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 2006. Trichloroethene and several other volatile organics continue to be detected at concentrations of 4 μg/L (4 ppb) or less 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. Trichloroethene has not been detected in groundwater beyond the DOE property boundary at concentrations that exceed the EPA drinking water standard of 5 μg/L. The *2006 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 2006. The following sections provide an overview of the DOE PORTS groundwater monitoring program followed by a review of the history and 2006 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.

In 2006, 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

PORTS is the largest industrial user of water in the vicinity and obtains water from three water supply well fields that are next to the Scioto River south of Piketon. The wells tap the Scioto River Valley buried aquifer. In 2006, total groundwater production from the water supply well fields averaged approximately 3.1 million gallons per day for the entire site (including USEC activities). 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. In addition, the DOE has filed a deed notification at the Pike County Auditor's Office that restricts the use of groundwater beneath the PORTS site.

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.

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 2006.

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.

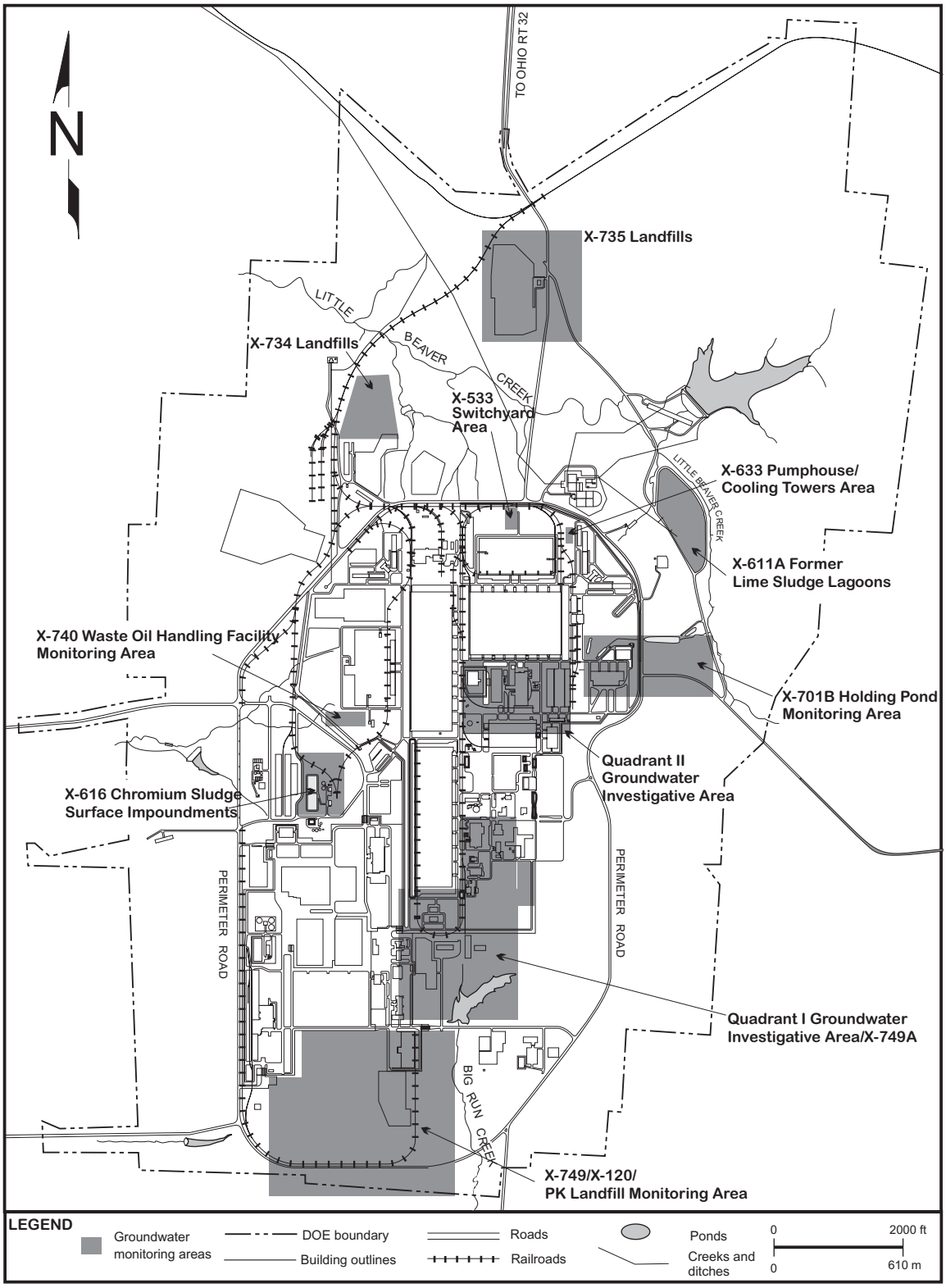


Figure 6.1. Groundwater monitoring areas at PORTS.

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]	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-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	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
X-633 Pumphouse/Cooling Towers Area	total metals[d]: Cr	

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

Monitoring Area or Program	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]: transuranics[d]:	 Ca, Fe, Mg, K, Na ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu

[a]Selected 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).

[b]Not all wells at this area are analyzed for all listed analytes.

[c]Acetone, 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).

[d]Appendix C lists the symbols for metals and transuranic radionuclides.

[e]Volatile 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/X-120 Old Training 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.

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 indicates 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.

The X-120 Old Training 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.

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. Groundwater quality monitoring required by the program began in the fourth quarter of 2003 and continued through the first quarter of 2005. 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.

Fifty-seven wells were sampled during 2006 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 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.

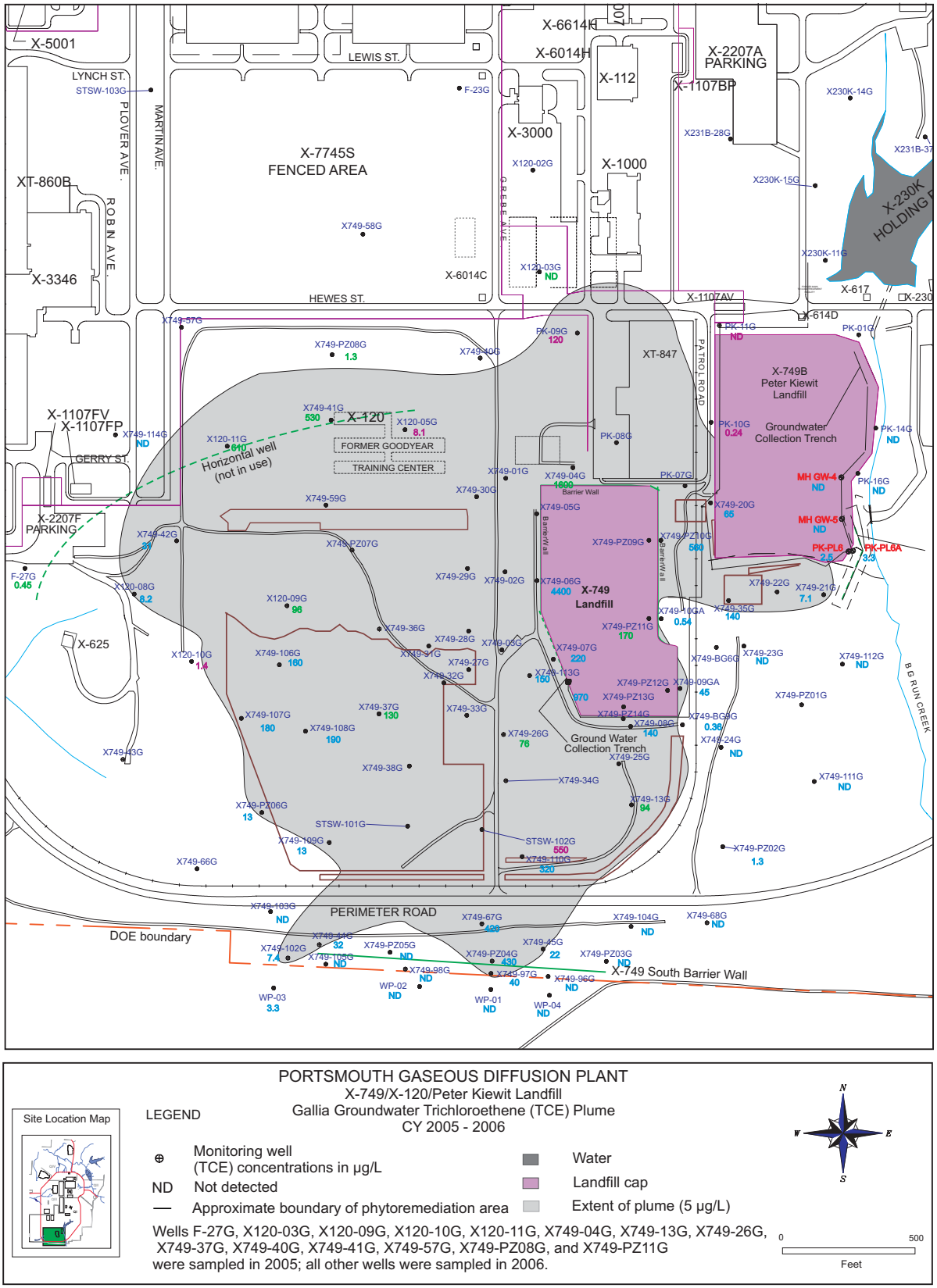
In 2006, 9 wells, 2 sumps, and 2 manholes were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells, sumps, and manholes in this area.

