

## 6. GROUNDWATER PROGRAMS

### 6.1 SUMMARY

Groundwater monitoring at PORTS is required by a combination of state and federal regulations, legal agreements with Ohio 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.

Groundwater plumes that consist of VOCs, primarily TCE, are found at five of the PORTS monitoring areas: X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, Quadrant I Groundwater Investigative (5-Unit) Area, Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Former Holding Pond, and X-740 Former Waste Oil Handling Facility. In general, concentrations of most contaminants detected within these plumes were stable or decreasing during 2018. However, a few contaminants increased in 2018 as discussed below and in the remaining sections of this chapter.

The groundwater plume at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility is near the southern boundary of PORTS. In 2018, concentrations of VOCs increased in several of the wells that monitor the X-749 South Barrier Wall area (the southern portion of the plume near the property boundary), including one off-site well. TCE and other VOCs (1,1-dichloroethane and 1,1-dichloroethene) were detected in the third and fourth quarter samples collected from off-site well WP-03G at concentrations of 0.4 µg/L or less. Prior to these detections in 2018, VOCs had not been detected in well WP-03G since 2012 (DOE 2013), although these VOCs were routinely detected in the well before 2012 (DOE 2011a, DOE 2012). No other VOCs were detected in 2018 in any of the off-site monitoring wells. TCE has not been detected in groundwater beyond the DOE property boundary at concentrations that exceed the Ohio EPA drinking water standard of 5 µg/L.

Several factors may have contributed to these increases including high rainfall and reduced pumping rates in the groundwater extraction wells in the X-749 South Barrier Wall area. The X-749 groundwater extraction wells operated at reduced pumping rates from the end of January through the end of May when repairs were completed on a pipeline that transfers groundwater from the X-749 extraction wells to the X-622 Groundwater Treatment Facility. The increased precipitation and reduced pumping rates caused higher than typical water levels in the X-749 South Barrier Wall area monitoring wells. Maintenance was performed on the X-749 Groundwater Collection System in 2018, and extraction wells in the X-749 South Barrier Wall Area were cleaned in 2019 to optimize groundwater extraction.

The *2018 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 (DOE 2019). This document and other documents referenced in this chapter are available in the PORTS Environmental Information Center.

### 6.2 GROUNDWATER PROGRAMS INTRODUCTION

This chapter provides an overview of groundwater monitoring at PORTS and the results of the groundwater monitoring program for 2018. The following sections provide an overview of the PORTS groundwater monitoring program followed by a review of the history and 2018 monitoring data for each area. Chapter 3, Section 3.3, provides additional information about the remedial actions implemented at a number of the areas discussed in this chapter to reduce or eliminate groundwater contamination.

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 permitted FBP NPDES outfalls.

## **6.3 OVERVIEW OF GROUNDWATER MONITORING AT 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, agreements between 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 was approved by Ohio EPA and implemented at PORTS starting in April 1999. The *Integrated Groundwater Monitoring Plan* is periodically revised by DOE and approved by Ohio EPA. An annual groundwater report is submitted to Ohio EPA in accordance with the *Integrated Groundwater Monitoring Plan*.

Groundwater monitoring in 2018 was completed in accordance with the *Integrated Groundwater Monitoring Plan* dated August 2017 (DOE 2017c). The August 2017 *Integrated Groundwater Monitoring Plan* incorporated minor revisions to the monitoring program that were previously approved by Ohio EPA. These revisions included a reduction in sampling parameters and frequency at the X-740 Former Waste Oil Handling Facility and deletion of one well from the monitoring program for the X-735 Landfills because the well required removal due to construction activities for the OSWDF.

