIONS

The DOE, through its managing contractors, is responsible for the Environmental Restoration, Waste Management, and Uranium Programs at the plant, as well as other nonleased DOE property. The Environmental Restoration Program performs remedial investigations and remedial actions to define the nature and extent of contamination, to evaluate the risk to public health and the environment, and to remediate areas of contamination at PORTS. The goal of the Environmental Restoration Program is to verify that releases from past operations at DOE PORTS are thoroughly investigated and that remedial actions are taken to protect human health and the environment.



Figure 1.2. Location of PORTS within the State of Ohio.

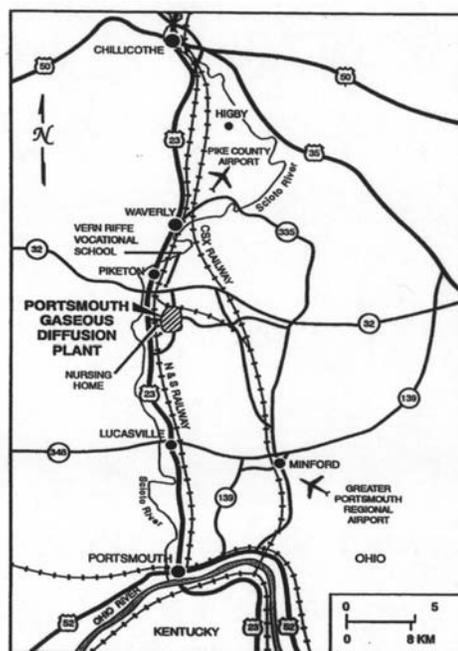


Figure 1.3. Location of PORTS in relation to the geographic region.

The Waste Management Program is responsible for managing wastes generated at the site. Wastes must be identified and stored in accordance with all environmental regulations. The Waste Management Program also arranges transportation and off-site disposal of wastes. The goal of the Waste Management Program is to manage waste from the time it is generated to its ultimate treatment, recycling, or disposal in accordance with all applicable regulations.

The Uranium Program is responsible for the cost-effective management of PORTS facilities and real property retained by the DOE. Responsibilities include managing contracts between DOE PORTS and other subcontractors for such services as maintenance, utilities, chemical operations, uranium material handling, and laboratory analysis. The Uranium Program also oversees the management and coordination of the PORTS Depleted Uranium Hexafluoride Program and warehousing of uranium materials.

2. COMPLIANCE SUMMARY

2.1 SUMMARY

DOE PORTS or the responsible DOE contractor holds a permit for discharge of water to surface streams, several air emission permits, and a permit for the storage of hazardous wastes. The DOE is responsible for preparing a number of reports for compliance with environmental regulations. These reports include an annual groundwater monitoring report, an annual hazardous waste report, an annual PCB document log, an annual summary of radionuclide air emissions and the associated dose to the public from these emissions, an annual report of specified non-radiological air emissions, a monthly report of National Pollutant Discharge Elimination System (NPDES) monitoring data, a quarterly radiological discharge monitoring report for NPDES outfalls, an annual hazardous chemical inventory, and an annual toxic chemical release inventory. Additional information on each of these reports is provided within this chapter.

USEC is responsible for compliance activities directly associated with the operations that are leased from the DOE, including air emission permits for uranium enrichment facilities, water discharge permits for several holding ponds and water treatment facilities, and management of wastes generated by current USEC operations.

DOE PORTS is inspected regularly by the federal, state, and local agencies responsible for enforcing environmental regulations at PORTS. DOE PORTS did not receive any Notices of Violation for inspections conducted during 2007.

2.2 INTRODUCTION

The DOE is responsible for the Environmental Restoration Program, Waste Management Program, Uranium Program, and operation of all facilities not leased to USEC. USEC is responsible for compliance activities directly associated with the operations that are leased from the DOE, including air emission permits for uranium enrichment facilities and water discharge permits for several holding ponds and water treatment facilities. USEC is also responsible for the management of wastes generated by current USEC operations.

DOE PORTS and/or DOE PORTS contractors (LPP, TPMC, and UDS) hold two NPDES permits for discharge of water to surface streams, several air emission permits, and a Resource Conservation and Recovery Act (RCRA) Part B permit for the storage of hazardous wastes. Appendix B lists the active DOE PORTS environmental permits and registrations for 2007.

Several federal, state, and local agencies are responsible for enforcing environmental regulations at DOE PORTS. Primary regulatory agencies include the U.S. Environmental Protection Agency (EPA) and Ohio EPA. These agencies issue permits, review compliance reports, conduct joint monitoring programs, inspect facilities and operations, and oversee compliance with applicable regulations.

DOE PORTS conducts self-assessments to identify environmental issues and consults the regulatory agencies to identify the appropriate actions necessary to achieve and maintain compliance.

2.3 COMPLIANCE STATUS

This section discusses the DOE PORTS compliance status with respect to environmental laws and regulations, DOE Orders, and Executive Orders.

2.3.1 Environmental Restoration and Waste Management

This section discusses the DOE PORTS compliance status with U.S. EPA and Ohio EPA regulations pertaining to environmental restoration and waste management.

2.3.1.1 Comprehensive Environmental Response, Compensation, and Liability Act

DOE PORTS is not on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List of sites requiring priority cleanup. The U.S. EPA Administrative Consent Order, issued on September 29, 1989 (amended in 1994 and 1997), and Consent Decree with the State of Ohio, issued on August 29, 1989, require the investigation and cleanup of surface water and air releases, groundwater contamination plumes, and solid waste management units at PORTS. The U.S. EPA and Ohio EPA oversee environmental remediation activities at DOE PORTS under the RCRA Corrective Action Program and CERCLA Program.

PORTS was divided into quadrants based on groundwater flow patterns to facilitate the expedient cleanup of contaminated sites in accordance with RCRA corrective action and closure requirements. The Environmental Restoration Program at PORTS addresses requirements of the Ohio Consent Decree and U.S. EPA Administrative Consent Order. Chapter 3, Section 3.2, provides additional information on the Environmental Restoration Program.

Section 103 of CERCLA requires notification to the National Response Center if hazardous substances are released to the environment in amounts greater than or equal to the reportable quantity. Reportable quantities are listed in the Act and vary depending on the type of hazardous substance released. During 2007, DOE PORTS had no reportable quantity releases of hazardous substances subject to Section 103 notification requirements.

2.3.1.2 Emergency Planning and Community Right-To-Know Act

The Emergency Planning and Community Right-To-Know Act of 1986, also referred to as the Superfund Amendments and Reauthorization Act Title III, requires reporting of emergency planning information, hazardous chemical inventories, and releases to the environment. Emergency Planning and Community Right-To-Know Act reports are submitted to federal, state, and local authorities.

For emergency planning purposes, facilities must submit information on chemicals present on site above specified quantities (called the threshold planning quantity) to state and local authorities. When a new chemical is brought on site or increased to exceed the threshold planning quantity, information about the new chemical must be submitted to state and local authorities within three months. In January 2007, TPMC notified state and local authorities that calcium chloride is now present at PORTS in quantities exceeding the threshold planning quantity. Calcium chloride is used for de-icing of roads and walkways.

Section 304 of the Emergency Planning and Community Right-To-Know Act requires reporting of off-site reportable quantity releases to state and local authorities. During 2007, DOE PORTS had no reportable quantity releases.

The Hazardous Chemical Inventory Report includes the identity, location, storage information, and hazards of the chemicals present on site in amounts above the threshold planning quantities specified by the U.S. EPA. This report is submitted annually to state and local authorities. DOE PORTS reported the following chemicals for 2007: aluminum oxide, argon, asbestos, calcium chloride, calcium oxide, carbon dioxide, citric acid, diesel fuel, ethylene glycol, fluorotrichloromethane (Freon-11), gasoline, hydrogen fluoride, hydrogen peroxide, kerosene, lubricating oil, fuel oil, methanol, nitric acid, nitrogen, PCBs, propane, sodium chloride, sodium fluoride, sodium hydroxide, sulfuric acid, transformer oil, triuranium octaoxide, uranium dioxide, uranium hexafluoride, uranium metal, uranium tetrafluoride, and uranium trioxide.

The Toxic Chemical Release Inventory is sent annually to the U.S. EPA and Ohio EPA. This report details releases to the environment of specified chemicals when they are manufactured, processed, or otherwise used by the entire site (including USEC) in amounts that exceed threshold quantities specified by the U.S. EPA. For this report, the U.S. EPA defines a release to include on-site treatment, off-site disposal, and recycling conducted in accordance with regulations.

For 2007, DOE PORTS reported the release, on-site treatment, and/or off-site transfer of three chemicals: lead compounds, nitrate compounds, and aerosol sulfuric acid. Releases were in compliance with applicable NPDES or air emission permits. Lead compounds and nitrate compounds were present in waste disposed or recycled off site by DOE PORTS. Nitrate compounds and aerosol sulfuric acid were produced by the recirculating hot water system used to heat former DOE PORTS buildings from January 2007 through September 28, 2007. Operation of this system was transferred to USEC beginning on September 29, 2007 because the buildings heated by this system were transferred to USEC for use by the American Centrifuge Plant.

USEC reported the release, off-site transfer, and/or on-site treatment of six chemicals in 2007: chlorine, dichlorotetrafluoroethane, nitrate compounds, sulfuric acid, hydrochloric acid, and lead compounds.

2.3.1.3 Resource Conservation and Recovery Act

RCRA regulates the generation, accumulation, storage, transportation, and disposal of solid and hazardous wastes. Wastes are designated as hazardous by the EPA because of various chemical properties, including ignitability, corrosivity, reactivity, and toxicity. RCRA also regulates wastes that are called "solid waste," although these wastes can be solids, liquids, sludges, or other materials.

Hazardous waste. During 2007, DOE and LPP held a permit to store hazardous waste in the X-7725 and X-326 buildings. The permit, often called a Part B Permit, was issued to DOE PORTS in 1995 and renewed by the Ohio EPA in 2001. The permit governs the storage of hazardous waste and includes requirements for waste identification, inspections of storage areas and emergency equipment, emergency procedures, training requirements, and other information required by the Ohio EPA.

The USEC, Inc. American Centrifuge Plant is being installed at PORTS in the existing X-7725 building. In 2007, DOE completed closure of the existing permitted RCRA storage areas in the X-7725 building, which was required prior to allowing USEC, Inc. use of the areas. In general, closure of RCRA storage areas includes removing stored waste, cleaning the area (as necessary), sampling to ensure that the area meets closure standards set by the Ohio EPA, and submittal of a report and certification to the Ohio EPA. The Ohio EPA reviews the report and approves the closure, at which time the area can be removed from the facility's Part B Permit. Ohio EPA approved the closure of the storage areas and their removal from the Part B permit in July 2007.

As of the end of 2007, DOE was permitted to store hazardous waste within seven designated areas of the X-326 building (38,105 square feet or 0.9 acre).

Facilities such as PORTS that generate or store hazardous waste are required to submit an annual report to the Ohio EPA. This annual report contains the name and address of each facility that waste was shipped to during the previous calendar year, the name and address of the transporter for each waste shipment, the description and quantity of each waste stream shipped off site, and a description of waste minimization efforts. PORTS submitted the report for calendar year 2007 to the Ohio EPA in February 2008. Chapter 3, Section 3.3, Waste Management Program, provides additional information on wastes from PORTS that were recycled, treated, or disposed in 2007.

RCRA may also require groundwater monitoring at hazardous waste units. As discussed in Chapter 6, groundwater monitoring requirements at PORTS have been integrated into one document, the *Integrated Groundwater Monitoring Plan*. Hazardous waste units included in the *Integrated Groundwater Monitoring Plan* are the X-231B Southwest Oil Biodegradation Plot, X-616 Chromium Sludge Surface Impoundments, X-701B Holding Pond, X-701C Neutralization Pit, X-735 RCRA Landfill (northern portion), and X-749 Contaminated Materials Storage Yard (northern portion). Other hazardous waste units at PORTS (the X-744Y Container Storage Area, X-701B surface impoundments, and X-230J7 Holding Pond) are being remediated as part of the RCRA Corrective Action Program at PORTS and are also monitored in accordance with the *Integrated Groundwater Monitoring Plan*. Chapter 6 discusses the groundwater monitoring requirements for these units.

A groundwater report that summarizes the results of monitoring completed in accordance with the *Integrated Groundwater Monitoring Plan* is submitted annually to Ohio EPA. Chapter 6 discusses these monitoring results for 2007.

Solid waste. Groundwater monitoring may be required at closed solid waste disposal facilities, such as landfills. Groundwater monitoring requirements for the closed X-734 Landfills, X-735 Industrial Solid Waste Landfill, and X-749A Classified Materials Disposal Facility are included in the *Integrated Groundwater Monitoring Plan*. Chapter 6 discusses the groundwater monitoring results for these units in 2007.

2.3.1.4 Federal Facility Compliance Act

DOE PORTS currently stores waste that is a mixture of RCRA hazardous waste and low-level radioactive waste. RCRA hazardous waste is subject to Land Disposal Restrictions, which with limited exceptions do not allow the storage of hazardous waste for longer than one year. The Federal Facility Compliance Act, enacted by Congress in October 1992, allows for the storage of mixed hazardous/low-level radioactive waste for longer than one year because treatment for this type of waste is not readily available. The Act also requires federal facilities to develop and submit site treatment plans for treatment of mixed wastes. On October 4, 1995, the Ohio EPA issued Director's Final Findings and Orders allowing the storage of mixed waste beyond one year and approving the DOE PORTS Proposed Site Treatment Plan. An annual update to the Site Treatment Plan is required by these Director's Final Findings and Orders. The annual update to the Site Treatment Plan for fiscal year 2007 was submitted to the Ohio EPA in December 2007.

2.3.1.5 Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) regulates the use, storage, and disposal of PCBs. The electrical power system at PORTS, which is leased by USEC, uses oil-based circuit breaker transformers

and large high-voltage capacitors, both containing PCB oil. One hundred-twenty PCB transformers and approximately 11,099 large PCB capacitors are either in service or stored for reuse at PORTS.

In February 1992, a TSCA Federal Facilities Compliance Agreement between the DOE and U.S. EPA addressing PCB issues became effective and resolved several compliance issues. These issues included the use of PCBs in systems that are not totally enclosed, storage of wastes containing both PCBs and radionuclides in accordance with nuclear criticality safety requirements, and storage of wastes containing both PCBs and radionuclides for longer than one year. The agreement required installation of troughs under motor exhaust duct gaskets located in production facilities to collect PCB oil leaks. When leaks or spills of PCBs occur, they are managed in accordance with the Federal Facilities Compliance Agreement.

Annual reports of progress made toward milestones specified in the Federal Facilities Compliance Agreement are submitted to the U.S. EPA. In the first quarter of 2007, the concentration of PCBs detected in two air samples collected in the X-326 building (0.96 and 1.05 micrograms per cubic meter [$\mu\text{g}/\text{m}^3$]) exceeded the threshold reporting value in the compliance agreement ($0.5 \mu\text{g}/\text{m}^3$). This threshold reporting value is well below the health and safety limit of $500 \mu\text{g}/\text{m}^3$. These results were reported to the U.S. EPA in accordance with the compliance agreement. DOE PORTS was in compliance with the requirements and milestones of this Federal Facilities Compliance Agreement during 2007.

DOE PORTS operates a number of storage areas for PCB wastes. An annual document log is prepared to meet regulatory requirements. The document log provides an inventory of PCB items in use, in storage as waste, and shipping/disposal information for PCB items disposed in 2007. The *2007 PCB Document Log for the Portsmouth Gaseous Diffusion Plant* was prepared in June 2008. Approximately 1793 tons (1,626,421 kilograms) of PCB waste were shipped off site in 2007.

In 2005, DOE received approval from U.S. EPA to manage depleted uranium cylinders that may have paint containing greater than 50 parts per million (ppm) of PCBs present on the outside of the cylinders. These cylinders may be stored in the X-745C, X-745E and X-745G Cylinder Storage Yards. The agreement includes monitoring of PCBs in surface water and sediment in drainage basins downstream from the DOE cylinder storage yards. Chapter 5, Sections 5.4.3 and 5.5.2 provide the results of this sampling.

2.3.1.6 Federal Insecticide, Fungicide, and Rodenticide Act

No restricted-use pesticides were used by DOE PORTS in 2007.

2.3.2 Radiation Protection

This section discusses the DOE PORTS compliance status with DOE Orders pertaining to radiation protection and management of radioactive waste.

2.3.2.1 DOE Order 5400.5, *Radiation Protection of the Public and the Environment*

DOE Order 5400.5 provides guidance and establishes radiation protection standards and control practices designed to protect the public and the environment from undue radiological risk from operations of DOE and DOE contractors. The order requires that off-site radiation doses do not exceed 100 millirem (mrem)/year above background for all exposure pathways. Chapter 4 provides the dose calculations for compliance with this DOE Order.

2.3.2.2 DOE Order 435.1 *Radioactive Waste Management*

The objective of DOE Order 435.1 is to ensure that radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment.

Low-level radioactive waste is generated and stored in accordance with the *Authorization Agreement and Radioactive Waste Management Basis for Portsmouth Gaseous Diffusion Plant Facilities and Material Storage Areas* and its implementing procedures. Chapter 3, Section 3.3 provides additional information about the Waste Management Program at DOE PORTS.

2.3.3 Air Quality and Protection

This section discusses the DOE PORTS compliance status with U.S. EPA and Ohio EPA regulations pertaining to air emissions (both radionuclides and non-radiological pollutants) and stratospheric ozone protection.

2.3.3.1 Clean Air Act

DOE PORTS had four permitted air emission sources, three registered air emission sources, and four permitted sources under construction by UDS at the end of 2007 (see Appendix B). DOE PORTS submitted a letter to Ohio EPA in May 2007 withdrawing the air emission permit for the X-744G Glovebox. The air permit associated with the boilers used to heat the X-7725 building was transferred to USEC on September 29, 2007, because use of the X-7725 building has been transferred to USEC for the American Centrifuge Plant. Radiological air emissions from the DOE air emission sources are discussed in Chapter 4 and non-radiological air emissions are discussed in Chapter 5.

DOE PORTS is not a major source of air pollutants as defined in Title 40 of the *Code of Federal Regulations*, Part 70. USEC is the only major source at the PORTS site, with three boilers at the X-600 Steam Plant emitting the majority of the pollutants that cause the designation as a major source. Chapter 5, Section 5.3.1, provides additional information for PORTS non-radiological air emissions and the annual Ohio EPA Fee Emission Report for non-radiological air pollutants.

2.3.3.2 Clean Air Act, Title VI, Stratospheric Ozone Protection

As part of the Stratospheric Ozone Protection Plan, the DOE has instituted a record-keeping system consisting of forms and labels to comply with the Title VI record-keeping and labeling requirements. These requirements affect all areas that use ozone-depleting substances in units or devices. The appliance service record and retrofit or retirement plan forms apply to units with a capacity of more than 50 pounds. The refrigeration equipment disposal log and associated appliance disposal label are used by all units regardless of capacity. The contractor technicians who service air conditioning/refrigeration units under DOE control have been trained in accordance with U.S. EPA requirements.

USEC uses an ozone-depleting substance, specifically dichlorotetrafluoroethane, as a coolant in the cascade system formerly used to produce enriched uranium. In 2007, USEC estimated that 22,000 pounds of dichlorotetrafluoroethane were released to the air.

2.3.3.3 National Emission Standards for Hazardous Air Pollutants

The National Emission Standards for Hazardous Air Pollutants require DOE PORTS to submit an annual report for radiological emissions from DOE PORTS sources. The DOE and LPP are responsible for five sources of radionuclide emissions including the X-622, X-623, X-624, X-627 Groundwater

Treatment Facilities, and the X-326 L-cage Glove Box. The groundwater treatment facilities are radionuclide sources subject to these standards, because the facilities use air strippers to remove volatile organic compounds from groundwater that is also contaminated with radionuclides. There were no emissions from UDS air emission sources in 2007.

Radiological emissions from DOE PORTS in 2007 are based on emissions from the X-326 L-cage Glove Box and the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Emissions from the groundwater treatment facilities were conservatively estimated based on periodic emissions testing and annual throughput (X-622 and X-627) or influent/effluent sampling and annual throughput (X-623 and X-624). Emissions from the X-326 Glove Box were based on the mass of the materials transferred within the glove box, analytical data available for each material, and emission factors provided by the EPA. Based on these assumptions, radiological air emissions from the X-326 Glove Box and the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities in 2007 were 0.0006 curie. Chapter 4, Section 4.3.3, provides the radiological dose calculations from these emissions.

2.3.4 Water Quality and Protection

This section discusses the DOE PORTS compliance status with U.S. EPA and Ohio EPA regulations pertaining to water quality and protection.

2.3.4.1 Clean Water Act

DOE PORTS contractors, LPP and UDS, hold two NPDES permits that allow discharges of water to surface streams. The LPP NPDES permit, effective December 2002, encompasses eight monitored outfalls. Three of the outfalls are classified as point-source discharges to waters of the state, and the other five outfalls are internal outfalls classified as effluents. Water from four of these internal outfalls is treated in the USEC Sewage Treatment Plant before reaching waters of the state. Water from the fifth internal outfall is discharged to the X-2230M Holding Pond, which discharges to DOE PORTS NPDES Outfall 012. Chapter 4, Section 4.3.5.1, and Chapter 5, Section 5.4.1.1, provide additional information on the LPP NPDES outfalls.

LPP submitted an NPDES permit renewal application to Ohio EPA on May 30, 2007. The new NPDES permit was issued by Ohio EPA on April 15, 2008 and became effective on May 1, 2008. The December 2002 NPDES permit was in effect throughout 2007.

UDS was issued an NPDES permit that became effective on June 1, 2007, for the discharge of process wastewaters from the Depleted Uranium Hexafluoride Conversion Facility. There were no discharges from the UDS NPDES outfall in 2007.

Data required to demonstrate compliance with the NPDES permit are submitted to Ohio EPA in a monthly operating report (see Chapter 5, Section 5.4.1.1). None of the NPDES permit effluent limitations was exceeded during 2007; therefore, the overall DOE NPDES compliance rate for 2007 was 100%. A quarterly discharge monitoring report that provides radiological monitoring data for the LPP NPDES outfalls is also submitted to Ohio EPA (see Chapter 4, Section 4.3.5).

2.3.5 Other Environmental Statutes

This section discusses the DOE PORTS compliance status with other U.S. EPA and Ohio EPA regulations, including underground storage tank regulations, the Endangered Species Act, and others.

2.3.5.1 Underground storage tank regulations

The Underground Storage Tank Program is managed in accordance with the Ohio State Fire Marshal's Bureau of Underground Storage Tank Regulations. Seven underground storage tanks are owned by DOE PORTS and leased to USEC. The registrations for these tanks are renewed annually.

2.3.5.2 National Environmental Policy Act

The National Environmental Policy Act requires evaluation of the environmental impacts of activities at federal facilities and of activities funded with federal dollars.

DOE PORTS has a formal program dedicated to compliance pursuant to DOE Order 451.1, *National Environmental Policy Act Compliance Program*. Restoration actions, waste management, enrichment facilities maintenance, and other activities are evaluated to determine the appropriate level of evaluation and documentation. Routine operation and maintenance activities are also evaluated to assess potential environmental impacts. Most activities at PORTS qualify for a categorical exclusion as defined in the regulations. These activities are considered routine and have no significant individual or cumulative environmental impacts.

2.3.5.3 Endangered Species Act

The Endangered Species Act of 1973, as amended, provides for the designation and protection of endangered and threatened wildlife and plants, and the habitat on which such species depend. When appropriate, formal consultations are made with the U.S. Fish and Wildlife Service and the Ohio Department of Natural Resources. A site-wide threatened and endangered species habitat survey and an Indiana bat (*Myotis sodalis*) survey were completed in August 1996. No Indiana bats were found at PORTS. Few potential critical habitats were identified, and a report of the survey activities and results was provided to the Ohio Department of Natural Resources as required by the Federal Fish and Wildlife permit obtained to conduct the survey. No additional activities were completed in 2007.

2.3.5.4 National Historic Preservation Act

The National Historic Preservation Act of 1966 is the primary law governing the protection of cultural resources (archaeological and historical properties). Cultural resource reviews are conducted on a case-by-case basis, and consultations with the Ohio State Historic Preservation Office are made as required by Section 106 of the Act. A programmatic agreement among the DOE, the Ohio Historic Preservation Office, and the Advisory Council on Historic Preservation concerning the management of historical and cultural properties at DOE PORTS is under development.

Phase I of the historical/archaeological survey was completed in September 1996. Fieldwork for Phase II of the project was completed in May 1997. Artifacts from the 1940s and 1950s were uncovered as well as remains from former dwellings that were present prior to construction of PORTS. Results from the survey will be coordinated with the Ohio Historic Preservation Office, and a Cultural Resources Management Plan will be developed.

In 2007, DOE PORTS notified the Ohio Historic Preservation Office of the proposed removal of two inactive support facilities at PORTS, the X-744T and X-744U Warehouses. These warehouses are not considered historically significant to PORTS.

2.3.5.5 Archaeological and Historic Preservation Act and Archaeological Resources Protection Act

The Archaeological and Historic Preservation Act and the Archaeological Resources Protection Act require the Secretary of the Department of Interior to report to Congress on various federal archaeological activities. The Archaeological Resources Protection Act requires federal land managers to provide archaeology program information to the Secretary of the Interior for this report; a questionnaire is completed by DOE PORTS annually. An archaeological survey of an area in the southwest corner of PORTS was completed in 2003. No sensitive archaeological sites were identified on DOE property in this area.

2.3.5.6 Farmland Protection Policy Act

The Farmland Protection Policy Act of 1981 requires federal agencies to consider the effects of their proposed actions on prime farmland. Prime farmland is generally defined as land that has the best combination of physical and chemical characteristics for producing crops of statewide or local importance. When required, prime farmland surveys are conducted, and consultations with the U.S. Department of Agriculture's Natural Resources Conservation Service are made. No prime farmland activities were conducted at DOE PORTS in 2007.

2.3.6 DOE Order 450.1, *Environmental Protection Program*

DOE Order 450.1, *Environmental Protection Program*, requires development and implementation of an Environmental Management System (EMS) in order to protect air, water, land, and other natural or cultural resources potentially impacted by DOE operations.

LPP, TPMC, and UDS have developed the following EMS criteria, as applicable: site EMS policy statement, EMS implementation training, identification of significant environmental aspects of site operations, establishment of measurable environmental objectives and targets, EMS awareness training (initial and ongoing), and establishment of EMS procedures. Because the UDS facility is under construction and will not be operational until 2009, UDS has not yet established measurable environmental objectives and targets. DOE completed the self-declaration protocol for establishment of the EMS in June 2006.

2.3.7 Executive Orders

An Executive Order is issued by a member of the executive branch of the government. Most Executive Orders are issued by the President to various federal agencies, including the DOE. This section discusses the DOE PORTS compliance status with Executive Orders pertaining to the environment.

2.3.7.1 Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*

On January 24, 2007, Executive Order 13423 was issued requiring federal facilities to conduct their environmental, transportation, and energy-related activities in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner.

Chapter 3, Section 3.4, provides a summary of the DOE PORTS Environmental Sustainability Program and associated activities for 2007.

2.3.7.2 Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*

Part 1022 of Title 10 of the Code of Federal Regulations establishes policy and procedures for compliance with Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*.

The site-wide wetland survey report was completed and submitted to the Corps of Engineers in 1996. There are 41 jurisdictional wetlands and four non-jurisdictional wetlands totaling 34.361 acres at PORTS. During 2007, no DOE activities were conducted in jurisdictional wetlands.

2.4 OTHER MAJOR ENVIRONMENTAL ISSUES AND ACTIONS

This section summarizes environmental inspection at DOE PORTS during 2007 and the results of these inspections.

2.4.1 Environmental Program Inspections

During 2007, 18 inspections of the DOE PORTS programs were conducted by federal, state, or local agencies. Table 2.1 lists these inspections. DOE PORTS received no Notices of Violation resulting from these inspections.

2.5 UNPLANNED RELEASES

No unplanned releases from DOE PORTS were reported in 2007.

2.6 SUMMARY OF PERMITS

Appendix B lists the permits held by DOE PORTS in 2007.

Table 2.1. Environmental inspections at DOE PORTS for 2007

Date	Agency	Type	Notices of Violation
March 13	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749A, X-735)	None
March 22	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-740 and Five-Unit area groundwater plume)	None
March 28	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-734, X-622, X-701C, X-720)	None
April 3	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749/X-120 groundwater plume)	None
April 17	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749 landfill)	None
May 8	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-700, X-705 sumps)	None
June 20	Pike County Health Department and Ohio EPA	Closed solid waste landfills: X-749A, X-749, and X-735 (solid waste portion)	None
June 28	Ohio EPA	RCRA closure activities	None
July 10	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-701B area, X-705, X-623, X-627, X-720)	None
August 7-8	Ohio EPA and U.S. EPA	RCRA	None
August 15	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-230J7 pond, X-616, X-231A/X-231B)	None
August 28	Ohio EPA	RCRA Corrective Action surveillance and maintenance (PK Landfill)	None
October 2	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749 landfill)	None
October 16	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-700 tanks, X-701C, X-342)	None
October 31	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749A landfill)	None
November 20	Ohio EPA	RCRA Corrective Action surveillance and maintenance (Don Marquis Holding Pond, X-744 warehouses)	None
November 27	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-533, X-230J6 Holding Pond)	None
December 18	Ohio EPA	NPDES	None

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3. ENVIRONMENTAL PROGRAM INFORMATION

3.1 SUMMARY

Environmental Restoration activities in 2007 included installation of new groundwater extraction wells and off-site monitoring wells in the southern portion of the X-749/X-120 groundwater plume in Quadrant I and implementation of the first phase of remedial actions required for the X-701B area in Quadrant II. The remedial actions for the X-701B area include construction of landfill caps in the western portion of the area, groundwater treatment through injection of a chemical oxidant, and phytoremediation, if necessary.

In 2007, more than 9 million pounds of waste from DOE PORTS were recycled, treated, or disposed at off-site facilities. Activities undertaken by the Waste Minimization, Pollution Prevention, Training, Inactive Facilities Removal, and Public Awareness programs are also discussed in this chapter.

Chapter 2, Section 2.3.6, provides information on DOE Order 450.1 and implementation of the DOE PORTS Environmental Management System.

3.2 ENVIRONMENTAL RESTORATION PROGRAM

The DOE established the Environmental Restoration Program in 1989 to identify, control, and remediate environmental contamination at PORTS. The Environmental Restoration Program addresses inactive sites through remedial action and deals with active facilities through eventual decontamination and decommissioning. Options for correcting or mitigating the contaminated sites and facilities include removal, containment, and treatment of contaminants. Because PORTS is a large facility, it is divided into quadrants (Quadrant I, II, III, and IV) to facilitate the cleanup process.

The Environmental Restoration Program was established to fulfill the cleanup requirements of the Ohio Consent Decree and U.S. EPA Administrative Consent Order. As required by these enforcement actions, DOE PORTS Environmental Restoration Program activities are conducted in accordance with the RCRA corrective action process, which consists of the following:

- *Description of current conditions* – to provide knowledge of the groundwater, surface water, soil, and air.
- *RCRA facility assessment* – to identify releases of contaminants and determine the need for further investigation.
- *RCRA facility investigation* – to determine the nature and extent of any contamination.
- *Cleanup alternatives study/corrective measures study* – to identify and evaluate remedial alternatives to address contamination identified during the RCRA facility investigation.
- *Corrective measures implementation* – to implement the selected remedial alternative(s).

DOE PORTS has completed the description of current conditions, RCRA facility assessment, RCRA facility investigation, and cleanup alternatives study/corrective measures study for each quadrant. Following the approval of the final cleanup alternative study/corrective measure study, the Ohio EPA

selects the remedial alternatives that will undergo further review for determining the final remedial actions for each quadrant (the Preferred Plan). Upon concurrence from the U.S. EPA and completion of the public review and comment period, the U.S. EPA and Ohio EPA select the final remedial actions for each quadrant. The Ohio EPA issues a decision document to select the final remedial actions.

Implementation of remedial actions is underway in each quadrant. Remedial actions are described for each quadrant in the sections presented below. Table 3.1 lists completed activities for the groundwater monitoring areas at PORTS, which include remedial actions required by decision document and other actions.

The Ohio EPA has deferred further investigation and/or remedial action for certain areas known as “deferred units.” Deferred units are areas that are in or adjacent to current production and operational areas such that remedial activities would interrupt operations, or are areas that could become recontaminated from ongoing operations. The Ohio EPA has deferred investigation/remedial action for these units until D&D of PORTS or until the unit no longer meets the requirements for deferred unit status.

In 2007, DOE Headquarters initiated the planning process for D&D of the PORTS gaseous diffusion facilities and associated buildings. DOE submitted the *Draft Deferred Units Strategic Plan*, which outlines DOE’s strategic approach for dealing with the deferred units, to Ohio EPA in January 2007. DOE and Ohio EPA continue to work together to develop the path forward for investigation of the deferred units during D&D of PORTS.

3.2.1 Quadrant I

The *Quadrant I Cleanup Alternative Study/Corrective Measures Study* was approved by the Ohio EPA in 2000. The Ohio EPA issued the Decision Document for Quadrant I in 2001, which provided the required remedial actions for the X-749/X-120 groundwater plume and the Quadrant I Groundwater Investigative Area (the Five-Unit Groundwater Investigative Area and X-231A/X-231B Oil Biodegradation Plots). Remedial actions required for the Peter Kiewit (PK) Landfill were provided in separate Decision Documents issued by Ohio EPA in 1996 and U.S. EPA in 1997. The following sections discuss the remedial actions required for the X-749/X-120 groundwater plume, PK Landfill, and the Quadrant I Groundwater Investigative Area. Deferred units in Quadrant I will be addressed during decontamination and decommissioning of PORTS.

3.2.1.1 X-749/X-120 groundwater plume

The remedial actions identified for X-749/X-120 groundwater plume include phytoremediation of the groundwater plume, installation of a barrier wall around the eastern and southern portion of the X-749 Landfill, and continued operation of the groundwater collection trenches installed at the PK Landfill and X-749 Landfill.

Phytoremediation is a process that uses plants to remove, degrade, or contain contaminants in soil and/or groundwater. Phytoremediation at the X-749/X-120 groundwater plume was installed in two phases during 2002 and 2003. A preliminary five-year review of the phytoremediation system will be submitted to Ohio EPA in 2008.

Table 3.1. Remedial actions completed at PORTS

Quadrant/monitoring area	Remedial action/year completed
Quadrant I X-749/X-120 plume	X-749 multimedia cap – 1992 X-749 barrier wall (north and northwest sides of landfill) – 1992 X-749 subsurface drains and sumps – 1992 South barrier wall – 1994 X-120 horizontal well – 1996 X-625 Groundwater Treatment Facility – 1996 X-749 barrier wall (east and south sides of landfill) – 2002 Phytoremediation (22 acres) – 2002 & 2003 Injection of hydrogen release compounds – 2004 X-749 South Barrier wall area extraction wells – 2007
Quadrant I PK Landfill (X-749B)	Relocation of Big Run Creek – 1994 Groundwater collection system – 1994 Groundwater collection system expansion – 1997 PK Landfill Subtitle D cap – 1998
Quadrant I Quadrant I Groundwater Investigative Area (Five-Unit Groundwater Investigative Area)	Groundwater extraction wells (3) – 1991 X-622 Groundwater Treatment Facility – 1991 (upgraded in 2001) Interim soil cover at X-231B – 1995 X-231A/X-231B multimedia caps – 2000 Groundwater extraction wells (11) – 2002
Quadrant I X-749A Classified Materials Disposal Facility	Cap – 1994
Quadrant II Quadrant II Groundwater Investigative Area (Seven-Unit Groundwater Investigative Area)	Operation of X-700 and X-705 building sumps – 1989 X-622T Groundwater Treatment Facility – 1992 Removal of X-720 Neutralization Pit (NP) – 1998 Removal of X-701C Neutralization Pit – 2001 Removal of contaminated soil near X-720 NP – 2001 X-627 Groundwater Treatment Facility – 2004 (replaced the X-622T facility)
Quadrant II X-701B Holding Pond	X-237 Groundwater Collection System – 1991 X-624 Groundwater Treatment Facility – 1991 (upgraded 2006) Extraction wells (3) – 1993 X-623 Groundwater Treatment Facility – 1993 X-701B sump – 1995 Groundwater remediation by oxidant injection Phase I oxidant injections – 2005 Phase IIa oxidant injections – 2006 Phase IIb and IIc oxidant injections – 2007
Quadrant III X-740 Waste Oil Handling Facility	Phytoremediation – 1999

Table 3.1. Remedial actions completed at PORTS (continued)

Quadrant/monitoring area	Remedial action/year completed
Quadrant IV X-611A Former Lime Sludge Lagoons	Soil cover – 1996 Prairie vegetation planted – 1997
Quadrant IV X-735 Landfills	Cap on northern portion – 1994 Cap on southern portion – 1998
Quadrant IV X-734 Landfills	Cap on X-734B Landfill (Phase I) – 1999 Cap on X-734 and X-734A Landfills (Phase II) – 2000

A monitoring plan entitled *Comprehensive Monitoring Program for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant* was developed and implemented in 2003 to provide additional data to monitor the effect of the new X-749 barrier wall on groundwater quality and movement in the northern area of the X-749 plume and at the PK Landfill. Data were collected for this monitoring program throughout 2004, and an annual summary report was submitted to the Ohio EPA in December 2004. The report [*Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Area*] found that the barrier wall on the south and east sides of the X-749 Landfill, installed in 2001 through 2002, was impeding additional contamination from flowing out of the landfill, and that the groundwater collection system and sump pump in the southwestern corner of the X-749 Landfill was removing water from the landfill.