6.4.1.3 Monitoring results for the X-749/X-120/PK Landfill in 2006

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 2006, 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 46 μg/L. Although trichloroethene is usually detected in this well, previous detections did not exceed 10 μg/L. Concentrations of trichloroethene detected in samples collected from this well in the third and fourth quarters of 2006 remained elevated (32 and 40 μg/L, respectively).

Concentrations of trichloroethene also increased in well X749-102G, which is on DOE property approximately 117 feet west of the X-749 South Barrier Wall. In quarterly sampling during 2006, concentrations of trichloroethene ranged from non-detect to 11 μg/L. In 2005, concentrations of trichloroethene detected in samples collected from well X749-102G ranged from 4.5 to 7 μg/L.



PORTSMOUTH GASEOUS DIFFUSION PLANT
X-749/X-120/Peter Kiewit Landfill
Gallia Groundwater Trichloroethene (TCE) Plume
CY 2005 - 2006

Site Location Map

LEGEND

⊕ Monitoring well
(TCE) concentrations in µg/L

ND Not detected

— Approximate boundary of phytoremediation area

Water

Landfill cap

Extent of plume (5 µg/L)

Wells F-27G, X120-03G, X120-09G, X120-10G, X120-11G, X749-04G, X749-13G, X749-26G, X749-37G, X749-40G, X749-41G, X749-57G, X749-PZ08G, and X749-PZ11G were sampled in 2005; all other wells were sampled in 2006.

N
W
E
S

0 500
Feet

Figure 6.2. Trichloroethene-contaminated Gallia groundwater plume at the X-749/X-120/PK Landfill – 2006.

Volatile organic compounds continue to be detected in well WP-03, which is the westernmost well of the four off-site wells in this area. Although concentrations of volatile organics have increased in this well since 2004, none of the detections are above the respective preliminary remediation goals. Concentrations of volatile organics detected in quarterly samples collected from well WP-03 during 2006 remained relatively stable; for example, concentrations of trichloroethene detected in the well ranged from 3.2 to 4 μg/L. These concentrations are below the EPA drinking water standard for trichloroethene of 5 μg/L.

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-17B and PK-21B at concentrations ranging from 7.6 to 29 μg/L, which are above the preliminary remediation goal of 2 μg/L. Vinyl chloride is typically detected in these wells.

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. The X-231B Southwest Oil Biodegradation Plot is a part of the Quadrant I Groundwater Investigative Area and was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*. The X-749A was also monitored prior to implementation of the *Integrated Groundwater Monitoring Plan* under requirements for solid waste landfills.

6.4.2.1 X-231B Southwest Oil Biodegradation Plot

The X-231B Southwest Oil Biodegradation Plot was used from 1976 to 1983 for land application of contaminated oil/solvent mixtures generated from the enrichment process and maintenance activities. The X-231B area, located west of the X-600 Steam Plant, consisted of two disposal plots, each surrounded by an elevated soil berm, that were periodically fertilized and plowed to enhance aeration and promote biological degradation of waste oil.

Three groundwater extraction wells were installed in the Gallia in 1991 as part of the X-231B interim remedial measure. Eleven additional groundwater extraction wells were installed in 2001-2002 and 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. A multimedia landfill cap was installed over this area in 2000 to minimize water infiltration and control the spread of contamination.

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 2006, nine wells were sampled as part of the routine monitoring program for 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 2006

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 2005 to 2006.

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 11 and 13 μg/L in samples collected during 2006 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 μg/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 9000 μg/L in the third quarter of 2006. 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.

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. Both control limits for alkalinity were exceeded in the sample collected from well X749A-01G during the fourth quarter of 2006. Verification resampling conducted in January 2007 confirmed the exceedence. In examining alkalinity data for the upgradient well for the X749A landfill (X749A-07G), it appears that there may be an increasing trend in concentrations of alkalinity in the background well. Therefore, the exceedence in well X749A-01G may not be caused by a release from the landfill, but may be due to an overall increasing trend in levels of alkalinity in groundwater in this area. DOE is working with Ohio EPA to determine the actions to be taken to assess the X-749A landfill. None of the control limits for the statistical monitoring parameters were exceeded in the other X-749A wells during 2006.

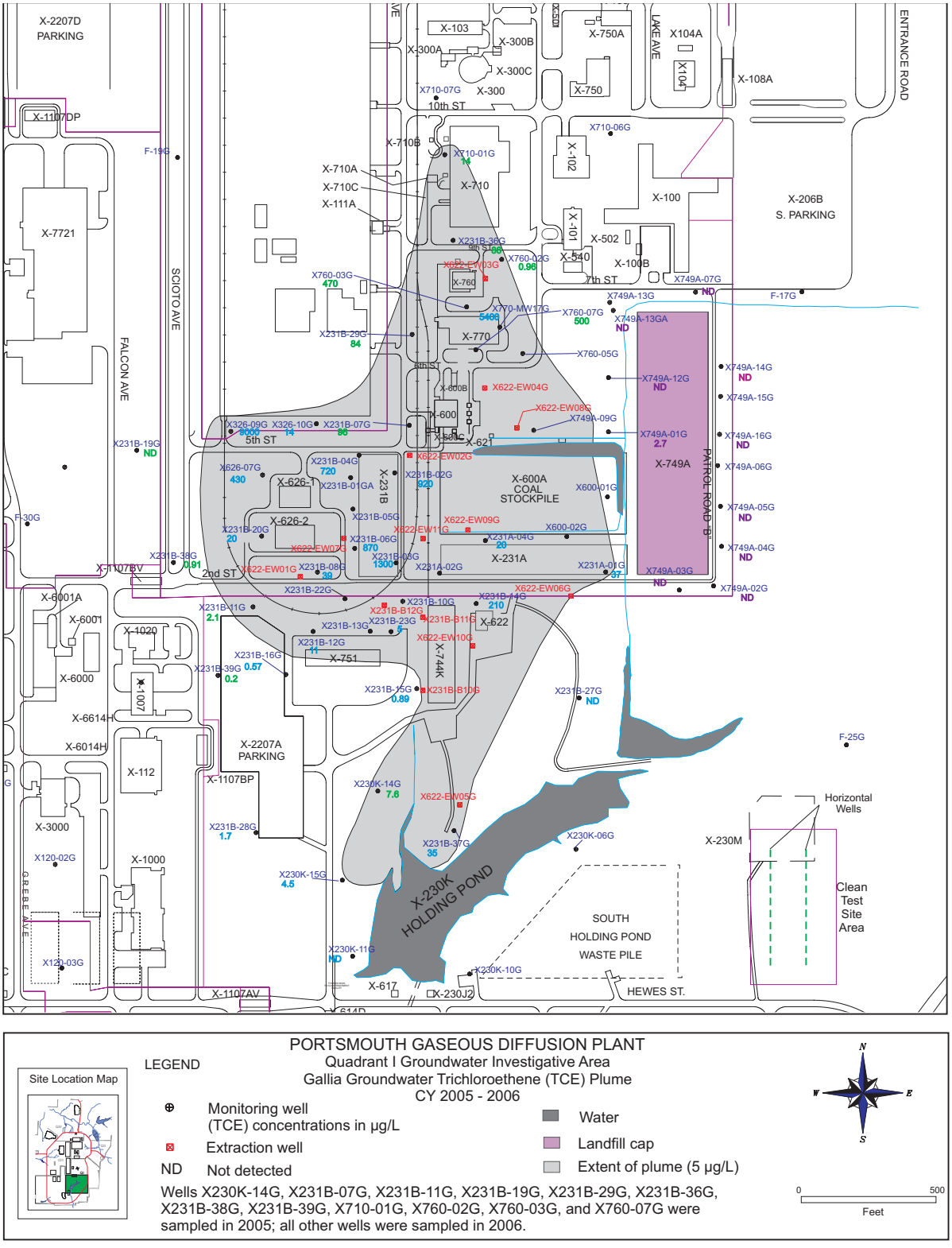


Figure 6.3. Trichloroethene-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative Area – 2006.

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.

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 2006

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 2005 to 2006. Numerous other volatile organics were also detected within the plume. Inorganics (metals) and radionuclides were also detected in 2006. 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 to 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.