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 the industrialized portion of 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 water supply well fields north and west of PORTS in the Scioto River Valley buried aquifer. 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 the following areas within the quadrants of the site designated by the RCRA Corrective Action Program (DOE 2017c). These areas (see Figure 6.1) are:

- Quadrant I
  - X-749 Contaminated Materials Disposal Facility /X-120 Former Training Facility,
  - PK Landfill,
  - Quadrant I Groundwater Investigative (5-Unit) Area,
  - X-749A Classified Materials Disposal Facility,
- Quadrant II
  - Quadrant II Groundwater Investigative (7-Unit) Area,
  - X-701B Former Holding Pond,
  - X-633 Former Recirculating Cooling Water Complex,
- Quadrant III
  - X-616 Former Chromium Sludge Surface Impoundments,
  - X-740 Former Waste Oil Handling Facility,
- Quadrant IV
  - X-611A Former Lime Sludge Lagoons,
  - X-735 Landfills,
  - X-734 Landfills,
  - X-533 Former Switchyard Complex, and
  - X-344C Former Hydrogen Fluoride Storage Building.

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 (DOE 2017c).

In general, samples are collected from wells (or surface water locations) at each area listed above and are analyzed for metals, VOCs, and/or radionuclides. Table 6.1 lists the analytical requirements for each groundwater monitoring area and other monitoring programs described in this chapter. Constituents detected in the groundwater are then compared to standards called preliminary remediation goals to assess the potential for each constituent to affect human health and the environment. Preliminary remediation goals are initial clean-up goals developed early in the decision-making process that are 1) protective of human health and the environment, and 2) comply with applicable or relevant and appropriate requirements. Preliminary remediation goals are intended to satisfy regulatory cleanup requirements. For groundwater at PORTS, preliminary remediation goals are the Ohio EPA drinking water standards (maximum contaminant levels).

Five areas of groundwater contamination, commonly called groundwater plumes, have been identified at PORTS. Groundwater contamination consists of VOCs (primarily TCE) and radionuclides such as technetium-99. The areas that contain groundwater plumes are X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, Quadrant I Groundwater Investigative (5-Unit) Area, Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Former Holding Pond, and X-740 Former Waste Oil Handling Facility. Other areas are monitored to evaluate 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 2018.