A project was begun in 2004 to remediate volatile organics at the southern edge of the X-749/X-120 groundwater plume in the area of the X-749 South Barrier Wall (an interim remedial measure constructed in 1994) and the DOE property boundary. Hydrogen release compounds, which act as an accelerant to the natural microbial process that breaks down volatile organics into nontoxic compounds, were injected into the soil in over 150 locations during March and April 2004. Additional sampling monitored the concentrations of volatile organics, gases, and other breakdown products in the groundwater. Based on data collected from 2004 through 2006, optimal breakdown of the volatile organics was briefly achieved in the treatment zones, but is no longer occurring due to depletion of the hydrogen release compounds. Additional hydrogen release compounds will not be injected because of the short duration of this remedial technique.

In 2007, activities proposed in the *Work Plan for the X-749/X-120 Groundwater Optimization Project* were begun to address the groundwater plume in the X-749 South Barrier Wall area and enhance groundwater monitoring and remedial activities in the X-749/X-120 area. Four new groundwater extraction wells were installed in the X-749 South Barrier Wall area and began operation on June 29, 2007. Additional off-site sampling was also completed and three new off-site groundwater monitoring wells were installed to monitor the portion of the X-749 plume that has moved off site. Chapter 6, Section 6.4.1.4, provides 2007 groundwater monitoring results for the X-749/X-120 groundwater plume, including the new off-site groundwater monitoring wells.

3.2.1.2 PK Landfill

The remedial actions required by the PK Landfill Decision Documents consisted of the continued operation of the eastern groundwater collection system installed in 1994 and construction of an engineered cap that meets the RCRA Subtitle D and related requirements. In addition, the southeastern groundwater collection system was constructed in 1997 to contain surface seeps, groundwater from the

southern slope of the PK Landfill, and the groundwater plume migrating toward Big Run Creek from the X-749 Contaminated Materials Disposal Facility.

A five-year review was completed for the PK Landfill in 2002 to evaluate the effectiveness of the remedial actions implemented at this area (the groundwater collection systems and landfill cap). The U.S. EPA and Ohio EPA approved the report contingent upon additional evaluation and monitoring at PK Landfill. A monitoring plan entitled *Comprehensive Monitoring Program for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant* was developed and implemented in 2003 to provide additional data to evaluate the performance of the groundwater collection systems and landfill cap for the PK Landfill and to monitor the effect of the new X-749 barrier wall on groundwater quality and movement in the northern area of the X-749 plume and at the PK Landfill. Data were collected for this monitoring program throughout 2004, and an annual summary report was submitted to the Ohio EPA in December 2004.

The report [*Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Area*] found that the PK Landfill cap was performing adequately to impede surface water from percolating through landfill waste and potentially contaminating groundwater. Construction of a barrier wall on the upgradient (west and north) sides of the PK Landfill did not appear to be necessary based on evaluation of the PK Landfill cap, construction of the X-749 barrier walls, and evaluation of monitoring data. The second five-year review for the PK Landfill will be submitted to Ohio EPA in 2008.

Chapter 6, Section 6.4.1.3, provides 2007 groundwater monitoring results for the PK Landfill area.

3.2.1.3 Quadrant I Groundwater Investigative Area

Remedial actions identified for the Quadrant I Groundwater Investigative Area (also called the Five-Unit Groundwater Investigative Area) are: 1) installation of multimedia caps over the X-231A and X-231B Biodegradation Plots and 2) installation of 11 additional groundwater extraction wells to extract contaminated groundwater for treatment in the X-622 Groundwater Treatment Facility. A five-year review of these remedial actions will be submitted to Ohio EPA in 2008. Table 3.1 lists the remedial actions completed for the Quadrant I Groundwater Investigative Area.

Operation of the groundwater extraction wells is affecting the concentrations of contaminants detected in some of the wells in the groundwater plume. Chapter 6, Section 6.4.2.3, provides information on the groundwater monitoring completed in this area during 2007.

3.2.2 Quadrant II

The *Quadrant II Cleanup Alternative Study/Corrective Measures Study* was approved by the Ohio EPA on March 26, 2001. After approval of the document, however, the Ohio EPA requested an amendment to the approved study to address additional remedial alternatives for the X-701B area. Amendments were submitted in 2001 and 2002. In January 2003, the Ohio EPA informed the DOE that a separate Preferred Plan and Decision Document would be prepared for the X-701B area. The Ohio EPA issued the X-701B Preferred Plan in September 2003 and the X-701B Decision Document in December 2003.

Remedial actions required for soil in the X-701B area include removal of contaminated soil in the western portion of the area and consolidation of the soil under two landfill caps to be constructed over the X-701B Holding Pond/East Retention Basin and the West Retention Basin. Two landfill caps will be

constructed so that an existing storm water drainage pipe will not be covered. Groundwater remediation will be accomplished by injection of a chemical oxidant followed by phytoremediation, if necessary.

Phase I field activities for groundwater remediation began in September 2005 to determine operating parameters for the oxidant injection system including injection methodology, rate, pressure and spacing; reagent concentration; and reagent volume. Based on the results of the Phase I field activities, DOE developed a work plan for the completion of the groundwater remediation at X-701B, which was approved by Ohio EPA in September 2006. The first phase of oxidant injections was completed during October 2006, with the second and third phases completed in April 2007 and August 2007, respectively. The *Work Plan for the Groundwater Remediation of the X-701B Solid Waste Management Unit* and the *Phase IIc Report for the Groundwater Remediation of the X-701B Solid Waste Management Unit* provide additional information, including sampling results associated with the injections. The results show that the oxidant injections have been effective in removing trichloroethene contamination from the area. Additional injections are planned for 2008.

Deferred units in Quadrant II will be addressed during decontamination and decommissioning of PORTS. In 2003, the DOE agreed to conduct an annual review of all deferred units at PORTS to confirm that the status of the units has not changed. The annual update to the Deferred Unit Plan was submitted to the Ohio EPA in January 2007. A number of deferred units are in the groundwater plume in the Quadrant II Groundwater Investigative Area. The DOE has evaluated existing Quadrant II monitoring data for deferred units to determine whether actions could be taken to reduce or eliminate sources of contamination; however, operation of the sumps in buildings X-700 and X-705 appears to be sufficient to control groundwater contamination in this area.

Chapter 6 provides 2007 groundwater monitoring results for the following areas in Quadrant II that require groundwater monitoring: X-701B Holding Pond, Quadrant II Groundwater Investigative Area, and X-633 Pumphouse/Cooling Towers Area (a deferred unit).

3.2.3 Quadrant III

The *Quadrant III Cleanup Alternative Study/Corrective Measures Study* was approved by the Ohio EPA in 1998. The Decision Document for Quadrant III required phytoremediation of the groundwater plume near the X-740 Waste Oil Handling Facility. Deferred units in Quadrant III will be addressed during decontamination and decommissioning of PORTS.

Over 700 hybrid poplar trees were planted on a 2.6-acre area above the X-740 groundwater plume in 1999. Groundwater monitoring of both the elevation of groundwater in the aquifer and the concentration of contaminants in the groundwater plume is used to monitor the system. Chapter 6, Section 6.4.7.1, provides information about the groundwater monitoring completed for this area in 2007.

In 2003, a five-year review was completed for the X-740 groundwater plume to evaluate the effectiveness of the phytoremediation system. The report, entitled *Five-Year Evaluation Report for the X-740 Phytoremediation Project*, indicated that the trees in the phytoremediation system did not noticeably affect the overall groundwater flow in the Gallia at this area, although the trees did appear to influence water levels in individual wells. Concentrations of trichloroethene in the X-740 groundwater plume had not decreased appreciably.

Upon review of the 2003 Five-Year Evaluation Report, the Ohio EPA required another evaluation of this area in three years to determine if the phytoremediation system is effective in remediating the groundwater plume. Additional data to be collected for this evaluation included soil moisture at specified depths below ground surface, wind speed/direction, rainfall, air/soil temperature, tree growth rates, and sap flow measurements. The *Supplemental Evaluation to the Five-Year Evaluation Report for the X-740 Phytoremediation System*, submitted to Ohio EPA in January 2007, found that the phytoremediation system has not performed as predicted by groundwater modeling included in the *Quadrant III Cleanup Alternative Study/Corrective Measures Study*. Ohio EPA is requiring DOE to evaluate other remedial alternatives to be implemented in conjunction with the current remedy. Evaluation of other remedial alternatives took place throughout the remainder of 2007.

Chapter 6 provides 2007 groundwater monitoring results for the following areas in Quadrant III that require groundwater monitoring: X-616 Chromium Sludge Surface Impoundments and X-740 Waste Oil Handling Facility.

3.2.4 Quadrant IV

The *Quadrant IV Cleanup Alternative Study/Corrective Measures Study* was approved by the Ohio EPA in 1998. The DOE received the Decision Document for Quadrant IV in 2000. No new remedial actions were required in Quadrant IV (remedial actions had already taken place at the X-344D Hydrogen Fluoride Neutralization Pit, X-735 Landfills, X-611A Former Lime Sludge Lagoons, and X-734 Landfills). Deferred units in Quadrant IV will be addressed during decontamination and decommissioning of PORTS.

Ohio EPA and U.S. EPA issued a Decision Document for the X-611A area in 1996, which required a soil cover over the former lagoons and establishment of a prairie habitat. In 2002, a five-year review was completed for the X-611A Former Lime Sludge Lagoons to evaluate the effectiveness of the corrective measures implemented at this area. The report found that the soil cover and prairie habitat constructed at the X-611A Former Lime Sludge Lagoons is meeting the objectives for this unit by eliminating exposure pathways to the contaminants of concern present in the sludge located beneath the soil cover in this area. The second five-year review for the X-611A Former Lime Sludge Lagoons will be submitted to Ohio EPA in 2008.

Ohio EPA issued a Decision Document for the X-734 Landfills in 1999. Remedial actions required by the Decision Document included construction of a multimedia cap over the northern portion of the landfills and a soil cap over the southern portion of the area. These caps were installed in 1999 and 2000. A review of this remedial action will be submitted to Ohio EPA in 2008.

In 2007, DOE conducted an investigation of potential sources of PCBs in the Little Beaver Creek drainage area, which focused on the X-533 Switchyard area (a deferred unit in Quadrant IV). Sediment and surface water were sampled from Little Beaver Creek and associated tributaries, drainage ditches, and storm sewers. Soil sampling in the X-533A Switchyard did not reveal any pervasive high concentrations of PCB contamination, although low concentrations of PCBs were detected in soil in the vicinity of several transformers and an associated drainage line. Ohio EPA stated that although releases of PCBs have occurred in the switchyard, it does not appear to be the sole source of PCB contamination found in Little Beaver Creek. The *Investigation of Potential Sources of PCB Contamination in Little Beaver Creek* provides additional information and results from this investigation.

Chapter 6 provides 2007 groundwater monitoring results for the following areas in Quadrant IV that require groundwater monitoring: X-611A Former Lime Sludge Lagoons, X-735 Landfills, X-734 Landfills, and X-533 Switchyard Area (a deferred unit).

3.3 WASTE MANAGEMENT PROGRAM

The DOE PORTS Waste Management Program directs the safe storage, treatment, and disposal of waste generated by past and present operations and from current Environmental Restoration projects. DOE PORTS also stores USEC-generated waste in the RCRA Part B permitted storage areas. Waste managed under the program is divided into the following seven categories, which are defined below:

- *Low-level radioactive waste* – radioactive waste not classified as high level or transuranic waste.
- *Hazardous (RCRA) waste* – waste listed under RCRA or that exhibits one or more of the four RCRA hazardous characteristics: ignitability, corrosivity, reactivity, and toxicity. Universal waste, which includes common items such as batteries and light bulbs, is a subset of RCRA waste that is subject to reduced requirements for storage, transportation, and disposal or recycling.
- *PCB wastes* – waste containing PCBs, a class of synthetic organic chemicals. Disposal of PCB materials is regulated under TSCA.
- *RCRA/low-level radioactive mixed waste* – waste containing both hazardous and radioactive components. The waste is subject to RCRA, which governs the hazardous components, and to the Atomic Energy Act that governs the radioactive components.
- *PCB/low-level radioactive mixed waste* – waste containing both PCB and radioactive components. The waste is subject to TSCA regulations that govern PCB components, and to the Atomic Energy Act that governs radioactive components.
- *PCB/RCRA/low-level radioactive mixed waste* – waste containing PCB and radioactive components that is also a RCRA hazardous waste. The waste is subject to RCRA regulations, TSCA regulations that govern PCBs, and to the Atomic Energy Act that governs radioactive components.
- *Solid waste* – Waste that includes construction and demolition debris, industrial waste, and sanitary waste, as defined by Ohio regulations. These wastes can include waste from construction or demolition activity and office waste. Waste contaminated with asbestos may also be included in this category if it is not included in any of the categories listed above (PCB, RCRA, and/or low-level radioactive waste).

In 2007, more than 9 million pounds of waste from PORTS were recycled, treated, or disposed at off-site facilities (see Table 3.2). Future waste management projects include continuing shipments for disposal of low-level radioactive waste and mixed waste, and the treatment of mixed and PCB/mixed waste at off-site commercial facilities.

Waste management requirements are varied and are sometimes complex because of the variety of waste streams generated by DOE PORTS activities. DOE Orders, Ohio EPA regulations, and U.S. EPA regulations must be satisfied to demonstrate compliance for waste management activities. Additional policies have been implemented for management of radioactive, hazardous, and mixed wastes. These policies include the following:

- minimizing waste generation;
- characterizing and certifying wastes before they are stored, processed, treated, or disposed;

Table 3.2. Waste Management Program off-site treatment, disposal, and recycling accomplishments for 2007

Waste type	Waste stream	Quantity (pounds)	Treatment, disposal, or recycling facility
RCRA	Waste soldering materials, floor stripper, and other wastes	805	PermaFix
LLW ^a	Empty drums, wastewater, and waste oil	14,456	Diversified Scientific Solutions
LLW	Floor sweepings, empty containers, scrap metal	19,979	Materials & Energy Corp
LLW	Empty containers, scrap metal, burnables, and other solids	660,099	Energy Solutions
LLW	Scrap metal, alumina waste, and other solids	3,983,936	Nevada Test Site
LLW	Various chemicals, cleaners, used oil, and other solutions	36,090	PermaFix
LLW	Gauge with radionuclide source (returned to lab for recycling)	125	Troxler Laboratories
PCB	Light ballasts and other materials contaminated with PCBs	6801	PermaFix
PCB/LLW	Capacitors, empty containers, and other PCB wastes	4978	Materials & Energy Corp
PCB/LLW	Scrap metal, plastics, rags, sludges, and other solids	174,872	Energy Solutions
PCB/LLW	Transite siding, scrap metal, and other solids	3,244,891	Nevada Test Site
PCB/LLW/ RCRA	Circuit boards, batteries, scrap metal, plastics, and other materials contaminated with metals	11,093	Energy Solutions
PCB/LLW/ RCRA	Lab wastes and other materials	12,689	Materials & Energy Corp
PCB/LLW/ RCRA	Water solutions and other materials	21,637	TSCA incinerator
PCB/LLW/ RCRA	Excess samples, absorbents, and other debris contaminated with solvents and/or metals	248	PermaFix
RCRA/LLW	Waste oils, other wastewater, and sludges contaminated with solvents and/or metals	11,874	Diversified Scientific Solutions
RCRA/LLW	Solids contaminated with solvents from X-624 tanks and other solid debris contaminated with metals	6534	Energy Solutions
RCRA/LLW	Decontamination solutions and carbon wastes	221,984	TSCA incinerator
RCRA/LLW	Filter ash, waste oils, alumina, and other materials contaminated with solvents and/or metals	530,017	Materials & Energy Corp

Table 3.2. Waste Management Program off-site treatment, disposal, and recycling accomplishments for 2007 (continued)

Waste type	Waste stream	Quantity (pounds)	Treatment, disposal, or recycling facility
RCRA/LLW	Liquids and solids contaminated with metals and solvents, flammable liquids, and waste paint/paint sludge	37,390	PermaFix
Industrial waste	Used oil	2038	Diversified Scientific Solutions
Industrial waste	Batteries, circuit boards, and light bulbs	2435	Materials & Energy Corp
Industrial waste	Flux, silver plating powder, and other materials	33	PermaFix
Industrial waste	Lead sheets for recycling	41,706	Roane Metals Group

^aLow-level radioactive waste.

- pursuing volume reduction (such as blending and bulking) as well as on-site storage in preparation for safe and compliant final treatment and/or disposal; and
- recycling.

3.4 WASTE MINIMIZATION AND POLLUTION PREVENTION PROGRAM

DOE PORTS is committed to reducing environmental risks, costs, wastes, and future liability by effectively integrating environmental sustainability principles into DOE PORTS activities in a cost effective and environmentally conscious manner. The DOE PORTS Environmental Sustainability Program is a balanced, holistic approach that links planning, budgeting, measuring, and improving PORTS overall environmental performance to specific goals and outcomes. The DOE PORTS approach is described in the *Environmental Sustainability Plan* and integrates the tenets of an environmental management system. The PORTS Environmental Sustainability Program includes elements of pollution prevention, waste minimization, affirmative procurement, sustainable design, and energy and water efficiency.

DOE PORTS is committed to minimizing and/or eliminating the amounts and types of wastes generated and to achieving reduced life cycle costs for managing and dispositioning property and wastes during all of DOE PORTS projects and activities.

Effective environmental sustainability management begins with an integrated strategy. In order to achieve the objectives and targets of the Environmental Sustainability Program, DOE PORTS has developed and implemented a well-defined strategy for setting, updating, and achieving PORTS objectives and targets in line with the environmental management system and in conjunction with DOE pollution prevention goals. The broad objectives are core elements of the DOE PORTS Environmental Sustainability Program. These objectives, presented below, are both qualitative and quantitative and reduce the life cycle cost and liability of DOE PORTS programs and operations:

- eliminating, minimizing, or recycling wastes that would otherwise require storage, treatment, disposal, and long-term monitoring and surveillance;
- eliminating or minimizing use of toxic chemicals and associated environmental releases that would otherwise require control, treatment, monitoring, and reporting;
- maximizing the use (procurement) of recycled-content materials and environmentally preferable products and services, thereby minimizing the economic and environmental impacts of managing by-products and wastes generated in the conduct of mission-related activities; and
- reducing the life-cycle cost of managing personal property at PORTS.

Highlights of the DOE PORTS Environmental Sustainability Program in fiscal year 2007 include the following accomplishments:

- recycling approximately 13,669 pounds of office and mixed paper, 11,905 pounds of cardboard, and 750 pounds of plastic;
- recycling 758 pounds of batteries, 1437 pounds of fluorescent light tubes, and 2205 pounds of toner cartridges;
- providing approximately 150 gallons of excess paint to the local Boy Scouts and the Civil Air Patrol for reuse in the community;
- recycling or reusing computer hard drives, desktop computers, and monitors;
- recycling 18,000 pounds of Freon;
- purchasing excess equipment from and providing excess equipment to other DOE facilities and private companies rather than purchasing new equipment or disposing of old equipment; and
- continuing use of 80/20 biodiesel in on-site tractors and mowers (began in 2006).

In addition, DOE PORTS continued energy reduction programs focused on accomplishing the goals of Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and DOE Order 430.2A, *Departmental Energy and Utilities Management*. In 2007, a dry pipe sprinkler system was installed in a DOE pumphouse to eliminate the need to heat the pumphouse during the winter to keep the pipes from freezing, which is expected to save approximately \$350,000 in electrical costs annually. The boilers for the Recirculating Heating Water System that heated former DOE buildings (transferred to USEC beginning September 29, 2007) were shut down from June through September saving \$175,000 in natural gas. DOE PORTS also purchased 24,000 megawatt hours of electricity from renewable energy sources.

3.5 INACTIVE FACILITIES REMOVAL

DOE continued demolition of a number of inactive, surplus PORTS facilities during 2007. Table 3.3 lists the facilities removed in 2006 (when the removals began) and 2007.

**Table 3.3 Inactive facilities removed from DOE PORTS
2006 – 2007**

Facility	Year removed	Location (Quadrant)
X-770 Mechanical Testing Facility	2007	I
X-230J8 Environmental Storage Building	2006	I
X-230J1 Environmental Monitoring Station	2006	II
X-701D Water Deionization Building	2006	II
X-720A Maintenance & Stores Gas Manifold Shed	2006	II
X-105 Electronic Maintenance Building	2006	II
X-740 Waste Oil Storage Facility	2006	III
X-106B Old Fire Training Building	2006	III
X-616 Liquid Effluent Control Facility	2006	III
X-615 Old Sewage Treatment Plant	2006	III
X-344C Hydrogen Fluoride Storage Building	2006	IV
X-344E Gas Ventilation Stack	2006	IV
X-344F Safety Building	2006	IV
X-342C Waste Hydrogen Fluoride Neutralization Pit	2006	IV

The X-770 Mechanical Testing Facility, a deferred unit with potentially contaminated soils, was demolished during 2007. This facility is located in the northern portion of the Quadrant I Groundwater Investigative Area (see Section 3.2.1.2 and Chapter 6, Section 6.4.2). The DOE and Ohio EPA are working together to develop a plan to investigate the soil beneath the X-770 Mechanical Testing Facility.

3.6 ENVIRONMENTAL TRAINING PROGRAM

DOE PORTS provides environmental training to increase employee awareness of environmental activities and to enhance the knowledge and qualifications of personnel performing tasks associated with environmental assessment, planning, and restoration. The program includes on- and off-site classroom instruction, on-the-job training, seminars, and specialized workshops and courses. Environmental training conducted or prepared by DOE PORTS includes hazardous waste training required by RCRA and numerous Occupational Safety and Health Administration training requirements.

3.7 PUBLIC AWARENESS PROGRAM

A comprehensive community relations and public participation program is in place at PORTS. The purpose of the program is to foster a spirit of openness and credibility between PORTS officials and local citizens, elected officials, business, media, and various segments of the public. The program also provides the public with opportunities to become involved in the decisions affecting environmental issues at PORTS.

DOE PORTS opened a public Environmental Information Center in February 1993 to provide public access to all documents used to make decisions on remedial actions being taken at the plant. The Information Center is located just north of PORTS at the Ohio State University Endeavor Center (Room 220), 1862 Shyville Road, Piketon, Ohio 45661. The email address is eic@falcon1.net. Hours for the Information Center are 9 a.m. to noon Monday and Tuesday, noon to 4 p.m. Wednesday and Thursday, or by appointment (call 740-289-8898 or email eic@falcon1.net). The latest Annual Environmental Report and other information can also be obtained from the PORTS web site at www.lppports.com.

Public update meetings and public workshops on specific topics are also held to keep the public informed and to receive their comments and questions. Periodically, fact sheets about major projects are written for the public. The *Portsmouth Environmental Bulletin* is distributed to more than 4,000 recipients, including those on the community relations mailing list, neighbors within 2 miles of the plant, plant employees, and plant retirees.

Points of contact have been established for the public to obtain information or direct questions regarding the Environmental Management Program. The DOE Site Office may be contacted at 740-897-5010. The LPP Office of Public Affairs (740-897-2336) also provides information on the program.

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4. ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

4.1 SUMMARY

Environmental monitoring at PORTS includes air, water, soil, sediment, and biota (animals, vegetation, and crops) as well as measurement of both radiological and chemical parameters. This chapter discusses the radiological component of environmental monitoring programs at PORTS; Chapter 5 discusses the non-radiological parameters for the monitoring programs.

Environmental monitoring programs are required by state and federal regulations, permits, and DOE Orders. These programs may also be developed to address public concerns about plant operations. In 2007, environmental monitoring information was collected by both the DOE and USEC. Unlike other chapters of this report that focus on DOE activities at PORTS, this chapter includes monitoring information collected by USEC.

Environmental monitoring data collected at PORTS are used to assess potential impacts to human health and the environment from radionuclides released by current and historical PORTS operations. This impact, called a dose, can be caused by radionuclides released to air and/or water, or radiation emanating directly from buildings or other objects at PORTS. The U.S. EPA sets a 10 mrem/year limit for the dose from radionuclides released to the air, and the DOE sets a 100 mrem/year limit for the dose from radionuclides from all potential pathways. A person living in southern Ohio receives a dose of approximately 300 mrem/year from natural sources of radiation.

This chapter includes radiological dose calculations for the dose to the public from radionuclides released to the air and surface water (the Scioto River), from direct radiation, and from radionuclides detected in 2007 by environmental monitoring programs for sediment, soil, vegetation, deer, and crops. The maximum dose a member of the public could receive from radiation released by PORTS in 2007 (both the DOE and USEC) or detected by environmental monitoring programs in 2007 is 1.1 mrem/year. This summary of the dose calculations uses a worst-case approach; that is, the summary of the dose calculations assumes that the same individual is exposed to the most extreme conditions from each pathway. Table 4.1 summarizes this dose information.

Table 4.1. Summary of potential doses to the public from PORTS in 2007

Source of dose	Dose (mrem/year) ^a
Airborne radionuclides	0.0051
Radionuclides released to the Scioto River	0.022
Direct radiation from depleted uranium cylinder storage yards	0.97
Radionuclides detected by environmental monitoring programs (sediment, soil, vegetation, deer, and crops)	0.12
Total	1.1

^a100 mrem/year is the DOE limit.

4.2 INTRODUCTION

Environmental monitoring programs at PORTS are designed to detect the effects (if any) of PORTS operations on human health and the environment. Multiple samples are collected throughout the year and analyzed for radionuclides that could be present from PORTS activities. The results of these monitoring programs are used to gauge the environmental impacts of PORTS operations and to set priorities for environmental improvements.

Environmental regulations, permits, DOE Orders, and public concerns are all considered in developing environmental monitoring programs. State and federal regulations drive some of the monitoring conducted at DOE PORTS such as limitations on discharges to air and water. DOE Orders 231.1A, *Environment Safety and Health Reporting*, and 5400.5, *Radiation Protection of the Public and the Environment*, also address environmental monitoring requirements.

The DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* describes the environmental monitoring programs for DOE PORTS. 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 total 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 beginning in the late 1950s.

Environmental monitoring data are collected by both the DOE and USEC. Because USEC data are important in developing a complete picture of environmental monitoring at PORTS, these data are included in this report. This chapter provides information on the USEC NPDES monitoring program. USEC data are provided for informational purposes only; the DOE cannot certify the accuracy of USEC data.

Data from the following environmental monitoring programs are included in this chapter:

- Airborne discharges,
- Ambient air,
- Radiation,
- Discharges to surface water,
- Surface water,
- Sediment,
- Soil,
- Vegetation, and
- Biota.

The DOE also conducts an extensive groundwater monitoring program at PORTS. Chapter 6 provides information on the groundwater monitoring program, associated surface water monitoring, and water supply monitoring.

As discussed in this chapter, dose is a measure of the potential biological damage that could be caused by exposure to and subsequent absorption of radiation to the body. Because there are many natural sources of radiation, a person living in the Portsmouth area receives a dose of approximately 300 mrem/year from sources of natural radiation. Appendix A provides additional information on radiation and dose.

Releases of radionuclides from PORTS activities can result in a dose to a member of the public in addition to the dose received from natural sources of radiation. PORTS activities that release radionuclides are regulated by the U.S. EPA and the DOE. Airborne releases of radionuclides from DOE facilities are regulated by the U.S. EPA under the Clean Air Act and the National Emission Standards for Hazardous Air Pollutants. These regulations set an annual dose limit of 10 mrem/year to any member of the public as a result of airborne radiological releases.

The DOE regulates radionuclide emissions to all environmental media through DOE Orders 450.1, *Environmental Protection Program*, and 5400.5, *Radiation Protection of the Public and the Environment*. DOE Order 5400.5 sets an annual dose limit of 100 mrem/year to any member of the public from all radionuclide releases from a facility. The National Emission Standards for Hazardous Air Pollutants apply only to airborne radiological releases.

Small quantities of radionuclides were released to the environment from DOE PORTS operations during 2007. This chapter describes the methods used to estimate the potential doses that could result from radionuclides released from PORTS operations. In addition, this chapter assesses the potential doses that could result from radionuclides historically released by PORTS and detected in 2007 by environmental monitoring programs.

4.3 RADIOLOGICAL EMISSIONS AND DOSES

Exposure to radioactive materials can occur from releases to the atmosphere, surface water, or groundwater and from exposure to direct external radiation emanating from buildings or other objects. For 2007, doses are estimated for exposure to atmospheric releases, direct radiation, and releases to surface water (the Scioto River).

Doses are also estimated for exposure to radionuclides from PORTS operations that were detected in 2007 as part of the DOE PORTS environmental monitoring programs. Analytical data from the environmental monitoring programs are assessed to determine whether radionuclides were detected at locations accessible to the public. If radionuclides were detected at locations accessible to the public, a dose assessment is usually completed based on the monitoring data. In 2007, doses are estimated for exposure to radionuclides detected by the monitoring programs for sediment, soil, vegetation, deer, and crops. Exposure to radionuclides detected in groundwater at PORTS is not included because contaminated groundwater at PORTS is not a source of drinking water.

In addition, DOE Order 5400.5 sets an absorbed dose rate limit of 1 rad per day to native aquatic organisms. This chapter discusses the dose calculations completed to demonstrate compliance with this requirement.

DOE PORTS workers and visitors who may be exposed to radiation are also monitored. These results are also provided in this chapter.

4.3.1 Dose Terminology

Most consequences associated with radionuclides released to the environment are caused by interactions between human tissue and various types of radiation emitted by the radionuclides. These interactions involve the transfer of energy from radiation to tissue, potentially resulting in tissue damage. Radiation may come from radionuclides outside the body (in or on environmental media or objects) or from radionuclides deposited inside the body (by inhalation, ingestion, and, in a few cases, absorption through the skin). Exposures to radiation from radionuclides outside the body are called external

exposures, and exposures to radiation from radionuclides inside the body are called internal exposures. This distinction is important because external exposure occurs only as long as a person is near the external radionuclide; simply leaving the area of the source will stop the exposure. Internal exposure continues as long as the radionuclide remains inside the body.

The three natural uranium isotopes (uranium-234, uranium-235, and uranium-238) and technetium-99 are the most commonly detected radionuclides in environmental media samples collected around PORTS. Other radioactive isotopes (americium-241, neptunium-237, plutonium-238, plutonium-239/240, and uranium-236) are rarely detected at PORTS but may be included as a conservative measure in the calculations used to determine the potential dose received from PORTS operations.

A number of specialized measurement units have been defined for characterizing exposures to ionizing radiation. Because the damage associated with exposure to radiation results primarily from the exposure of tissue to ionizing radiation, the units are defined in terms of the amount of ionizing radiation absorbed by human (or animal) tissue and in terms of the biological consequences of the absorbed energy. These units include the following:

- *Absorbed dose* – the quantity of ionizing radiation energy absorbed by an organ divided by the organ’s mass. Absorbed dose is measured in units of rad or gray (1 rad = 0.01 gray).
- *Dose equivalent* – the product of the absorbed dose (rad) in tissue and a quality factor. Dose equivalent is expressed in units of rem or sievert (1 rem = 0.01 sievert).
- *Effective dose equivalent* – the sum of the dose equivalents received by all organs or tissues of the body after each one has been multiplied by an appropriate weighting factor. In this report, the term “effective dose equivalent” is often shortened to “dose.”
- *Collective dose equivalent/collective effective dose equivalent* – the sum of the dose equivalents or effective dose equivalents of all individuals in an exposed population expressed in units of person-rem or person-sievert. The collective effective dose equivalent is also frequently called the “population dose.”

4.3.2 Airborne Emissions

Airborne discharges of radionuclides from PORTS are regulated under the Clean Air Act National Emission Standards for Hazardous Air Pollutants. Releases of radionuclides are used to calculate a dose to members of the public, which is reported annually to U.S.EPA. Section 4.3.3 discusses the results of this dose calculation.

USEC operations account for many of the sources that emit radionuclides, although the gaseous diffusion uranium enrichment process is not operational. USEC emissions currently result from reprocessing of uranium hexafluoride feedstock, equipment decontamination, and the Lead Cascade (the demonstration centrifuge for uranium enrichment). In 2007, USEC reported emissions of 0.0188 curie (a measure of radioactivity) from its radionuclide emission sources.

DOE PORTS and LPP are responsible for five radiological emission sources. One source, the X-326 L-cage Glove Box, is used to repackage wastes or other materials that contain radionuclides. The remaining four sources, the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities, treat groundwater contaminated with radionuclides. There were no emissions from UDS air emission sources in 2007.

Emissions from the X-622 and X-627 Groundwater Treatment Facilities are based on the maximum concentrations of radionuclides emitted from the facilities during emissions testing and the number of hours each facility operated during the year. Emissions from the X-623 and X-624 Groundwater Treatment Facilities were calculated based on influent and effluent sampling at each facility and annual throughput. Emissions from the X-326 Glove Box were based on the mass of the materials transferred within the glove box, analytical data available for each material, and emission factors provided by U.S. EPA. Emissions for 2007 were calculated to be 0.0006 curie.

4.3.3 Dose Calculation Based on Airborne Emissions

A dose calculation for atmospheric, or airborne, radionuclides is required by the U.S. EPA under the program called the National Emission Standards for Hazardous Air Pollutants (NESHAP) and is provided to the U.S. EPA in an annual report. The effect of radionuclides released to the atmosphere by DOE PORTS during 2007 was characterized by calculating effective dose equivalents to the maximally exposed person (the individual who resides at the most exposed point near the plant) and to the entire population (approximately 670,000 residents) within 50 miles of the plant. Dose calculations were made using a computer program called CAP88-PC Version 3.0, which was developed under sponsorship of the U.S. EPA for use in demonstrating compliance with the radionuclide NESHAP. The program uses models to calculate levels of radionuclides in the air and on the ground and in foodstuffs (e.g., vegetables, meat, and milk) and subsequent intakes by individuals. The program also uses meteorological data collected at PORTS such as wind direction, wind speed, atmospheric stability, rainfall, and average air temperature.

Radionuclide emissions were modeled for the four DOE PORTS groundwater treatment facilities and the X-326 L-cage Glove Box as discussed in Section 4.3.2. The dose calculations assumed that each person remained unprotected, resided at home (actually outside the house) during the entire year, and obtained food according to the rural pattern defined in the NESHAP background documents. This pattern specifies that 70% of the vegetables and produce, 44% of the meat, and 40% of the milk consumed by each person are produced in the local area (e.g., in a home garden). The remaining portion of each food is assumed to be produced within 50 miles of DOE PORTS. These assumptions most likely result in a significant overestimate of the dose received by a member of the public, since it is unlikely that a person spends the entire year outside at home and consumes food from the local area as described above.

The maximum potential dose to an off-site individual from radiological releases from DOE air emission sources at PORTS in 2007 was 0.0018 mrem/year. USEC also completes the dose calculations described above for the air emission sources leased to USEC (e.g., the uranium enrichment facilities and other sources). The combined dose from USEC and DOE sources is 0.0051 mrem/year, well below the 10-mrem/year limit applicable to PORTS and the approximate 300-mrem/year dose that the average individual in the United States receives from natural sources of radiation.