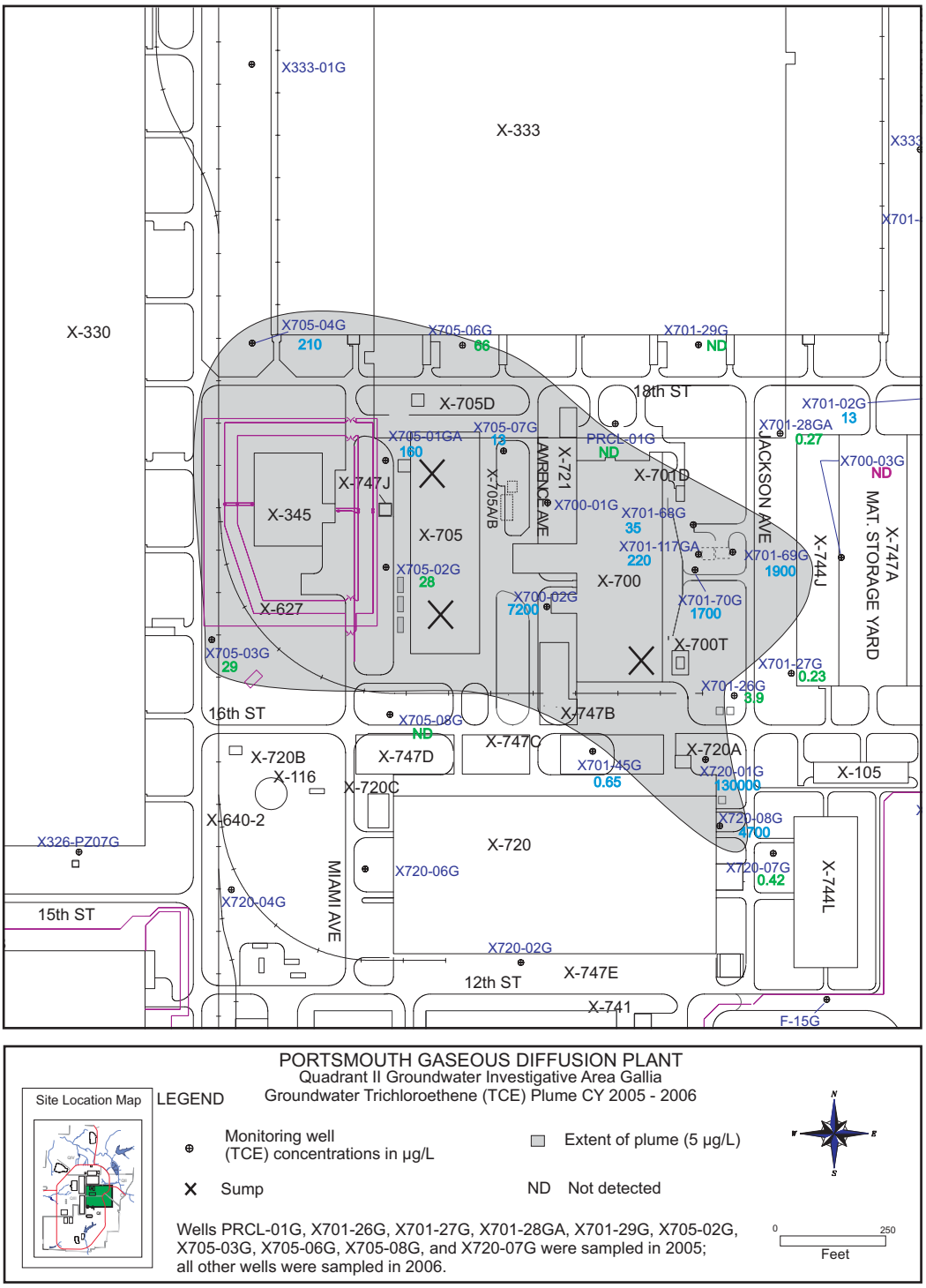


Figure 6.4. Trichloroethene-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative Area – 2006.

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.

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 2006

The trichloroethene plume at this groundwater monitoring area contains the highest concentrations of trichloroethene measured in groundwater at PORTS, approximately 500,000 μg/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 2005 to 2006 (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 2006.

Samples from five wells in the western portion of the monitoring area were analyzed for selected metals (cadmium, chromium, cobalt, lead, manganese, nickel, and thallium). In third quarter 2006 samples, three metals were detected above the respective preliminary remediation goal in the sample collected from well X701-09G: chromium at 350 μg/L, manganese at 18,000 μg/L, and nickel at 140 μg/L. The turbidity in this well (a measurement of suspended solids or cloudiness of the water) was higher than usual, however, which may have contributed to the elevated concentrations of metals detected in this sample.

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 (see Figure 6.6) are sampled semiannually for chromium as part of the monitoring program for this area.

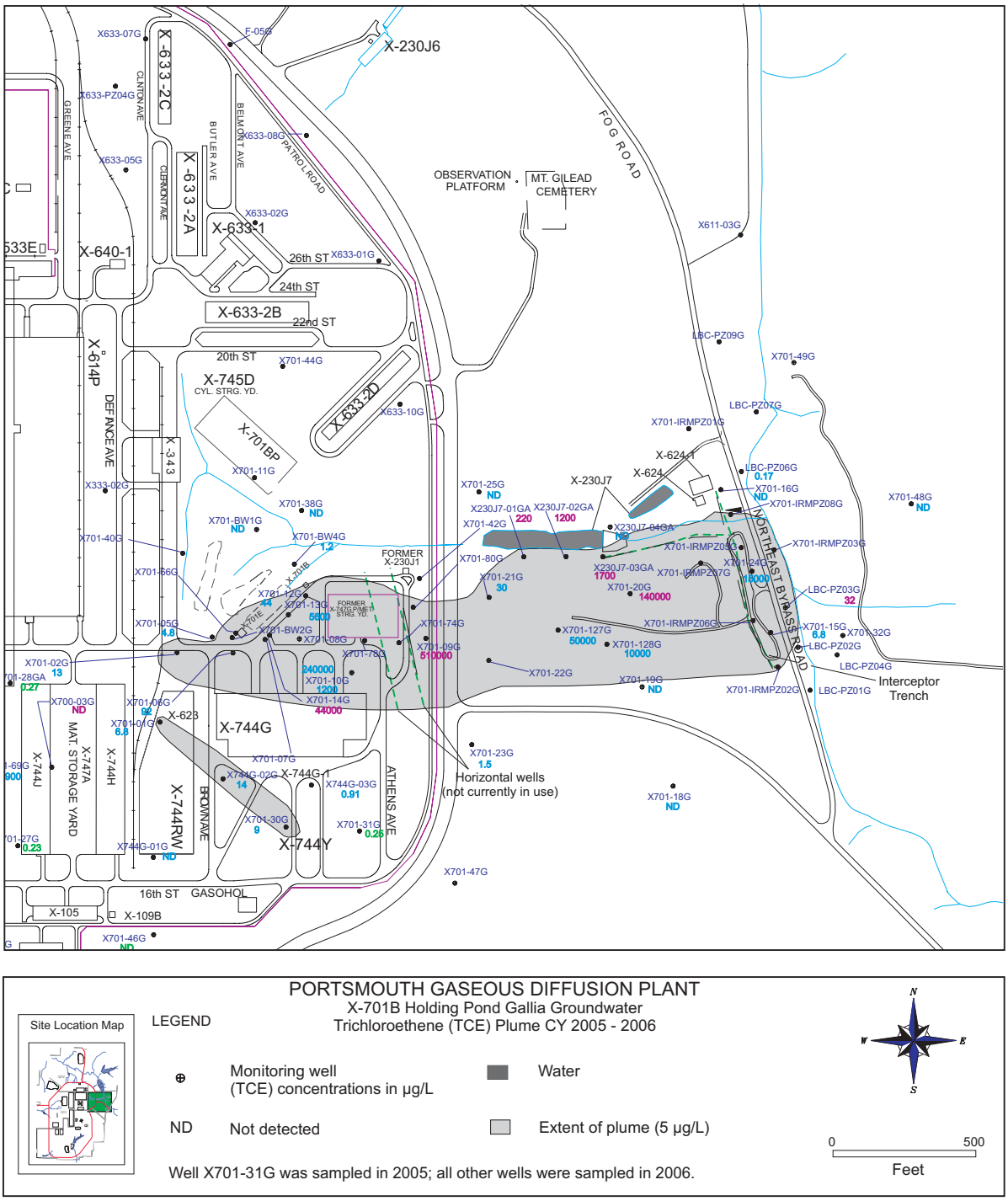


Figure 6.5. Trichloroethene-contaminated Gallia groundwater plume at the X-701B Holding Pond – 2006.