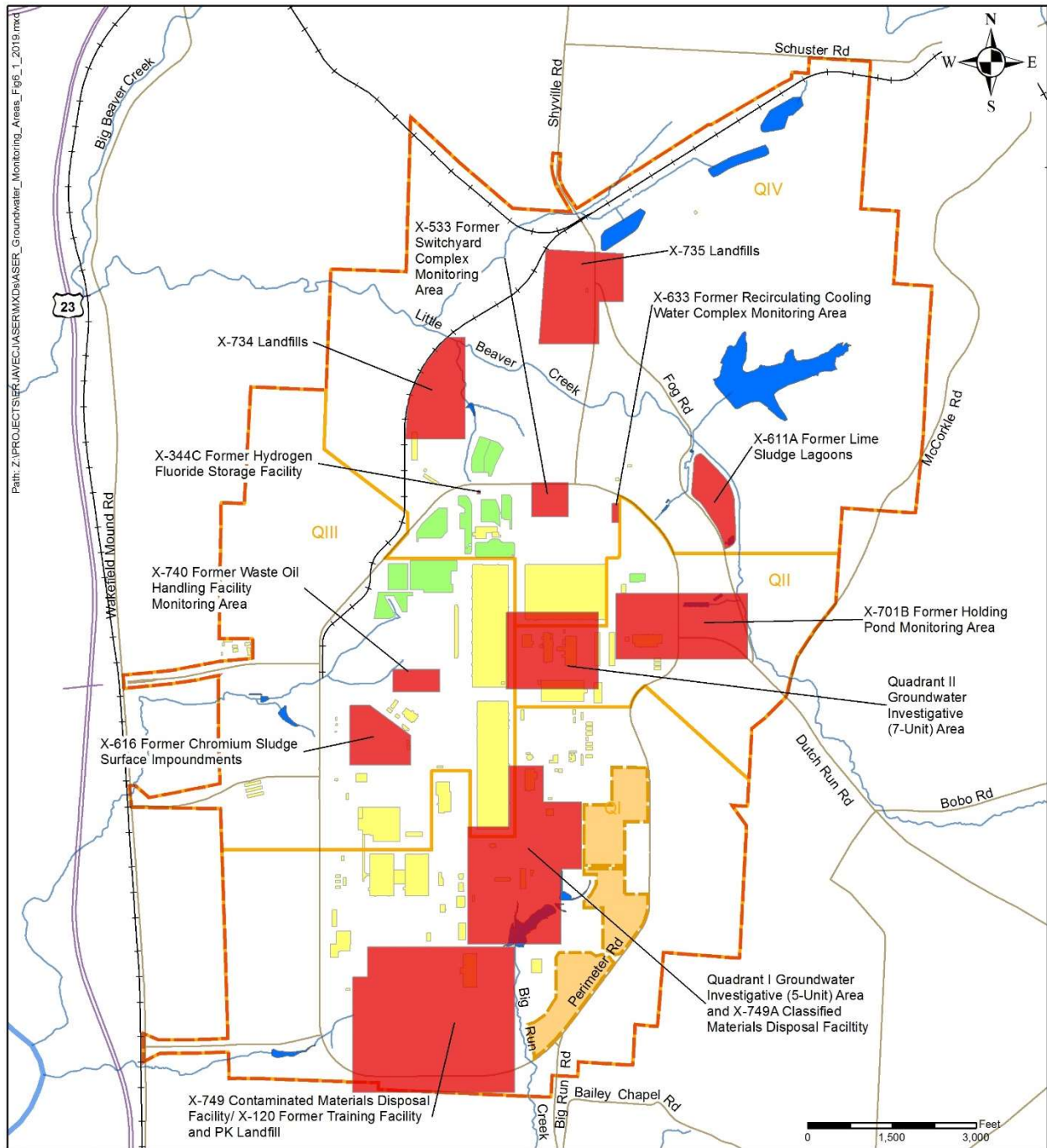


Figure 6.1. Groundwater monitoring areas at PORTS.

**Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2018**

Monitoring Area or Program		Analytes
X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility <sup>a,b</sup>	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu	technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U total metals: Be, Cd, Cr, Mn, Ni
PK Landfill <sup>b</sup>	VOCs	total metals: Be, Cd, Cr, Mn, Ni
Quadrant I Groundwater Investigative (5-Unit) Area <sup>a,b</sup>	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu	technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U total metals: Be, Cd, Cr, Mn, Ni
X-749A Classified Materials Disposal Facility	VOCs-2 technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U alkalinity chloride sulfate chemical oxygen demand total dissolved solids	total metals: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn nitrate/nitrite ammonia
Quadrant II Groundwater Investigative (7-Unit) Area <sup>a,b</sup>	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu	technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U total metals: Be, Cd, Cr, Mn, Ni
X-701B Former Holding Pond <sup>a,b</sup>	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U	alkalinity chloride sulfate total dissolved solids total metals: Be, Cd, Cr, Mn, Ni
X-633 Former Recirculating Cooling Water Complex	total metals: Cr	
X-616 Former Chromium Sludge Surface Impoundments	VOCs	total metals: Be, Cd, Cr, Mn, Ni
X-740 Former Waste Oil Handling Facility <sup>a</sup>	VOCs	
X-611A Former Lime Sludge Lagoons	total metals: Be, Cr	
X-735 Landfills	VOCs-2 technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U alkalinity chloride sulfate chemical oxygen demand total dissolved solids	total metals: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Hg, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn nitrate/nitrite ammonia

**Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2018 (continued)**

Monitoring Area or Program	Analytes	
X-734 Landfills	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U alkalinity chloride	total metals: Be, Cd, Cr, Mn, Ni, Na ammonia chemical oxygen demand nitrate/nitrite sulfate total dissolved solids
X-533 Former Switchyard Complex	total metals:	Cd, Ni
X-344C Former Hydrogen Fluoride Storage Building	VOCs	
Surface Water	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu	technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U
Water Supply	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu	technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U alpha activity
Exit Pathway	VOCs transuranics: <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu	technetium-99 U, <sup>233/234</sup> U, <sup>235/236</sup> U, <sup>238</sup> U

<sup>a</sup>Selected well(s) in this area are sampled once every two years for a comprehensive list of more than 200 potential contaminants (40 CFR Part 264 Appendix IX – Appendix to Ohio Administrative Code Rule 3745-54-98).