The collective dose equivalent (or population dose) is the sum of the individual doses to the entire population within 50 miles of PORTS. In 2007, the population dose from PORTS emissions was 0.084 person-rem/year, based on USEC calculations of 0.077 person-rem/year from USEC sources and 0.00666 person-rem/year from DOE sources. The population dose to the nearest community, Piketon, was calculated to be 0.0025 person-rem/year, based on USEC calculations of 0.0024 person-rem/year from USEC sources and 0.000054 person-rem/year from DOE sources. The population dose based on PORTS emissions is negligible; for example, the average population dose to all people within 50 miles of PORTS from the domestic water supply (not affected by PORTS operations) is approximately 2345 person-rem/year based on an average dose of approximately 3.5 mrem/year to an individual (National Council on Radiation Protection 1987). The dose from the domestic water supply is based on the presence of radon in drinking water, which is a naturally-occurring radioactive gas.

4.3.4 Dose Calculation Based on Ambient Air Monitoring

The DOE collects samples from 15 ambient air monitoring stations (see Figure 4.1) and analyzes them for the radionuclides that could be present in ambient air due to PORTS activities. These radionuclides are isotopic uranium (uranium-233/234, uranium-235, uranium-236, and uranium-238), technetium-99, and selected transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). The ambient air monitoring stations measure radionuclides released from the DOE and USEC point sources (the sources described in Section 4.3.2), fugitive air emissions (emissions that are not associated with a specific release point such as a stack), and background levels of radiation (radiation that occurs naturally in the environment and is not associated with PORTS operations).

The CAP88 model generates a dose conversion factor that was used to calculate a dose for a given level of each radionuclide in air. The following assumptions were made to calculate the dose at each station: (1) the highest concentration of each radionuclide detected in 2007 was assumed to be present for the entire year; or (2) if a radionuclide was not detected, the radionuclide was assumed to be present at half the detection limit for the analytical method.

The dose associated with each radionuclide at each ambient air monitoring station was added to obtain the gross dose for each station. The net dose for each station was obtained by subtracting the dose measured at the background station (A37). The net dose ranged from 0 (at stations with a gross dose less than the background station) to 0.0000020 mrem/year at station A12, which is on the eastern PORTS boundary.

The highest net dose measured at the ambient air monitoring stations (0.0000020 mrem/year) is approximately 0.04% of the dose calculated from the combined DOE and USEC point source emissions (0.0051 mrem/year). This dose is significantly less than the 10 mrem/year NESHAP limit for airborne radiological releases and 100 mrem/year DOE limit for all radiological releases from a facility.

4.3.5 Discharges of Radionuclides from NPDES Outfalls

DOE contractors and USEC are responsible for NPDES outfalls at PORTS. This section describes these outfalls and the discharges of radionuclides from these outfalls during 2007. Quarterly reports that provide radiological monitoring data for the NPDES outfalls are submitted to Ohio EPA by the responsible DOE contractor and USEC for their respective outfalls.

4.3.5.1 DOE outfalls

The responsible DOE contractor holds the NPDES permit for discharge points, or outfalls, associated with DOE activities. UDS was issued an NPDES permit that became effective on June 1, 2007, for the discharge of process wastewaters from the Depleted Uranium Hexafluoride Conversion Facility to the West Ditch, which flows to USEC NPDES Outfall 010 and then to the Scioto River. There were no discharges from the UDS outfall in 2007.

LPP holds an NPDES permit for eight outfalls through which water is discharged from the site (see Figure 4.2). LPP submitted an NPDES permit renewal application to Ohio EPA in May 2007. This permit renewal application did not include four outfalls; three outfalls are being transferred to USEC (Outfalls 012, 013, and 613), and Outfall 612 is no longer in use. The new NPDES permit was issued by Ohio EPA on April 15, 2008 and became effective on May 1, 2008. The old permit was in effect throughout 2007.

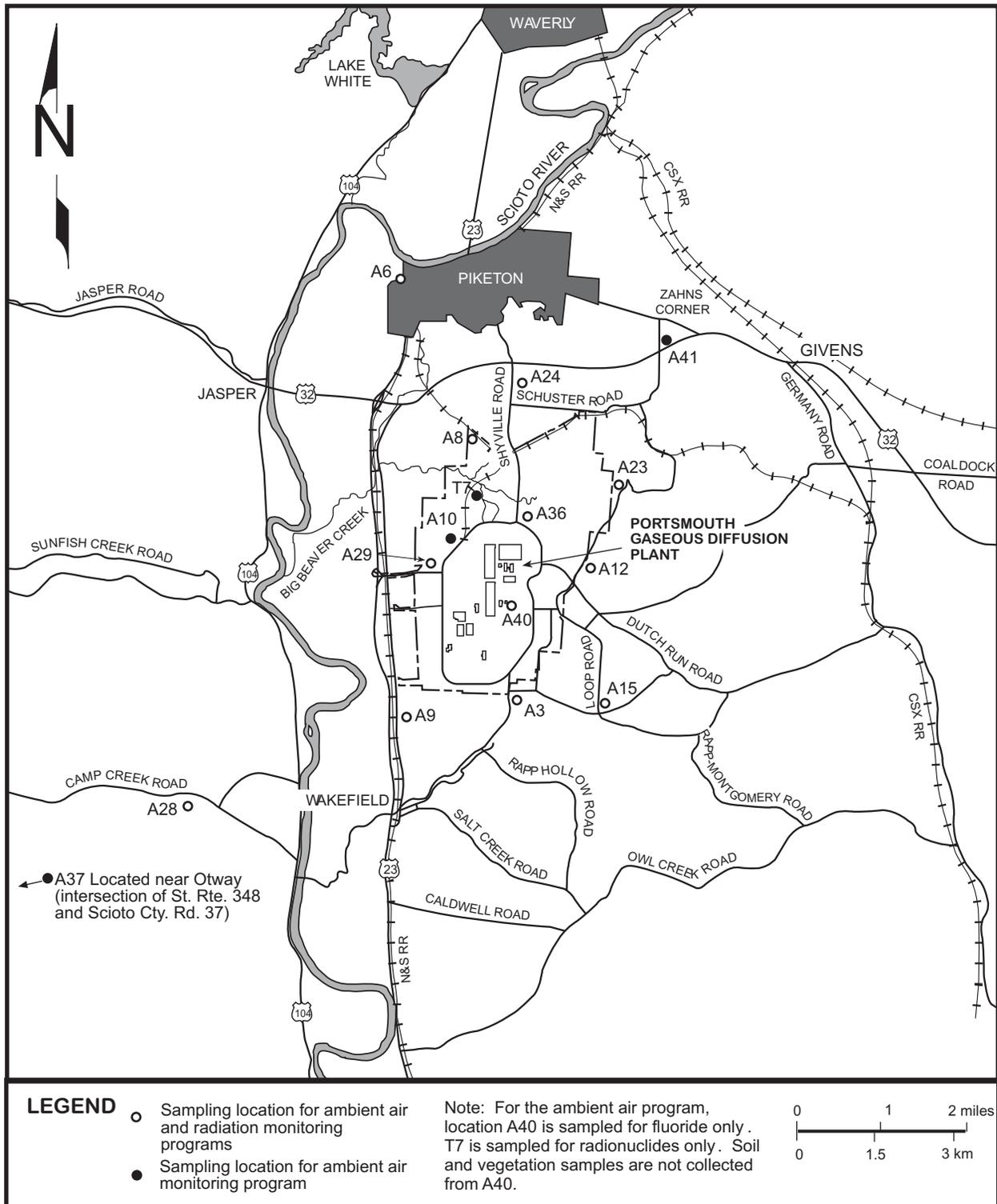


Figure 4.1. DOE ambient air and radiation monitoring locations.

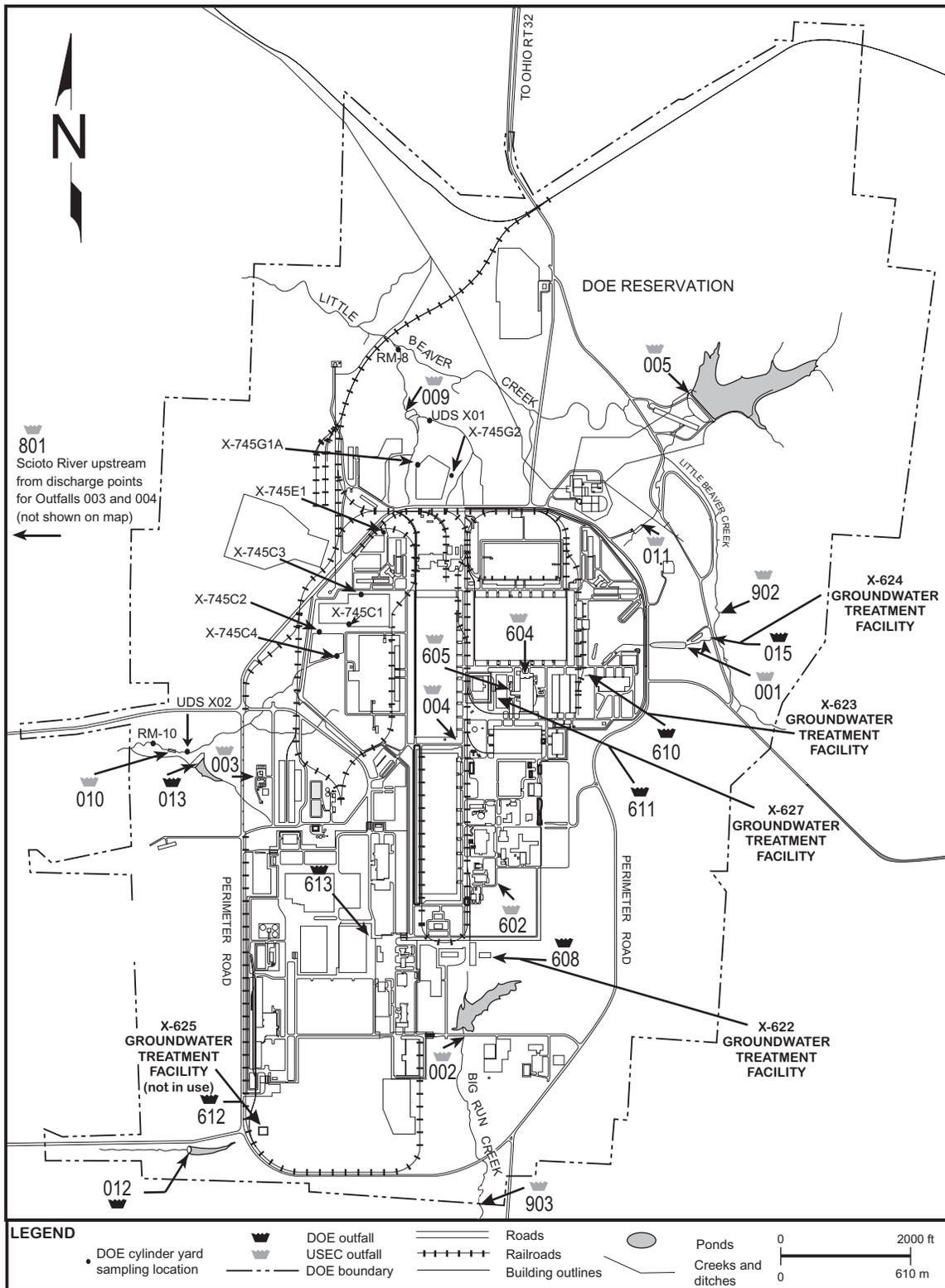


Figure 4.2. DOE and USEC NPDES outfalls/monitoring points and DOE cylinder storage yards sampling locations.

Of the LPP NPDES outfalls included in the LPP NPDES permit effective during 2007, three LPP outfalls discharge directly to surface water, four discharge to the USEC X-6619 Sewage Treatment Plant (USEC NPDES Outfall 003), and one discharges to the X-2230M Holding Pond (DOE Outfall 012). A brief description of each LPP outfall at PORTS follows.

LPP NPDES Outfall 012 (X-2230M Holding Pond) – The X-2230M Holding Pond accumulates treated water from DOE NPDES Outfall 612 and precipitation runoff, non-contact cooling water, and steam condensate from the southern portion of PORTS. 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. The 2007 LPP NPDES Permit renewal application did not include this outfall and requested its transfer to USEC.

LPP NPDES Outfall 013 (X-2230N Holding Pond) – The X-2230N Holding Pond accumulates precipitation runoff, non-contact cooling water, and steam condensate from the southwestern portion of PORTS. 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 Ditch, which flows to the Scioto River. The 2007 LPP NPDES Permit renewal application did not include this outfall and requested its transfer to USEC.

LPP NPDES Outfall 015 (X-624 Groundwater Treatment Facility) – The X-624 Groundwater Treatment 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 a ditch that flows to Little Beaver Creek.

LPP NPDES Outfall 608 (X-622 Groundwater Treatment Facility) – The X-622 Groundwater Treatment 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 (see Chapter 3, Section 3.2.1). Treated water is discharged to the sanitary sewer and then through USEC NPDES Outfall 003.

LPP NPDES Outfall 610 (X-623 Groundwater Treatment Facility) – The X-623 Groundwater Treatment 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 and then through USEC NPDES Outfall 003.

LPP NPDES Outfall 611 (X-627 Groundwater Treatment Facility) – The X-627 Groundwater Treatment 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 and then through USEC NPDES Outfall 003.

LPP NPDES Outfall 612 (X-625 Groundwater Treatment Facility) – On July 9, 2003, the X-625 Groundwater Treatment Facility was placed on stand-by with approval from the Ohio EPA. This facility removed volatile organic compounds from groundwater collected by the horizontal well in the western portion of the X-749/X-120 groundwater plume. Treated water was discharged to the X-2230M Holding Pond that discharges through DOE NPDES Outfall 012. The 2007 LPP NPDES Permit renewal application did not include this outfall because the X-625 Groundwater Treatment Facility is no longer in use.

LPP NPDES Outfall 613 (X-6002 Particulate Separator) – The X-6002 Particulate Separator removes suspended solids from water used in the X-6002 Recirculating Hot Water Plant, which provides

heat to DOE buildings at PORTS. Treated water is discharged to the sanitary sewer and then through USEC NPDES Outfall 003. The 2007 LPP NPDES Permit renewal application did not include this outfall and requested its transfer to USEC.

When in use, DOE contractors monitor the NPDES outfalls for radiological discharges by collecting water samples and analyzing the samples for total uranium, uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238), technetium-99, and transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), with the exception of Outfall 613. Outfall 613 is not monitored for radionuclides because no source exists for radiological contamination of the water discharged from Outfall 613.

Discharges of radionuclides in liquids through DOE NPDES outfalls have no significant impact on public health and the environment. Uranium discharges in 2007 from external DOE NPDES outfalls (Outfalls 012, 013, and 015) were estimated at 0.604 kilogram. Total radioactivity released from the external outfalls was 0.00051 curie of uranium isotopes.

Discharges of radionuclides were calculated using monthly monitoring data from the DOE NPDES outfalls. Analytical results below the detection limit were assigned a value of zero in the calculations to determine the quantities of uranium and radiation discharged through the DOE NPDES outfalls. Discharges of radionuclides from external DOE outfalls are used in the dose calculation for releases to surface water (Section 4.3.6). The dose calculated with these data is significantly less than the 100 mrem/year limit for all radiological releases from a facility.

No technetium-99 or transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) were detected in samples collected from the DOE external NPDES outfalls during 2007.

4.3.5.2 USEC outfalls

USEC is responsible for 11 NPDES outfalls through which water is discharged from the site (see Figure 4.2). Eight outfalls discharge directly to surface water, and three discharge to another USEC NPDES outfall before leaving the site. A brief description of each USEC NPDES outfall follows.

USEC NPDES Outfall 001 (X-230J7 East Holding Pond) – The X-230J7 East Holding Pond receives non-contact cooling water, steam condensate, foundation drainage, storm runoff, hydro-testing water from cylinders, 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 a ditch that flows to Little Beaver Creek.

USEC NPDES Outfall 002 (X-230K South Holding Pond) – The X-230K South Holding Pond receives non-contact cooling water, steam condensate, foundation drainage, treated coal pile runoff, storm runoff, fire-fighting training and fire suppression system water, 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, oil can be contained, and pH can be adjusted. Water from this holding pond is discharged to Big Run Creek.

USEC NPDES Outfall 003 (X-6619 Sewage Treatment Plant) – The X-6619 Sewage Treatment Plant treats PORTS sewage as well as water discharged from DOE groundwater treatment facilities, the X-700 Bionitrification Facility, the X-705 Decontamination Microfiltration System, and miscellaneous waste streams. 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.

USEC NPDES Outfall 004 (Cooling Tower Blowdown) – Outfall 004 was relocated in 2000 to the junction of Pike Avenue and 15th Avenue at PORTS. It monitors blowdown water from various cooling towers on site prior to discharge to the Scioto River.

USEC 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 rainwater runoff. Currently the lagoon only discharges during periods of excess rainfall.

USEC NPDES Outfall 009 (X-230L North Holding Pond) – The X-230L North Holding Pond receives non-contact cooling water, steam condensate, storm runoff, fire suppression system water, 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 an unnamed stream that flows to Little Beaver Creek.

USEC NPDES Outfall 010 (X-230J5 Northwest Holding Pond) – The X-230J5 Northwest Holding Pond receives non-contact cooling water, steam condensate, storm runoff, fire-fighting training and fire suppression system water, 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 West Ditch, which flows to the Scioto River.

USEC NPDES Outfall 011 (X-230J6 Northeast Holding Pond) – The X-230J6 Northeast Holding Pond receives non-contact cooling water, steam condensate, storm runoff, fire suppression system water, 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 an unnamed stream that flows to Little Beaver Creek.

USEC 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 (USEC NPDES Outfall 002).

USEC NPDES Outfall 604 (X-700 Bionitrification Facility) – The X-700 Bionitrification 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 (USEC NPDES Outfall 003).

USEC 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 (USEC NPDES Outfall 003).

In 2007, USEC also monitored three additional monitoring points that are not discharge points as described in the previous paragraphs. USEC NPDES Station Number 801 is a background monitoring location on the Scioto River upstream from USEC NPDES Outfalls 003 and 004. USEC NPDES Station Number 902 is a monitoring location on Little Beaver Creek downstream from USEC NPDES Outfall 001, and USEC NPDES Station Number 903 is a monitoring location on Big Run Creek downstream from USEC NPDES Outfall 002.

Uranium discharges in 2007 from external USEC NPDES outfalls (Outfalls 001, 002, 003, 004, 005, 009, 010, and 011) were estimated at 8.67 kilograms. Radioactivity released from the external outfalls

was 0.06 curie of technetium-99. These values were calculated using quarterly discharge monitoring reports for the USEC NPDES outfalls. Analytical results below the detection limit were assigned a value of zero in the calculations to determine the quantities of uranium and radiation (technetium-99) discharged through the USEC NPDES outfalls.

Plutonium-239/240 was detected at 0.080 picocurie per liter (pCi/L) in the second quarter sample collected from USEC Outfall 009. Transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) were not detected in any of the other quarterly transuranic samples collected from USEC NPDES outfalls in 2007.

Discharges of radionuclides from external USEC outfalls are used in the dose calculation for releases to surface water (Section 4.3.6). The dose calculated with these data and data from external DOE outfalls is significantly less than the 100 mrem/year limit for all radiological releases from a facility.

4.3.6 Dose Calculation for Releases to Surface Water

Radionuclides are measured at the DOE and USEC NPDES external outfalls (three DOE outfalls and eight USEC outfalls). Water from these external outfalls is either directly discharged to the Scioto River or eventually flows into the Scioto River from Little Beaver Creek, Big Run Creek, or unnamed tributaries to these water bodies. A hypothetical dose to a member of the public was calculated using the measured radiological discharges and the average annual flow rate of the Scioto River.

Total uranium mass (in micrograms per liter [$\mu\text{g/L}$]) and activity (pCi/L) for americium-241, neptunium-237, plutonium-238, plutonium-239/240, and technetium-99 were measured in the water discharged from the DOE or USEC outfalls. As a conservative measure, radionuclides that were not detected were assumed to be present at the detection limit. Total uranium was assumed to be 5.2% uranium-235, 94% uranium-238, and 0.8% uranium-234 based on the highest enrichment of uranium produced by PORTS in recent years prior to shutdown of the gaseous diffusion uranium enrichment operations. The maximum individual dose was calculated using the above-mentioned measured radionuclide discharges from the plant outfalls and the average annual flow rate of the Scioto River. All discharge radioactivity levels were expressed in total activity per year (curie/year) and used along with the average river flow to calculate radioactivity per volume.

The dose calculations were derived from the procedures developed for a similar DOE facility: *LADTAPXL: An Improved Electronic Spreadsheet Version of LADTAP II* (Hamby 1991). Environmental pathways considered were ingestion of water, ingestion of fish, swimming, boating, and shoreline activities. The calculations assume that a person eats 21 kilograms (46 pounds) of fish caught in the Scioto River, drinks 730 liters (190 gallons) of river water, swims for 27 hours, boats for 105 hours, and occupies the shoreline for 69 hours during the year. Based on the calculations across all isotopes found in the outfalls, this individual could receive an annual dose of about 0.022 mrem. This exposure scenario is very conservative because the Scioto River is not used for drinking water downstream of PORTS (89% of the hypothetical dose from liquid effluents is from drinking water) and it is unlikely that a person would eat 46 pounds of fish from the river (6% of the hypothetical dose). This dose (0.022 mrem) is significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

4.3.7 Radiological Dose Calculation for Direct Radiation

The DOE PORTS Radiological Protection Organization monitors direct radiation levels in active DOE PORTS facilities on a continual basis. This radiation monitoring assists in determining the radiation levels that workers are exposed to and in identifying changes in radiation levels. These measurements provide (1) information for worker protection, (2) a means to trend radiological exposure data for

specified facilities, and (3) a means to estimate potential public exposure to radiation from DOE PORTS activities.

Due to increased security at PORTS following September 11, 2001, the general public no longer has uncontrolled access to the entire perimeter of the PORTS facility (Perimeter Road). Some portions of Perimeter Road were reopened to the public in 2005; however, other portions of the road remain closed to the general public. Perimeter Road passes close to the edge of the cylinder yards, which emit radiation from depleted uranium cylinders stored in these areas. This portion of Perimeter Road remains closed to the public; however certain members of the public, such as delivery people, are allowed on this portion of the road. Therefore, data from direct radiation monitoring at the cylinder yards are used to assess potential exposure to the members of the public that drive on Perimeter Road.

In 2007, the average effective dose equivalent recorded at the cylinder yards near Perimeter Road was 978 mrem/year, based on exposure to ionizing radiation for an entire year (i.e., 24 hours/day, 7 days/week, 52 weeks/year - 8,736 hours/year). The radiological exposure to members of the general public is estimated as the time that a person drives on Perimeter Road past the cylinder yards, which is conservatively estimated at 8.7 hours per year (1 minute per trip, 2 trips per day, 5 work-days per week, and 52 weeks per year).

Based on these assumptions, exposure to a member of the public from radiation from the cylinder yards is approximately 0.97 mrem/year. The average yearly dose to a person in the United States is approximately 366 mrem: 300 mrem from natural radiation sources and 66 mrem from manmade radiation sources (see Appendix A). The potential estimated dose from the cylinder yards to a member of the public is approximately 0.3 percent of the average yearly radiation exposure for a person in the United States and is significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

4.3.8 Radiological Dose Results for DOE PORTS Workers and Visitors

The Radiation Exposure Information Reporting System report is an electronic file created annually to comply with DOE Order 231.1A. This report contains exposure results for all monitored individuals at DOE PORTS, including visitors, with a positive exposure during the previous calendar year. The 2007 Radiation Exposure Information Reporting System report indicated that there were no visitors with a positive exposure.

Over 600 DOE PORTS workers were monitored during 2007. Only 18 workers, primarily cylinder yard workers, received a measurable dose (defined as 10 mrem or more). These 18 workers received a measurable dose that averaged 81 mrem.

No administrative guidelines or regulatory dose limits were exceeded in 2007.

4.3.9 Radiological Dose Calculations for Off-site Environmental Monitoring Data

Environmental monitoring at PORTS includes collecting samples at off-site locations around PORTS and analyzing the samples for radionuclides that could be present due to PORTS operations. Samples are analyzed for uranium, uranium isotopes, technetium-99, and/or selected transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Uranium occurs naturally in the environment; therefore, detections of uranium cannot necessarily be attributed to PORTS operations. Technetium-99 and transuranics could come from PORTS operations because they were present in recycled uranium processed by PORTS during the Cold War. Technetium-99 and transuranics could also come from sources other than PORTS because they are generally present in the environment in very small amounts

due to radioactive fallout in the atmosphere from nuclear weapons testing by various countries around the world.

The DOE sets 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 may be completed for detections of radionuclides in environmental media (residential drinking water [well water], sediment, and soil) and biota (vegetation, deer, fish, crops, and dairy products) at off-site sampling locations. Detections of radionuclides on the PORTS facility are not used to assess risk because the public does not have access to the facility. The summary of these dose calculation uses a worst-case approach; that is, the summary of the dose calculations assumes that the same individual is exposed to the most extreme conditions from each pathway.

In 2007, dose calculations were completed for public exposure to radionuclides detected in sediment, soil, vegetation, deer, and crops. Radionuclides were not detected in fish and dairy samples collected during 2007. Chapter 6, Section 6.4.13, provides additional information concerning detections of radionuclides in residential drinking water.

The following sections provide brief descriptions of the dose calculations for each monitoring program. Methodologies used to complete each risk calculation are based on information developed and approved by the U.S. EPA including the *Exposure Factors Handbook* (U.S. EPA 1997) and *Internal Dose Conversion Factors for Calculation of Dose to the Public* (DOE 1988). Table 4.2 summarizes the results of each dose calculation. Potential doses to the public from radionuclides detected by the PORTS environmental monitoring program in 2007 are significantly less than the DOE limit of 100 mrem/year.

Table 4.2. Summary of potential doses to the public from radionuclides detected by PORTS environmental monitoring programs in 2007

Source of dose	Dose (mrem/year) ^a
Sediment	0.051
Soil	0.063
Vegetation	0.0028
Deer	0.0067
Crops	0.00028
Total	0.12

^a100 mrem/year is the DOE limit.

4.3.9.1 Dose calculation for sediment

The dose calculation for sediment is based on the detection of 17.6 picocuries per gram (pCi/g) of technetium-99, 4.36 pCi/g of uranium-233/234, 0.206 pCi/g of uranium-235, and 1.26 pCi/g of uranium-238 in the sediment sample collected in 2007 from monitoring location RM-7, an off-site sampling location on Little Beaver Creek downstream from PORTS. Based on exposure factors from U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997), the dose that could be received by an individual from sediment contaminated at these levels is 0.051 mrem/year. Section 4.6.5 provides additional information on the sediment monitoring program as well as a map of sediment sampling locations.

4.3.9.2 Dose calculation for soil

The dose calculation for soil is based on the detection of 0.907 pCi/g of uranium-233/234 and 0.85 pCi/g of uranium-238 at the background ambient air sampling station approximately 13 miles southwest of PORTS in Otway, Ohio (A37). Based on exposure factors from U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997), the dose that could be received by an individual from soil contaminated at these levels is 0.063 mrem/year. Section 4.6.7 provides additional information on the soil monitoring program.

4.3.9.3 Dose calculation for vegetation

The dose calculation for vegetation is based on the detection of 0.227 pCi/g of technetium-99, 0.0562 pCi/g of uranium-233/234, and 0.0499 pCi/g of uranium-238 at sampling location A23, which is on the northeastern property line of the DOE reservation. The dose calculation of 0.0028 mrem/year is based on human consumption of beef cattle would eat grass contaminated at this level and exposure factors from U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997). Section 4.6.8 provides additional information on the vegetation monitoring program.

4.3.9.4 Dose calculation for deer

The dose calculation for consumption of deer is based on the average level of technetium-99 (0.226 pCi/g) detected in the muscle samples collected from a deer killed by a vehicle collision at PORTS in January 2007. Based on exposure factors from U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997), the dose that could be received by an individual from deer meat contaminated at this level is 0.0067 mrem/year. Section 4.6.9.1 provides additional information on this monitoring program.

4.3.9.5 Dose calculation for crops

The dose calculation for crops is based on the detection of uranium-233/234 at 0.00539 pCi/g in a red pepper collected from off-site location #3. Based on exposure factors from U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997), the dose that could be received by a person consuming peppers contaminated at this level throughout the year is 0.00028 mrem/year. Section 4.6.9.3 provides additional information on this monitoring program.

4.4 PROTECTION OF BIOTA

DOE Order 5400.5 sets an absorbed dose rate of 1 rad/day to native aquatic organisms. The DOE Technical Standard *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002) was used to demonstrate compliance with this limit.

Analytical data for radionuclides detected in sediment and water collected at approximately the same location are used to assess compliance with the 1 rad/day limit for aquatic organisms. Data used in the evaluation are sampling data collected at sampling location RW/RM-7, which are off-site surface water and sediment sampling locations just before Little Beaver Creek flows into Big Beaver Creek. Sections 4.6.4 and 4.6.5 provide more information about these sampling programs.

The maximum values of transuranic radionuclides, technetium-99, and uranium isotopes detected in sediment or surface water samples collected from these locations in 2007 were entered into the RESRAD-BIOTA program that is designed to implement the DOE Technical Standard (DOE 2002). The

assessment indicates that the concentrations of radionuclides detected in water and sediment at this location do not result in a dose of more than 1 rad/day to aquatic organisms.

Although there are no formal DOE limits for the dose rate to terrestrial biota, it is recommended that DOE sites meet international limits for terrestrial biota that are 1 rad/day for terrestrial plants and 0.1 rad/day for terrestrial animals. Analytical data for surface water and soil collected from the northern side of the PORTS reservation (surface water sampling location NHP-SW01 and soil sampling location A8) were used to assess the dose recommendations for terrestrial plants and animals. These locations were selected because levels of uranium isotopes detected in surface water and soil from these locations were among the highest detected in samples collected in 2007. Chapter 6, Section 6.4.12 and Section 4.6.7, provide additional information for the surface water monitoring programs and soil sampling program, respectively.

Data for the highest levels of radionuclides detected at these locations in 2007 were entered into the RESRAD-BIOTA program that is designed to implement the DOE Technical Standard (DOE 2002). The assessment indicates that the concentrations of radionuclides detected in water and soil at this location do not result in a dose of more than 1 rad/day to terrestrial plants and 0.1 rad/day to terrestrial animals.

4.5 UNPLANNED RADIOLOGICAL RELEASES

No unplanned releases of radionuclides took place at DOE PORTS in 2007.

4.6 ENVIRONMENTAL RADIOLOGICAL MONITORING

This section discusses the radiological monitoring programs at PORTS: ambient air monitoring, environmental radiation, surface water, sediment, settleable solids, soil, vegetation and biota (deer, fish, crops, milk, and eggs).

4.6.1 Ambient Air Monitoring

The ambient air monitoring stations measure radionuclides released from (1) DOE and USEC point sources (the sources discussed in Section 4.3.2), (2) fugitive air emissions (emissions from PORTS that are not associated with a stack or pipe such as remediation sites or normal building ventilation), and (3) background levels of radionuclides (radionuclides that occur naturally, such as uranium). These radionuclides are isotopic uranium (uranium-233/234, uranium-235, uranium-236, and uranium-238), technetium-99, and selected transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240).

In 2007, samples were collected from 15 ambient air monitoring stations located within and around PORTS (see Section 4.3.4, Figure 4.1). A background ambient air monitoring station (A37) is located approximately 13 miles southwest of the plant. The analytical results from air sampling stations closer to the plant are compared to these background measurements.

No transuranic radionuclides were detected in the samples collected from the ambient air stations in 2007. Technetium-99 was detected once at station A12 (on the eastern PORTS boundary) at an ambient activity of 0.0030 picocurie per cubic meter (pCi/m^3), which is well below the DOE derived concentration guide of $2000 \text{ pCi}/\text{m}^3$.

Uranium-233/234 and uranium-238 were detected in each of the samples. The highest average activity of uranium-233/234 (0.00039 pCi/m³) was detected at station A9, which is south of PORTS on Wakefield Mound Road. The highest average activity of uranium-238 (0.00033 pCi/m³) was detected at station A24, which is north of PORTS on Shyville Road.

To confirm that air emissions from PORTS are within regulatory requirements and are not harmful to human health, the ambient air monitoring data were used to calculate a dose to a hypothetical person living at the monitoring station. The highest net dose calculation for the off-site ambient air stations (0.0000020 mrem/year) was at station A12, which is on the eastern PORTS boundary. This hypothetical dose is well below the 10 mrem/year limit applicable to PORTS. Section 4.3.4 provides additional information about this dose calculation.

4.6.2 Environmental Radiation

Radiation is measured continuously by the DOE at 19 locations that include most of the ambient air monitoring locations (see Section 4.3.4, Figure 4.1) and other on-site locations (see Figure 4.3). Measuring devices are placed at the monitoring locations at the beginning of each quarter, remain at the monitoring location throughout the quarter, and are removed from the monitoring location at the end of the quarter and sent to the laboratory for processing. A new measuring device replaces the removed device. Radiation is measured in millirems as a whole body dose, which is the dose that a person would receive if they were continuously present at the monitored location.

Three locations detected elevated levels of radiation in 2007: location #874, which monitors the X-745C Depleted Uranium Cylinder Storage Yard; location #862, which is south of the cylinder yards and west of the X-530A Switchyards; and location #933, which is east of the X-744G building in the X-701B Holding Pond groundwater monitoring area. The cumulative whole body dose calculated for each of the 16 locations excluding locations #874, #862, and #933 ranged from 76 to 107 mrem. The cumulative whole body doses at locations #874, #862, and #933 were 698 mrem, 135 mrem, and 180 mrem, respectively. The control and trip blanks associated with these results, which measure background radiation, averaged 97 mrem.

In addition, the dose resulting from radiation emanating from the DOE cylinder storage yards is measured at five locations around the northwest corner of PORTS just inside Perimeter Road (see Figure 4.3). These locations are not accessible to the general public. The cumulative annual whole body doses at locations #41 and #890 were 260 mrem and 229 mrem, respectively. Locations #874 and #882 recorded cumulative annual whole body doses of 667 mrem and 994 mrem, respectively, and location #868 recorded a cumulative annual whole body dose of 1581 mrem. Section 4.3.8 provides dose results for DOE workers, including workers in the cylinder yards. No administrative guidelines or regulatory dose limits were exceeded in 2007. Section 4.3.7 provides a dose calculation for members of the public, such as delivery people, that are allowed on the portion of Perimeter Road near the DOE cylinder storage yards. The potential estimated dose from the cylinder yards to a member of the public (0.97 mrem/year) is significantly less than DOE's 100 mrem/year dose limit to the public for radionuclides from all potential pathways.