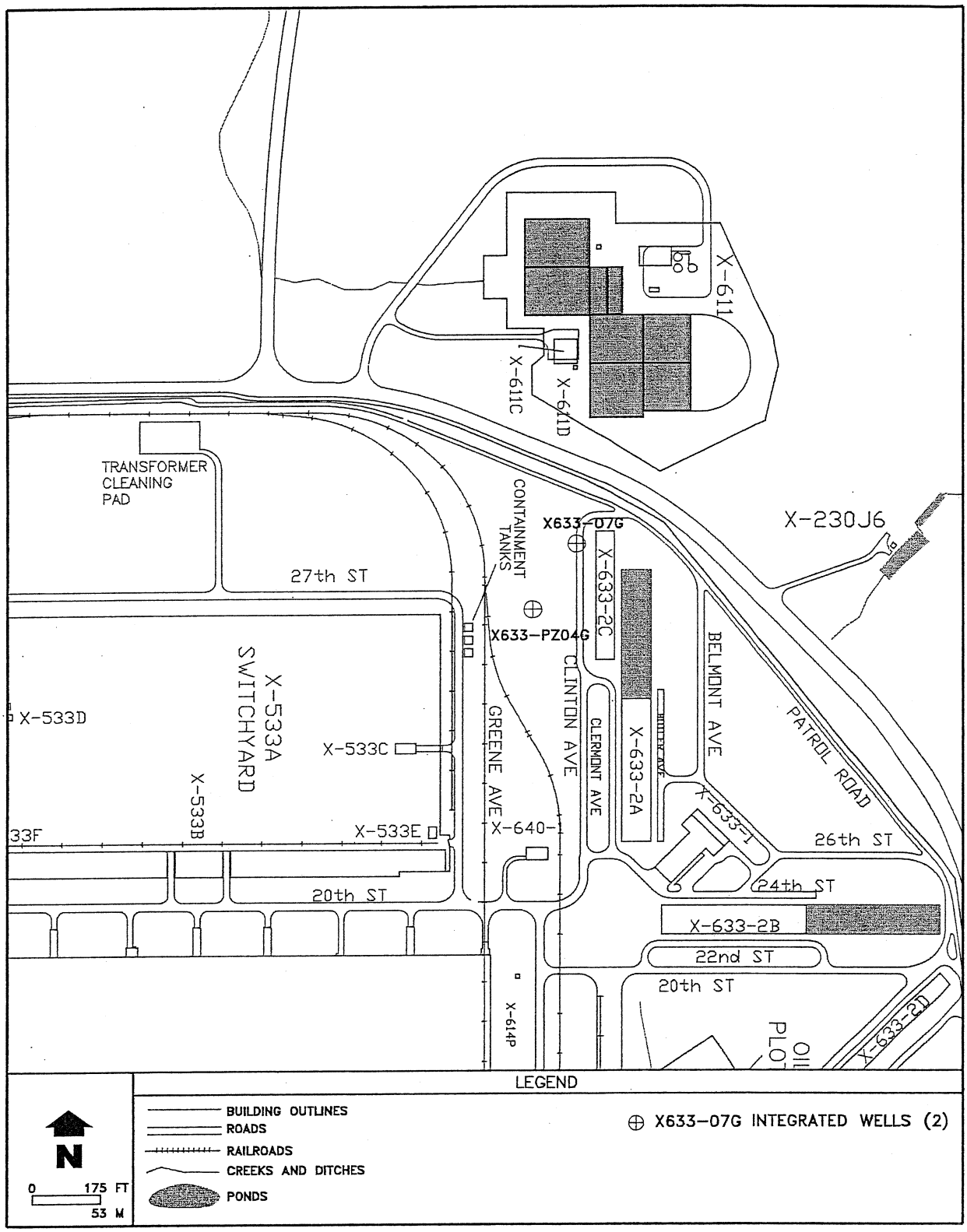


Figure 6.6. Groundwater monitoring wells at the X-633 Pumphouse/Cooling Towers Area.

6.4.5.1 Monitoring results for the X-633 Pumphouse/Cooling Towers Area in 2006

Chromium was detected in both of the X-633 monitoring wells in 2006. Samples collected from well X633-07G contained chromium at concentrations above the preliminary remediation goal of 100 μg/L: 510 μg/L (second quarter) and 790 μg/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.

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 2006

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 μg/L) in the samples collected from well X616-05G and was detected at 580 μg/L in the sample collected in 2006. 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. Figure 6.7 shows the concentrations of chromium in wells at the X-616. Nickel was also detected above the preliminary remediation goal (100 μg/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.

Volatile organic compounds were detected at low levels in samples collected from five wells in this area. The only volatile organic compounds detected above the preliminary remediation goals were 1,1-dichloroethene and trichloroethene. 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.

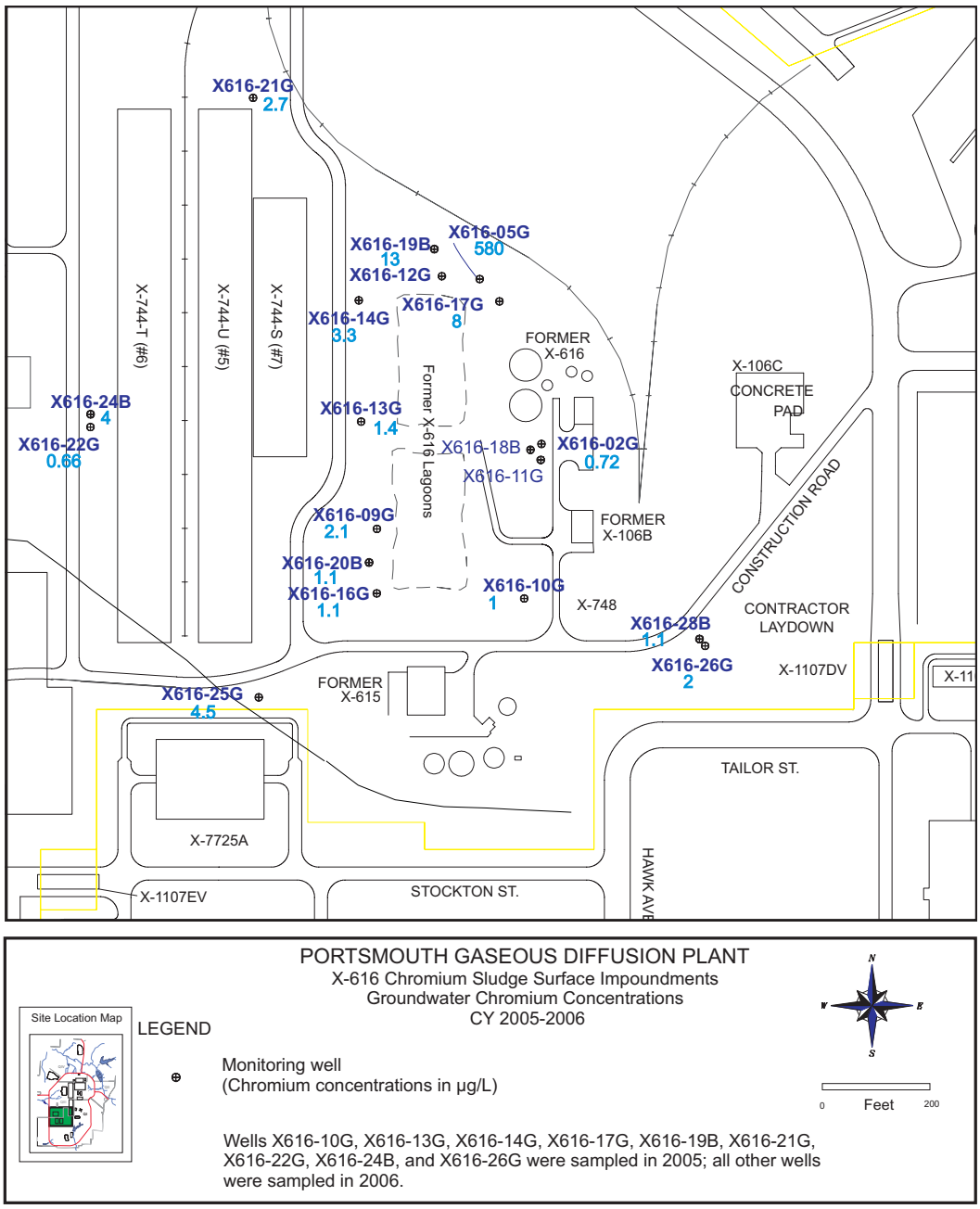


Figure 6.7. Chromium concentrations in groundwater at the X-616 Chromium Sludge Surface Impoundments – 2006.

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.

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 2006

Water level measurements are collected on a frequent basis from the X-740 monitoring wells during the growing season to determine whether the poplar trees that comprise the phytoremediation system for this area are using water as intended. Hourly water level measurements collected at two X-740 Gallia wells from July 1 through September 30, 2006 indicated groundwater usage by the trees.

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. Inorganics (metals) and radionuclides were also detected in 2006. 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 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 cover a surface area of approximately 18 acres. The lagoons 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. 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 2006

The six monitoring wells at X-611A (see Figure 6.9) are sampled and analyzed for beryllium and chromium. In 2006, chromium was detected in each well in this area at concentrations between 0.58 and 5.6 μg/L. These results are below the preliminary remediation goal (100 μg/L).

Beryllium was detected in both samples collected from well F-07G at 8.6 μg/L (first quarter) and 3 μg/L (third quarter). The result for the first quarter is above the preliminary remediation goal (6.5 μg/L for Gallia wells), and the result for the third 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 2006.