<sup>b</sup>Not all wells in this area are analyzed for all listed analytes.

Notes:

VOCs: 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, TCE, trichlorofluoromethane (CFC-11), vinyl chloride, xylenes (m,p-xylenes).

VOCs-2: VOCs listed above 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.

Appendix A lists the symbols for metals and transuranic radionuclides.

#### **6.4.1 X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility**

In the southernmost portion of PORTS in Quadrant I, groundwater concerns focus on three contaminant sources: X-749 Contaminated Materials Disposal Facility (also called the X-749 Landfill), X-120 Former Training Facility, and PK Landfill. A contaminant plume consisting of VOCs, primarily TCE, is associated with the X-749 Contaminated Materials Disposal Facility and X-120 Former Training Facility. The PK Landfill, located immediately northeast of the X-749 Landfill, is not a contaminant source to the X-749/X-120 groundwater plume.

##### **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 in Quadrant I. The landfill covers approximately 11.5 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 in 1992 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 extended 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 FBP NPDES Outfall 608, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

The leading edge of the contaminated groundwater plume emanating from the X-749 Landfill is near 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, VOCs moved beyond the wall. In 2007, four groundwater extraction wells were installed in the X-749 South Barrier Wall Area, and in 2008, two extraction wells were installed in the groundwater collection system on the southwest side of the landfill. These extraction wells are controlling migration of the plume off plant property and reducing concentrations of TCE in groundwater. Two additional groundwater extraction wells were installed in 2010 to further control migration of the X-749/X-120 groundwater plume and remediate areas of higher TCE concentrations within the plume. A third extraction well was installed in the X-120 area of the plume (see Section 6.4.1.2). Chapter 3, Section 3.3.1.1, provides additional information about the remedial actions implemented to address the X-749/X-120 groundwater plume.

Eighty-four wells and one sump/extraction well were sampled during 2018 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells and sump in this area.

##### **6.4.1.2 X-120 Former Training Facility**

The X-120 Former Training Facility (originally called the Goodyear Training Facility and also called 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 west of the present-day XT-847 building. The

X-120 Former Training Facility 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 VOCs, primarily TCE. 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. In 2003, operation of the X-625 Groundwater Treatment Facility and horizontal well ceased with the approval of Ohio EPA due to the limited amount of groundwater collected by the well. A groundwater extraction well was installed in 2010 in the area west of the X-120 Former Training Facility to remediate the higher concentrations of TCE in groundwater in this area. Chapter 3, Section 3.3.1.1, provides additional information about the remedial actions implemented to address the X-749/X-120 groundwater plume.

Eighty-four wells and one sump/extraction well were sampled during 2018 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells and sump in this area.

#### **6.4.1.3 Monitoring results for the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility in 2018**

The most extensive and most concentrated constituents associated with the X-749/X-120 plume (see Figure 6.2) are VOCs, particularly TCE.