4.6.3 Surface Water from DOE Cylinder Storage Yards

The Ohio EPA requires monthly collection of surface water samples from four locations: X-745C1 at the X-745C Depleted Uranium Hexafluoride Cylinder Storage Yards, X-745E1 at the X-745E Depleted Uranium Hexafluoride Cylinder Storage Yard, and X-745G1A and X-745G2 at the X-745G Depleted Uranium Hexafluoride Cylinder Storage Yard. The DOE voluntarily collects samples at three additional

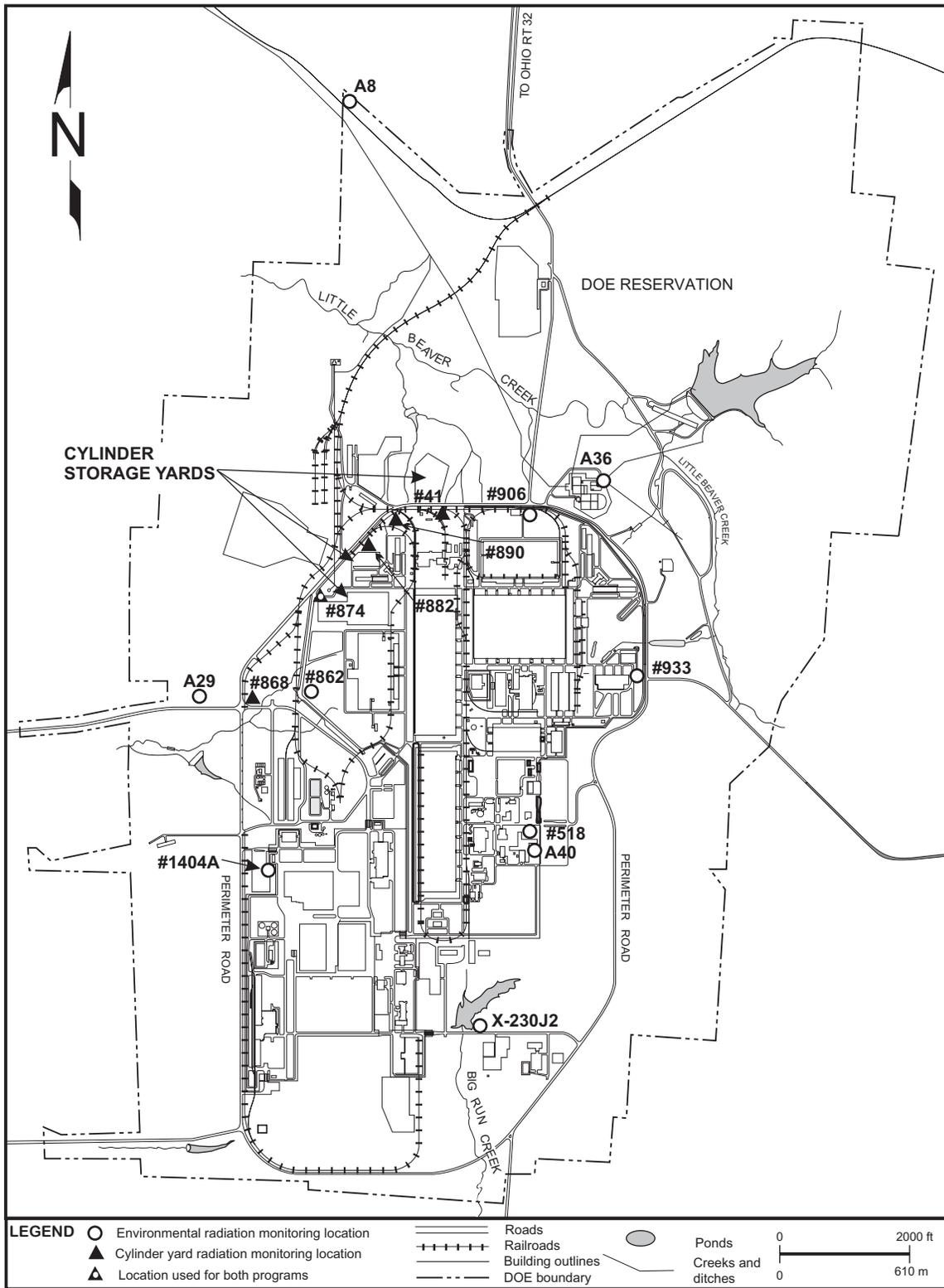


Figure 4.3. On-site radiation and cylinder yard dose monitoring locations.

locations (X-745C2, X-745C3, and X-745C4). Figure 4.2 shows the sampling locations. Samples collected during 2007 were analyzed for total uranium, uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238), technetium-99, and transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240).

No transuranic radionuclides, technetium-99, or uranium-236 were detected in the surface water samples collected during 2007. Maximum detections of total uranium, uranium-233/234, uranium-235, and uranium-238 were as follows: uranium at 37 $\mu\text{g/L}$, uranium-233/234 at 8.19 pCi/L, uranium-235 at 0.362 pCi/L, and uranium-238 at 6.41 pCi/L. Surface water from the cylinder storage yards flows to USEC NPDES outfalls prior to discharge from the site; therefore, releases of radionuclides from the cylinder yards are monitored by sampling conducted at the USEC outfalls. Radionuclides detected at USEC outfalls (see Section 4.3.5.2) are used in the dose calculation for releases to surface water (see Section 4.3.6).

4.6.4 Local Surface Water

In 2007, local surface water samples were collected from 14 locations upstream and downstream from PORTS. These samples were taken from the Scioto River, Little Beaver Creek, Big Beaver Creek, and Big Run Creek (see Figure 4.4). As background measurements, samples were also collected from local streams approximately 10 miles north, south, east, and west of PORTS.

Samples were collected semiannually and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, total uranium, and uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant*.

Plutonium-238 and plutonium-239/240 were detected in the second quarter sample collected from RW-3 (downstream from PORTS on Big Run Creek) at 0.226 and 0.203 pCi/L, respectively. These detections are well below the DOE derived concentration guide for each isotope (40 pCi/L for plutonium-238 and 30 pCi/L for plutonium-239/240). No other transuranics were detected in any of the local surface water samples collected in 2007, including samples collected from RW-3 in the fourth quarter of 2007. No technetium-99 was detected in any of the surface water samples collected in 2007.

Maximum detections of uranium and uranium isotopes in local surface water samples were detected at locations RW-6 (Scioto River upstream from PORTS in Piketon) and RW-7 (Little Beaver Creek). Uranium was detected at 2.26 $\mu\text{g/L}$ (RW-6), uranium-233/234 was detected at 2.01 pCi/L (RW-7), uranium-235 was detected at 0.09717 pCi/L (RW-7), and uranium-238 was detected at 0.759 pCi/L (RW-6). Uranium-236 was not detected in any of the local surface water samples collected in 2007. Detections of uranium and uranium isotopes in local surface water samples in 2007 remain well below the DOE derived concentration guide for the respective uranium isotope in drinking water (500 pCi/L for uranium-233/234 and 600 pCi/L for uranium-235 and uranium-238).

4.6.5 Sediment

Sediment samples are collected from the same locations upstream and downstream from PORTS where local surface water samples are collected and at the NPDES outfalls on the east and west sides of PORTS (see Figure 4.4). Samples are collected annually and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, total uranium, and uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant*.

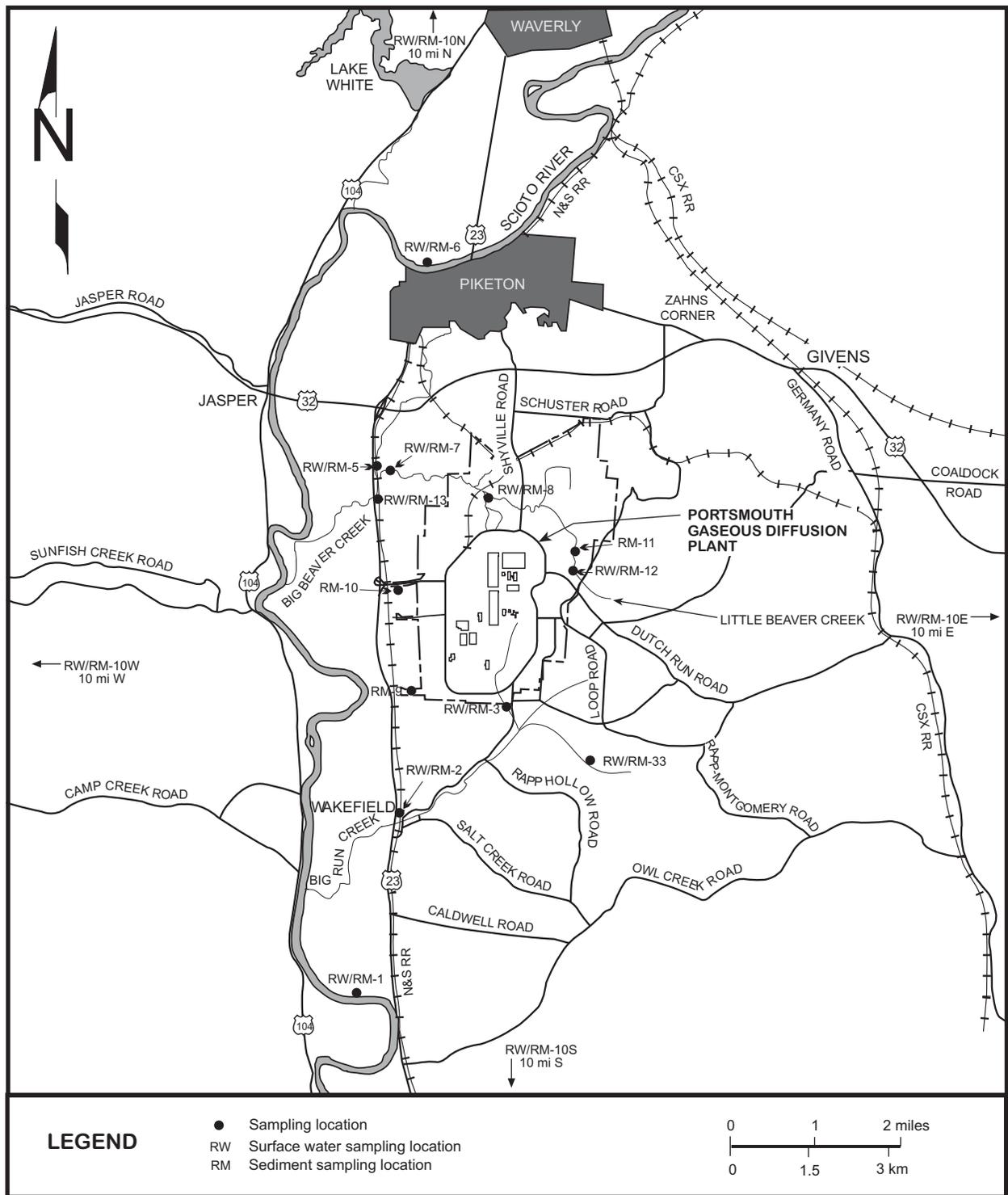


Figure 4.4. Local surface water/sediment monitoring locations.

Uranium and uranium isotopes are naturally occurring, but may also be present due to PORTS activities. Uranium and uranium isotopes detected in the 2007 samples have been detected at similar levels in previous sampling events from 1999 through 2006. Transuranics were not detected in any of the sediment samples collected in 2007.

Technetium-99 is often detected in sediment samples collected at locations downstream from PORTS. In 2007, technetium-99 was detected in samples collected from upstream and downstream locations on Big Beaver Creek (RM-5 and RM-13), downstream locations on Little Beaver Creek (RM-11, RM-7, and RM-8), a downstream location on Big Run Creek (RM-3), and at the West Ditch (USEC NPDES Outfall 010 and DOE NPDES Outfall 013) (RM-10). These detections of technetium-99 are consistent with data from previous sampling events (2002 through 2006).

Section 4.3.9.1 provides a dose assessment to a member of the public based on detections of technetium-99 and uranium isotopes at the downstream sampling location on Little Beaver Creek just before it flows into Big Beaver Creek (RM-7). This off-site sampling location had the highest levels of radionuclides detected in 2007: 17.6 pCi/g of technetium-99, 4.36 pCi/g of uranium-233/234, 0.206 pCi/g of uranium-235, and 1.26 pCi/g of uranium-238. The total potential dose to a member of the public resulting from PORTS operations (1.1 mrem/year), which includes this dose calculation (0.051 mrem/year), is well below the DOE standard of 100 mrem/year.

4.6.6 Settleable Solids

The DOE collects semiannual water samples from several locations (see Figure 4.5) to determine the concentration of radioactive material that is present in the sediment suspended in the water sample. The data are used to determine compliance with DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, Chapter II, paragraph 3a(4). 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.

Sampling locations for the first 2007 sampling event consisted of two background surface water locations (BG-SW01 and BG-US23), six surface water sampling locations (BRC-SW02, EDD-SW01, LBC-SW04, NHP-SW01, UND-SW02, and WDD-SW03), and three NPDES effluent locations (J6-SW01, X-616, and X-6619). The sampling program for settleable solids was revised beginning in October 2007, and sampling locations for this second sampling event included only the three NPDES effluent locations (J6-SW01, X-616, and X-6619). For both sampling events, one sample was analyzed for total suspended solids, total alpha activity, and total beta activity. The other sample was analyzed for non-settleable solids, total alpha activity, and total beta activity.

In 2007, the DOE standards (5 pCi/g for alpha activity and 50 pCi/g for beta activity) were not exceeded at any location.

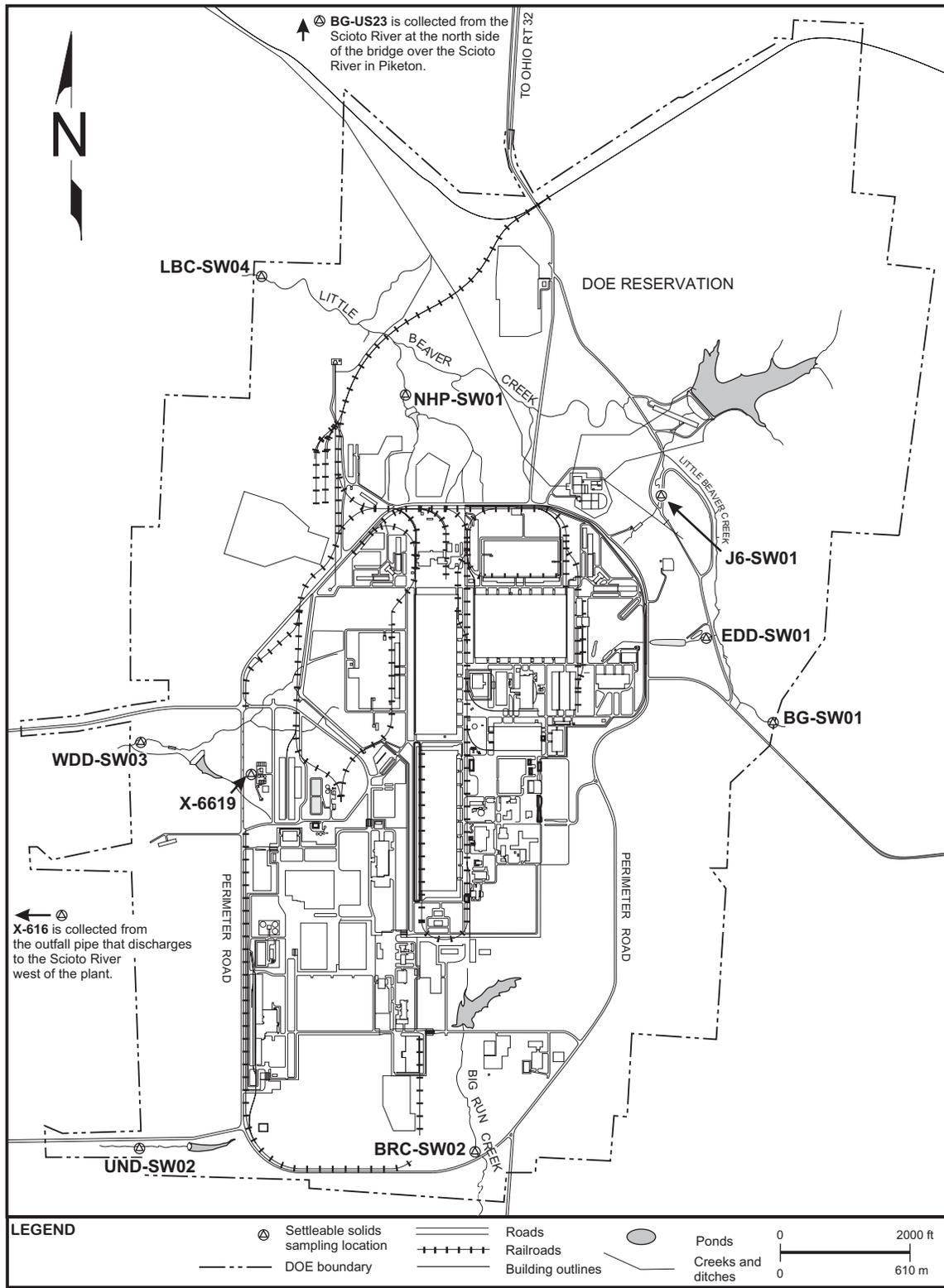


Figure 4.5. DOE settleable solids monitoring locations.

4.6.7 Soil

Soil samples are collected annually from ambient air monitoring locations (see Figure 4.1) and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, total uranium, and uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant*.

No transuranics were detected at any of the sampling locations in 2007. Technetium-99 was detected at 0.589 pCi/g in the sample collected from the ambient air monitoring station A9 (south of PORTS on Wakefield Mound Road).

Uranium (total), uranium-233/234, and uranium-238 were detected at all of the sampling locations. Uranium-235 was detected at 4 of 15 locations. Uranium-236 was not detected in any of the soil samples collected in 2007. Uranium and uranium isotopes were detected at similar levels at all the soil sampling locations, including the background location (A37), which suggests that the uranium detected in these samples is due to naturally-occurring uranium.

Section 4.3.9.2 provides a dose assessment based on the detections of uranium-233/234 (0.907 pCi/g) and uranium-238 (0.85 pCi/g) at the off-site ambient air station with the detections of radionuclides that could cause the highest dose to a member of the public (Station A37). The total potential dose to a member of the public resulting from PORTS operations (1.1 mrem/year), which includes this dose calculation (0.063 mrem/year), is well below the DOE standard of 100 mrem/year.

4.6.8 Vegetation

To assess the uptake of radionuclides into plant material, vegetation samples are collected in the same areas where soil samples are collected at the ambient air monitoring stations (see Figure 4.1). Samples are collected annually and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, total uranium, and uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant*.

No transuranics were detected in vegetation samples collected in 2007. Technetium-99 was detected at activities less than 0.3 pCi/g in samples collected from four locations (A10, A23, A28, and A36).

Uranium, uranium-233/234, and uranium-238 were detected in the sample collected from Station A23 (northeastern PORTS boundary). Uranium and uranium isotopes are detected infrequently, but have been detected at similar levels in previous sampling (2002 through 2006). Section 4.3.9.3 provides a dose assessment for a member of the public based on consumption of beef cattle that would eat grass contaminated with technetium-99 and uranium at these levels. The total potential dose to a member of the public resulting from PORTS operations (1.1 mrem/year), which includes this dose calculation (0.0028 mrem/year), is well below the DOE standard of 100 mrem/year.

4.6.9 Biological Monitoring

The DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* requires biological monitoring to assess the uptake of radionuclides into local biota (deer, fish, crops, milk, and eggs).

4.6.9.1 Deer

Two sets of deer samples were collected during 2007. Samples of liver, kidney, and muscle from deer killed on site in collisions with motor vehicles in January and October 2007 were analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, total uranium, and uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238).

The January 2007 deer samples were each split into two samples called regular and duplicate samples. Regular and duplicate samples are used to assess the accuracy of sampling activities and laboratory analyses, although there is an inherent level of variability in environmental samples. Technetium-99 was detected in each of the liver, kidney and muscle samples at low levels, less than 0.25 pCi/g.

No radionuclides, including technetium-99, were detected in the deer samples collected in October 2007.

As a conservative measure, a dose assessment to a member of the public based on consumption of deer meat containing technetium-99 at an average level of 0.226 pCi/g was completed (see Section 4.3.9.4). The total potential dose to a member of the public resulting from PORTS operations (1.1 mrem/year), which includes this dose calculation (0.0067 mrem/year), is well below the DOE standard of 100 mrem/year.

4.6.9.2 Fish

In 2007, fish samples were collected from downstream sampling locations on Little Beaver Creek (RW-8) and the Scioto River (RW-1). Samples were analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, total uranium, and uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238). No radionuclides were detected in the fish samples.

4.6.9.3 Crops

In 2007, 12 crop samples, including peppers, corn, tomatoes, cucumbers, beets, and squash, were collected from five residential locations near PORTS.

Each sample was analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, total uranium, and uranium isotopes (uranium-233/234, uranium-235, uranium-236, and uranium-238). No transuranics or technetium-99 were detected in any of the samples. Uranium, uranium-233/234, or uranium-238 were detected at low levels less than 0.02 $\mu\text{g}/\text{kg}$ (uranium) and 0.006 pCi/g (uranium isotopes) in four samples.

Section 4.3.9.5 provides a dose assessment to a member of the public based on consumption of red peppers containing uranium-233/234 at 0.00539 pCi/g. The total potential dose to a member of the public resulting from PORTS operations (1.1 mrem/year), which includes this dose calculation (0.00028 mrem/year), is well below the DOE standard of 100 mrem/year.

4.6.9.4 Milk and eggs

No radionuclides were detected in the milk and egg samples collected during 2007.

4.7 RELEASE OF PROPERTY CONTAINING RESIDUAL RADIOACTIVE MATERIAL

In 2007, no DOE property (equipment, excess materials, etc.) was released to the public that contained residual radioactive material that exceeded the release limits for DOE PORTS. The release limits are established in accordance with DOE Order 5400.5 and Title 10 of the *Code of Federal Regulations*, Part 835.

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5. ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

5.1 SUMMARY

Non-radiological environmental monitoring at PORTS includes air, water, sediment, and fish. Monitoring of non-radiological parameters is required by state and federal regulations and/or permits, but is also performed to reduce public concerns about plant operations. Non-radiological data collected in 2007 are similar to data collected in previous years.

5.2 INTRODUCTION

Environmental monitoring programs at PORTS usually monitor both radiological and non-radiological constituents that could be released to the environment as a result of PORTS activities. The radiological components of each monitoring program were discussed in the previous chapter. The DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* specifies non-radiological monitoring requirements for ambient air, surface water, sediment, and fish. Non-radiological data are not collected for some sampling locations and some monitoring programs.

Environmental permits issued by the Ohio EPA to the DOE, DOE contractors, or USEC specify discharge limitations, monitoring requirements, and/or reporting requirements for air emissions and water discharges. Because USEC data are important in developing a complete picture of environmental monitoring at PORTS, these data are included in this report. USEC information is provided for informational purposes only; the DOE cannot certify the accuracy of USEC data. Data from the following environmental monitoring programs are included in this chapter:

- Air,
- Surface water,
- Sediment, and
- Biota (fish).

The DOE also conducts an extensive groundwater monitoring program at PORTS that includes both radiological and non-radiological constituents. Chapter 6 provides information on the groundwater monitoring program, associated surface water monitoring, and water supply monitoring.

5.3 AIR

Permitted air emission sources at PORTS emit non-radiological air pollutants. In addition, the DOE ambient air monitoring program measures fluoride at monitoring stations within PORTS boundaries and in the surrounding area.

5.3.1 Airborne Discharges

DOE PORTS operates several sources of conventional air pollutants such as nitrogen oxides, sulfur dioxide, and particulate matter. The boilers that provide heat for DOE facilities, primarily the X-7725 building, account for almost all of the conventional air pollutants emitted by DOE sources. Because all DOE operations were removed from the X-7725 building in 2007, the building and the air permit for the boilers and associated aboveground oil storage tanks were transferred to USEC in 2007. USEC is using the X-7725 building for the American Centrifuge Plant. The DOE reported the following emissions from the boilers for 2007 (January 1 through September 28 only) in the Ohio EPA Fee Emissions Report: 0.045 ton of particulate matter, 0.033 ton of sulfur dioxide, 1.664 tons of nitrogen oxides, 0.0000038 ton of lead, and 0.397 ton of organic compounds. There were no emissions from the permitted UDS air emission sources in 2007.

Other emissions sources at DOE PORTS, which include two landfill venting systems, one glove box, and four groundwater treatment facilities, emit less than 1 ton per year of conventional air pollutants (on an individual basis), and therefore do not require reporting in the Ohio EPA Fee Emissions Report.

Another potential air pollutant present at DOE PORTS is asbestos released by renovation or demolition of plant facilities. Asbestos emissions are controlled by a system of work practices. The amount of asbestos removed and disposed is reported to the Ohio EPA. In 2007, 95.55 tons of material contaminated with asbestos were shipped from DOE PORTS. These wastes included scrap metal, pipe insulation, and other demolition debris that were contaminated with asbestos.

USEC reported the following emissions of non-radiological air pollutants for 2007 in the Ohio EPA Fee Emissions Report: 27.87 tons of particulate matter, 1.49 tons of organic compounds, 2050.32 tons of sulfur dioxide, and 251.64 tons of nitrogen oxides. These emissions are associated with three boilers at the X-600 Steam Plant, which provide steam for PORTS, the former DOE boilers (September 29 through December 31 only), compressors associated with two dry air systems (diesel engine-powered), and a mobile emergency generator.

5.3.2 Ambient Air Monitoring

In addition to the radionuclides discussed in Chapter 4, DOE ambient air monitoring stations also measure fluoride. Fluoride detected at the ambient air monitoring stations could be present due to background concentrations (fluoride occurs naturally in the environment) or from USEC activities associated with the former gaseous diffusion process.

In 2007, samples for fluoride were collected weekly from 15 ambient air monitoring stations in and around PORTS (see Chapter 4, Figure 4.1). A background ambient air monitoring station (A37) is located approximately 13 miles southwest of the plant; however, this station experienced intermittent mechanical problems during 2007. The highest average ambient concentration of fluoride for the ambient air monitoring stations in 2007 was reported at station A37 ($0.091 \mu\text{g}/\text{m}^3$), which is possibly related to the mechanical issues at this station. Therefore, analytical results from an air station southwest of the plant (A28) are also used to compare to air sampling stations closer to the plant. In 2007, the average ambient concentration of fluoride measured in samples collected at station A28 was $0.067 \mu\text{g}/\text{m}^3$. Average ambient concentrations of fluoride measured at the stations ranged from $0.058 \mu\text{g}/\text{m}^3$ at station A15, located east of the southern plant boundary, to $0.091 \mu\text{g}/\text{m}^3$ at station A36 (located on site at PORTS) and station A37. There is no standard for fluoride in ambient air. The data indicate that ambient concentrations of fluoride at background locations are not appreciably different from concentrations near PORTS.

5.4 WATER

Surface water and groundwater are monitored at PORTS. Groundwater monitoring is discussed in Chapter 6, along with surface water monitoring conducted as part of the groundwater monitoring program. Non-radiological surface water monitoring primarily consists of sampling water discharges associated with both the DOE and USEC NPDES-permitted outfalls. Non-radiological parameters are also monitored in the Scioto River upstream and downstream of PORTS to determine whether discharges from PORTS affect water quality in the river. PCBs are monitored in surface water discharges and surface water downstream from the DOE depleted uranium cylinder storage yards.

5.4.1 Water Discharges (NPDES Outfalls)

Both the DOE and USEC are responsible for NPDES outfalls at PORTS. This section describes non-radiological discharges from these outfalls during 2007.

5.4.1.1 DOE NPDES outfalls

Non-radiological discharges from DOE NPDES outfalls are regulated by the NPDES permit issued to the responsible DOE contractor (LPP or UDS). In 2007, UDS was issued an NPDES permit for the discharge of process wastewaters from the Depleted Uranium Hexafluoride Conversion Facility to the West Ditch, which flows to USEC NPDES Outfall 010 and then to the Scioto River. There were no discharges from the UDS outfall in 2007 because the facility was not operating.

In 2007, LPP was responsible for eight discharge points, or outfalls, through which water is discharged from the site. Three outfalls discharge directly to surface water, four discharge to the USEC X-6619 Sewage Treatment Plant (USEC NPDES Outfall 003), and one discharges to the X-2230M Holding Pond (DOE Outfall 012). Chapter 4, Section 4.3.5.1, provides a brief description of each LPP outfall and provides a site diagram showing each LPP NPDES outfall (see Chapter 4, Figure 4.2).

The Ohio EPA selects the chemical parameters that must be monitored at each outfall based on the chemical characteristics of the water that flows into the outfall and sets discharge limitations for some of these parameters. For example, the LPP outfalls that discharge water from the groundwater treatment facilities (Outfalls 015, 608, 610, 611, and 612) are monitored for trichloroethene because the groundwater treatment facilities treat water contaminated with this chemical. Chemicals monitored at each LPP outfall are as follows:

- LPP NPDES Outfall 012 (X-2230M Holding Pond) – chlorine, iron, oil and grease, suspended solids, total PCBs, and trichloroethene.
- LPP NPDES Outfall 013 (X-2230N Holding Pond) – chlorine, oil and grease, suspended solids, and total PCBs.
- LPP NPDES Outfall 015 (X-624 Groundwater Treatment Facility) – total PCBs and trichloroethene.
- LPP NPDES Outfall 608 (X-622 Groundwater Treatment Facility) – trichloroethene and *trans*-1,2-dichloroethene.
- LPP NPDES Outfall 610 (X-623 Groundwater Treatment Facility) – trichloroethene and *trans*-1,2-dichloroethene.
- LPP NPDES Outfall 611 (X-627 Groundwater Treatment Facility) – trichloroethene.

- LPP NPDES Outfall 612 (X-625 Groundwater Treatment Facility) – iron and trichloroethene. There were no discharges from this outfall in 2007.
- LPP NPDES Outfall 613 (X-6002A Recirculating Hot Water Plant particle separator) – chlorine and suspended solids.

The monitoring data detailed in the previous paragraph are submitted to Ohio EPA in a monthly operating report. In 2007, none of the discharge limitations for LPP NPDES outfalls was exceeded; therefore, the overall DOE NPDES compliance rate with the NPDES permit was 100%.

5.4.1.2 USEC NPDES outfalls

USEC is responsible for 11 NPDES outfalls through which water is discharged from the site (see Chapter 4, Figure 4.2). Eight outfalls discharge directly to surface water, and three discharge to another USEC NPDES outfall before leaving the site. Chapter 4, Section 4.3.5.2, provides a brief description of each USEC NPDES outfall. Chemicals monitored at each USEC outfall are as follows:

- USEC NPDES Outfall 001 (X-230J7 East Holding Pond) – cadmium, chlorine, dissolved solids fluoride, oil and grease, silver, suspended solids, zinc.
- USEC NPDES Outfall 002 (X-230K South Holding Pond) – cadmium, fluoride, mercury, oil and grease, silver, suspended solids, thallium.
- USEC NPDES Outfall 003 (X-6619 Sewage Treatment Plant) – ammonia-nitrogen, biochemical oxygen demand, chlorine (May-October only), copper, fecal coliform (May-October only), mercury, nitrite + nitrate, oil and grease, silver, suspended solids, zinc.
- USEC NPDES Outfall 004 (Cooling Tower Blowdown) – chlorine, copper, dissolved solids, mercury, oil and grease, suspended solids, zinc.
- USEC NPDES Outfall 005 (X-611B Lime Sludge Lagoon) – suspended solids.
- USEC NPDES Outfall 009 (X-230L North Holding Pond) – cadmium, fluoride, oil and grease, suspended solids, zinc.
- USEC NPDES Outfall 010 (X-230J5 Northwest Holding Pond) – cadmium, mercury, oil and grease, suspended solids, zinc.
- USEC NPDES Outfall 011 (X-230J6 Northeast Holding Pond) – cadmium, chlorine, copper, fluoride, oil and grease, suspended solids, zinc.
- USEC NPDES Outfall 602 (X-621 Coal Pile Runoff Treatment Facility) – iron, manganese, suspended solids.
- USEC NPDES Outfall 604 (X-700 Bionitrification Facility) – copper, iron, nickel, nitrate-nitrogen, zinc.
- USEC NPDES Outfall 605 (X-705 Decontamination Microfiltration System) – ammonia-nitrogen, chromium, hexavalent chromium, copper, iron, Kjeldahl nitrogen, nickel, nitrate-nitrogen, nitrite-nitrogen, oil and grease, sulfate, suspended solids, trichloroethene, zinc.

The USEC NPDES Permit also identifies additional monitoring points that are not discharge points as described in the previous paragraphs. USEC NPDES Station Number 801 is a background monitoring location on the Scioto River upstream from USEC NPDES Outfalls 003 and 004. Samples are collected from this monitoring point to measure toxicity to minnows and another aquatic organism, *Ceriodaphnia*.

USEC NPDES Station Number 902 is a monitoring location on Little Beaver Creek downstream from USEC NPDES Outfall 001. USEC NPDES Station Number 903 is a monitoring location on Big Run Creek downstream from USEC NPDES Outfall 002. Water temperature is the only parameter measured at each of these monitoring points.

The monitoring data are submitted to Ohio EPA in a monthly operating report. In 2007, none of the discharge limitations for USEC NPDES outfalls was exceeded; therefore, the overall USEC NPDES compliance rate with the NPDES permit was 100%.

5.4.2 Local Surface Water Monitoring

In the first through third quarters of 2007, non-radiological monitoring of local surface water locations was conducted on the Scioto River upstream and downstream of PORTS (sampling locations RW-6 and RW-1 – see Chapter 4, Figure 4.4). Samples from the Scioto River were analyzed for total phosphate – phosphorus, fluoride, 29 metals, and PCBs. Each of these measurements, with the exception of PCBs, will detect naturally-occurring constituents; therefore, measurements from the upstream location are compared to the downstream location to assess whether PORTS activities have affected the river. Natural variation and manmade activities not related to PORTS can also cause sample variation. This sampling was discontinued in the fourth quarter of 2007 because data collected in previous years indicate that there are no significant differences in the monitored parameters between upstream and downstream locations.

One sample was collected for fluoride and total phosphate – phosphorus. In 2007, the concentrations of fluoride were not appreciably different in upstream and downstream samples : 0.36 and 0.33 milligram per liter (mg/L or ppm) in the upstream and downstream samples, respectively. Concentrations of total phosphate – phosphorus were not appreciably different in upstream and downstream samples collected in 2007: 0.38 and 0.32 mg/L in upstream and downstream samples, respectively.

Samples were collected for PCBs and 29 metals from the upstream and downstream Scioto River sampling locations. PCBs were not detected in any of the samples collected in 2007. No significant differences in the concentrations of metals were noted at the upstream and downstream Scioto River sampling locations. Discharges of non-radiological constituents from PORTS do not appear to affect surface water quality in the Scioto River downstream from PORTS.

5.4.3 Surface Water Monitoring Associated with DOE Cylinder Storage Yards

Surface water samples (filtered and unfiltered) are collected quarterly from four locations in the drainage basins downstream from the DOE depleted uranium cylinder storage yards (UDS X01, RM-8, UDS X02, and RM-10 - see Chapter 4, Figure 4.2) and analyzed for PCBs. No PCBs were detected in surface water samples collected in 2007. Section 5.5.2 presents the results for sediment samples collected as part of this program.

5.5 SEDIMENT

In 2007, sediment monitoring at PORTS included local streams and the Scioto River upstream and downstream from PORTS and drainage basins downstream from the DOE depleted uranium cylinder storage yards.

5.5.1 Local Sediment Monitoring

Sediment samples are collected annually at the same locations upstream and downstream from PORTS where local surface water samples are collected and at the NPDES outfalls on the east and west sides of PORTS (see Chapter 4, Figure 4.4). In 2007, samples were analyzed for 30 metals and PCBs, in addition to the radiological parameters discussed in Chapter 4.

PCBs, primarily PCB-1260, were detected in some of the sediment samples collected in 2007 at concentrations up to 160 micrograms per kilogram ($\mu\text{g}/\text{kg}$) or parts per billion (ppb). PCB-1260 was detected in samples collected from Little Beaver Creek at the confluence from the X-230L North Holding Pond (RM-8), Little Beaver Creek west of the PORTS boundary (RM-7), Little Beaver Creek at the discharge point from the X-230J7 Pond (RM-11), downstream Big Beaver Creek (RM-13), downstream Big Run Creek at the PORTS boundary (RM-3), downstream Big Run Creek at Wakefield (RM-2), and the West Drainage Ditch USEC Outfall 010/DOE Outfall 013 (RM-10). PCB-1248 was detected in both the upstream and downstream Scioto River sampling locations (RM-6 and RM-1, respectively). PCB-1260 is associated with PORTS activities, although it is also present in the environment from other sources. PCB-1248 is not usually detected at PORTS and is most likely present in the Scioto River samples as a result of contamination not attributable to PORTS. The detections of PCBs in sediment around PORTS are less than the risk-based concentration of PCBs for protection of human health developed by U.S. EPA Region 9 and utilized by Ohio EPA: 220 $\mu\text{g}/\text{kg}$.

The results of metals sampling conducted in 2007 indicate that no appreciable differences are evident in the concentrations of metals present in sediment samples taken upstream from PORTS, at background sampling locations, and downstream from PORTS. Metals occur naturally in the environment. Accordingly, the metals detected in the samples most likely did not result from activities at PORTS.

5.5.2 Sediment Monitoring Associated with the DOE Cylinder Storage Yards

Sediment samples are collected quarterly from four locations in the drainage basins downstream from the DOE depleted uranium cylinder storage yards (UDS X01, RM-8, UDS X02, and RM-10) and analyzed for PCBs. These locations are on site at PORTS and not accessible to the public.

In 2007, PCBs (PCB-1254, PCB-1260, and/or PCB-1262) were detected in at least one of the sediment samples collected from each location at concentrations ranging from 5.1 to 920 $\mu\text{g}/\text{kg}$ (ppb). These concentrations are below the 1 ppm (1000 ppb) reference value set forth in the U.S. EPA Region 5 *TSCA Approval for Storage for Disposal of PCB Bulk Product (Mixed) Waste*, which applies to the storage of depleted uranium cylinders at PORTS that may have paint on the exterior of the cylinders that contains more than 50 ppm PCBs.

Section 5.4.3 presents the results for surface water samples collected as part of this program.