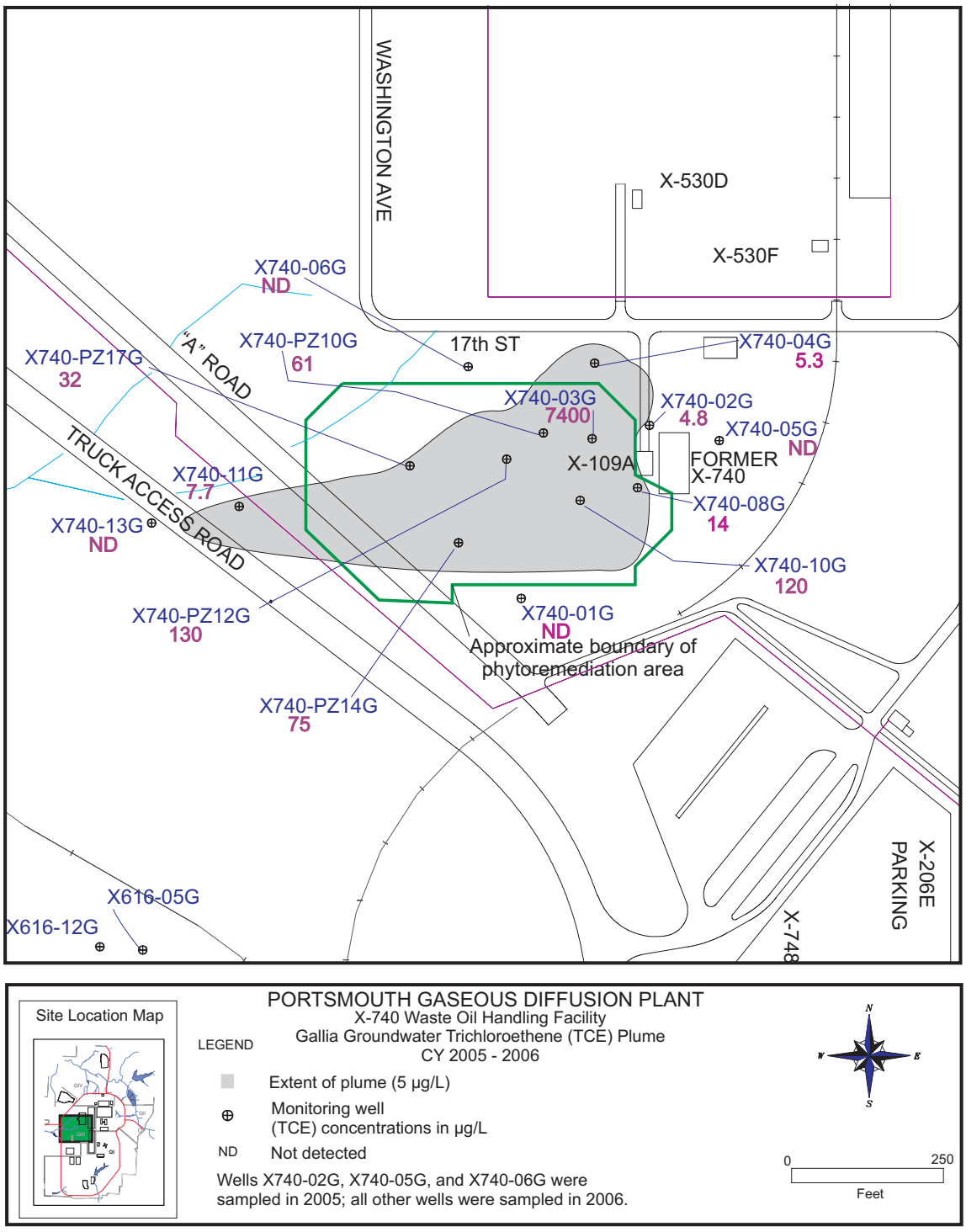


Figure 6.8. Trichloroethene-contaminated Gallia groundwater plume near the X-740 Waste Oil Handling Facility – 2006.

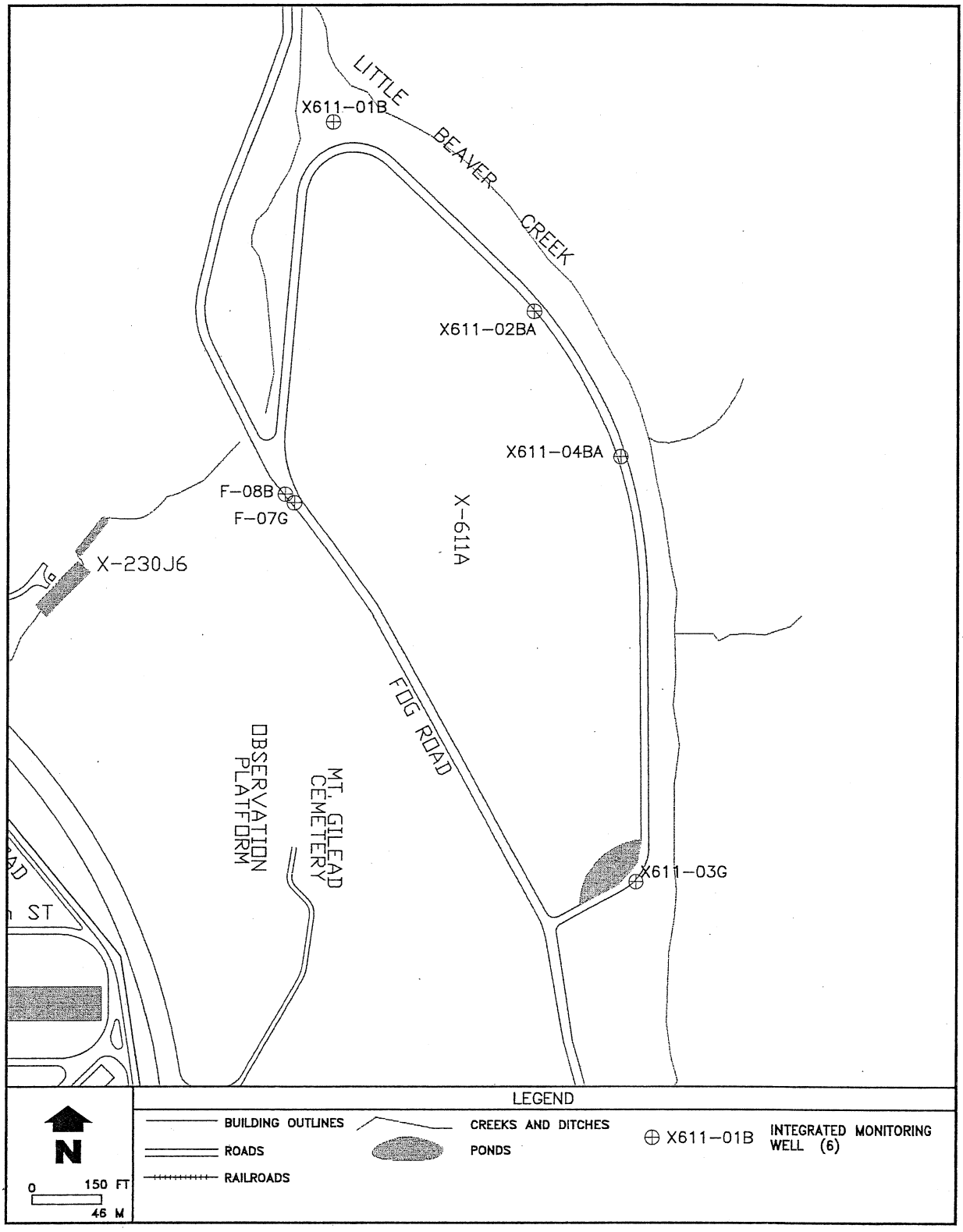


Figure 6.9. Monitoring wells at the X-611A Former Lime Sludge Lagoons.

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. 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 2006

Statistical evaluations of data collected from wells at the X-735 Landfills are completed to monitor the landfill for releases. In general, analytical results from previous sampling events are used to calculate control limits for selected monitoring parameters at designated X-735 monitoring wells. For example, analytical results for alkalinity from eight sampling events at well X735-05GA between 1998 and 2001 are used to calculate two control limits for alkalinity at this well (these data are considered the baseline data). For each sampling event, results for alkalinity in well X735-05G are evaluated against these limits. If the limits are exceeded, it is possible that a release from the landfill has occurred, although exceedences can also happen due to variations in groundwater quality and other reasons.

Assessment monitoring at the X-735 Landfills began in 2004 and continued through 2006 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. Data for assessment monitoring at the X-735 Landfills in 2006 are provided in the *2006 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant*.

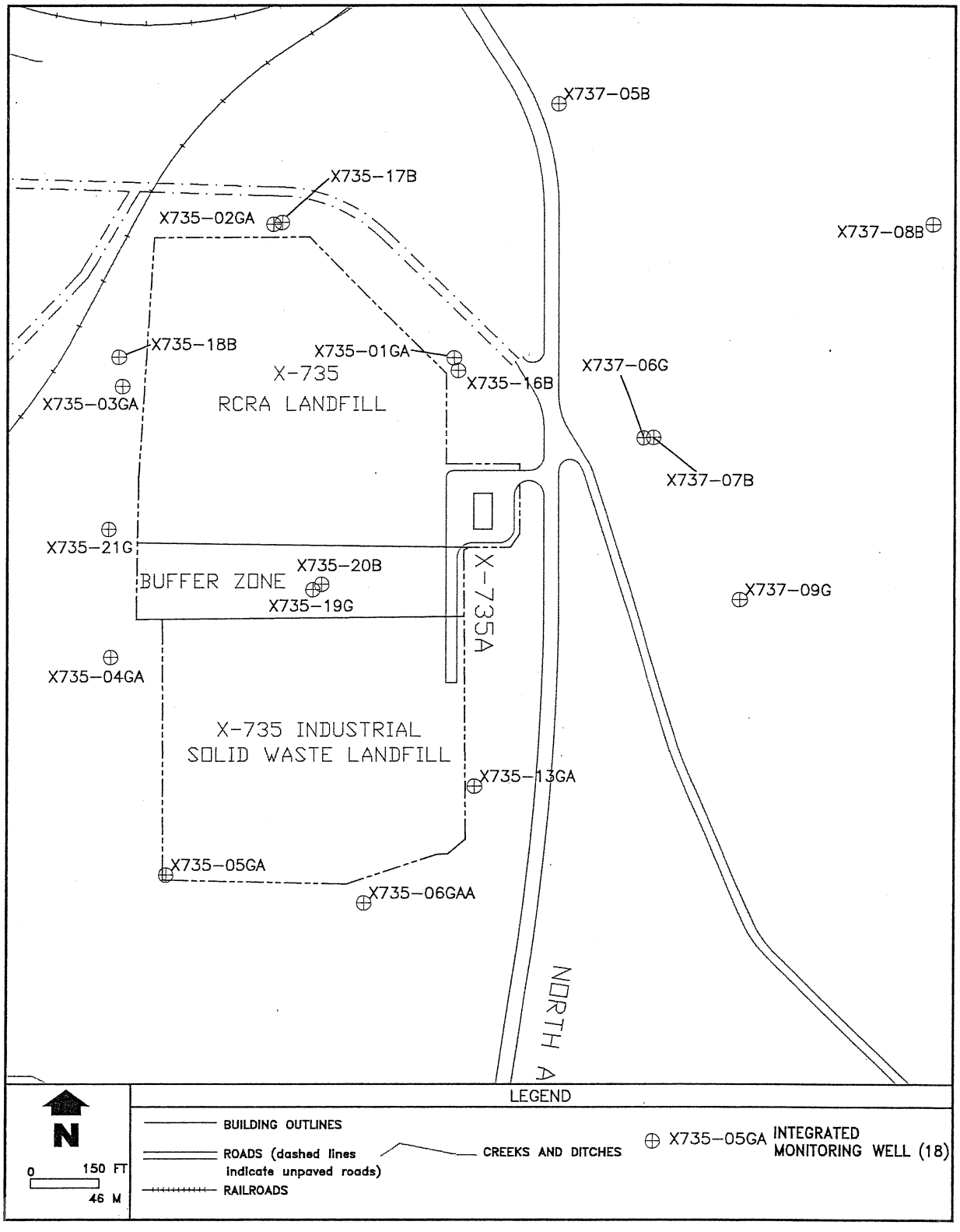


Figure 6.10. Monitoring wells at the X-735 Landfills.