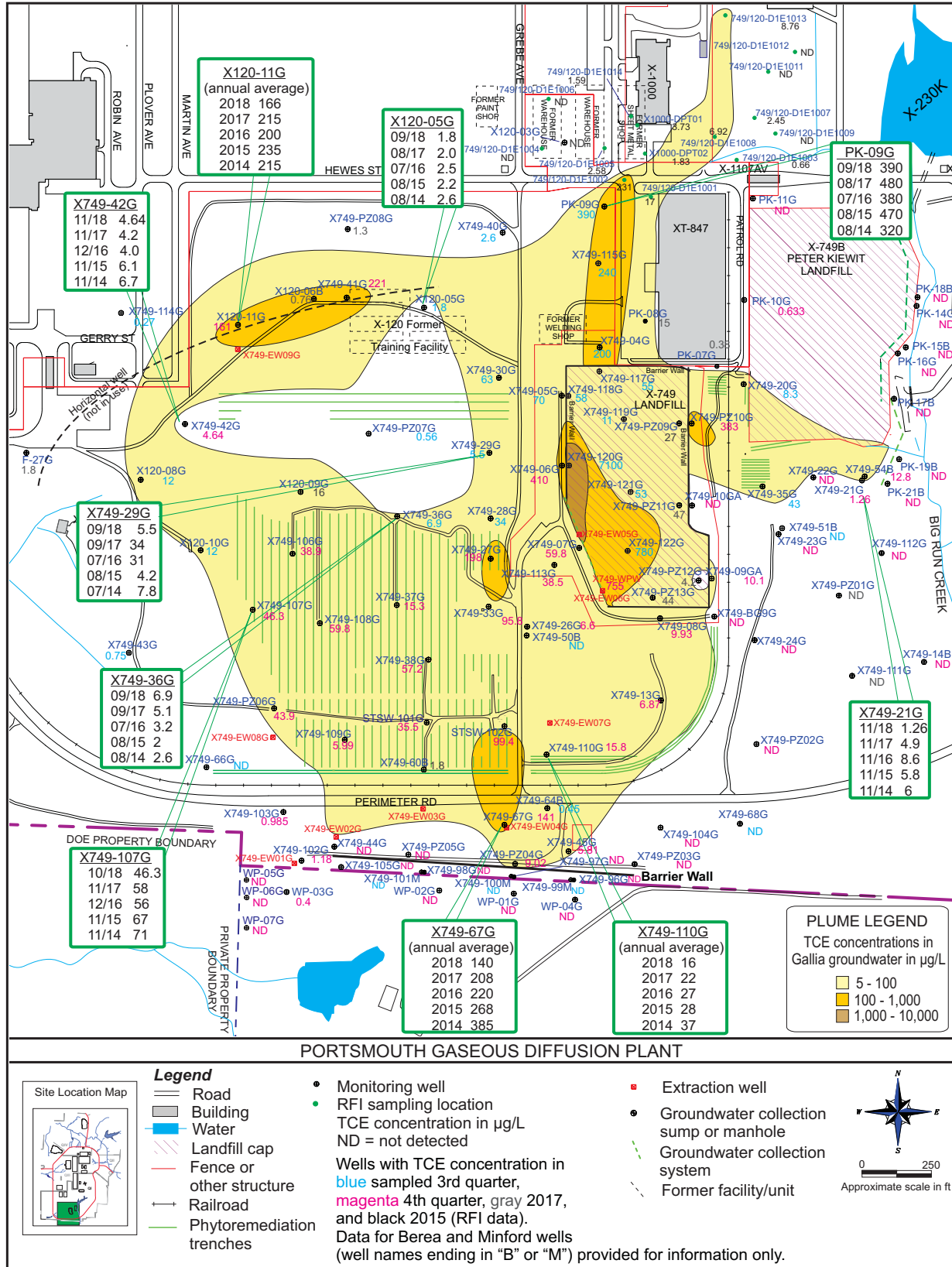
In 2018, concentrations of VOCs increased in several of the wells that monitor the X-749 South Barrier Wall area (the southern portion of the plume). TCE and other VOCs (1,1-dichloroethane and 1,1-dichloroethene) were detected in the third and fourth quarter samples collected from off-site well WP-03G at concentrations of 0.4 µg/L or less. Prior to these detections in 2018, VOCs had not been detected in well WP-03G since 2012 (DOE 2013), although these VOCs were routinely detected in the well from its installation in 2004 to 2012 (DOE 2011a, DOE 2012). No other VOCs were detected in 2018 in any of the off-site monitoring wells.