5.6 BIOLOGICAL MONITORING - FISH

In 2007, fish were collected from downstream sampling locations on Little Beaver Creek (RW-8) and the Scioto River (RW-1) as part of the routine fish monitoring program at PORTS. Chapter 4, Figure 4.4, shows the surface water monitoring locations where the fish were caught. Fish samples were analyzed for chromium and PCBs, in addition to the radiological parameters discussed in Chapter 4. Fish samples collected for this program included only the fish fillet, that is, only the portion of the fish that would be eaten by a person.

Chromium was detected at 0.22 and 0.68 milligram per kilogram (mg/kg) in both fish samples. These concentrations of chromium are similar to or less than concentrations of chromium detected in fish caught in 2004 through 2006 (0.208 to 8.18 mg/kg).

The chromium detected in these fish in 2007 is most likely due to naturally-occurring chromium. Chromium occurs naturally in soil and is often present in stream sediment and surface water. For example, chromium is usually detected in samples of surface water collected at the upstream Scioto River sampling location (RW-6) and in the sediment sample collected from this location.

PCBs were detected at 54 $\mu\text{g}/\text{kg}$ (ppb) in the fish sample collected from the Scioto River (a mixture of small mouth bass and suckers). Concentrations of PCBs in fish were compared to the Ohio Fish Consumption Advisory Chemical Limits provided in the *State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program* (Ohio EPA 2008). These limits are set for the following consumption rates: unrestricted, 1/week, 1/month, 6/year, and do not eat. This concentration of PCBs (54 $\mu\text{g}/\text{kg}$) is just above the unrestricted level (50 $\mu\text{g}/\text{kg}$) and below the 1/week maximum limit (220 $\mu\text{g}/\text{kg}$).

The Ohio Sport Fish Consumption Advisory, available from the Ohio EPA, Division of Surface Water, advises the public on consumption limits for sport fish caught from all water bodies in Ohio and should be consulted before eating any fish caught in Ohio waters.

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6. GROUNDWATER PROGRAMS

6.1 SUMMARY

Groundwater monitoring at DOE PORTS is required by a combination of state and federal regulations, legal agreements with the Ohio EPA and U.S. EPA, and DOE Orders. More than 400 monitoring wells are used to track the flow of groundwater and to identify and measure groundwater contaminants. Groundwater programs also include on-site surface water monitoring and water supply monitoring.

In general, the contaminated groundwater plumes present at PORTS did not change significantly in 2007. Trichloroethene and several other volatile organics continue to be detected at concentrations less than 4 $\mu\text{g/L}$ (4 ppb) in an off-site well located approximately 45 feet south of the DOE property line that is part of the X-749/X-120 plume. In addition, trichloroethene and two other volatile organic compounds were detected at concentrations less than 1 $\mu\text{g/L}$ in a new off-site groundwater monitoring well approximately 110 feet south of the DOE property line. In 2007, three new extraction wells were installed in the southern portion of the X-749/X-120 groundwater plume near the property line to control the plume in this area and attempt to capture the off-site portion of the plume. Trichloroethene has not been detected in groundwater beyond the DOE property boundary at concentrations that exceed the EPA drinking water standard of 5 $\mu\text{g/L}$.

The *2007 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides further details on the groundwater plumes at PORTS, specific monitoring well identifications, and analytical results for monitoring wells. This document and other documents referenced in this chapter are available in the PORTS Environmental Information Center.

6.2 INTRODUCTION

This chapter provides an overview of groundwater monitoring at PORTS and the results of the groundwater monitoring program for 2007. The following sections provide an overview of the DOE PORTS groundwater monitoring program followed by a review of the history and 2007 monitoring data for each area.

This chapter also includes information on the groundwater treatment facilities at PORTS. These facilities receive contaminated groundwater from the groundwater monitoring areas and treat the water prior to discharge through the DOE PORTS permitted NPDES outfalls.

6.3 OVERVIEW OF GROUNDWATER MONITORING AT DOE PORTS

This section provides an overview of the regulatory basis for groundwater monitoring at PORTS, groundwater use and geology, and monitoring activities and issues.

6.3.1 Regulatory Programs

Groundwater monitoring at PORTS was initiated in the 1980s. Groundwater monitoring has been conducted in response to state and/or federal regulations, regulatory documents prepared by DOE PORTS, agreements between the DOE and Ohio EPA or U.S. EPA, and DOE Orders.

Because of the numerous regulatory programs applicable to groundwater monitoring at PORTS, an *Integrated Groundwater Monitoring Plan* was developed to address all groundwater monitoring requirements for PORTS. The initial plan, dated November 1998, was reviewed and approved by the Ohio EPA and implemented at PORTS starting on April 1, 1999. The *Integrated Groundwater Monitoring Plan* is periodically revised and approved by the Ohio EPA. An annual groundwater report is submitted to Ohio EPA in accordance with the *Integrated Groundwater Monitoring Plan*.

In 2007, groundwater monitoring at PORTS was performed under the *Integrated Groundwater Monitoring Plan* dated October 2004 and replacement pages dated May 2005 that resolved a minor issue with monitoring at the X-749A and X-735 Landfills. However, the results of two special studies at the X-749/X-120/PK Landfill Area in Quadrant I caused changes to the monitoring of this area that are not part of the October 2004 *Integrated Groundwater Monitoring Plan*. The Ohio EPA approved the *Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Areas* in a letter dated March 14, 2005. Approval of this report discontinued sampling conducted solely for the report beginning in the second quarter of 2005. The Ohio EPA approved the *Evaluation of the Groundwater Monitoring Network for the X-749/X-120/PK Landfill Area* in a letter dated June 2, 2005, and the changes to the monitoring program for the X-749/X-120/PK Landfill area provided in this report were implemented beginning in the third quarter of 2005. In general, the evaluation decreased the number of parameters and frequency of monitoring at X-749/X-120/PK Landfill wells, although the monitoring frequency and number of parameters increased at some wells.

Groundwater monitoring is also conducted to meet DOE Order requirements. Exit pathway monitoring assesses the effect of PORTS on off-site groundwater quality. DOE Orders are the basis for radiological monitoring of groundwater at PORTS.

6.3.2 Groundwater Use and Geology

Two water-bearing zones are present beneath PORTS: the Gallia and Berea formations. The Gallia is the uppermost water-bearing zone and contains most of the groundwater contamination at PORTS. The Berea is deeper than the Gallia and is usually separated from the Gallia by the Sunbury shale, which acts as a barrier to impede groundwater flow between the Gallia and Berea formations. Additional information about site hydrogeology is available in the PORTS Environmental Information Center.

Groundwater directly beneath PORTS is not used as a domestic, municipal, or industrial water supply, and contaminants in the groundwater beneath PORTS do not affect the quality of the water in the Scioto River Valley buried aquifer. PORTS is the largest industrial user of water in the vicinity and obtains water from three water supply well fields south of Piketon in the Scioto River Valley buried aquifer. The DOE has filed a deed notification at the Pike County Auditor's Office that restricts the use of groundwater beneath the PORTS site.

6.3.3. Monitoring Activities

Groundwater monitoring at PORTS includes several activities. Samples of water are collected from groundwater monitoring wells and analyzed to obtain information about contaminants and naturally-occurring compounds in the groundwater. Monitoring wells are also used to obtain other information about groundwater. When the level of water, or groundwater elevation, is measured in a number of wells over a short period of time, the groundwater elevations, combined with information about the subsurface soil, can be used to estimate the rate and direction of groundwater flow. The rate and direction of groundwater flow can be used to predict the movement of contaminants in the groundwater and to develop ways to control or remediate groundwater contamination.

6.4 GROUNDWATER MONITORING AREAS

The *Integrated Groundwater Monitoring Plan* requires groundwater monitoring of 11 areas within the quadrants of the site designated by the RCRA Corrective Action Program. These areas (see Figure 6.1) are:

- X-749/X-120/PK Landfill,
- Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility,
- Quadrant II Groundwater Investigative Area,
- X-701B Holding Pond,
- X-633 Pumphouse/Cooling Towers Area,
- X-616 Chromium Sludge Surface Impoundments,
- X-740 Waste Oil Handling Facility,
- X-611A Former Lime Sludge Lagoons,
- X-735 Landfills,
- X-734 Landfills, and
- X-533 Switchyard Area.

The *Integrated Groundwater Monitoring Plan* also contains requirements for (1) surface water monitoring in creeks and drainage ditches at PORTS that receive groundwater discharge, and (2) water supply monitoring.

In general, samples are collected from wells (or surface water locations) at each area listed above and are analyzed for metals, volatile organic compounds, and/or radiological constituents. Table 6.1 lists the analytical requirements for each groundwater monitoring area and other monitoring programs described in this chapter. DOE PORTS then compares constituents detected in the groundwater to standards called preliminary remediation goals to assess the potential for each constituent to affect human health and the environment.

Five areas of groundwater contamination, commonly called groundwater plumes, have been identified at PORTS. Groundwater contamination consists of volatile organic compounds (primarily trichloroethene) and radionuclides such as uranium and technetium-99. The areas that contain groundwater plumes are X-749/X-120/PK Landfill, Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility, Quadrant II Groundwater Investigative Area, X-701B Holding Pond, and X-740 Waste Oil Handling Facility. Other areas are monitored to evaluate areas of groundwater contaminated with metals, to ensure past uses of the area (such as a landfill) have not caused groundwater contamination, or to monitor remediation that has taken place in the area.

The following sections describe the history of each groundwater monitoring area and groundwater monitoring results for each area in 2007.

6.4.1 X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility/PK Landfill

In the southernmost portion of PORTS, groundwater concerns focus on three contaminant sources: X-749 Contaminated Materials Disposal Facility, X-120 Old Training Facility, and PK Landfill.

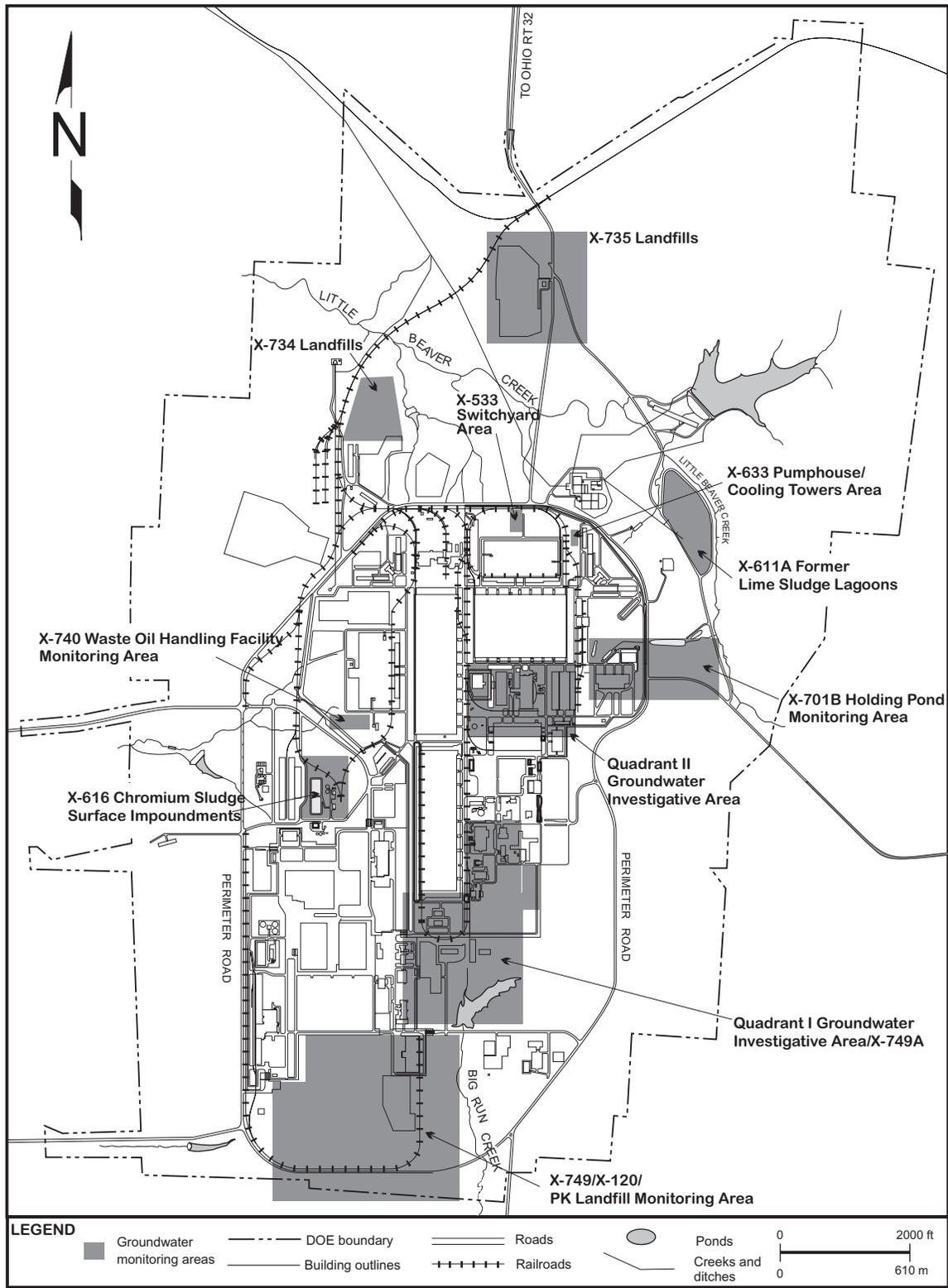


Figure 6.1. Groundwater monitoring areas at PORTS.

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS

Monitoring Area or Program	Analytes	
X-749/X-120/PK Landfill ^{a,b}		
X-749/X-120 plume	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity	chloride sulfate total metals ^d : Ca, Fe, Mg, K, Na transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu
PK Landfill	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity chloride sulfate	total metals ^d : As, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Ni, K, Se, Na, V, Zn transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu
Quadrant I Groundwater Investigative Area ^{a,b}		
X-231B plume	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity chloride	sulfate total metals ^d : Ca, Fe, Mg, Mn, K, Na transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu
X-749A Classified Materials Disposal Facility	volatile organic compounds ^e technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^c alkalinity chloride sulfate nitrite nitrate ammonia	total metals ^d : Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu chemical oxygen demand total dissolved solids
Quadrant II Groundwater Investigative Area ^a		
X-701B Holding Pond ^{a,b}	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity chloride	chloride sulfate total metals ^d : Ca, Fe, Mg, K, Na transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu
X-633 Pumphouse/Cooling Towers Area	total metals ^d : Cr	sulfate total metals ^d : Ca, Cd, Co, Cr, Fe, Mg, Mn, K, Pb, Na, Ni, Tl transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS (continued)

Monitoring Area or Program	Analytes	Analytes
X-616 Chromium Sludge Surface Impoundments	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity	chloride sulfate total metals ^d : Ca, Fe, Mg, K, Na, Ba, Cd, Cr, Pb, Mn, Ni, Sb, Tl
X-740 Waste Oil Handling Facility ^a	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity	chloride sulfate total metals ^d : Ca, Fe, Mg, K, Na transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu
X-611A Former Lime Sludge Lagoons	total metals ^d : Be, Cr	
X-735 Landfills	volatile organic compounds ^e technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity chloride sulfate nitrite nitrate ammonia	total metals ^d : Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Hg, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu chemical oxygen demand total dissolved solids
X-734 Landfills	volatile organic compounds ^e technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity chloride sulfate nitrite nitrate ammonia	total metals ^d : Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu chemical oxygen demand total dissolved solids
X-533 Switchyard Area	total metals ^d : Cd, Co, Ni	
Surface Water	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity	chloride sulfate total metals ^d : Ca, Fe, Mg, K, Na transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu
Water Supply	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity	chloride sulfate total metals ^d : Ca, Fe, Mg, K, Na transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS (continued)

Monitoring Area or Program	Analytes	
Exit Pathway ^b	volatile organic compounds ^c technetium-99 total U, ^{233/234} U, ²³⁵ U, ²³⁶ U, ²³⁸ U ^d alkalinity	chloride sulfate total metals ^d : Ca, Fe, Mg, K, Na transuranics ^d : ²⁴¹ Am, ²³⁷ Np, ²³⁸ Pu, ^{239/240} Pu

^aSelected well(s) in this area are sampled once every two years for a comprehensive list of over 200 potential contaminants (Title 40, Code of Federal Regulations, Part 264 Appendix IX – Appendix to Ohio Administrative Code Rule 3745-54-98).

^bNot all wells in this area are analyzed for all listed analytes.

^cAcetone, benzene, bromodichloromethane, bromoform, carbon disulfide, carbon tetrachloride, chlorobenzene, chloroethane, chloroform, dibromochloromethane, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, bromomethane, chloromethane, methylene chloride, 2-butanone (methyl ethyl ketone), 4-methyl-2-pentanone (methyl isobutyl ketone), 1,1,2,2-tetrachloroethane, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, trichlorofluoromethane (CFC-11), vinyl chloride, xylenes (M+P xylenes).

^dAppendix C lists the symbols for metals and transuranic radionuclides.

^eVolatile organic compounds listed in footnote c plus: acrylonitrile, bromochloromethane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, trans-1,4-dichloro-2-butene, 1,2-dichloropropane, cis-1,3-dichloropropene, trans-1,3-dichloropropene, 2-hexanone (methyl butyl ketone), dibromomethane, iodomethane, styrene, 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane, and vinyl acetate.

6.4.1.1 X-749 Contaminated Materials Disposal Facility

The X-749 Contaminated Materials Disposal Facility is a landfill located in the south-central section of the facility. The landfill covers approximately 7.5 acres and was built in an area of highest elevation within the southern half of PORTS. The landfill operated from 1955 to 1990, during which time buried wastes were generally contained in metal drums or other containers compatible with the waste.

The northern portion of the X-749 landfill contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, sludges classified as hazardous, and low-level radioactive materials. The southern portion of the X-749 landfill contains non-hazardous, low-level radioactive scrap materials.

The initial closure of the X-749 landfill included installation of (1) a multimedia cap, (2) a barrier wall along the north side and northwest corner of X-749 landfill, and (3) subsurface groundwater drains on the northern half of the east side and the southwest corner of the landfill, including one sump within each of the groundwater drains. The barrier wall and subsurface drains extend down to bedrock. An additional barrier wall on the south and east sides of the X-749 landfill was constructed in 2002. The groundwater drain and sump on the east side of the landfill were removed for construction of this barrier wall. Groundwater from the remaining subsurface drain is treated at the X-622 Groundwater Treatment Facility and discharged through DOE NPDES Outfall 608, which flows to the USEC Sewage Treatment Plant.

In 2002 and 2003, hybrid poplar trees were planted in two areas of the X-749/X-120 groundwater plume. The trees are used in a process called phytoremediation to degrade or contain contaminants in soil and/or groundwater. Chapter 3, Section 3.2.1.1, provides additional information about this remediation system.

The leading edge of the contaminated groundwater plume emanating from the X-749 landfill has been approaching the southern boundary of PORTS. In 1994, a subsurface barrier wall was completed across a portion of this southern boundary of PORTS. The X-749 South Barrier Wall was designed to inhibit migration of the plume off plant property prior to the implementation of a final remedial measure; however, volatile organics have moved beyond the wall. A project was begun in 2004 to remediate volatile organics in this area. Hydrogen release compounds, which act as an accelerant to the natural microbial process that breaks down volatile organics into nontoxic compounds, were injected into the soil in over 150 locations during March and April 2004. Sampling data collected through 2006 indicate that optimal reductive dechlorination of chlorinated solvents was briefly achieved in the treatment zones, but is no longer effective due to the depletion of the hydrogen release compounds. In 2007, four new groundwater extraction wells were installed in the X-749 South Barrier Wall area, which began operation on June 29, 2007. These extraction wells are intended to control migration of the plume off plant property in this area. Three new off-site groundwater monitoring wells were also installed in 2007 to monitor the portion of the X-749 plume that has moved off site.

The *Comprehensive Monitoring Program for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant* was developed in 2003 to evaluate the effect of the X-749 barrier wall installed in 2001-2002 on groundwater quality and migration in the northern area of the X-749 plume and at the PK Landfill. The program found that the barrier wall on the south and east sides of the X-749 landfill, installed in 2001-2002, is impeding additional contamination from flowing out of the landfill, and that the groundwater collection system and sump pump in the southwestern corner of the X-749 landfill is removing water from the landfill.

Eighty-three wells were sampled during 2007 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.1.2 X-120 Old Training Facility

The X-120 Old Training Facility, which is west and north of the X-749 Contaminated Materials Disposal Facility, covered an area of approximately 11.5 acres near the present-day XT-847 building. The X-120 facility, which no longer exists, included a machine shop, metal shop, paint shop, and several warehouses used during the construction of PORTS in the 1950s. Groundwater in the vicinity of this facility is contaminated with volatile organic compounds, primarily trichloroethene. In 1996, a horizontal well was installed along the approximate axis of the X-120 plume. Contaminated groundwater flowed from this well to the X-625 Groundwater Treatment Facility. On July 9, 2003, operation of the X-625 Groundwater Treatment Facility and horizontal well was placed on stand-by with approval from Ohio EPA. The horizontal well and treatment facility did not operate during 2006.

Eighty-three wells were sampled during 2007 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.1.3 PK Landfill

The PK Landfill is located west of Big Run Creek just south of the X-230K Holding Pond. The landfill, which began operations in 1952, was used as a salvage yard, burn pit, and trash area during the construction of PORTS. After the initial construction, the disposal site was operated as a sanitary landfill until 1968, when soil was graded over the site and the area was seeded with native grasses.

During site investigations, intermittent seeps were observed emanating from the PK Landfill into Big Run Creek. In 1994, a portion of Big Run Creek was relocated approximately 50 feet to the east. A groundwater collection system was installed in the old creek channel to capture the seeps emanating from the landfill. A second collection system was constructed in 1997 on the southeastern landfill boundary to contain the groundwater plume migrating toward Big Run Creek from the southern portion of the PK landfill. A cap was constructed over the landfill in 1998.

In 2002, a 5-year review was completed for the PK Landfill to evaluate the effectiveness of the corrective measures implemented at this area (see the report entitled *X-611A Prairie and the X-749B Peter Kiewit Landfill Five-Year Evaluation Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*). In response to the findings of the 5-year review, the *Comprehensive Monitoring Program for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant* was developed to provide additional data to evaluate the effectiveness of the landfill cap and groundwater collection systems, to determine whether a barrier wall is needed on the north and west sides of the PK Landfill, and to monitor the effect of the X-749 barrier wall installed in 2001-2002 as previously described (see Section 6.4.1.1). The *Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Areas* found that the landfill cap and groundwater collection systems are performing adequately and construction of a barrier wall on the upgradient (west and north) sides of the PK Landfill does not appear to be necessary.

The second five-year review for the PK Landfill was completed in 2007. This report, the *Second Five-Year Review for the X-749B Peter Kiewit Landfill*, also found that the groundwater collection systems and landfill cap are performing adequately and reiterated that construction of a barrier wall on the upgradient (west and north) sides of the PK Landfill does not appear to be necessary.

In 2007, 9 wells, 2 sumps, and 2 manholes were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells, sumps, and manholes in this area.

6.4.1.4 Monitoring results for the X-749/X-120/PK Landfill in 2007

A contaminated groundwater plume is associated with the X-749/X-120/PK Landfill groundwater monitoring area (see Figure 6.2). The most extensive and most concentrated constituents associated with the X-749/X-120 plume are volatile organic compounds, particularly trichloroethene.

In recent years, concentrations of trichloroethene have been increasing in the southern area of this plume, known as the X-749 South Barrier Wall Area, near the DOE property boundary. In the second quarter of 2007, the concentration of trichloroethene detected in the sample collected from well X749-97G (on site immediately south of the X-749 South Barrier Wall) increased to 110 $\mu\text{g/L}$. The new extraction wells in this area began operating on June 29, 2007, and concentrations of trichloroethene detected in this on-site well in the third and fourth quarters of 2007 decreased to 63 $\mu\text{g/L}$ and 13 $\mu\text{g/L}$, respectively.

In the second quarter of 2007, volatile organic compounds were detected for the first time in off-site monitoring well WP-01G, which is directly south of well X749-97G. Volatile organics, including trichloroethene, were detected at 1.2 $\mu\text{g/L}$ or less. None of these volatile organic compounds were detected in the fourth quarter sample collected from WP-01G.

Volatile organic compounds continue to be detected in off-site monitoring well WP-03G. Although concentrations of volatile organics have increased in this well since it was installed in 2004, none of the detections are above the respective preliminary remediation goals. Concentrations of volatile organics detected in quarterly samples collected from well WP-03G during 2007 remained relatively stable; for example, concentrations of trichloroethene detected in the well ranged from 2.9 to 3.7 $\mu\text{g/L}$, which is similar to the trichloroethene detections in this well during 2006 (3.2 to 4 $\mu\text{g/L}$). These concentrations are below the EPA drinking water standard for trichloroethene of 5 $\mu\text{g/L}$.

Three new off-site groundwater monitoring wells, WP-05G, WP-06G, and WP-07G were installed in October 2007 and sampled for selected volatile organic compounds, including trichloroethene. No volatile organic compounds were detected in the samples collected from wells WP-05G and WP-06G. The sample collected from well WP-07G contained trichloroethene and two other volatile organic compounds at concentrations less than 0.6 $\mu\text{g/L}$, which are below the applicable EPA drinking water standards.

In addition to volatile organic compounds, inorganics (metals) and radionuclides have also been detected in the groundwater beneath the X-749 area. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

Some of the wells associated with the PK Landfill also appear to be contaminated with low levels of volatile organic compounds, but usually at concentrations below preliminary remediation goals. Vinyl chloride, however, was detected in samples collected from wells PK-16G, PK-17B and PK-21B at concentrations ranging from 2 to 34 $\mu\text{g/L}$, which equal or exceed the preliminary remediation goal of 2 $\mu\text{g/L}$. Vinyl chloride is typically detected in these wells.

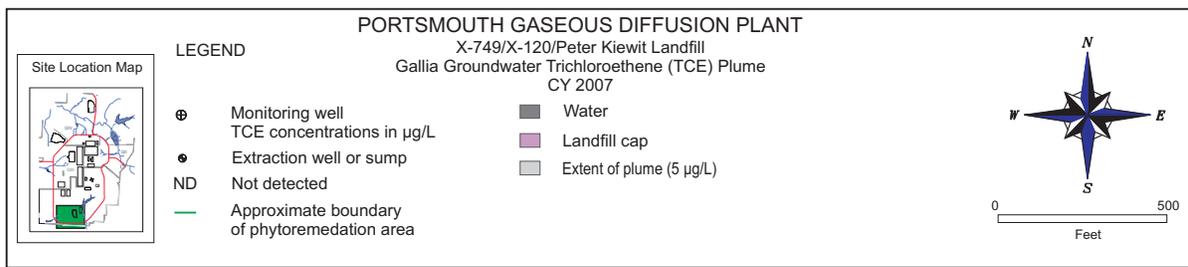
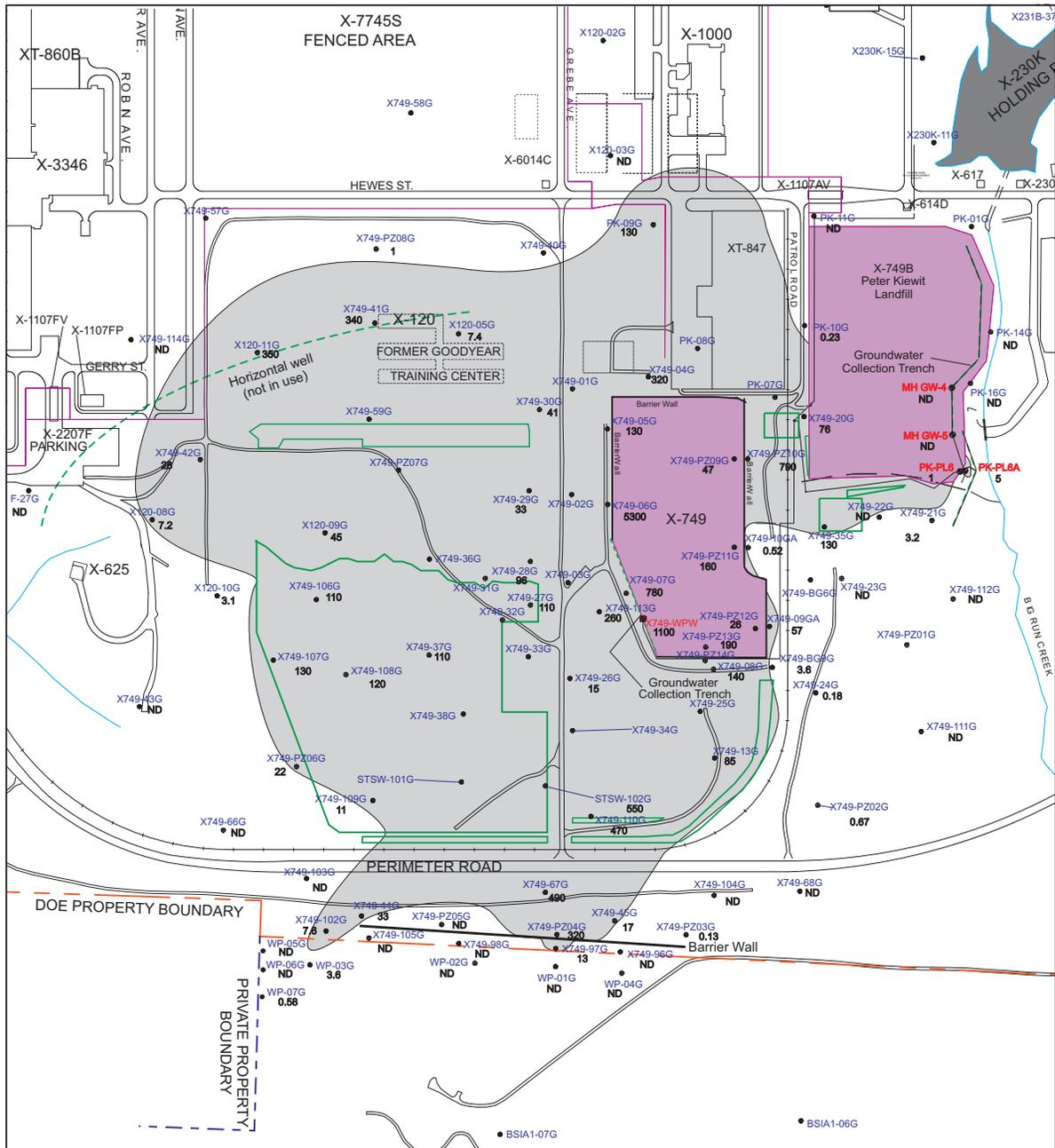


Figure 6.2. Trichloroethene-contaminated Gallia groundwater plume at the X-749/X-120/PK Landfill – 2007.

6.4.2 Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility

In the northern portion of Quadrant I, groundwater concerns are focused on two areas: the Quadrant I Groundwater Investigative Area and the X-749A Classified Materials Disposal Facility.

6.4.2.1 Quadrant I Groundwater Investigative Area

The Quadrant I Groundwater Investigative Area, also called the Five-Unit Groundwater Investigative Area, consists of a groundwater plume resulting from a number of potential sources of groundwater contamination: the X-231A and X-231B Oil Biodegradation Plots, X-600 Coal-Fired Steam Plant, X-600A Coal Pile Yard, X-621 Coal Pile Runoff Treatment Facility, X-710 Technical Services Building, X-749A Classified Materials Disposal Facility, the X-760 Pilot Investigation Building, and the X-770 Mechanical Testing Facility. The X-231B Southwest Oil Biodegradation Plot was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*.

Three groundwater extraction wells were installed in the Gallia in 1991 as part of an interim remedial measure for the X-231B Southwest Oil Biodegradation Plot. Eleven additional groundwater extraction wells were installed in 2001-2002 as part of the remedial actions required by the Quadrant I Decision Document (see Chapter 3, Section 3.2.1.3). These wells began operation in 2002. The extracted groundwater is treated at the X-622 Groundwater Treatment Facility and discharged through DOE NPDES Outfall 608, which flows into the USEC Sewage Treatment Plant. Multimedia landfill caps were installed over the former X-231B area and a similar area, X-231A, in 2000 to minimize water infiltration and control the spread of contamination.

A five-year review of the groundwater extraction well system and landfill caps was completed and submitted to Ohio EPA in 2007. This report, the *First Five-Year Review for the Five-Unit Groundwater Investigative Area and X-231A/X-231B Oil Biodegradation Plots*, found that the groundwater extraction wells and landfill caps have reduced concentrations of trichloroethene in the groundwater and reduced potential exposure pathways to contaminants of concern.

Twenty-two wells are sampled semiannually as part of the monitoring program for the Quadrant I Groundwater Investigative Area. An additional 16 wells are sampled annually or biennially. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.2.2 X-749A Classified Materials Disposal Facility

The 6-acre X-749A Classified Materials Disposal Facility is a landfill that operated from 1953 through 1988 for the disposal of wastes classified under the Atomic Energy Act. Potential contaminants include PCBs, asbestos, radionuclides, and industrial waste. Closure of the landfill, completed in 1994, included the construction of a multilayer cap and the installation of a drainage system to collect surface water runoff. The drainage system discharges via a USEC NPDES-permitted outfall.

In 2005, the monitoring program for the X-749A landfill was revised based on Ohio EPA comments on the *2004 Groundwater Monitoring Report*. The extraction wells in the Quadrant I Groundwater Investigative Area have caused a change in the direction of groundwater flow at the X-749A landfill, which required changes to the monitoring program for the X-749A landfill. In 2007, 12 wells were sampled at the X-749A landfill. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.2.3 Monitoring results for the Quadrant I Groundwater Investigative Area/X-749A in 2007

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the Quadrant I Groundwater Investigative Area (see Figure 6.3). Other volatile organic compounds are also present in the plume. The plume perimeter did not change significantly from 2006 to 2007.

Concentrations of trichloroethene detected in several wells within the plume have decreased when compared to data collected prior to 2002 because of the 11 new extraction wells in the Quadrant I Groundwater Investigative Area, which began operation in April 2002. For example, trichloroethene was detected at 8.2 and 7.7 $\mu\text{g/L}$ in samples collected during 2007 from well X231B-12G, which is in the middle western edge of the plume. Concentrations of trichloroethene detected in samples from this well in 1999-2001 ranged from 96 to 260 $\mu\text{g/L}$.

Concentrations of trichloroethene detected in well X326-09G (on the western edge of the plume at the southwest corner of the X-326 building) increased to 11,000 $\mu\text{g/L}$ in the third quarter of 2007. Concentrations of trichloroethene detected in this well have been increasing since the well was installed in 2002. These increasing concentrations could be due to the extraction wells, which may be causing groundwater with higher concentrations of trichloroethene to flow from beneath the X-326 building. DOE is planning to add an additional extraction well in the vicinity of this well to address this contamination.

Inorganics (metals) and radionuclides have also been detected in the groundwater beneath the area. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

Statistical evaluations of data collected from wells at the X-749A landfill are also completed to monitor the landfill for releases. These statistical evaluations identified exceedences in the statistical control limits for alkalinity in the sample collected from well X749A-01G, which began in the fourth quarter of 2006. Because of these exceedences, assessment monitoring began at the X-749A Classified Materials Disposal Facility in 2007. Monitoring of the X-749A landfill will continue as required by the IGWMP and Ohio EPA.

6.4.3 Quadrant II Groundwater Investigative Area

The Quadrant II Groundwater Investigative Area consists of an area of groundwater contamination with several potential sources. One of these sources, the X-701C Neutralization Pit, was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*. The X-701C Neutralization Pit was an open-topped neutralization pit that received process effluents and basement sump wastewater such as acid and alkali solutions and rinse water contaminated with trichloroethene and/or trichloroethane from metal-cleaning operations. The X-701C Neutralization Pit was located within a trichloroethene plume centered around the X-700 and X-705 buildings. The pit was removed in 2001.