Based on the results of assessment monitoring, DOE developed the *Corrective Measures Plan for the X-735 Landfill* in 2006. Ohio EPA had not approved this plan by the end of 2006.

In addition to assessment monitoring, routine monitoring required by the *Integrated Groundwater Monitoring Plan* was completed during 2006. Samples collected during the second quarter of 2006 were analyzed for volatile organic compounds. No volatile organics were detected in the routine X-735 samples collected in the second quarter of 2006 with the exception of methylene chloride and acetone, which are common laboratory contaminants and not indicative of a release.

No transuranic radionuclides or technetium-99 were detected in the X-735 wells sampled during 2006.

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 include 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.

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 2006

Volatile organic compounds (not including sample contaminants acetone and methylene chloride) were detected in samples collected from seven wells in the X-734 monitoring area in 2006. Vinyl chloride is the only compound that exceeded the preliminary remediation goal (2 μg/L). In the second quarter and fourth quarter samples collected from well X734-23G, vinyl chloride was detected at 4.2 and 3.7 μg/L, respectively. The presence of vinyl chloride, *cis*-1,2-dichloroethene, and *trans*-1,2-dichloroethene in well X734-23G, along with the absence of trichloroethene may indicate that natural reductive dechlorination of the trichloroethene is occurring beneath the X-734 Landfills.

Cobalt is also monitored in the X-734 Landfills area. Cobalt was detected in five wells in 2006 (X734-01G, X734-06G, X734-15G, X734-16G, and X734-23G) at concentrations equal to or exceeding the preliminary remediation goal of 13 μg/L for Gallia wells. These detections ranged from 13 to 110 μg/L and are typical for these wells. Additional inorganics (metals) and radionuclides were also detected in 2006. Control and monitoring of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

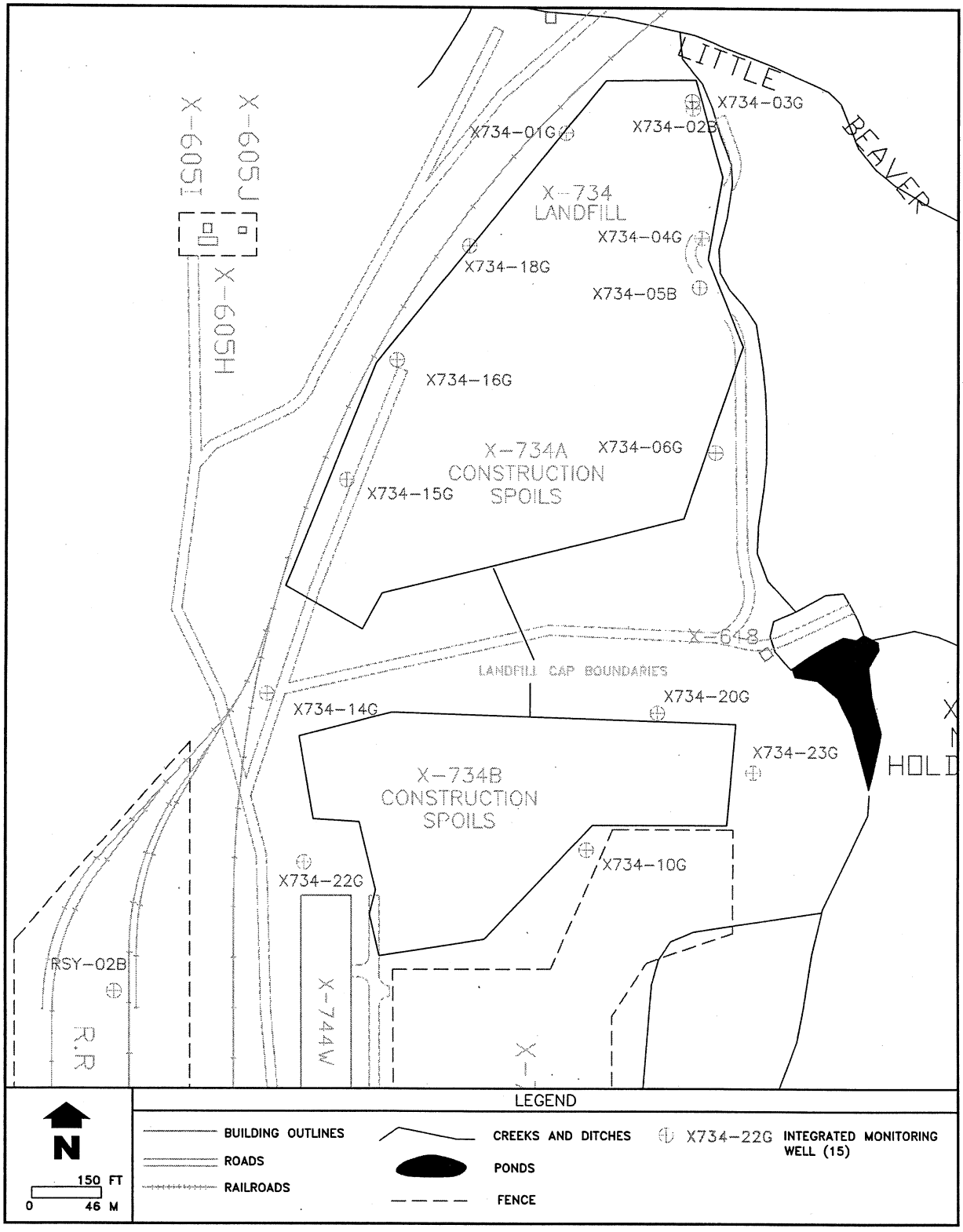


Figure 6.11. Monitoring wells at the X-734 Landfills.

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 2006

Two Gallia wells that monitor the X-533 Switchyard Area (see Figure 6.12) were sampled in the second and fourth quarters of 2006 and analyzed for cadmium, cobalt, and nickel. Each of the well samples contained these metals at concentrations above the preliminary remediation goals (6.5 μg/L for cadmium, 13 μg/L for cobalt, and 100 μg/L for nickel). Concentrations of cadmium detected in the wells ranged from 10 to 38 μg/L, concentrations of cobalt detected in the wells ranged from 32 to 70 μg/L, and concentrations of nickel detected in the wells ranged from 170 to 430 μg/L. These results are typical for these wells.

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 6.13). 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 related to the X-231B Southwest Oil Biodegradation Plot, the Quadrant I Groundwater Investigative Area plume, and the X-749/X-120/PK Landfill area plume, all of which discharge into the X-230K Holding Pond 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.