In on-site monitoring wells in the X-749 South Barrier Wall area, TCE was detected above the preliminary remediation goal (5 µg/L) in samples collected from wells X749-45G and X749-PZ04G. Although TCE is typically detected in these two wells, concentrations are usually less than 5 µg/L.

Several factors may have contributed to these increases including high rainfall and reduced pumping rates in the groundwater extraction wells in the X-749 South Barrier Wall area. The X-749 groundwater extraction wells operated at reduced pumping rates from the end of January through the end of May when repairs were completed on a pipeline that transfers groundwater from the X-749 extraction wells to the X-622 Groundwater Treatment Facility. The increased precipitation and reduced pumping rates caused higher than typical water levels in the X-749 South Barrier Wall area monitoring wells. Maintenance was performed on the X-749 Groundwater Collection System in 2018, and extraction wells in the X-749 South Barrier Wall Area were cleaned in 2019 to optimize groundwater extraction.

Groundwater in the area north of the X-749 Landfill was investigated in 2015 as part of the Deferred Units RCRA Facility Investigation. The results of this investigation have expanded the X-749/X-120 Gallia groundwater plume in the northern portion of the monitoring area. Analytical data for this investigation are provided in the *Deferred Units Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Report* (DOE 2017a).





Extraction well X749-EW09G was installed in 2010 to remediate higher concentrations of TCE associated with the former X-120 facility in the northern portion of the X-749/X-120 groundwater plume. Well X120-11G, which is immediately north of X749-EW09G, monitors the highest concentrations of TCE in this area. The average concentration of TCE detected in 2018 in well X120-11G (166 µg/L) is less than average concentrations in 2014-2017 (200-235 µg/L) (see Figure 6.2).

Extraction well X749-EW08G is intended to control migration of the southwestern portion of the X-749/X-120 groundwater plume. TCE was not detected in the downgradient well X749-66G in 2018.

Groundwater extraction well X749-EW07G was installed in 2010 to remediate areas of higher TCE concentrations south of the X-749 Landfill. Wells X749-67G and X749-110G monitor the performance of extraction well X749-EW07G. The average concentration of TCE detected in 2018 in well X749-67G (140 µg/L) has decreased from the average annual concentrations detected in 2014-2017 (see Figure 6.2). The average concentration of TCE detected in 2018 in well X749-110G (16 µg/L) has decreased from the average annual concentrations detected in 2014-2017 (see Figure 6.2). These results indicate that extraction well X749-EW07G is functioning as intended to reduce concentrations of TCE south of the X-749 Landfill.

#### **6.4.2 PK Landfill**

The PK Landfill is located west of Big Run Creek just south of the X-230K Holding Pond in Quadrant I and northeast of the X-749 Landfill. PK 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. Although the PK Landfill is adjacent to the X-749 Landfill and X-749/X-120 groundwater plume, it is not a source of contaminants detected in the X-749/X-120 groundwater plume. A cap was constructed over the landfill in 1998. Chapter 3, Section 3.3.1.2, provides additional information about the remedial actions implemented at PK Landfill.

In 2018, nine wells and two sumps were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells and sumps in this area.

##### **6.4.2.1 Monitoring results for the PK Landfill in 2018**

The PK Landfill is not part of the X-749/X-120 groundwater plume, although some of the wells associated with the PK Landfill are contaminated with low levels of VOCs, including TCE (see Figure 6.2). Most of the detections of VOCs in the PK Landfill monitoring wells are below preliminary remediation goals. In 2018, vinyl chloride was detected in samples collected from wells PK-17B and PK-21B at concentrations ranging from 7.34 to 19 µg/L, which exceed the preliminary remediation goal of 2 µg/L. Vinyl chloride is typically detected in these wells at concentrations above the preliminary remediation goal. No other VOCs were detected in the PK Landfill monitoring wells at concentrations that exceeded the preliminary remediation goals.