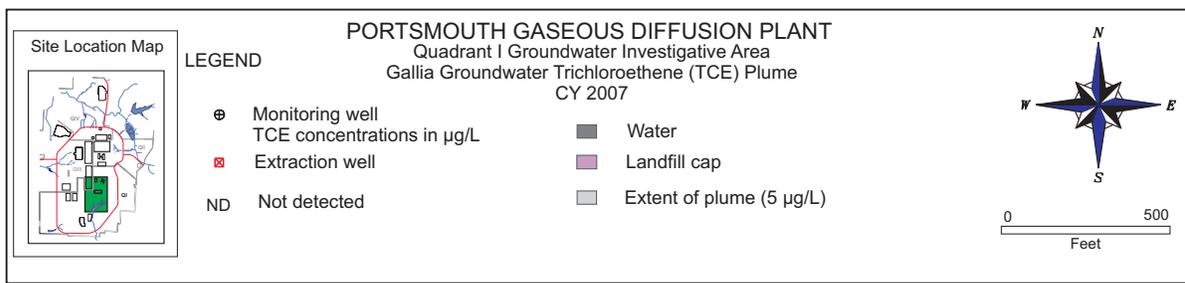
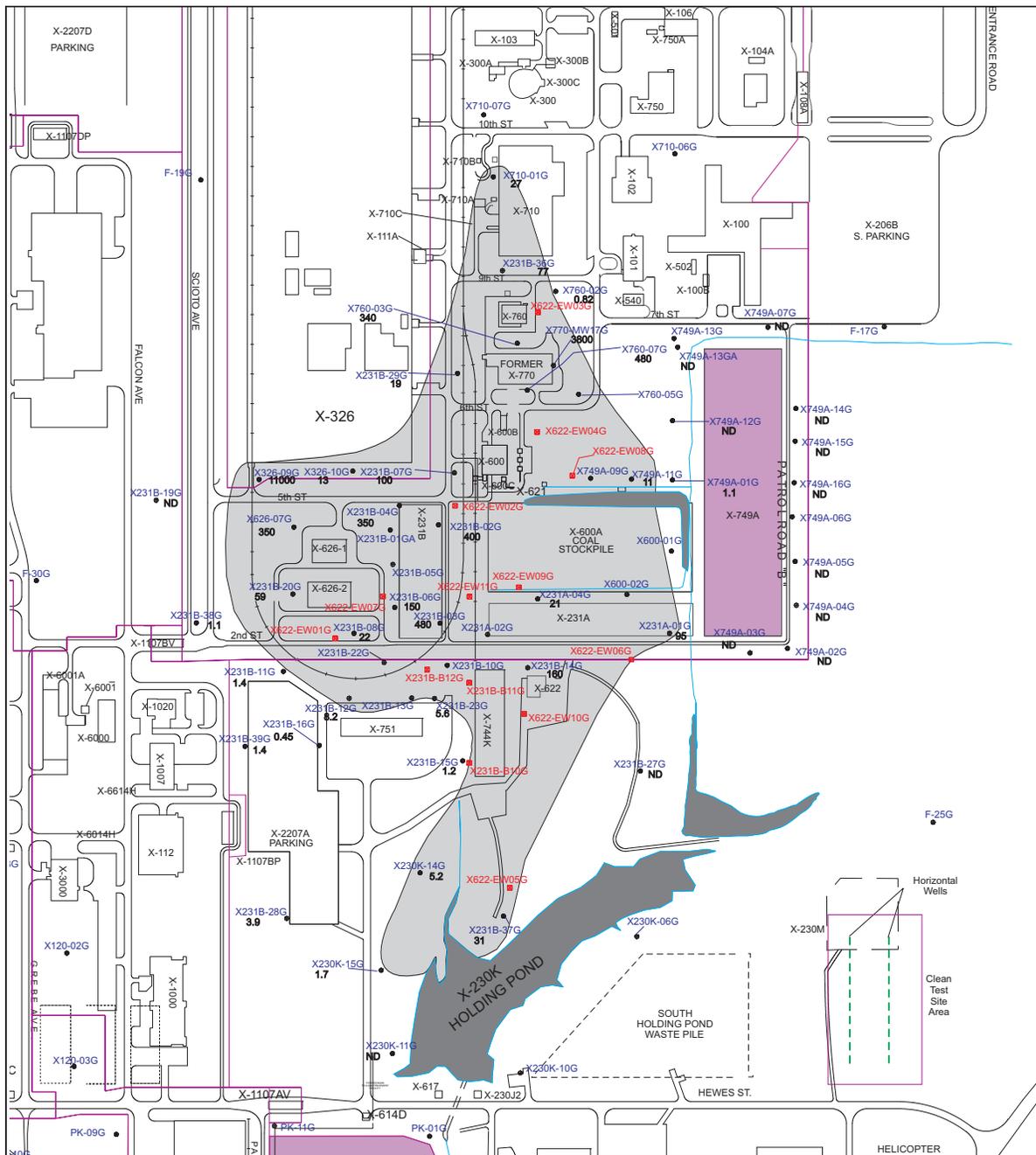


Figure 6.3. Trichloroethene-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative Area – 2007.

The natural groundwater flow direction in this area is to the east toward Little Beaver Creek. The groundwater flow pattern has been changed in this area by use of sump pumps in the basements of the X-700 and X-705 buildings. Thus, the groundwater plume in this area does not spread but instead flows toward the sumps where it is collected and then treated at the X-627 Groundwater Treatment Facility. This facility discharges through DOE NPDES Outfall 611, which flows to the USEC Sewage Treatment Plant. Eleven wells are sampled annually as part of the monitoring program for this area. An additional 14 wells are sampled biennially. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.3.1 Monitoring results for the Quadrant II Groundwater Investigative Area in 2007

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the Quadrant II Groundwater Investigative Area (see Figure 6.4). The plume perimeter did not change significantly from 2006 to 2007. Numerous other volatile organics were also detected within the plume. Inorganics (metals) and radionuclides were also detected in 2007. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

6.4.4 X-701B Holding Pond

In the eastern portion of Quadrant II, groundwater concerns focus on three areas: the X-701B Holding Pond, the X-230J7 Holding Pond, and the X-744Y Waste Storage Yard.

The X-701B Holding Pond was used from the beginning of plant operations in 1954 until November 1988. The pond was designed for neutralization and settlement of acid waste from several sources. Trichloroethane and trichloroethene were also discharged to the pond. Two surface impoundments (sludge retention basins) were located west of the holding pond. The X-230J7 Holding Pond received wastewater from the X-701B Holding Pond. The X-744Y Waste Storage Yard is south of the X-701B Holding Pond. The yard is approximately 15 acres and surrounds the X-744G Bulk Storage Building. RCRA hazardous waste was managed in this area.

A contaminated groundwater plume extends from the X-701B Holding Pond towards Little Beaver Creek. Three groundwater extraction wells were installed southeast of the X-701B Holding Pond as part of the ongoing RCRA closure of the unit. These wells were designed to intercept contaminated groundwater emanating from the holding pond area before it could join the existing groundwater contaminant plume. Extracted groundwater is processed at the X-623 Groundwater Treatment Facility and discharged through DOE NPDES Outfall 610, which flows to the USEC Sewage Treatment Plant. This facility also processes water recovered from a shallow sump in the bottom of the X-701B Holding Pond.

Two groundwater interceptor trenches (French drains) are used to intercept trichloroethene-contaminated groundwater emanating from X-701B. These interceptor trenches, called the X-237 Groundwater Collection System, have significantly reduced trichloroethene migration into Little Beaver Creek. The 660-foot-long primary trench has two sumps in the backfill, and a 440-foot-long secondary trench intersects the primary trench. The extracted groundwater is treated at the X-624 Groundwater Treatment Facility and discharges through DOE NPDES Outfall 015, which flows to Little Beaver Creek.

Remedial actions have begun in the X-701B Pond area to reduce concentrations of trichloroethene in soil and groundwater. Chapter 3, Section 3.2.2, provides additional information.

Thirty-four wells are sampled semiannually as part of the monitoring program for this area. An additional 11 wells are sampled annually or biennially. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.4.1 Monitoring results for the X-701B Holding Pond in 2007

The trichloroethene plume at this groundwater monitoring area contains the highest concentrations of trichloroethene measured in groundwater at PORTS, approximately 500,000 $\mu\text{g/L}$ in one of the groundwater monitoring wells near the middle of the plume. Numerous other volatile organics are also detected in samples collected from the monitoring wells in this area. The plume perimeter did not change significantly from 2006 to 2007 (see Figure 6.5). Additionally, the second trichloroethene plume in the X-701B monitoring area (the plume southwest of the X-744G Bulk Storage Building) did not change significantly in 2007.

In 2007, elevated concentrations of metals were detected in several monitoring wells in the western portion of the monitoring area: X701-09G, X701-14G, X701-74G, and X701-BW2G. Concentrations of metals in these wells are affected by the oxidant injections associated with the X-701B groundwater remedy (see Chapter 3, Section 3.2.2). The oxidant, which affects the chemical composition of the soil and/or groundwater, temporarily causes naturally-occurring metals in soil to be mobilized into the groundwater. Dissolved oxygen measurements were higher than typical in the groundwater in the vicinity of these wells, which indicates that the wells were affected by the oxidant. It is expected that the metals will move downgradient with groundwater flow for a short distance and then be re-adsorbed into the soil as the geochemistry of the soil and groundwater returns to typical conditions.

Samples from five wells in or near the X-744Y Storage Yard and X-744G Bulk Storage Building were analyzed for cadmium and nickel, which were detected above preliminary remediation goals in three of the five wells. These results are typical for the X-744 area wells.

Radionuclides were also detected in the groundwater in this area. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

6.4.5 X-633 Pumphouse/Cooling Towers Area

The X-633 Pumphouse/Cooling Towers Area consists of a recirculating water pumphouse and four cooling towers with associated basins. Chromium-based corrosion inhibitors were added to the cooling water until the early 1990s, when the system was converted to a phosphate-based inhibitor.

The X-633 Pumphouse/Cooling Towers Area was identified as an area of concern for potential metals contamination in 1996 based on historical analytical data for groundwater wells in this area. Samples from wells in this area were collected to assess the area for metals contamination. Based on the results of this study, this area was added to the PORTS groundwater monitoring program. Two wells are sampled semiannually for chromium as part of the monitoring program for this area.

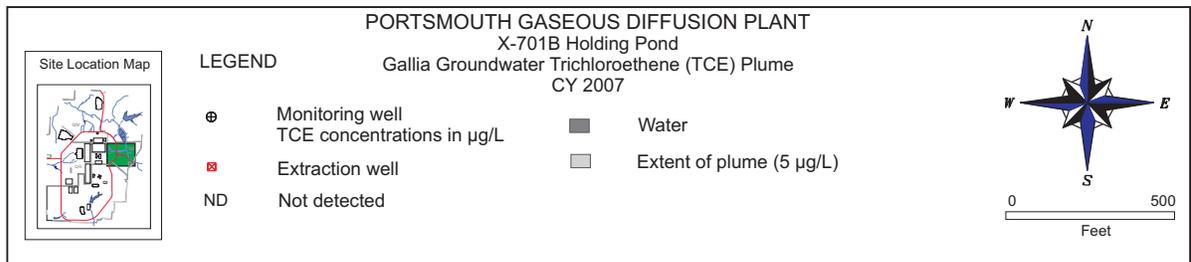
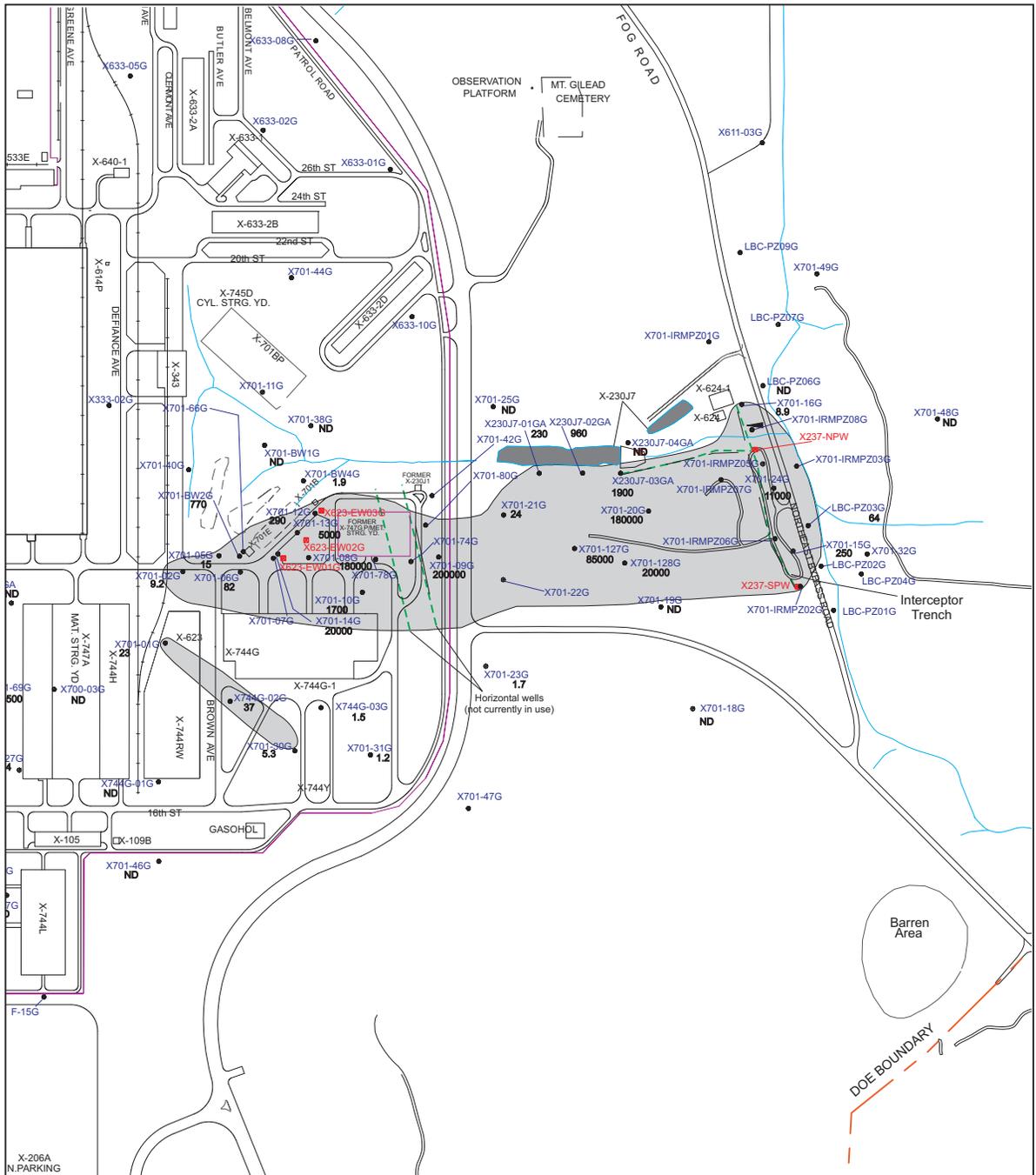


Figure 6.5. Trichloroethene-contaminated Gallia groundwater plume at the X-701B Holding Pond – 2007.

6.4.5.1 Monitoring results for the X-633 Pumphouse/Cooling Towers Area in 2007

Chromium was detected in both of the X-633 monitoring wells in 2007. Samples collected from well X633-07G contained chromium at concentrations above the preliminary remediation goal of 100 $\mu\text{g/L}$: 690 $\mu\text{g/L}$ (second quarter) and 500 $\mu\text{g/L}$ (fourth quarter). Samples collected from well X633-PZ04G also contained chromium but at levels well below the preliminary remediation goal. These results are typical for these wells. Figure 6.6 shows the chromium concentrations detected in the X-633 Pumphouse/Cooling Tower area wells.

6.4.6 X-616 Chromium Sludge Surface Impoundments

The X-616 Chromium Sludge Surface Impoundments were two unlined surface impoundments used from 1976 to 1985 for storage of sludge generated by the treatment of water from the PORTS process cooling system. A corrosion inhibitor containing chromium was used in the cooling water system. Sludge containing chromium was produced by the water treatment system and was pumped into and stored in the X-616 impoundments. The sludge was removed from the impoundments and remediated as an interim action in 1990 and 1991. The unit was certified closed in 1993. Seven wells are sampled annually and nine wells are sampled biennially as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.6.1 Monitoring results for the X-616 Chromium Sludge Surface Impoundments in 2007

Chromium is of special concern at the X-616 because of the previous use of the area. Chromium is routinely detected above the preliminary remediation goal (100 $\mu\text{g/L}$) in the samples collected from well X616-05G and was detected at 820 $\mu\text{g/L}$ in the sample collected in 2007. Chromium was not detected at concentrations above the preliminary remediation goal in any other X-616 well. Concentrations of chromium detected in well X616-05G have exceeded the preliminary remediation goal in previous years as well. Nickel was also detected above the preliminary remediation goal (100 $\mu\text{g/L}$ for Gallia wells) in two wells (X616-05G and X616-25G). Nickel is typically detected above the preliminary remediation goal in these two wells. Figure 6.7 shows the concentrations of chromium and nickel in wells at the X-616 Chromium Sludge Surface Impoundments.

Volatile organic compounds were detected at low levels in samples collected from six wells in this area. The only volatile organic compounds detected above the preliminary remediation goals were 1,1-dichloroethene and trichloroethene. Figure 6.7 shows the concentrations of trichloroethene detected in the X-616 wells. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

6.4.7 X-740 Waste Oil Handling Facility

The X-740 Waste Oil Handling Facility, which is located on the western half of PORTS south of the X-530A Switchyard, consists of two hazardous waste management units: the X-740 Waste Storage Facility and the X-740 Hazardous Waste Storage Tank (sump), which was located within the building. The X-740 facility, which operated from 1983 until 1991, was used as an inventory and staging facility for waste oil and waste solvents that were generated from various plant operational and maintenance activities. The tank/sump, which was operated until 1990, was used to collect residual waste oil and waste solvents from containers crushed in a hydraulic drum crusher at the facility. The facility and sump were initially identified as hazardous waste management units in 1991. The X-740 Waste Oil Handling Facility (both the facility and sump identified as hazardous waste management units) underwent closure, and closure certification was approved by Ohio EPA in 1998.

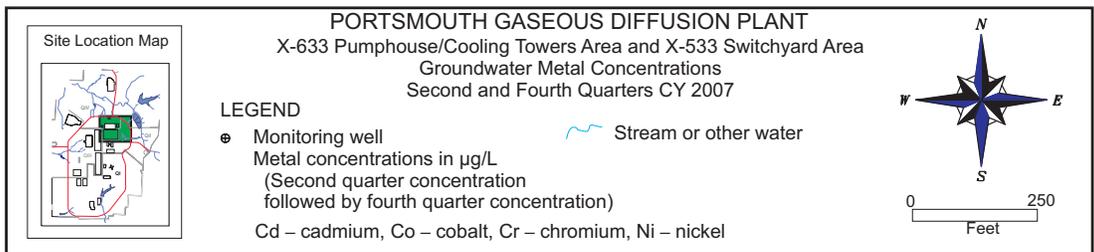
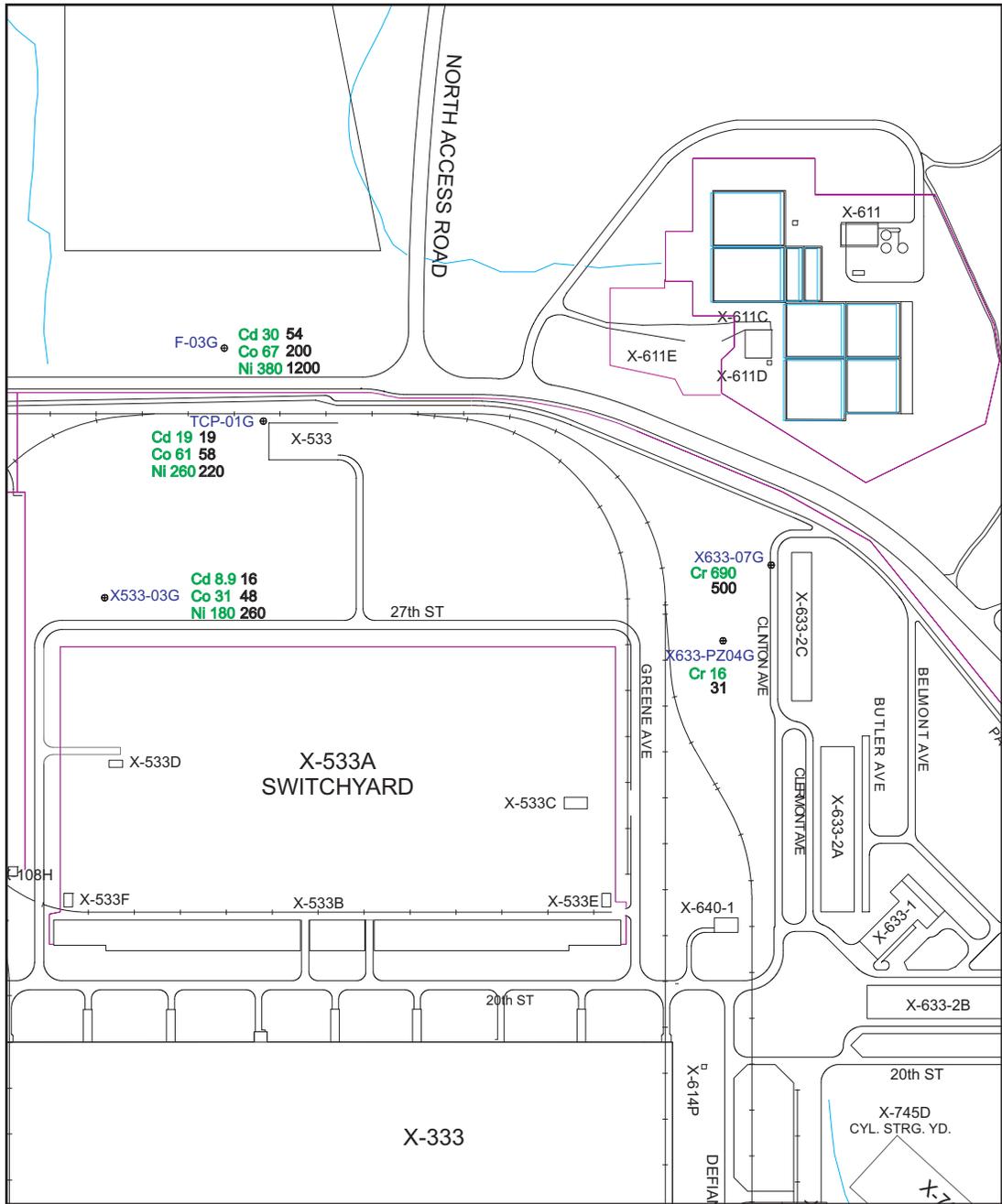


Figure 6.6. Metal concentrations in groundwater at the X-633 Pumhouse Cooling Towers Area and X-533 Switchyard Area – 2007.

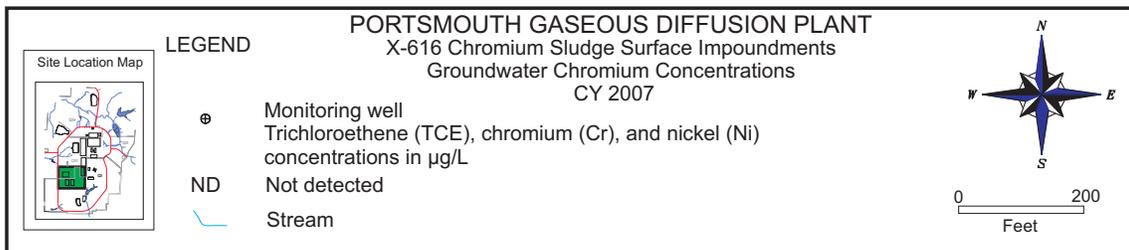
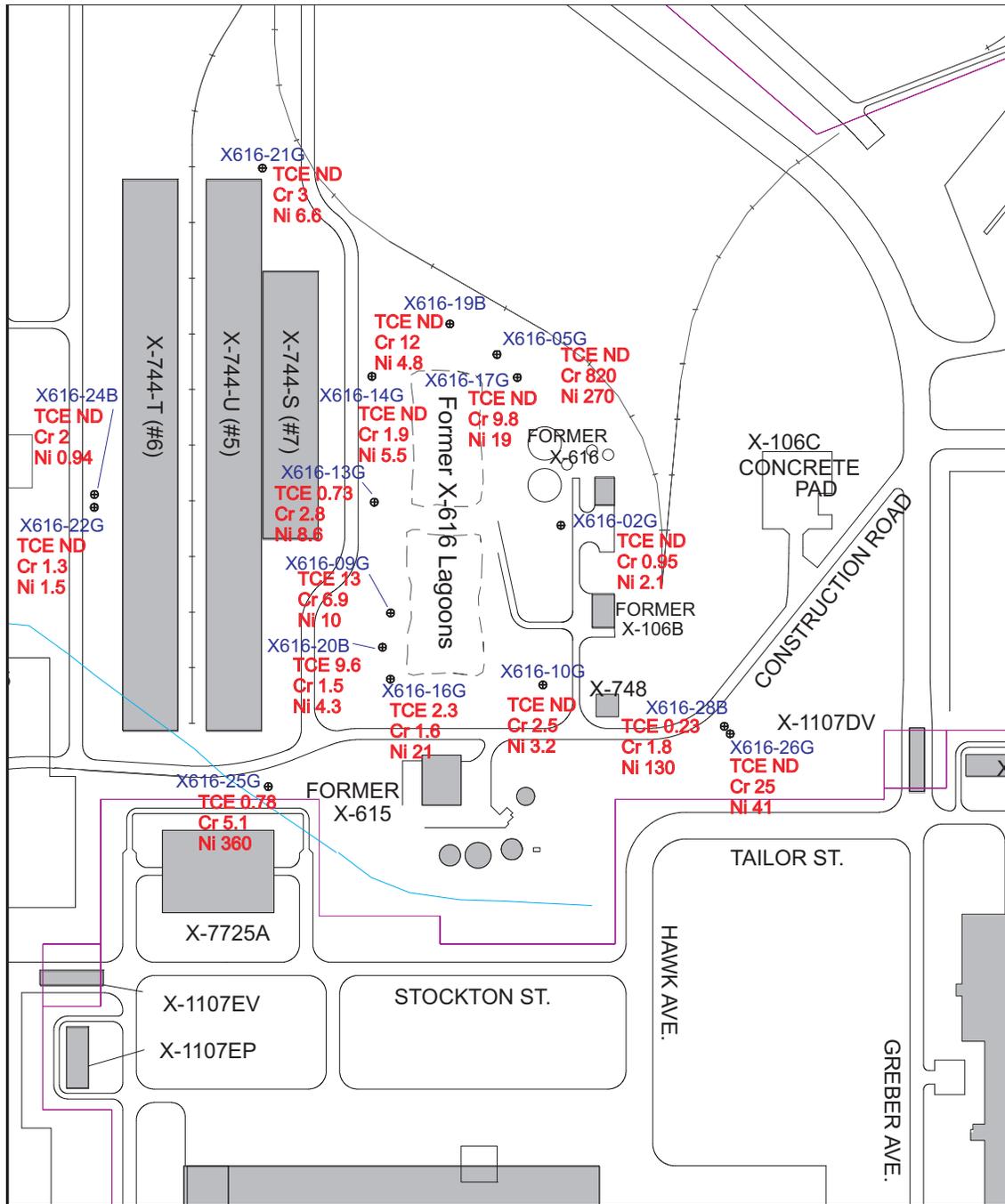


Figure 6.7. Trichloroethene, chromium, and nickel concentrations in groundwater at the X-616 Chromium Sludge Surface Impoundments – 2007.

In 1999, poplar trees were planted in a 2.6-acre area above the groundwater plume near the X-740 Waste Oil Handling Facility. This remediation technique, called phytoremediation, uses plants to remove or degrade contaminants in soil and groundwater. The monitoring program for the X-740 area includes monitoring of water levels around the trees to evaluate water usage by the trees, in addition to routine monitoring of groundwater wells for contaminants. Chapter 3, Section 3.2.3, provides additional information about this remediation.

Eleven wells are sampled semiannually, three wells are sampled annually, and four wells are sampled biennially as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.7.1 Monitoring results for the X-740 Waste Oil Handling Facility in 2007

A contaminated groundwater plume consisting of primarily trichloroethene is located near the X-740 Waste Oil Handling Facility (see Figure 6.8). Concentrations of trichloroethene detected in the X-740 wells, as well as the plume perimeter, were similar to data collected in previous years. Metals, including uranium, were detected at typical background levels below preliminary remediation goals. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

6.4.8 X-611A Former Lime Sludge Lagoons

The X-611A Former Lime Sludge Lagoons were comprised of three adjacent unlined sludge retention lagoons constructed in 1954 and used for disposal of lime sludge waste from the site water treatment plant from 1954 to 1960. The lagoons covered a surface area of approximately 18 acres and were constructed in a low-lying area that included Little Beaver Creek. As a result, approximately 1500 feet of Little Beaver Creek was relocated to a channel just east of the lagoons.

As part of the RCRA Corrective Action Program, a prairie habitat has been developed in this area by placing a soil cover over the north, middle, and south lagoons. A soil berm was also constructed outside the northern boundary of the north lagoon to facilitate shallow accumulation of water in this low-lying area. Chapter 3, Section 3.2.4, provides more information about this remediation. Six wells are sampled semiannually as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.8.1 Monitoring results for the X-611A Former Lime Sludge Lagoons in 2007

The six monitoring wells at X-611A (see Figure 6.9) are sampled and analyzed for beryllium and chromium. In 2007, chromium was detected in each well in this area at concentrations between 0.71 and 3.4 $\mu\text{g/L}$. These results are below the preliminary remediation goal (100 $\mu\text{g/L}$).

Beryllium was detected in both samples collected from well F-07G at 1.4 $\mu\text{g/L}$ (first quarter) and 7.8 $\mu\text{g/L}$ (third quarter). The result for the third quarter is above the preliminary remediation goal (6.5 $\mu\text{g/L}$ for Gallia wells), and the result for the first quarter sample is below the preliminary remediation goal. Samples collected from well F-07G routinely contain beryllium at concentrations just below or just above the preliminary remediation goal. Beryllium was not detected above the preliminary remediation goal in any other samples collected from X-611A wells in 2007.

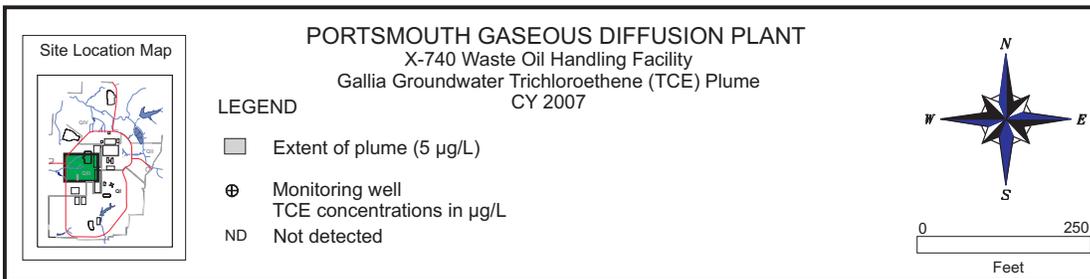
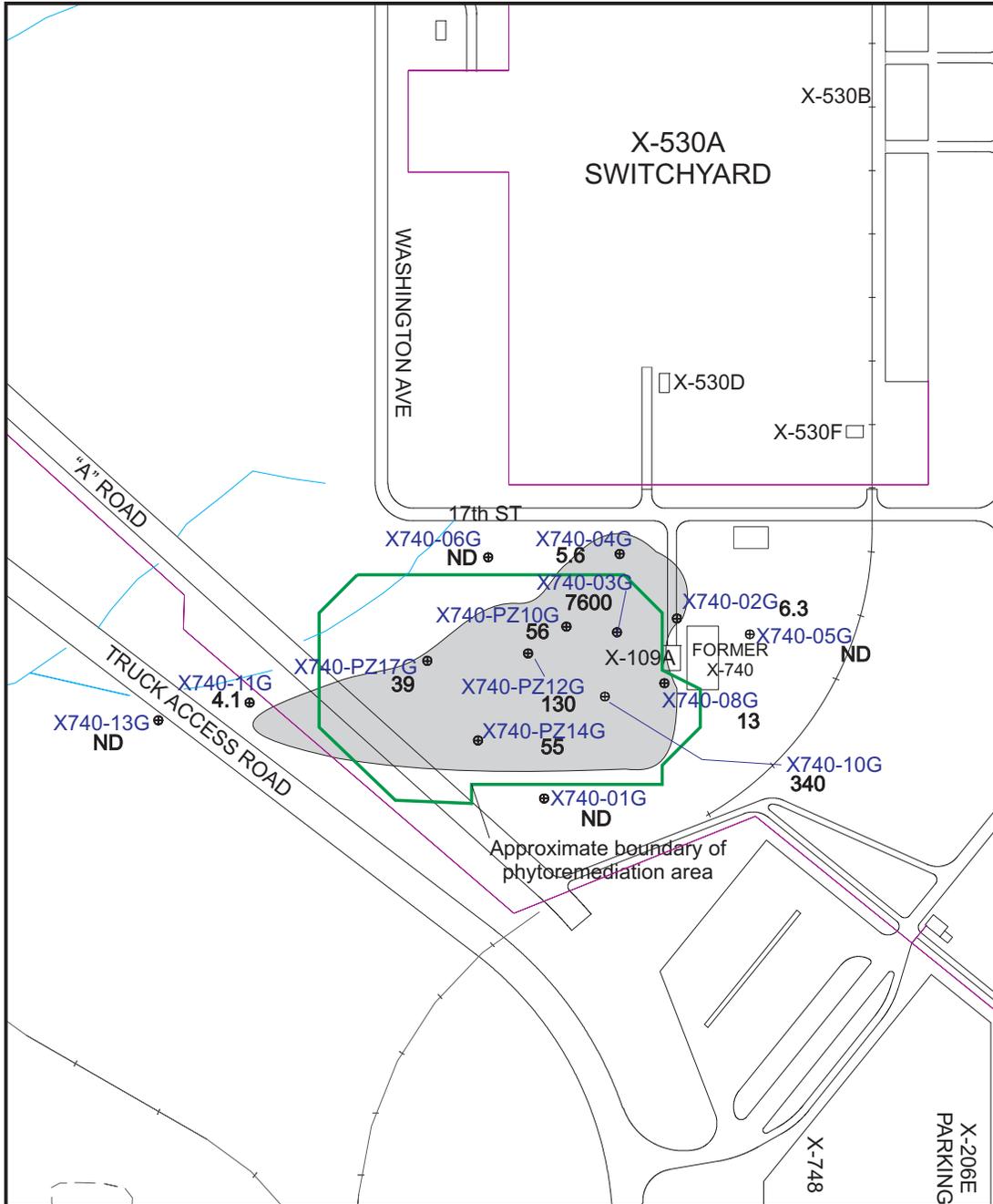


Figure 6.8. Trichloroethene-contaminated Gallia groundwater plume near the X-740 Waste Oil Handling Facility – 2007.

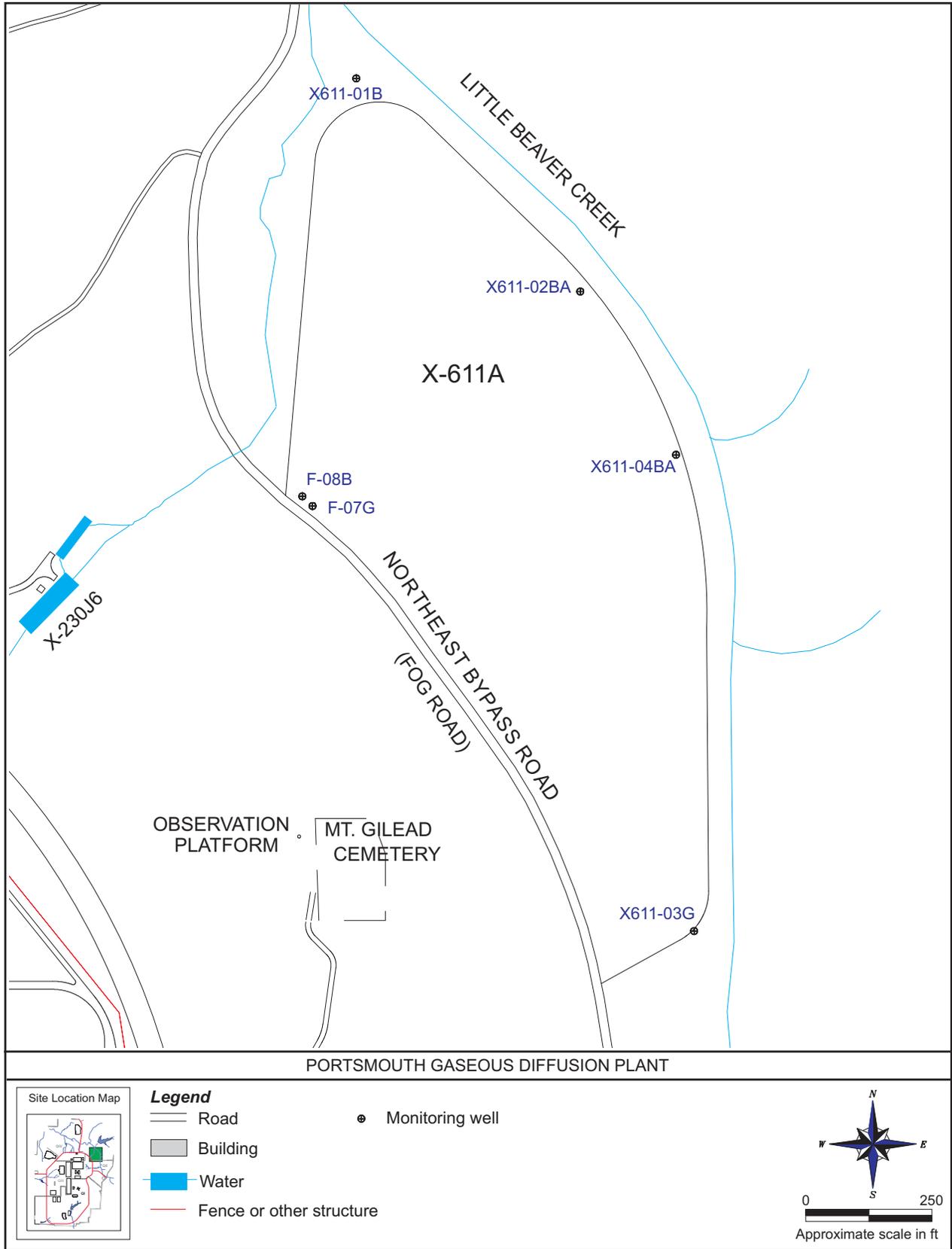


Figure 6.9. Monitoring wells at the X-611A Former Lime Sludge Lagoons.