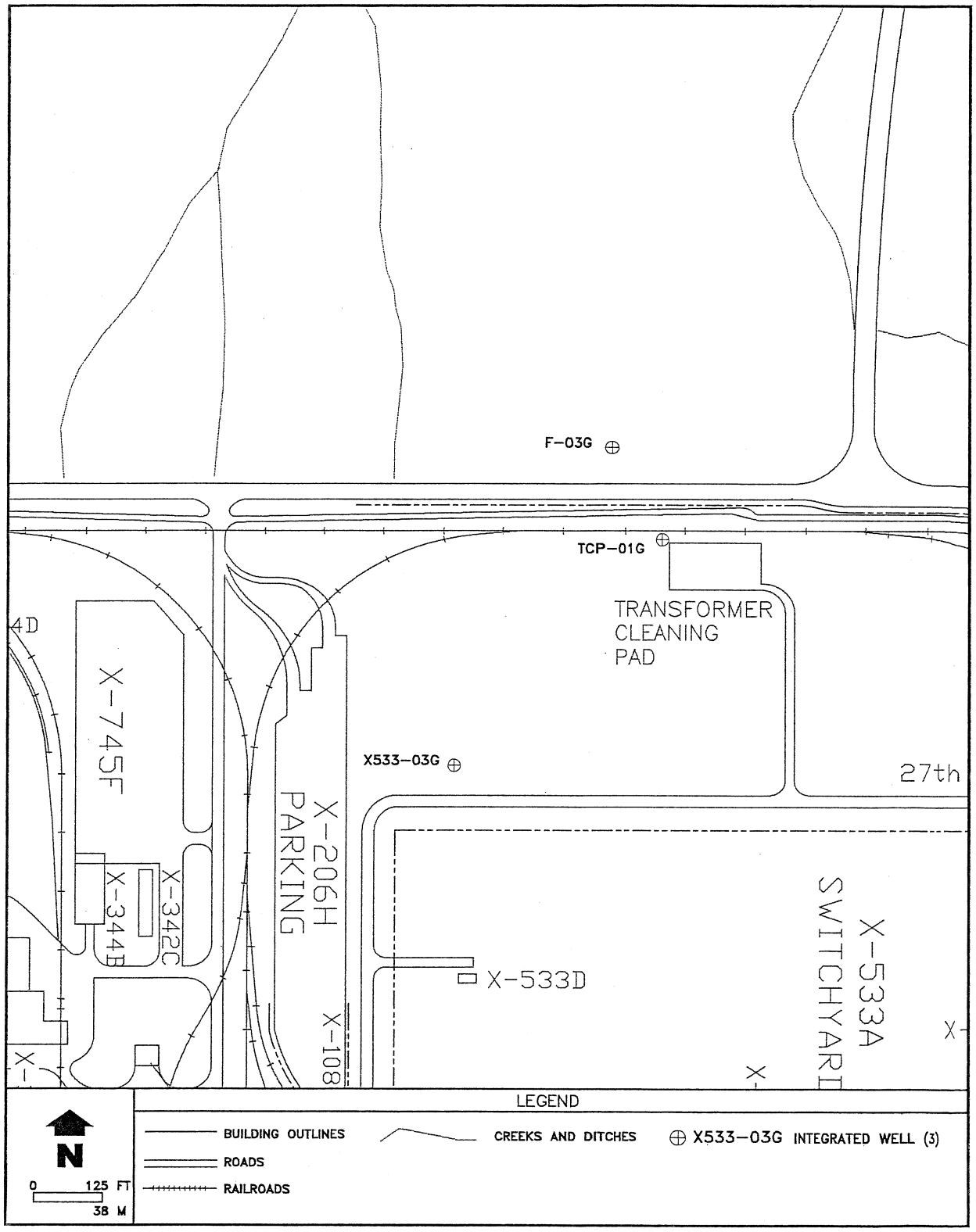


Figure 6.12. Monitoring wells at the X-533 Switchyard Area.

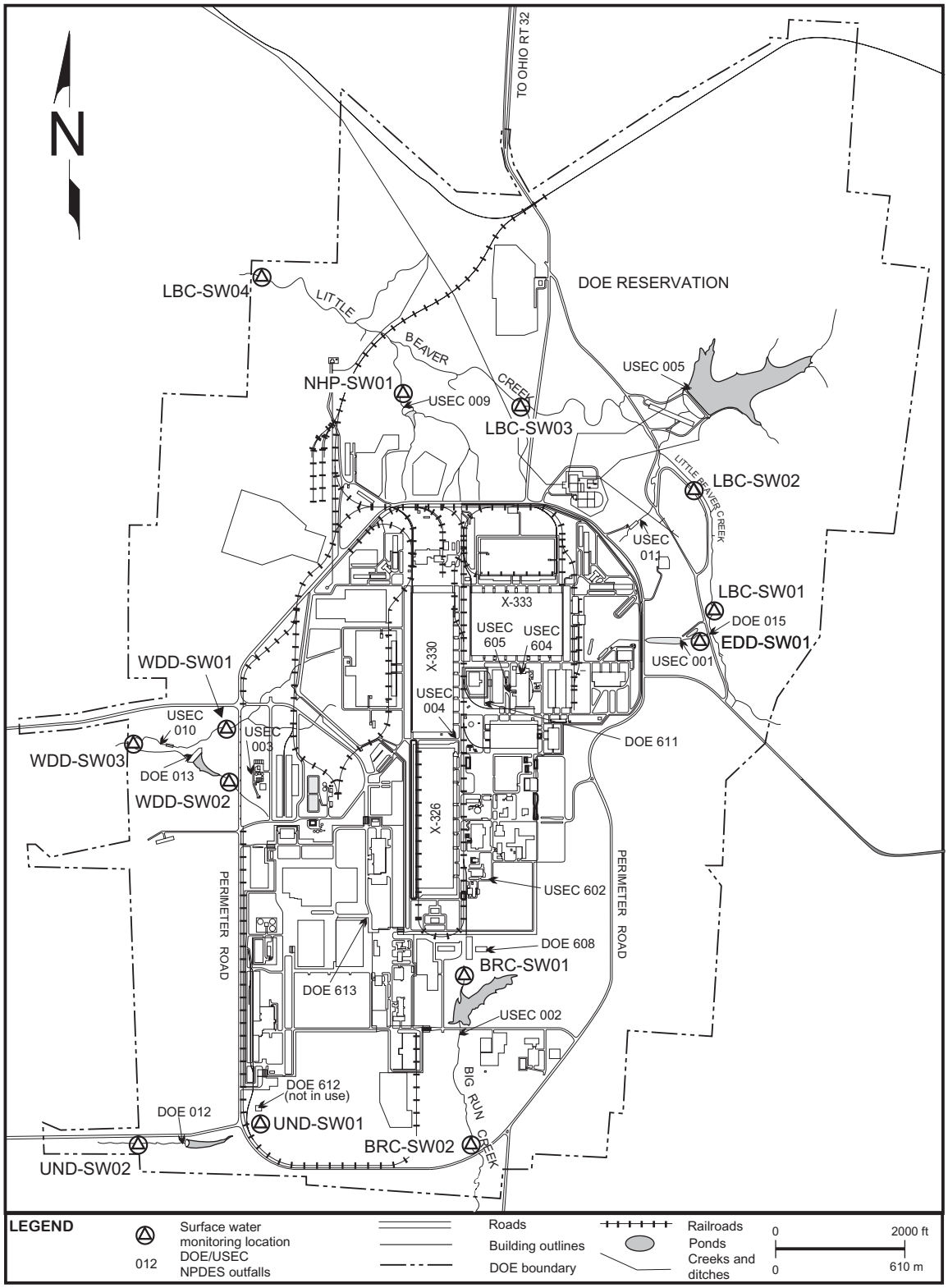


Figure 6.13. Surface water monitoring locations.

- 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 2006

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). Trichloroethene was detected at concentrations ranging from 1.7 to 6.9 μg/L in three of the four samples collected from the Southwestern Drainage Ditch at UND-SW01 in 2006. Trichloroethene was not detected in the sample collected at UND-SW01 in the fourth quarter, but trichloroethene was detected at an estimated concentration of 1.5 μg/L in the sample collected from UND-SW02, which is downstream from UND-SW01. Trichloroethene was not detected in the first through third quarter samples collected at UND-SW02. Several other volatile organic compounds were detected at estimated concentrations less than 1 μg/L in the samples collected from UND-SW01 (*cis*-1,2-dichloroethene, 1,1-dichloroethene, and 1,1-dichloroethane). Concentrations of volatile organic compounds detected at the Southwestern Drainage Ditch sampling location UND-SW01 (trichloroethene, *cis*-1,2-dichloroethene, 1,1-dichloroethene, and 1,1-dichloroethane) and UND-SW02 (trichloroethene) 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 μg/L for trichloroethene and 32 μg/L for 1,1-dichloroethene.

Trichloroethene and/or *cis*-1,2-dichloroethene were also detected at estimated concentrations less than 0.6 μg/L in samples collected during 2006 from East Drainage Ditch sampling location EDD-SW01 and Little Beaver Creek sampling locations LBC-SW01 and LBC-SW02. The detections of trichloroethene were well below the applicable Ohio EPA water quality criterion for trichloroethene (810 μg/L) for the protection of human health in the Ohio River drainage basin.

Discharges of trichloroethene from DOE NPDES Outfall 015 in 2006 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. Therefore, these compounds were not present in the surface water exiting the PORTS site.

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 μg/L; bromoform – 3600 μg/L; chloroform – 4700 μg/L; and dibromochloromethane – 340 μg/L).

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 2006.

In the first quarter of 2006, technetium-99 was detected in the East Drainage Ditch sample and each Little Beaver Creek sample at activities ranging from 12.7 pCi/L (LBC-SW01) to 22.8 pCi/L (EDD-SW01). Technetium-99 was not detected in any of the surface water samples collected during the second, third, or fourth quarters of 2006. 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 2005. 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 2006 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).

Six residential drinking water sources participated in the program in 2006 (see Figure 6.14). 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 third quarter, trichloroethene was detected at an estimated concentration of 0.2 μg/L in both residential water supply samples collected at location RES-004 (south of PORTS on the east side of Big Run Creek). 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 μg/L).

Chloromethane was also detected at an estimated concentration of 0.42 μg/L in one of the two third quarter samples collected from RES-014 (south of PORTS on Wakefield Mound Road). This detection is most likely associated with cross-contamination or contamination of the sample containers. No other volatile organic compounds were detected in the water supply samples collected during 2006, with the exception of the common sample contaminants acetone and methylene chloride, which were also detected in some of the laboratory blanks and trip blanks associated with the samples and do not indicate any water quality problems.

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 2006. Low levels of uranium and uranium isotopes detected in some of the wells are consistent with naturally-occurring concentrations found in common geologic materials.