### 6.4.3. Quadrant I Groundwater Investigative (5-Unit) Area

The Quadrant I Groundwater Investigative (5-Unit) Area consists of a groundwater plume resulting from a number of potential sources of groundwater contamination in the northern portion of Quadrant I: the X-231A and X-231B Oil Biodegradation Plots, X-600 Former Steam Plant Complex, X-600A Former Coal Pile Yard, X-621 Coal Pile Runoff Treatment Facility, X-710 Technical Services Building, the X-760 Former Pilot Investigation Building, and the X-770 Former 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 1991 as part of an IRM 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. These wells began operation in 2002. An additional extraction well south of the X-326 Process Building began operating in 2009. The extracted groundwater is treated at the X-622 Groundwater Treatment Facility and discharged through FBP NPDES Outfall 608, which flows into the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). Multimedia landfill caps were installed over the X-231B area and a similar area, X-231A, in 2000 to minimize water infiltration and control the spread of contamination. Chapter 3, Section 3.3.1.3, provides additional information about the remedial actions implemented in the Quadrant I Groundwater Investigative (5-Unit) Area.

Twenty-four wells were sampled in 2018 as part of the monitoring program for the Quadrant I Groundwater Investigative (5-Unit) Area. Table 6.1 lists the analytical parameters for the wells in this area.

#### 6.4.3.1 Monitoring results for the Quadrant I Groundwater Investigative (5-Unit) Area in 2018

A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant I Groundwater Investigative (5-Unit) Area (see Figure 6.3). Other VOCs are also present in the plume.

TCE is increasing in well X231B-36G, which monitors the northern portion of the plume on the south side of the X-710 Technical Services Building. TCE was detected at 690 µg/L in 2018, which has increased from 180 µg/L in 2014 (see Figure 6.3). TCE is also increasing in well X626-07G. Extraction well X622-EW12G is intended to draw groundwater contaminated with higher levels of TCE into the area monitored by X626-07G. No other significant changes in TCE concentrations were identified in wells that monitor the Quadrant I Groundwater Investigative (5-Unit) Area in 2018.

#### 6.4.4 X-749A Classified Materials Disposal Facility

The 6-acre X-749A Classified Materials Disposal Facility (also called the X-749A Landfill) is a landfill that operated from 1953 through 1988 for the disposal of wastes classified under the Atomic Energy Act (see Figure 6.3). 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 the X-230K South Holding Pond (FBP NPDES Outfall 002). Although the X-749A Classified Materials Disposal Facility is located at the eastern edge of the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume, the X-749A Landfill is not the source of the VOCs detected in some of the X-749A monitoring wells at the eastern edge of the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume.

Ten wells associated with the landfill were sampled in 2018. Table 6.1 lists the analytical parameters for the wells in this area.