6.4.9 X-735 Landfills

Several distinct waste management units are contained within the X-735 Landfills area. The main units consist of the hazardous waste landfill, referred to as the X-735 Landfill (Northern Portion), and the X-735 Industrial Solid Waste Landfill. The X-735 Industrial Solid Waste Landfill includes the industrial solid waste cells, asbestos disposal cells, and the closed chromium sludge monocells A and B. The chromium sludge monocells contain a portion of the chromium sludge generated during the closure of the X-616 Chromium Sludge Surface Impoundments.

Initially, a total of 17.9 acres was approved by the Ohio EPA and Pike County Department of Health for landfill disposal of conventional solid wastes. The landfill began operation in 1981. During operation of the landfill, PORTS investigations indicated that wipe rags contaminated with solvents had inadvertently been disposed in the northern portion of the landfill. The contaminated rags were considered a hazardous waste. Waste disposal in the northern area ended in December 1991, and Ohio EPA determined that the area required closure as a RCRA hazardous waste landfill. Consequently, this unit of the sanitary landfill was identified as the X-735 Landfill (Northern Portion).

A buffer zone was left unexcavated to provide space for groundwater monitoring wells and a space between the RCRA landfill unit and the remaining southern portion, the X-735 Industrial Solid Waste Landfill. Routine groundwater monitoring has been conducted at the X-735 Landfills since 1991.

The industrial solid waste portion of the X-735 Landfills included a solid waste section and an asbestos waste section. The X-735 Industrial Solid Waste Landfill, not including the chromium sludge monocells, encompasses a total area of approximately 4.1 acres. Operation of the X-735 Industrial Solid Waste Landfill ceased in 1997; this portion of the landfill was capped in 1998.

The *Integrated Groundwater Monitoring Plan* incorporates monitoring requirements for the hazardous and solid waste portions of the X-735 Landfills. Eighteen wells are sampled semiannually under the routine monitoring program for this area. Five additional wells are part of the assessment monitoring program for this area. Table 6.1 lists the analytical parameters and Figure 6.10 shows the monitoring wells in this area.

6.4.9.1 Monitoring results for the X-735 Landfills in 2007

Statistical evaluations of data collected from wells at the X-735 Landfills are completed to monitor the landfill for releases. Assessment monitoring at the X-735 Landfills began in 2004 and continued through 2007 because of exceedences in the control limits for several monitoring parameters at several of the Gallia monitoring wells for the X-735 Landfills. Assessment monitoring is intended to determine the concentration, rate, and extent of migration of contaminants in the groundwater. The Ohio EPA concluded that a small release of leachate constituents is occurring, or has occurred from the X-735 Landfills. Although DOE could not determine conclusively whether a release is occurring or has occurred through assessment monitoring, DOE moved forward and developed the *Corrective Measures Plan for the X-735 Landfill* in 2006. Ohio EPA had not approved this plan by the end of 2007.

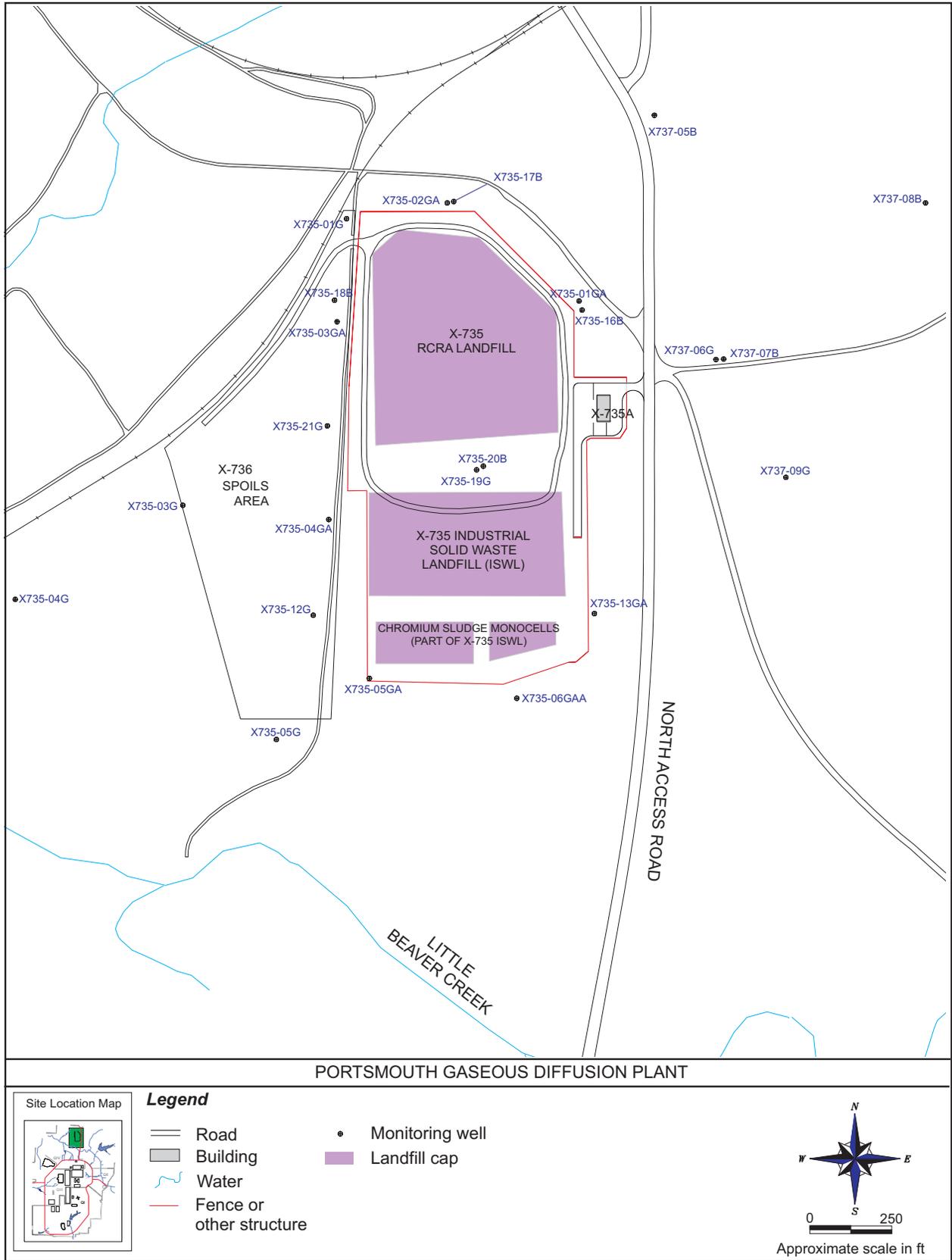


Figure 6.10. Monitoring wells at the X-735 Landfills.

In addition to assessment monitoring, routine monitoring required by the *Integrated Groundwater Monitoring Plan* was completed during 2007. Samples collected during the second quarter of 2007 were analyzed for volatile organic compounds. No volatile organics were detected in the routine X-735 samples collected in the second quarter of 2007 with the exception of benzene in the sample collected from well X735-01GA. This result was qualified with a “B,” which indicates that benzene was also detected in the laboratory blank associated with the sample. The detection of benzene is most likely present due to laboratory contamination and not indicative of a release.

No transuranic radionuclides or technetium-99 were detected in the X-735 wells sampled during 2007.

6.4.10 X-734 Landfills

The X-734 Landfills consisted of three landfill units that were used until 1985. Detailed records of materials disposed in the landfills were not kept. However, wastes known to be disposed at the landfills included trash and garbage, construction spoils, wood and other waste from clearing and grubbing, and empty drums. Other materials reportedly disposed in the landfills may have included waste contaminated with metals, empty paint cans, and uranium-contaminated soil from the X-342 area.

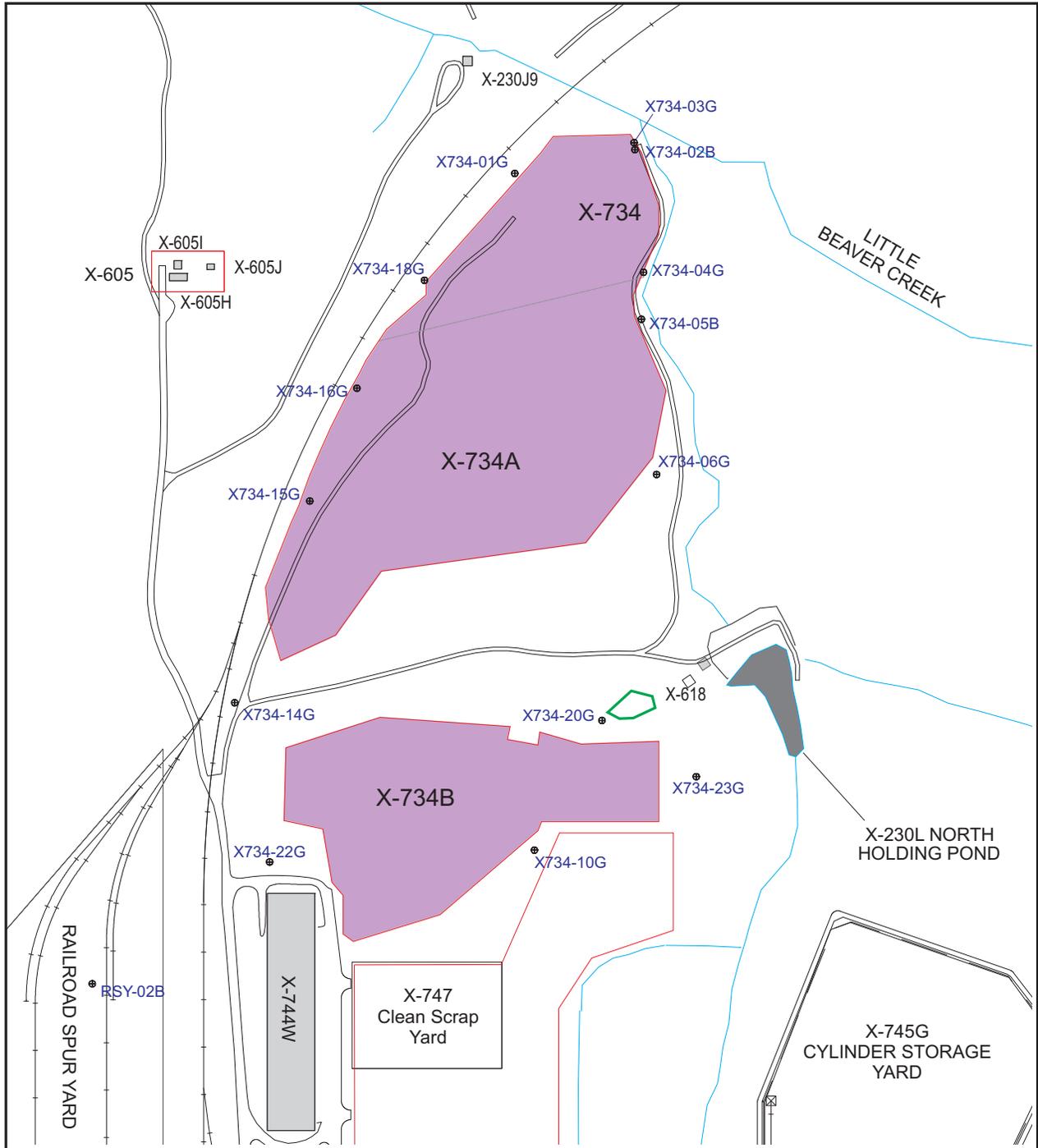
The X-734 Sanitary Landfill was closed in accordance with the solid waste regulations in effect at that time, and no groundwater monitoring of the unit was required. The X-734 Landfills were capped in 1999-2000 as part of the remedial actions required for Quadrant IV. Chapter 3, Section 3.2.4, provides more information about the remedial actions for this area.

Fifteen wells (see Figure 6.11) are sampled semiannually as part of the monitoring program for this area. Table 6.1 lists the monitoring parameters for the wells in this area.

6.4.10.1 Monitoring results for the X-734 Landfills in 2007

Volatile organic compounds (not including sample contaminants acetone and methylene chloride) were detected in samples collected from five wells in the X-734 monitoring area in 2007. Vinyl chloride is the only compound that equaled or exceeded the preliminary remediation goal ($2 \mu\text{g/L}$). In the second quarter and fourth quarter samples collected from well X734-23G, vinyl chloride was detected at 4.2 and $2 \mu\text{g/L}$, respectively. The presence of vinyl chloride, *cis*-1,2-dichloroethene, and *trans*-1,2-dichloroethene in well X734-23G, along with the low concentrations or absence of trichloroethene, may indicate that trichloroethene is breaking down naturally beneath the X-734 Landfills.

Cobalt is also monitored in the X-734 Landfills area. Cobalt was detected in five wells in 2007 (X734-01G, X734-06G, X734-15G, X734-16G, and X734-23G) at concentrations exceeding the preliminary remediation goal of $13 \mu\text{g/L}$ for Gallia wells. These detections ranged from 14 to $100 \mu\text{g/L}$ and are typical for these wells. Additional inorganics (metals) and radionuclides were also detected in 2007. Control and monitoring of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.



PORTSMOUTH GASEOUS DIFFUSION PLANT

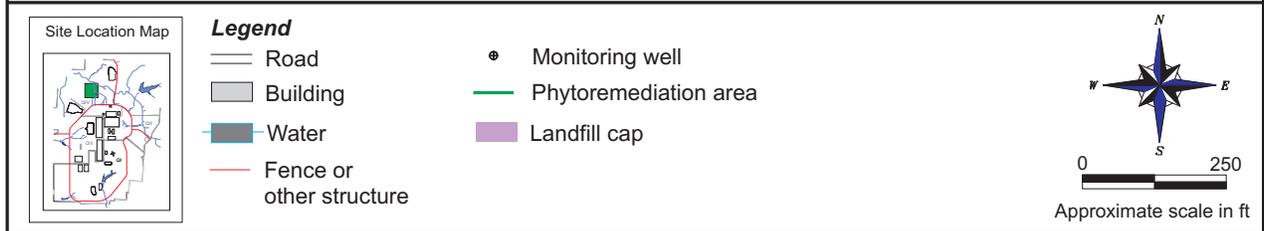


Figure 6.11. Monitoring wells at the X-734 Landfills.

6.4.11 X-533 Switchyard Area

The X-533 Switchyard Area consists of a switchyard containing electrical transformers and circuit breakers, associated support buildings, and a transformer cleaning pad. The groundwater area of concern is located north of the switchyard and associated support buildings near the transformer cleaning pad.

The X-533 Switchyard Area was identified as an area of concern for potential metals contamination in 1996 based on historical analytical data for groundwater wells in this area. Samples from wells in this area were collected to assess the area for metals contamination. The area was added to the PORTS groundwater monitoring program because the study identified three metals (cadmium, cobalt, and nickel) that may have contaminated groundwater in this area. Three wells are sampled semiannually for cadmium, cobalt, and nickel.

6.4.11.1 Monitoring results for the X-533 Switchyard Area in 2007

Two Gallia wells that monitor the X-533 Switchyard Area (see Figure 6.6) were sampled in the second and fourth quarters of 2007 and analyzed for cadmium, cobalt, and nickel. Each of the well samples contained these metals at concentrations above the preliminary remediation goals (6.5 $\mu\text{g/L}$ for cadmium, 13 $\mu\text{g/L}$ for cobalt, and 100 $\mu\text{g/L}$ for nickel). Concentrations of cadmium detected in the wells ranged from 8.9 to 54 $\mu\text{g/L}$, concentrations of cobalt detected in the wells ranged from 31 to 200 $\mu\text{g/L}$, and concentrations of nickel detected in the wells ranged from 180 to 1200 $\mu\text{g/L}$.

6.4.12 Surface Water Monitoring

Surface water monitoring is conducted in conjunction with groundwater assessment monitoring to determine if contaminants present in groundwater are detected in surface water samples. Surface water is collected quarterly from 13 locations (see Figure 6.12). Surface water samples are analyzed for the parameters listed in Table 6.1. The purpose for each surface water monitoring location is described as follows:

- Little Beaver Creek and East Drainage Ditch sample locations LBC-SW01, LBC-SW02, and EDD-SW01 assess possible X-701B area plume groundwater discharges.
- Little Beaver Creek sample location LBC-SW03 assesses potential contamination from the Former X-611A Lime Sludge Lagoons.
- Big Run Creek sample locations BRC-SW01 and BRC-SW02 assess potential groundwater discharges from the Quadrant I Groundwater Investigative Area plume and the PK Landfill area to the X-230K Holding Pond (Quadrant I Groundwater Investigative Area only) and Big Run Creek.
- Southwestern Drainage Ditch sample locations UND-SW01 and UND-SW02 assess potential groundwater releases to this creek and the X-2230M Holding Pond from the western portion of the X-749/X-120 groundwater plume.
- 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.

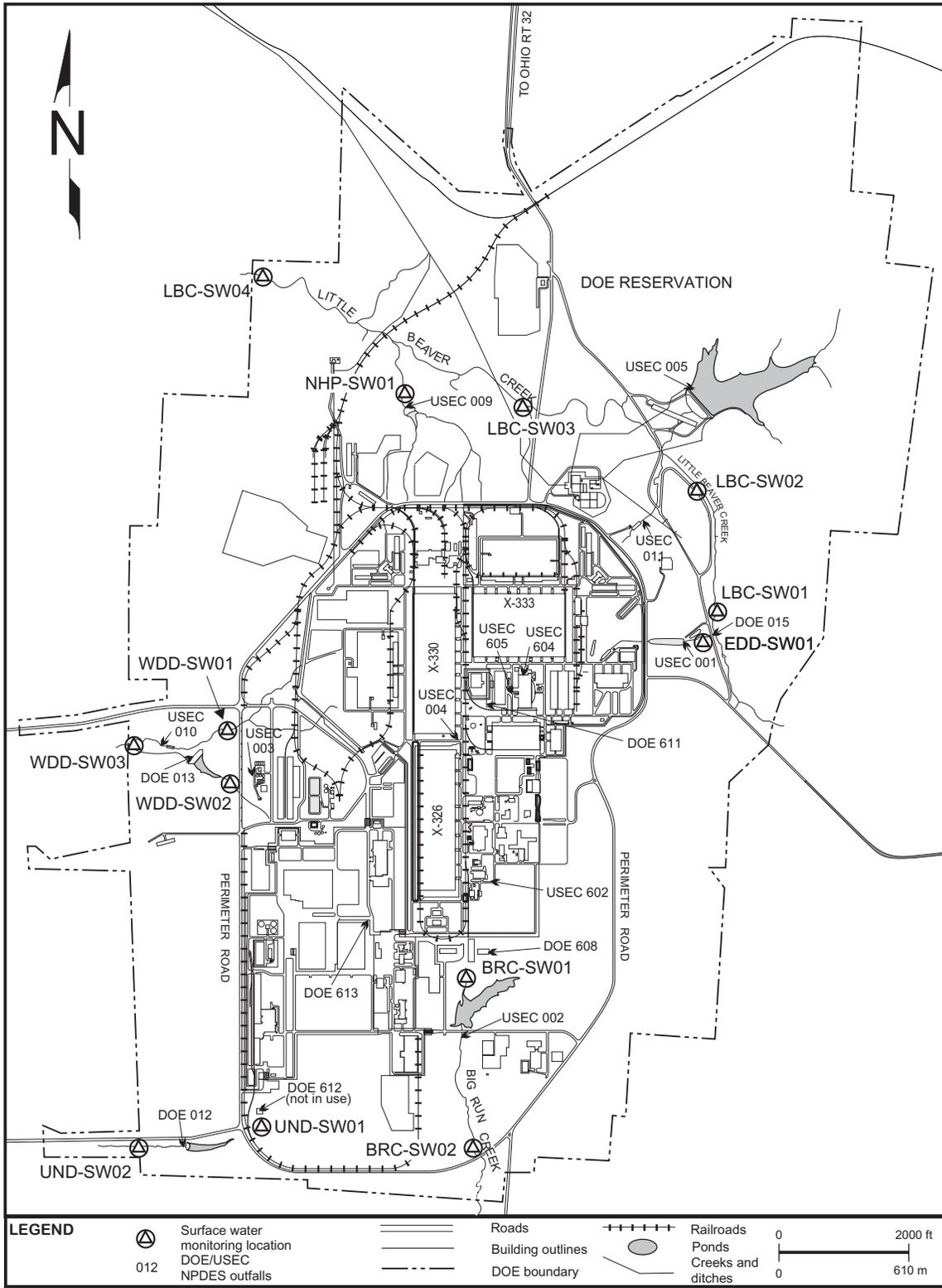


Figure 6.12. Surface water monitoring locations.

- 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 Holding Pond.

6.4.12.1 Monitoring results for surface water in 2007

Trihalomethanes are a category of volatile organic compounds that are byproducts of water chlorination and include bromodichloromethane, bromoform, chloroform, and dibromochloromethane. These compounds are detected at most of the surface water sampling locations because the streams receive discharges that contain chlorinated water from the PORTS NPDES outfalls. These detections were well below the applicable Ohio EPA water quality criteria for the protection of human health in the Ohio River drainage basin (bromodichloromethane – 460 $\mu\text{g/L}$; bromoform – 3600 $\mu\text{g/L}$; chloroform – 4700 $\mu\text{g/L}$; and dibromochloromethane – 340 $\mu\text{g/L}$).

Since 1990, trichloroethene has been detected regularly at low levels in samples collected from the Southwestern Drainage Ditch (UND-SW01, located inside the perimeter road). In 2007, trichloroethene was detected at concentrations ranging from 2.3 to 7.1 $\mu\text{g/L}$ in the four samples collected from the Southwestern Drainage Ditch at UND-SW01. Other volatile organics detected in one or more samples collected at UND-SW01 are 1,1-dichloroethane, 1,1-dichloroethene, *cis*-1,2-dichloroethene, and trichlorofluoromethane. Each of these detections were estimated at concentrations of less than 1 $\mu\text{g/L}$. Concentrations of volatile organic compounds detected at the Southwestern Drainage Ditch sampling location UND-SW01 were below applicable Ohio EPA water quality criteria (if available) for the protection of human health in the Ohio River drainage basin. These criteria are 810 $\mu\text{g/L}$ for trichloroethene and 32 $\mu\text{g/L}$ for 1,1-dichloroethene. No volatile organics were detected at UND-SW02, which is downstream from UND-SW01.

In the first quarter of 2007, trichloroethene and *cis*-1,2-dichloroethene were detected at estimated concentrations of less than 0.6 $\mu\text{g/L}$ and 0.3 $\mu\text{g/L}$, respectively, in the samples collected from East Drainage Ditch sampling location EDD-SW01 and Little Beaver Creek sampling locations LBC-SW01 and LBC-SW02. Trichloroethene (7.4 $\mu\text{g/L}$) and *cis*-1,2-dichloroethene (1.6 $\mu\text{g/L}$) were detected in the second quarter sample collected from EDD-SW01. Trichloroethene and *cis*-1,2-dichloroethene were also detected at estimated concentrations of less than 1 $\mu\text{g/L}$ in the second quarter samples collected from Little Beaver Creek sampling locations LBC-SW01 and LBC-SW02. Neither of these volatile organics were detected in first or second quarter samples collected from downstream Little Beaver Creek sampling locations LBC-SW03 and LBC-SW04. No volatile organics (except trihalomethanes) were detected in the third or fourth quarter samples collected from the East Drainage Ditch or Little Beaver Creek. Additionally, trichloroethene was detected at an estimated concentration of 0.35 $\mu\text{g/L}$ in the second quarter sample collected from Big Run Creek sampling location BRC-SW01. The detections of trichloroethene were well below the applicable Ohio EPA water quality criterion for trichloroethene (810 $\mu\text{g/L}$) for the protection of human health in the Ohio River drainage basin.

Discharges of trichloroethene in 2007 from DOE NPDES Outfall 015, which discharges to Little Beaver Creek, were all below the discharge limitation set by Ohio EPA. None of the compounds detected in these samples was detected at sampling location LBC-SW04, which monitors Little Beaver Creek at the PORTS boundary indicating that these compounds were not present in the surface water exiting the PORTS site.

Surface water samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). No transuranics were detected in the surface water samples collected during 2007.

In the first quarter of 2007, technetium-99 was detected at 31.4 pCi/L in the sample collected from East Drainage Ditch sampling location EDD-SW01 and at activities ranging from 8.83 to 14.7 pCi/L in Little Beaver Creek. In the second quarter of 2007, technetium-99 was detected at 39.7 pCi/L in the sample collected from East Drainage Ditch sampling location EDD-SW01 and at activities ranging from 10.4 to 12.6 pCi/L in Little Beaver Creek. Technetium-99 is occasionally detected at these locations. Technetium-99 was not detected in any of the surface water samples collected during the third or fourth quarters of 2007. These detections are well below the EPA drinking water standard for technetium-99 (900 pCi/L, based on a 4 mrem/year dose from beta emitters).

Uranium was routinely detected in surface water samples at concentrations similar to those detected in previous years. Because uranium occurs naturally in rocks and soil, some or all of the uranium detected in these samples may be due to naturally-occurring uranium. Detections of uranium and uranium isotopes in surface water samples in 2007 were well below the DOE derived concentration guide for the respective uranium isotope in drinking water (500 pCi/L for uranium-233/234 and 600 pCi/L for uranium-235 and uranium-238).

6.4.13 Water Supply Monitoring

Routine monitoring of residential drinking water sources is completed at PORTS in accordance with the requirements of Section VIII of the September 1989 Consent Decree between the State of Ohio and DOE and the Residential Groundwater Monitoring Requirements contained in the *Integrated Groundwater Monitoring Plan*.

The purpose of the program is to determine whether residential drinking water sources have been adversely affected by plant operations. Although this program may provide an indication of contaminant transport off site, it should not be interpreted as an extension of the on-site groundwater monitoring program, which bears the responsibility for detection of contaminants and determining the rate and extent of contaminant movement. Data from this program will not be used in environmental investigations due to the lack of knowledge of how residential wells were constructed and due to the presence of various types of pumps (which may not be ideal equipment for sampling).

Five residential drinking water sources participated in the program in 2007 (see Figure 6.13). Wells are sampled semiannually with two samples collected from each well: a regular sample and a duplicate sample. Each sample is analyzed for the parameters listed in Table 6.1. The PORTS water supply (RES-012 on Figure 6.14) is also sampled as part of this program. Sampling locations may be added or deleted if requested by a resident and as program requirements dictate. Typically, sampling locations are deleted when a resident obtains a public water supply.

In the first quarter, trichloroethene was detected at an estimated concentration of 0.36 $\mu\text{g/L}$ in the regular sample collected at location RES-004 (south of PORTS on the east side of Big Run Creek). Trichloroethene was undetected at a detection limit of 0.16 $\mu\text{g/L}$ in the duplicate sample collected from RES-004. These detections cannot be related to PORTS groundwater contamination because the water-bearing formations are not hydrogeologically connected. The detections are less than the EPA drinking water standard for trichloroethene (5 $\mu\text{g/L}$).

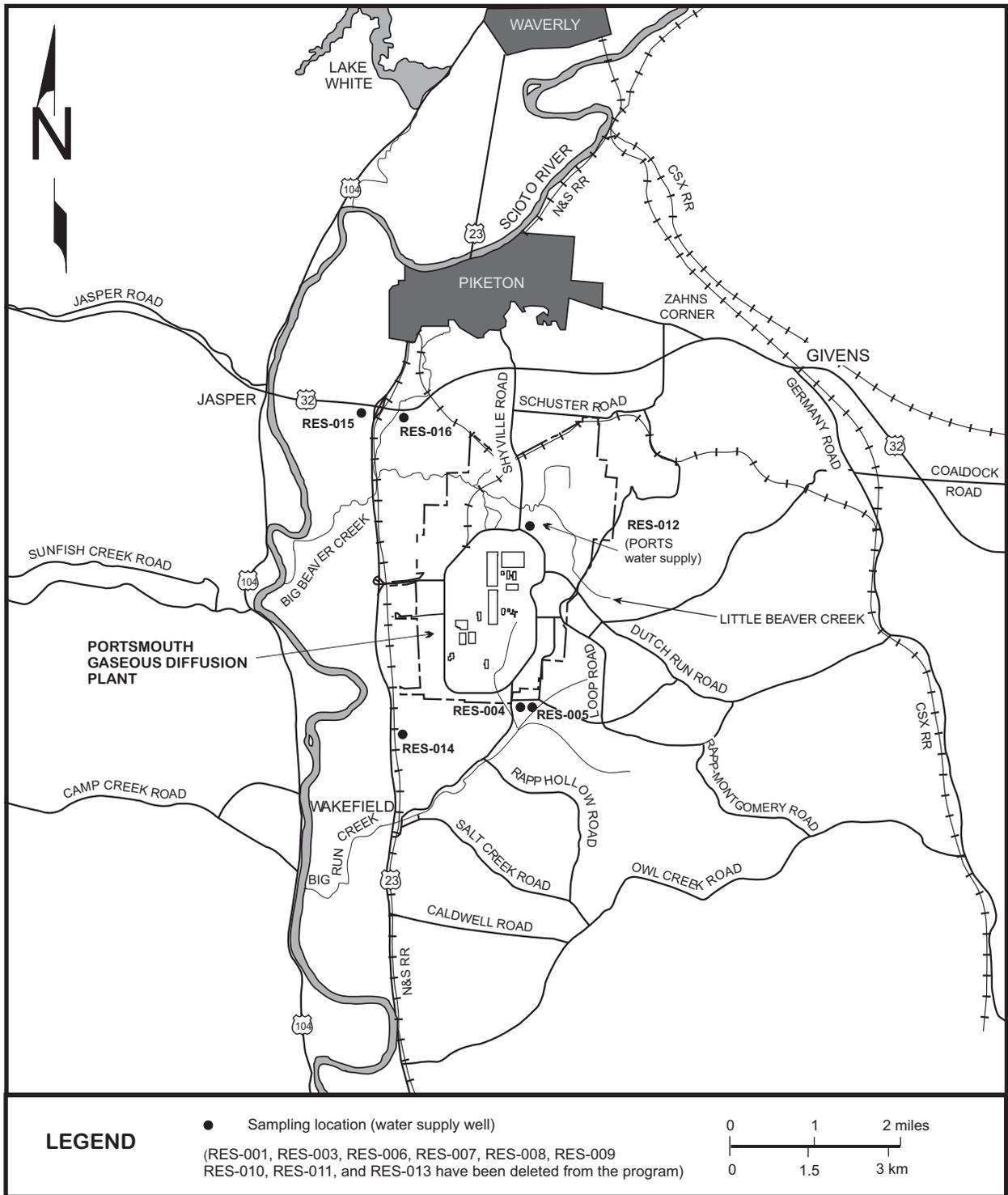


Figure 6.13. Water supply monitoring locations.

No other volatile organic compounds were detected in the water supply samples collected during 2007.

Metals detected in the water supply samples were within naturally-occurring concentrations found in the area. No transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) or technetium-99 were detected in any of the water supply samples collected in 2007. Low levels of uranium and uranium isotopes detected in some of the wells are consistent with naturally-occurring concentrations found in groundwater in the area.

6.5 DOE ORDER MONITORING PROGRAMS

The surveillance monitoring program at DOE PORTS consists of exit pathway monitoring. Exit pathway monitoring assesses the effect of the facility on off-site surface water and groundwater quality.

6.5.1 Exit Pathway Monitoring

Selected locations on local streams and drainage channels near the PORTS boundary are sampling points of the exit pathway monitoring program because surface water from PORTS NPDES outfalls and groundwater discharge to these surface waters. Monitoring wells near the PORTS boundary are also used in the exit pathway monitoring program. Figure 6.14 shows the sampling locations for exit pathway monitoring and Table 6.1 lists the analytical parameters.

Surface water sampling points on Big Run Creek (BRC-SW02), Little Beaver Creek (LBC-SW04), Southwestern Drainage Ditch (UND-SW02), and Western Drainage Ditch (WDD-SW03) are part of the exit pathway monitoring program. Trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in chlorinated drinking water, were detected in samples collected from the Western Drainage Ditch at concentrations well below Ohio EPA non-drinking water quality criteria for trihalomethanes for the protection of human health in the Ohio River drainage basin (see Section 6.4.12.1).

Technetium-99 was detected at 14.7 and 10.4 pCi/L in the first and second quarter samples collected from LBC-SW04, which are less than the EPA drinking water standard for technetium-99 (900 pCi/L, based on a 4 mrem dose from beta emitters).

Metals, including uranium, were detected at concentrations consistent with background concentrations for these parameters. Section 6.4.12.1 provides additional information for these monitoring results.

In 2007, volatile organic compounds, including trichloroethene, were detected on site in three of the exit pathway groundwater monitoring wells (X749-44G, X749-45G, and X749-97G) that monitor the X-749 South Barrier Wall and are part of the monitoring program for the X-749/X-120/PK Landfill monitoring area (see Figure 6.2 and Section 6.4.1.3). Concentrations of trichloroethene detected in the samples from these on-site wells were 34 and 33 $\mu\text{g/L}$ in well X749-44G, 80 and 17 $\mu\text{g/L}$ in well X749-45G, and 13 to 110 $\mu\text{g/L}$ in well X749-97G. These detections exceed the EPA drinking water standard for trichloroethene (5 $\mu\text{g/L}$); however, these monitoring wells are located within the PORTS boundary. Four new extraction wells were installed in the X-749 South Barrier Wall area during 2007 and began operating on June 29th. Trichloroethene detected in on-site well X749-97G decreased from 110 $\mu\text{g/L}$ in the second quarter (prior to operation of the extraction wells) to 13 $\mu\text{g/L}$ in the fourth quarter of 2007.