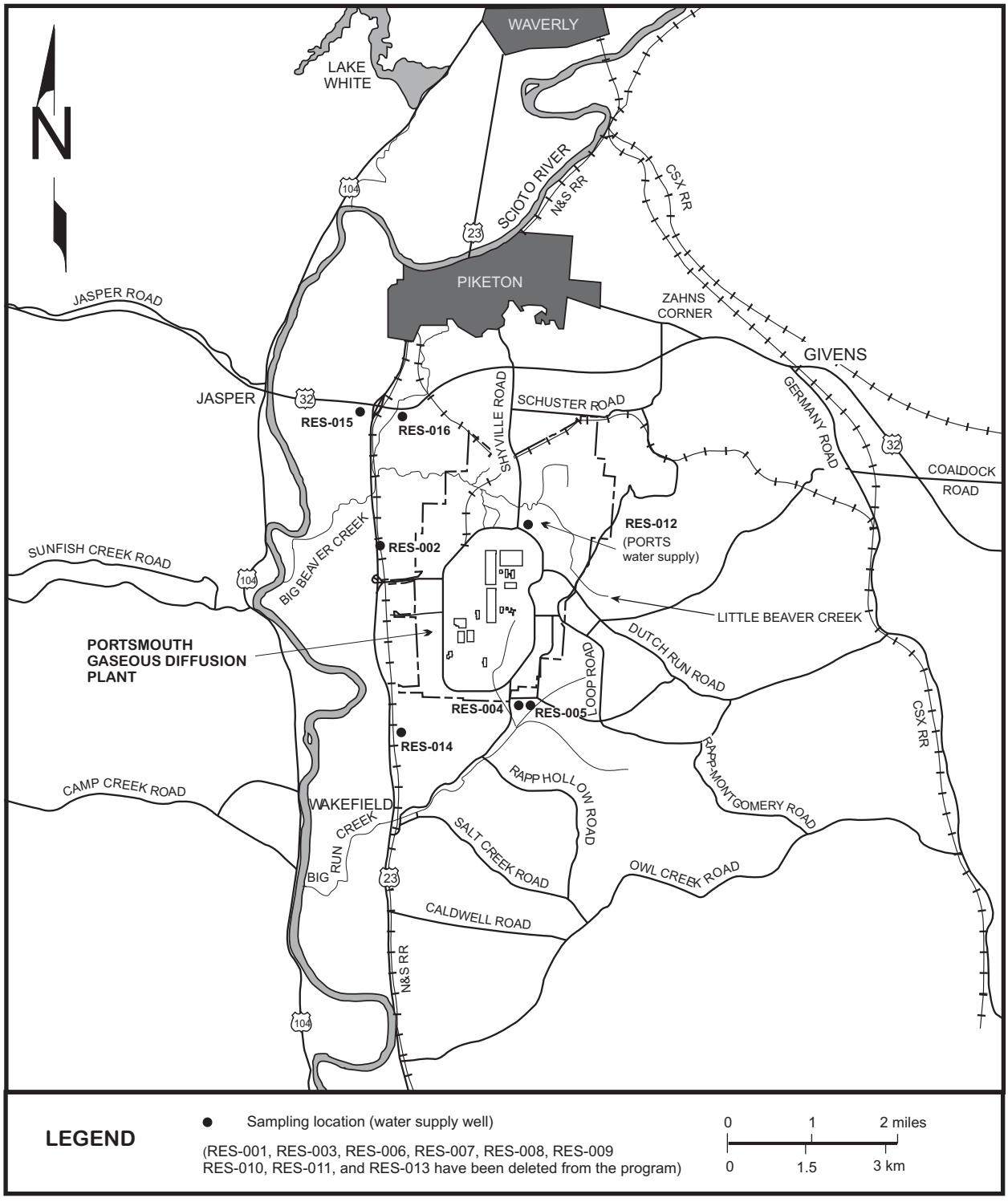


Figure 6.14. Water supply monitoring locations.

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 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 groundwater discharges to these surface waters. Monitoring wells near the PORTS boundary are also used in the exit pathway monitoring program. Figure 6.15 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. Sample contaminants acetone and methylene chloride were detected in a few of the samples collected from these locations in 2006. Trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in chlorinated drinking water, were detected in samples collected from Big Run Creek and 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.

Trichloroethene was detected at an estimated concentration of 1.5 μg/L in the fourth quarter sample collected from UND-SW02. This detection is less than both the applicable Ohio EPA non-drinking water quality criterion for trichloroethene (810 μg/L) for the protection of human health in the Ohio River drainage basin and the EPA drinking water standard for trichloroethene (5 μg/L). Technetium-99 was detected at 14.5 pCi/L in the first quarter sample collected from LBC-SW04, which is 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 2006, volatile organic compounds, including trichloroethene, were detected 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 wells were 31 and 32 μg/L in well X749-44G, 22 and 57 μg/L in well X749-45G, and 8.6 to 46 μg/L in well X749-97G. These detections exceed the EPA drinking water standard for trichloroethene (5 μg/L); however, these monitoring wells are located within the PORTS boundary. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

No transuranics or technetium-99 were detected in exit pathway monitoring wells sampled for radionuclides during 2006.

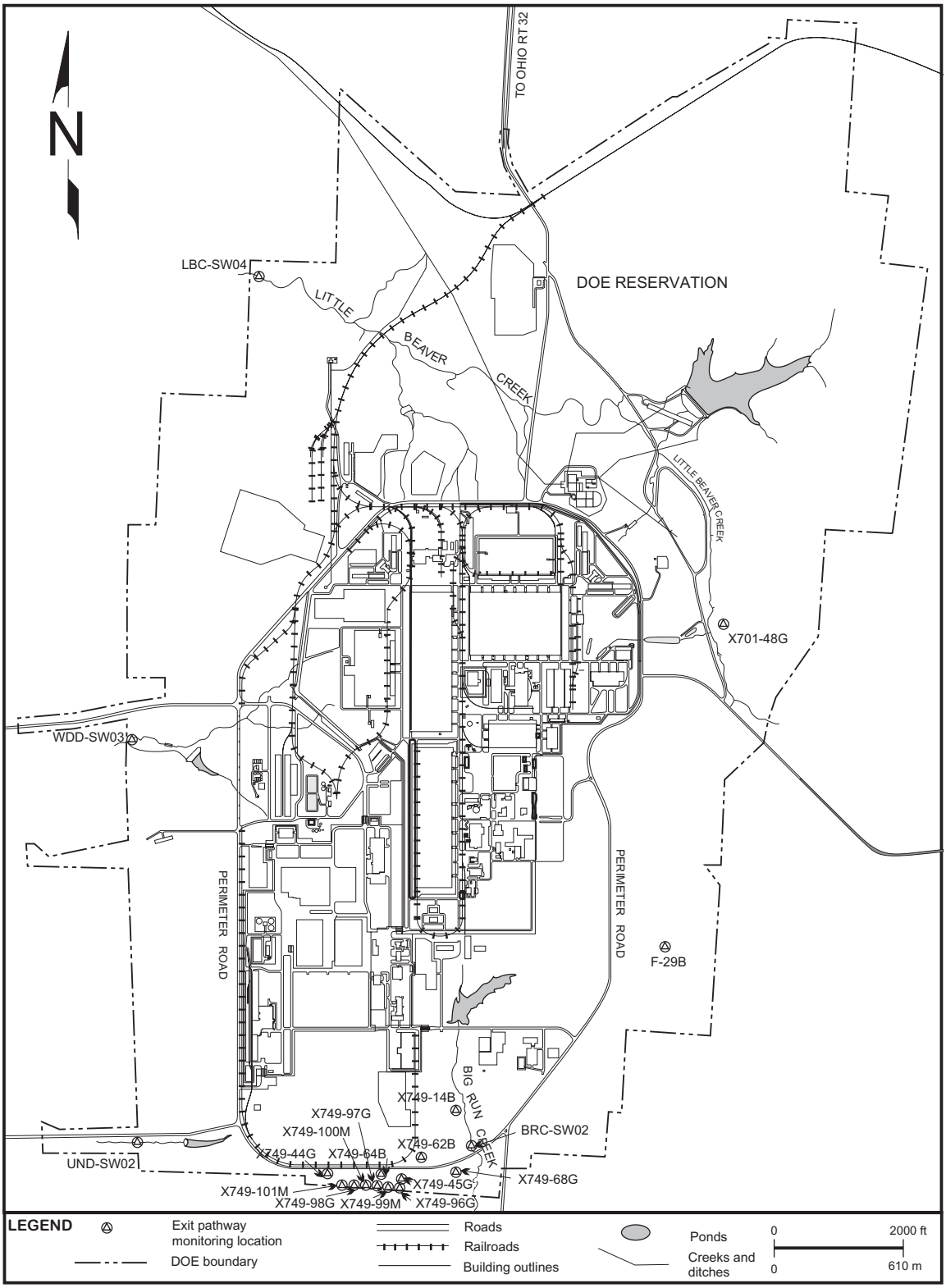


Figure 6.15. Exit pathway monitoring locations.

6.6 GROUNDWATER TREATMENT FACILITIES

In 2006, a combined total of approximately 25.2 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 97 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 2006

Facility	Gallons of water treated	Gallons of TCE removed
X-622	12,326,000	1
X-623	2,993,752	64
X-624	2,149,481	9
X-627	7,754,769	23

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 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 12.3 million gallons of groundwater during 2006, thereby removing approximately 1 gallon 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 2006.

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 (#1, #2, and #3) east of the holding pond

The facility treated approximately 3 million gallons of water during 2006, thereby removing approximately 64 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 2006.

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 2.1 million gallons of water in 2006, thereby removing approximately 9 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 015, which discharges to Little Beaver Creek. The X-624 Groundwater Treatment Facility did not operate from July 17, 2006 through September 30, 2006 due to construction in the area. Water from the treatment facility was transported to the X-623 Groundwater Treatment Facility for processing. No NPDES permit limitations were exceeded at Outfall 015 in 2006.

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 2006.

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 7.8 million gallons of groundwater were processed during 2006, thereby removing 23 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 2006.

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