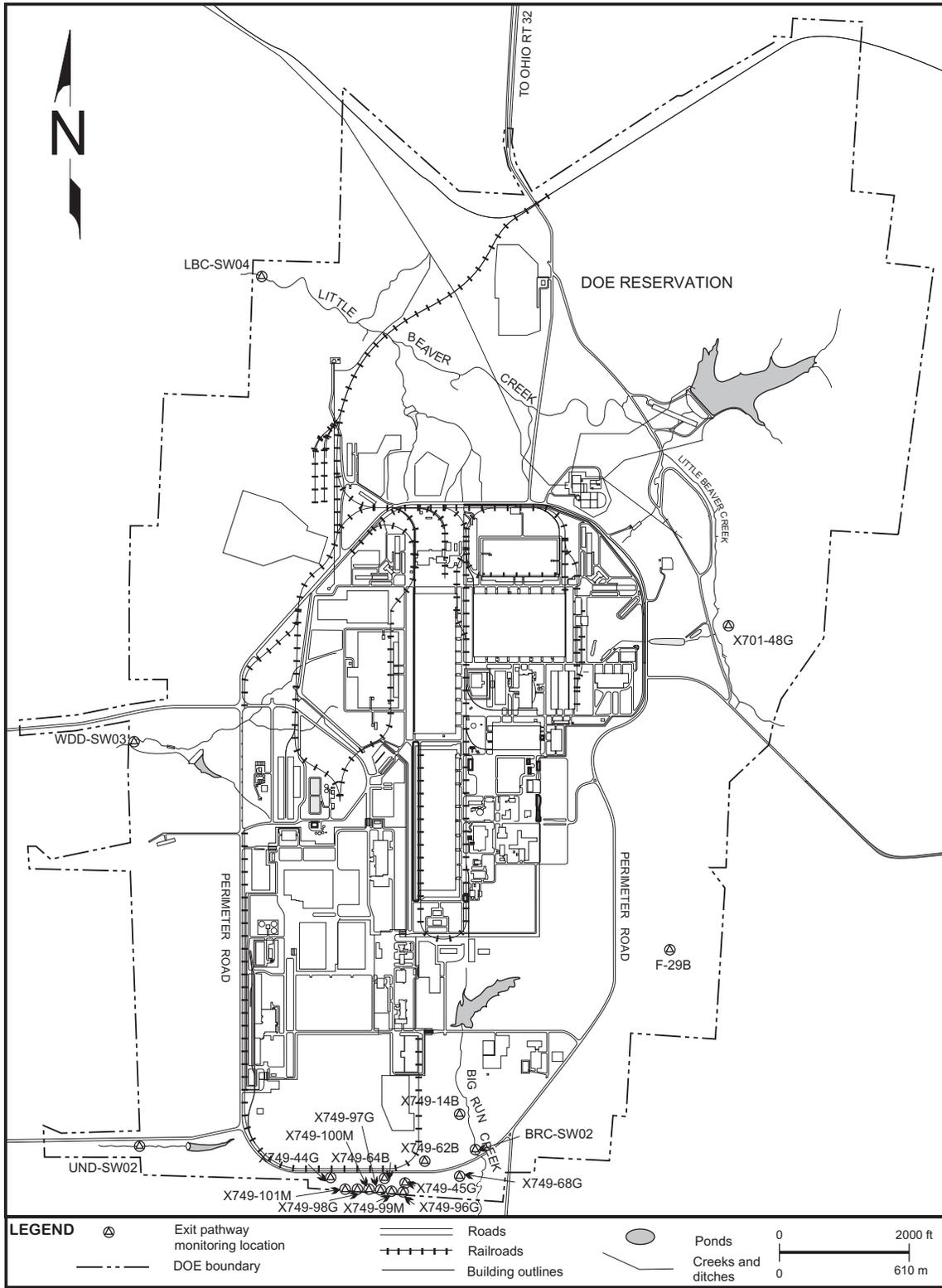


Figure 6.14. Exit pathway monitoring locations.

No transuranics were detected in exit pathway monitoring wells sampled for radionuclides during 2007. Technetium-99 was detected at 24.5 pCi/L in the fourth quarter sample collected from well X749-44G, which is less than the EPA drinking water standard for technetium-99 (900 pCi/L, based on a 4 mrem dose from beta emitters), Technetium-99 has been detected previously at similar levels in samples collected from well X749-44G.

6.6 GROUNDWATER TREATMENT FACILITIES

In 2007, a combined total of approximately 27.6 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 65 gallons of trichloroethene were removed from the water. All processed water is discharged through NPDES outfalls before exiting PORTS. Facility information is summarized in Table 6.2.

Table 6.2. Summary of trichloroethene removed by DOE PORTS groundwater treatment facilities in 2007

Facility	Gallons of water treated	Gallons of TCE removed
X-622	14,162,520	2
X-623	2,793,900	33
X-624	2,764,420	12
X-627	7,857,198	18

6.6.1 X-622 Groundwater Treatment Facility

The X-622 Groundwater Treatment Facility consists of an air stripper with aqueous-phase activated carbon filtration. This facility processes groundwater from the following systems in Quadrant I:

- Groundwater collection system and associated sump (X749-WPW) on the southwest boundary of the X-749 Landfill;
- Groundwater extraction wells installed in 2007 in the X-749 South Barrier Wall area;
- Groundwater collection system and associated sumps (PK-PL6 and PK-PL6A) on the eastern boundary of the PK Landfill; and
- Fourteen extraction wells located in the Quadrant I Groundwater Investigative Area.

The facility processed approximately 14.2 million gallons of groundwater during 2007, thereby removing approximately 2 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 608, which flows to the USEC Sewage Treatment Plant. No NPDES permit limitations were exceeded at Outfall 608 in 2007.

6.6.2 X-623 Groundwater Treatment Facility

The X-623 Groundwater Treatment Facility consists of an air stripper with offgas activated carbon filtration and aqueous-phase activated carbon filtration. The X-623 Groundwater Treatment Facility treats trichloroethene-contaminated groundwater from a sump in the bottom of the X-701B Holding Pond and three groundwater extraction wells (X623-EW01G, X623-EW02G, and X623-EW03G) east of the holding pond.

The facility treated approximately 2.8 million gallons of water during 2007, thereby removing approximately 33 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 610, which flows to the USEC Sewage Treatment Plant. No NPDES permit limitations were exceeded at Outfall 610 in 2007.

6.6.3 X-624 Groundwater Treatment Facility

At the X-624 Groundwater Treatment Facility, groundwater is treated via an air stripper with offgas activated carbon filtration and aqueous-phase activated carbon filtration. This facility processes trichloroethene-contaminated groundwater from the X-701B groundwater plume, specifically the X-237 Groundwater Collection System, which consists of north-south and east-west collection trenches and sumps #1 and #2.

The X-624 Groundwater Treatment Facility treated approximately 2.8 million gallons of water in 2007, thereby removing approximately 12 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 015, which discharges to Little Beaver Creek. No NPDES permit limitations were exceeded at Outfall 015 in 2007.

6.6.4 X-625 Groundwater Treatment Facility

On July 9, 2003, the X-625 Groundwater Treatment Facility was placed on stand-by with approval from Ohio EPA. The X-625 Groundwater Treatment Facility did not operate in 2007.

6.6.5 X-627 Groundwater Treatment Facility

The X-627 Groundwater Treatment Facility consists of an air stripper with offgas activated carbon filtration and aqueous phase activated carbon filtration. The X-700 and X-705 buildings are located above the Quadrant II Groundwater Investigative Area plume, and contaminated groundwater is extracted from sumps located in the basement of each building.

Approximately 7.9 million gallons of groundwater were processed during 2007, thereby removing 18 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 611, which flows to the USEC Sewage Treatment Plant. No NPDES permit limitations were exceeded at Outfall 611 in 2007.

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7. QUALITY ASSURANCE

7.1 SUMMARY

Quality assurance and quality control are essential components of environmental monitoring at DOE PORTS. Quality is integrated into sample preservation, field data and sample collection, sample transportation, and sample analysis. Numerous program assessment activities in the field and within the facilities are conducted at regular intervals to demonstrate that quality is built into and maintained in all DOE PORTS programs.

7.2 INTRODUCTION

Quality assurance, an integral part of environmental monitoring, requires systematic control of the processes involved in sampling the environment and in analyzing the samples. To demonstrate accurate results, DOE PORTS uses the following planned and systematic controls:

- implementation of standard operating procedures for sample collection and analysis;
- training and qualification of surveyors and analysts;
- implementation of sample tracking and chain-of-custody procedures to demonstrate traceability and integrity of samples and data;
- participation in external quality control programs;
- frequent calibration and routine maintenance of measuring and test equipment;
- maintenance of internal quality control programs;
- implementation of good measurement techniques and good laboratory practices; and
- frequent assessments of field sampling, measurement activities, and laboratory processes.

Environmental sampling is conducted at DOE PORTS in accordance with state and federal regulations and DOE Orders. Sampling plans and procedures are prepared, and appropriate sampling instruments or devices are selected in accordance with practices recommended by the U.S. EPA, the American Society for Testing and Materials, or other authorities. Chain-of-custody forms document sample custody from sample collection through receipt by the analytical laboratory. The samples remain in the custody of the sampling group until the samples are received at the laboratory. Samples shipped to an off-site laboratory are sealed within the shipping container to prevent tampering until they are received by the sample custodian at the off-site laboratory.

The analytical data are reviewed to determine compliance with applicable regulations and permits. The data are used to identify locations and concentrations of contaminants of concern, to evaluate the rate and extent of contamination at the site, and to help determine the need for remedial action. Adequate and complete documentation generated as a result of these efforts supports the quality standards established at DOE PORTS. Quality Assurance Project Plans were used by LPP during 2007 to ensure a consistent system for collecting, assessing, and documenting environmental data of known and documented quality.

7.3 FIELD SAMPLING AND MONITORING

Personnel involved in field sampling and monitoring are properly trained through a combination of classroom, on-line, and/or on-the-job training as required by environmental, health, and safety regulations and DOE PORTS contract requirements. Procedures are developed from guidelines and regulations created by DOE or other regulatory agencies that have authority over DOE PORTS activities. These procedures specify sampling protocol, sampling devices, and containers and preservatives to be used. Chain-of-custody procedures (used with all samples) are documented, and samples are controlled and protected from the point of collection to the generation of analytical results.

Data generated from field sampling can be greatly influenced by the methods used to collect and transport the samples. A quality assurance program provides the procedures for proper sample collection so that the samples represent the conditions that exist in the environment at the time of sampling. The DOE PORTS quality assurance program mandates compliance with written sampling procedures, use of clean sampling devices and containers, use of approved sample preservation techniques, and collection of field blanks, trip blanks, and duplicate samples. Chain-of-custody procedures are strictly followed to maintain sample integrity. In order to maintain sample integrity, samples are delivered to the laboratory as soon as practicable after collection.

7.4 ANALYTICAL QUALITY ASSURANCE

DOE PORTS only uses analytical laboratories that demonstrate compliance in the following areas through participation in independent audits and surveillance programs:

- compliance with federal waste disposal regulations,
- data quality,
- materials management,
- sample control,
- data management,
- electronic data management,
- implementation of a laboratory quality assurance plan, and
- review of external and internal performance evaluation program.

After analytical laboratory data are received by DOE PORTS, they are independently evaluated using a systematic process that compares the data to established quality assurance/quality control criteria. An independent data validator checks documentation produced by the analytical laboratory to verify that the laboratory has provided data that meet established criteria.

8. REFERENCES

- American Nuclear Society. 1986. *Glossary of Terms in Nuclear Science and Technology*, LaGrange Park, Illinois.
- Biological Effects of Ionizing Radiations. 1990. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, Committee on the Biological Effects of Ionizing Radiations (BEIR V), National Research Council, National Academy of Sciences, National Academy Press, Washington, D.C.
- Hamby, D. M. 1991. *LADTAP XL: An Improved Electronic Spreadsheet Version of LADTAP II*, DE93003179, Westinghouse Savannah River Company, Aiken, South Carolina.
- Kumazawa, S., et al. 1984. *Occupational Exposures to Ionizing Radiation in the United States: A Comprehensive Review for the Year 1980 and a Summary of Trends for the Years 1960-1985*, EPA/520/1-8-005, U.S. Government Printing Office, Washington, D.C.
- McGraw-Hill. 1989. *McGraw-Hill Dictionary of Scientific and Technical Terms*, 4th ed., McGraw-Hill, Inc., New York.
- National Council on Radiation Protection (NCRP). 1987. *Ionizing Radiation Exposure of the Population of the United States.*, NCRP Report No. 93, National Council on Radiation Protection and Measurements, Washington, D.C.
- National Council on Radiation Protection. 1989. *Exposure of the U.S. Population from Diagnostic Medical Radiation*, NCRP Report No. 100, National Council on Radiation Protection and Measurements, Bethesda, Maryland.
- Ohio EPA. 2008. *State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program*, February 2008, State of Ohio, Columbus, Ohio.
- U.S Census 2000. U.S. Census Bureau, www.census.gov.
- U.S. Department of Energy. 1988. *Internal Dose Conversion Factors for Calculation of Dose to the Public*, DOE/EH-0071, U.S. Department of Energy, Washington, D.C.
- U.S. Department of Energy. 2002. *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, DOE-STD-1153-2002, U.S. Department of Energy, Washington, D.C.
- U.S. Environmental Protection Agency. 1997. *Exposure Factors Handbook*, EPA/600/P-95/002Fa, U.S. Environmental Protection Agency, Washington, D.C.
- Westinghouse Savannah River Company. 1994. *Savannah River Site Environmental Report for 1993, Summary Pamphlet*, Savannah River, Georgia.

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APPENDIX A
RADIATION

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This appendix presents basic facts concerning radiation. The information is intended as a basis for understanding the dose associated with releases from DOE PORTS, not as a comprehensive discussion of radiation and its effects on the environment and biological systems. *The McGraw-Hill Dictionary of Scientific and Technical Terms* defines radiation and radioactivity as follows.

radiation — (1) The emission and propagation of waves transmitting energy through space or through some medium; for example, the emission and propagation of electromagnetic, sound, or elastic waves. (2) The energy transmitted through space or some medium; when unqualified, usually refers to electromagnetic radiation. Also known as radiant energy. (3) A stream of particles, such as electrons, neutrons, protons, alpha particles, or high-energy photons, or a mixture of these (McGraw-Hill 1989).

radioactivity—A particular type of radiation emitted by a radioactive substance, such as alpha radioactivity (McGraw-Hill 1989).

Radiation occurs naturally; it was not invented but discovered. People are constantly exposed to radiation. For example, radon in air, potassium in food and water, and uranium, thorium, and radium in the earth’s crust are all sources of radiation. The following discussion describes important aspects of radiation, including atoms and isotopes; types, sources, and pathways of radiation; radiation measurement; and dose information.

A.1 ATOMS AND ISOTOPES

All matter is made up of atoms. An atom is “a unit of measure consisting of a single nucleus surrounded by a number of electrons equal to the number of protons in the nucleus” (American Nuclear Society 1986). The number of protons in the nucleus determines an element’s atomic number, or chemical identity. With the exception of hydrogen, the nucleus of each type of atom also contains at least one neutron. Unlike protons, the number of neutrons may vary among atoms of the same element. The number of neutrons and protons determines the atomic weight. Atoms of the same element with a different number of neutrons are called isotopes. In other words, isotopes have the same chemical properties but different atomic weights. Figure A.1 depicts isotopes of the element hydrogen.

Another example is the element uranium, which has 92 protons; all isotopes of uranium, therefore, have 92 protons. However, each uranium isotope has a different number of neutrons. Uranium-238 (also denoted ²³⁸U) has 92 protons and 146 neutrons; uranium-235 has 92 protons and 143 neutrons; uranium-234 has 92 protons and 142 neutrons.

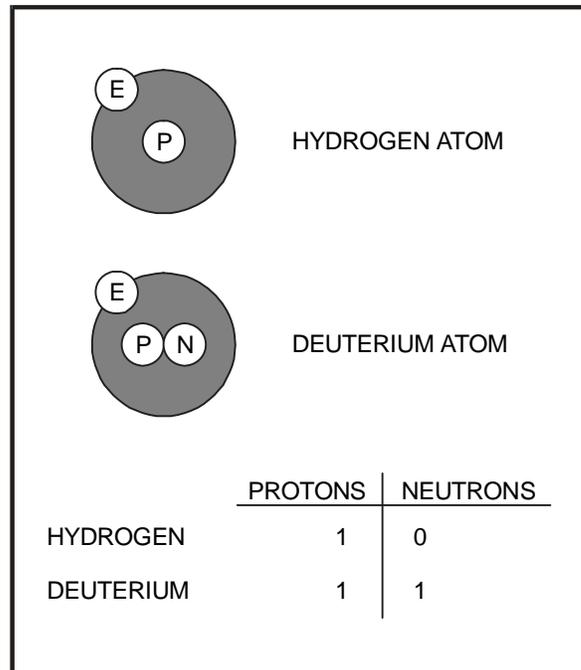


Figure A.1. Isotopes of the element hydrogen

Some isotopes are stable, or nonradioactive; some are radioactive. Radioactive isotopes are called radioisotopes, or radionuclides. In an attempt to become stable, radionuclides “throw away,” or emit, rays or particles. This emission of rays and particles is known as radioactive decay. Each radionuclide has a “radioactive half-life,” which is the average time that it takes for half of a specified number of atoms to decay. Half-lives can be very short (less than a second) or very long (millions of years), depending on the radionuclide. Appendix C presents the half-lives of radionuclides of interest at PORTS.

A.2 RADIATION

Radiation, or radiant energy, is energy in the form of waves or particles moving through space. Visible light, heat, radio waves, and alpha particles are examples of radiation. When people feel warmth from the sunlight, they are actually absorbing the radiant energy emitted by the sun.

Electromagnetic radiation is radiation in the form of electromagnetic waves; examples include gamma rays, ultraviolet light, and radio waves. Particulate radiation is radiation in the form of particles; examples include alpha and beta particles. Radiation also is characterized as ionizing or nonionizing radiation by the way in which it interacts with matter.

A.2.1 Ionizing Radiation

Normally, an atom has an equal number of protons and electrons; however, atoms can lose or gain electrons in a process known as ionization. Some forms of radiation can ionize atoms by “knocking” electrons off atoms. Examples of ionizing radiation include alpha, beta, and gamma radiation.

Ionizing radiation is capable of changing the chemical state of matter and subsequently causing biological damage and thus is potentially harmful to human health. Figure A.2 shows the penetrating potential of different types of ionizing radiation.

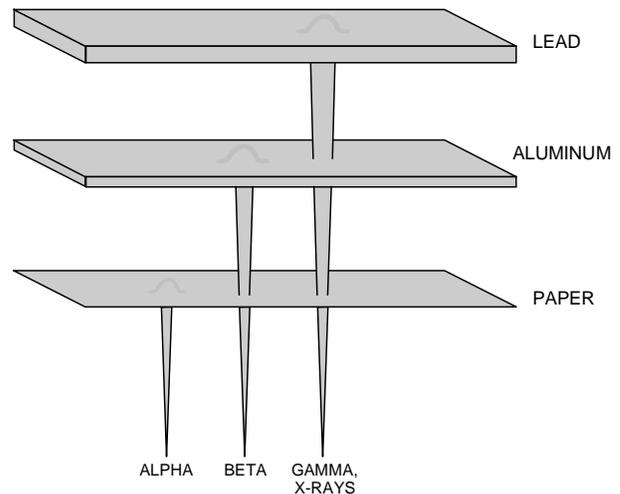


Figure A.2. Penetrating power of radiation.

A.2.2 Nonionizing Radiation

Nonionizing radiation bounces off or passes through matter without displacing electrons. Examples include visible light and radio waves. Currently, it is unclear whether nonionizing radiation is harmful to human health. In the discussion that follows, the term radiation is used to describe ionizing radiation.

A.3 SOURCES OF RADIATION

Radiation is everywhere. Most occurs naturally, but a small percentage is human-made. Naturally occurring radiation is known as background radiation.

A.3.1 Background Radiation

Many materials are naturally radioactive. In fact, this naturally occurring radiation is the major source of radiation in the environment. Although people have little control over the amount of background radiation to which they are exposed, this exposure must be put into perspective. Background radiation remains relatively constant over time; background radiation present in the environment today is much the same as it was hundreds of years ago.

Sources of background radiation include uranium in the earth, radon in the air, and potassium in food. Background radiation is categorized as cosmic, terrestrial, or internal, depending on its origin.

A.3.1.1 Cosmic radiation

Energetically charged particles from outer space continuously hit the earth's atmosphere. These particles and the secondary particles and photons they create are called cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level. For example, a person in Denver, Colorado, is exposed to more cosmic radiation than a person in Death Valley, California.

A.3.1.2 Terrestrial radiation

Terrestrial radiation refers to radiation emitted from radioactive materials in the earth's rocks, soils, and minerals. Radon (Rn); radon progeny, the relatively short-lived decay products of radium-235 (^{235}Ra); potassium (^{40}K); isotopes of thorium (Th); and isotopes of uranium (U) are the elements responsible for most terrestrial radiation.

A.3.1.3 Internal radiation

Radioactive material in the environment can enter the body through the air people breathe and the food they eat; it also can enter through an open wound. Natural radionuclides that can be inhaled and ingested include isotopes of uranium, thorium, radium, radon, polonium, bismuth, and lead in the ^{238}U and ^{232}Th decay series. In addition, the body contains isotopes of potassium (^{40}K), rubidium (^{87}Rb), and carbon (^{14}C).

A.3.2 Human-made Radiation

Most people are exposed to human-made sources of radiation. Examples include consumer products, medical sources, and fallout from atmospheric atomic bomb tests. (Atmospheric testing of atomic weapons has been suspended in the United States and most parts of the world.) Also, about one-half of 1% of the U.S. population performs work in which radiation in some form is present.

A.3.2.1 Consumer products

Some consumer products are sources of radiation. In some of these products, such as smoke detectors and airport X-ray baggage inspection systems, radiation is essential to the performance of the device. In other products, such as television and tobacco products, the radiation occurs incidentally to the product function.

A.3.2.2 Medical sources

Radiation is an important tool of diagnostic medicine and treatment, and, in this use, is the main source of exposure to human-made radiation. Exposure is deliberate and directly beneficial to the patients exposed. Generally, medical exposures from diagnostic or therapeutic X-rays result from beams directed to specific areas of the body. Thus, all body organs generally are not irradiated uniformly. Radiation and radioactive materials are also used in a wide variety of pharmaceuticals and in the preparation of medical instruments, including the sterilization of heat-sensitive products such as plastic heart valves. Nuclear medicine examinations and treatment involve the internal administration of radioactive compounds, or radiopharmaceuticals, by injection, inhalation, consumption, or insertion. Even then, radionuclides are not distributed uniformly throughout the body.

A.3.2.3 Other sources

Other sources of radiation include fallout from atmospheric atomic bomb tests; emissions of radioactive materials from nuclear facilities such as uranium mines, fuel processing plants, and nuclear power plants; emissions from mineral extraction facilities; and the transportation of radioactive materials.

A.4 PATHWAYS OF RADIATION

Radiation and radioactive materials in the environment can reach people through many routes (see Figure A.3). Potential routes for radiation are referred to as pathways. For example, radioactive material in the air could fall on a pasture. The grass could then be eaten by cows, and the radioactive material on the grass would be present in the cow's milk. People drinking the milk would thus be exposed to this radiation. Or people could simply inhale the radioactive material in the air. The same events could occur with radioactive material in water. Fish living in the water would be exposed; people eating the fish would then be exposed to the radiation in the fish. Or people swimming in the water would be exposed.

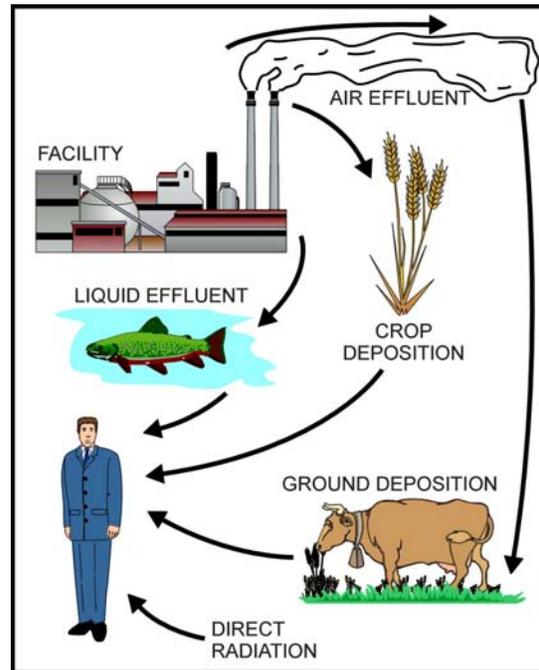


Figure A.3. Possible radiation pathways.

A.5 MEASURING RADIATION

To determine the possible effects of radiation on the environment and the health of people, the radiation must be measured. More precisely, its potential to cause damage must be determined.

A.5.1 Activity

When measuring the amount of radiation in the environment, what is actually being measured is the rate of radioactive decay, or activity. The rate of decay varies widely among the various radionuclides. For that reason, 1 gram of a radioactive substance may contain the same amount of activity as several tons of another material. This activity is expressed in a unit of measure known as a curie (Ci). More specifically, 1 Ci = 3.75E+10 (37,000,000,000) atom disintegrations per second (dps). In the international system of units, 1 dps = 1 becquerel (Bq). Table A.1 provides units of radiation measure and applicable conversions.

Table A.1. Units of radiation measures

Current System	International System	Conversion
curie (Ci)	Becquerel (Bq)	1 Ci = 3.7 x 10 ¹⁰ Bq
rad (radiation absorbed dose)	Gray (Gy)	1 rad = 0.01 Gy
rem (roentgen equivalent man)	Sievert (Sv)	1 rem = 0.01 Sv

A.5.2 Absorbed Dose

The total amount of energy absorbed per unit mass as a result of exposure to radiation is expressed in a unit of measure known as a rad. In the international system of units, 100 rad equals 1 gray (Gy). In terms of human health, however, it is the effect of the absorbed energy that is important, not the actual amount.

A.5.3 Dose Equivalent

The measure of potential biological damage caused by exposure to and subsequent absorption of radiation is expressed in a unit of measure known as a rem. One rem of any type of radiation has the same total damaging effect. Because a rem represents a fairly large dose, dose is expressed as a millirem (mrem) or 1/1000 of a rem. In the international system of units, 100 rem equals 1 sievert (Sv); 100 mrem equals 1 millisievert (mSv). Specific types of dose equivalents are defined as follows:

- **dose equivalent** – The product of the absorbed dose (rad) in tissue and a quality factor. Dose equivalent is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).
- **committed dose equivalent** – The calculated total dose equivalent to a tissue or organ over a 50-year period after known intake of a radionuclide into the body. Contributions from external dose are not included. Committed dose equivalent is expressed in units of rem (or sievert).
- **committed effective dose equivalent** – The sum of the committed dose equivalents to various tissues in the body, each multiplied by an appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

- **effective dose equivalent** – The sum of the dose equivalents received by all organs or tissues of the body after each one has been multiplied by the appropriate weighting factor. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent attributable to sources external to the body.
- **collective dose equivalent/collective effective dose equivalent** – The sums of the dose equivalents or effective dose equivalents of all individuals in an exposed population within a 50-mile (80-km) radius, expressed in units of person-rem (or person-sievert). When the collective dose equivalent of interest is for a specific organ, the units would be organ-rem (or organ-sievert). The 50-mile distance is measured from a point located centrally with respect to major facilities or DOE program activities.

A.6 DOSE

Many terms are used to report dose. Several factors are taken into account, including the amount of radiation absorbed, the organ absorbing the radiation, and the effect of the radiation over a 50-year period. The term “dose” in this report includes the committed effective dose equivalent and effective dose equivalent attributable to penetrating radiation from sources external to the body.

Determining dose is an involved process using complex mathematical equations based on several factors, including the type of radiation, the rate of exposure, weather conditions, and typical diet. Basically, ionizing radiation is generated from radioactive decay, or activity. People absorb some of the energy to which they are exposed. This absorbed energy is calculated as part of an individual’s dose. Whether radiation is natural or human-made, its effects on people are the same.

A.6.1 Comparison of Dose Levels

Table A.2 presents a scale of dose levels. Included is an example of the type of exposure that may cause such a dose or the special significance of such a dose. This information is intended to familiarize the reader with the type of doses individuals may receive.

A.6.1.1 Dose from cosmic radiation

The average annual dose received by residents of the United States from cosmic radiation is about 27 mrem (0.27 mSv) (National Council on Radiation Protection 1987). The average annual dose from cosmic radiation received by residents in the Portsmouth area is about 50 mrem (0.50 mSv).

A.6.1.2 Dose from terrestrial radiation

The average annual dose received from terrestrial gamma radiation is about 28 mrem (0.28 mSv) in the United States. This dose varies geographically across the country (National Council on Radiation Protection 1987); typical reported values are 16 mrem (0.16 mSv) at the Atlantic and Gulf coastal plains and 63 mrem (0.63 mSv) at the eastern slopes of the Rocky Mountains.

A.6.1.3 Dose from internal radiation

Short-lived decay products of radon are the major contributors to the annual dose equivalent for internal radionuclides (mostly ²²²Rn). They contribute an average dose of about 200 mrem (2.00 mSv) per year. This dose estimate is based on an average radon concentration of about 1 pCi/L (0.037 Bq/L) (National Council on Radiation Protection 1987).

Table A.2. Comparison and description of various dose levels

Dose level	Description
1 mrem (0.01 mSv)	Approximate daily dose from natural background radiation, including radon
2.5 mrem (0.025 mSv)	Cosmic dose to a person on a one-way airplane flight from New York to Los Angeles
10 mrem (0.10 mSv)	Annual exposure limit, set up by the U.S. EPA, for exposures from airborne emissions from operations of nuclear fuel cycle facilities, including power plants and uranium mines and mills
46 mrem (0.46 mSv)	Estimate of the largest dose any off-site person could have received from the March 28, 1979, Three Mile Island nuclear power plant accident
50 mrem (0.50 mSv)	Average yearly dose from cosmic radiation received by people in the Portsmouth area
66 mrem (0.66 mSv)	Average yearly dose to people in the United States from human-made sources
100 mrem (1.00 mSv)	Annual limit of dose from all DOE facilities to a member of the public who is not a radiation worker
110 mrem (1.10 mSv)	Average occupational dose received by U.S. commercial radiation workers in 1980
244 mrem (2.44 mSv)	Average dose from an upper gastrointestinal diagnostic X-ray series
300 mrem (3.00 mSv)	Average yearly dose to people in the United States from all sources of natural background radiation
1-5 rem (0.01-0.05 Sv)	U.S. EPA protective action guideline calling for public officials to take emergency action when the dose to a member of the public from a nuclear accident will likely reach this range
5 rem (0.05 Sv)	Annual limit for occupational exposure of radiation workers set by the Nuclear Regulatory Commission and DOE
10 rem (0.10 Sv)	The Biological Effects of Ionizing Radiations V report estimated that an acute dose at this level would result in a lifetime excess risk of death from cancer of 0.8% (Biological Effects of Ionizing Radiation 1990)
25 rem (0.25 Sv)	U.S. EPA guideline for voluntary maximum dose to emergency workers for non-lifesaving work during an emergency
75 rem (0.75 Sv)	U.S. EPA guideline for maximum dose to emergency workers volunteering for lifesaving work
50-600 rem (0.50-6.00 Sv)	Doses in this range received over a short period of time will produce radiation sickness in varying degrees. At the lower end of this range, people are expected to recover completely, given proper medical attention. At the top of this range, most people would die within 60 days

Adapted from Savannah River Site Environmental Report for 1993, Summary Pamphlet, WSRC-TR-94-076, Westinghouse Savannah River Company, 1994.

The average dose from other internal radionuclides is about 39 mrem (0.39 mSv) per year, most of which can be attributed to the naturally occurring isotope of potassium, ⁴⁰K. The concentration of radioactive potassium in human tissues is similar in all parts of the world (National Council on Radiation Protection 1987).

A.6.1.4 Dose from consumer products

The U.S. average annual dose received by an individual from consumer products is about 10 mrem (0.10 mSv) (National Council on Radiation Protection 1987).

A.6.1.5 Dose from medical sources

Nuclear medicine examinations, which involve the internal administration of radiopharmaceuticals, generally account for the largest portion of the dose received from human-made sources. The radionuclides used in specific tests, however, are not distributed uniformly throughout the body. In these cases, comparisons are made using the concept of effective dose equivalent, which relates exposure of organs or body parts to one effective whole-body dose. The average annual effective dose equivalent from medical examinations is 53 mrem (0.53 mSv), including 39 mrem (0.39 mSv) for diagnostic X-rays and 14 mrem (0.14 mSv) for nuclear medicine procedures (National Council on Radiation Protection 1989). The actual doses received by individuals who complete such medical exams are much higher than these values, but not everyone receives such exams each year (National Council on Radiation Protection 1989).

A.6.1.6 Doses from other sources

Small doses received by individuals occur as a result of radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive materials from nuclear facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials. The combination of these sources contributes less than 1 mrem (0.01 mSv) per year to the average dose to an individual (National Council on Radiation Protection 1987).

A comprehensive U.S. EPA report of 1984 projected the average occupational dose to monitored radiation workers in medicine, industry, the nuclear fuel cycle, government, and miscellaneous industries to be 105 mrem (1.05 mSv) per year for 1985, down slightly from 110 mrem (1.10 mSv) per year in 1980 (Kumazawa et al. 1984).

APPENDIX B
ENVIRONMENTAL PERMITS

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Table B.1. DOE PORTS environmental permits and registrations

Permit/registered source	Source no.	Issue date	Expiration date	Status
<i>Clean Air Act Permits</i>				
Permit to Operate X-627 Groundwater Treatment Facility	P474, T104, T105	2/26/2008	2/26/2013	Active
Permit to Install and Operate X-326 L-cage Glove Box	P022	11/12/2008	11/12/2018	Active
Permit to Install and Operate X-735 Landfill Cap and Venting System (northern portion)	P023	11/12/2008	11/12/2018	Active
X-624 Groundwater Treatment Facility (now considered a <i>de minimis</i> source)	P019		None	Active
Registered Source X-623 Groundwater Treatment Facility	P018		None	Active
Registered Source X-749 Contaminated Materials Disposal Facility	P027		None	Active
Permit to Install UDS Process Line 1	P001	10/5/2004	9/28/2008	Under construction
Permit to Install UDS Process Line 2	P002	10/5/2004	9/28/2008	Under construction
Permit to Install UDS Process Line 3	P003	10/5/2004	9/28/2008	Under construction
Permit to Install UDS Conversion Building HVAC System	P004	10/5/2004	9/28/2008	Under construction
<i>Clean Water Act Permits</i>				
NPDES Permit DOE (UDS)	OIS00034*AD	4/25/2007	5/31/2012	Active
NPDES Permit DOE (LPP)	OIO00000*JD	4/15/2008	4/30/2013	Active
Permit to Install X-622 Groundwater Treatment Facility	06-2951	11/20/1990	None	Active
Permit to Install X-623 Groundwater Treatment Facility	06-3528	1/9/19/1996	None	Active
Permit to Install X-624 Groundwater Treatment Facility	06-3556	10/28/1992	None	Active
Permit to Install X-627 Groundwater Treatment Facility	06-07283	1/13/2004	None	Active
Construction Storm Water Permit (LPP)	OHC000002	11/06/2007	None	Active
Construction Storm Water Permit (UDS)	OHC000002	12/23/2003	None	Active
Permit to Install Sewer Line (UDS)	06-7612	9/22/2004	None	Active
U.S. Army Corps of Engineers, Section 404 Nationwide Permit No. 39 (UDS)		3/17/2004	None	Active
<i>Hazardous Waste Permit</i>				
RCRA Part B Permit (DOE/LPP)	Ohio Permit No. 04-66-0680	3/15/2001	3/15/2011	Active
<i>Registrations</i>				
Underground Storage Tank Registration	66005107		Renewed annually	Active

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APPENDIX C

RADIONUCLIDE AND CHEMICAL NOMENCLATURE

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Table C.1. Nomenclature for elements and chemical constituents

Constituent	Symbol
Aluminum	Al
Ammonia	NH ₃
Antimony	Sb
Arsenic	As
Barium	Ba
Beryllium	Be
Cadmium	Cd
Calcium	Ca
Chromium	Cr
Cobalt	Co
Copper	Cu
Iron	Fe
Lead	Pb
Lithium	Li
Magnesium	Mg
Manganese	Mn
Mercury	Hg
Nickel	Ni
Nitrogen	N
Nitrate	NO ₃
Nitrite	NO ₂
Phosphorus	P
Phosphate	PO ₄
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Sulfate	SO ₄
Sulfur dioxide	SO ₂
Thallium	Tl
Uranium	U
Vanadium	V
Zinc	Zn

Table C.2. Nomenclature and half-life for radionuclides

Radionuclide	Symbol	Half-life (years)
Americium-241	²⁴¹ Am	432.2
Neptunium-237	²³⁷ Np	2,140,000
Plutonium-238	²³⁸ Pu	87.75
Plutonium-239	²³⁹ Pu	24,100
Plutonium-240	²⁴⁰ Pu	6,569
Technetium-99	⁹⁹ Tc	213,000
Uranium-233	²³³ U	159,200
Uranium-234	²³⁴ U	244,500
Uranium-235	²³⁵ U	703,800,000
Uranium-236	²³⁶ U	23,415,000
Uranium-238	²³⁸ U	4,468,000,000

Source: *Radioactive Decay Tables: A Handbook of Decay Data for Application to Radioactive Dosimetry and Radiological Assessments* (DOE/TIC-11026), as reported in the *Oak Ridge Reservation Annual Site Environmental Report for 2005* (DOE/ORO-2218).



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