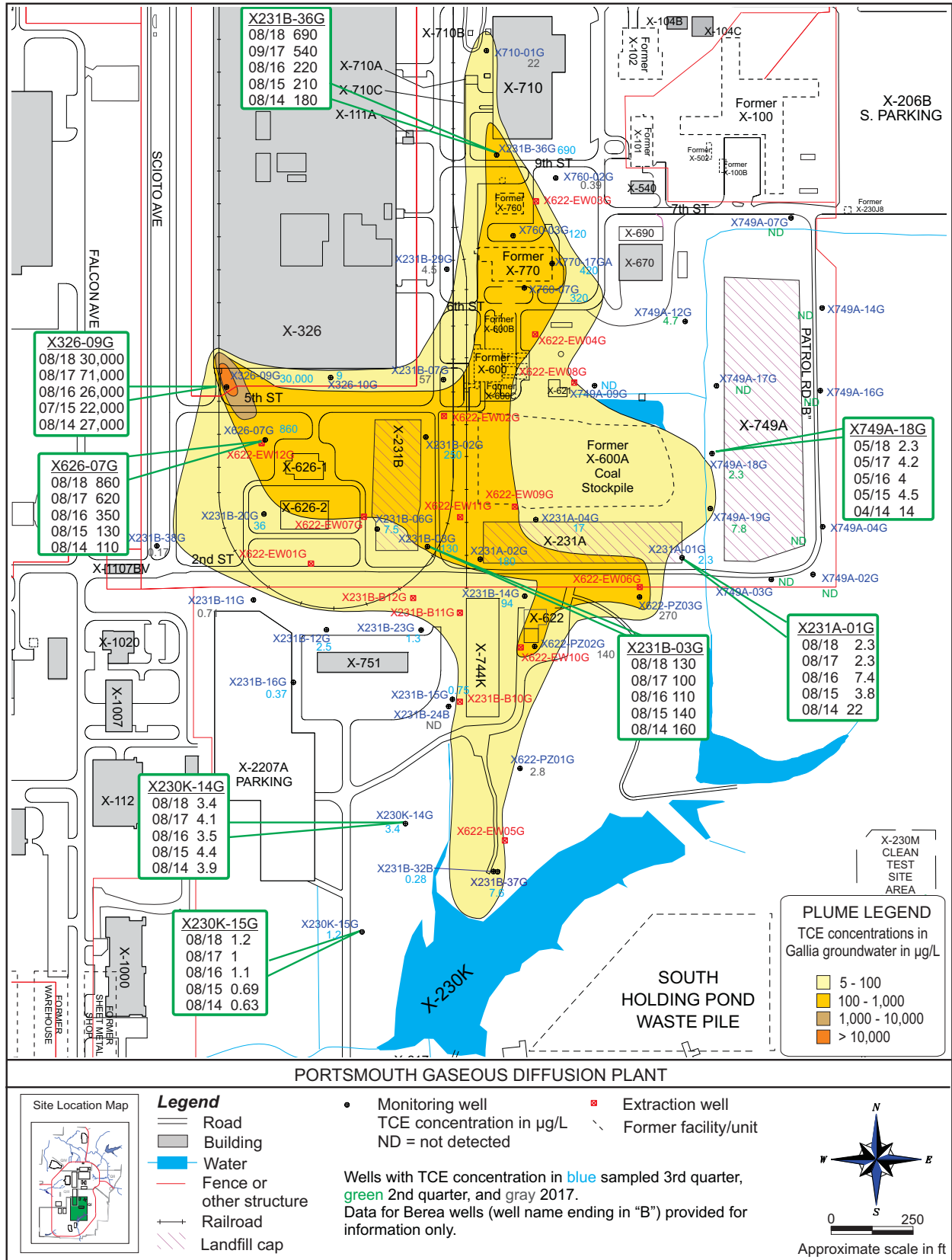


Figure 6.3. TCE-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative (5-Unit) Area – 2018.

#### **6.4.4.1 Monitoring results for the X-749A Classified Materials Disposal Facility in 2018**

Under the detection monitoring program for the X-749A Landfill, concentrations of alkalinity, ammonia, calcium, chloride, iron, nitrate/nitrite, sodium, and sulfate in downgradient Gallia wells were evaluated using two statistical procedures to monitor potential impacts to groundwater and trends in concentrations of these parameters. Ohio EPA is notified when the statistical control limit for any of the indicator parameters using the first statistical procedure is exceeded at any of the downgradient Gallia wells in two consecutive semiannual sampling events. The second statistical procedure monitors long-term trends in concentrations of the indicator parameters and does not require Ohio EPA notification.

None of the control limits requiring Ohio EPA notification were exceeded in the X-749A wells in 2018.

#### **6.4.5 Quadrant II Groundwater Investigative (7-Unit) Area**

The Quadrant II Groundwater Investigative (7-Unit) 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 TCE and other VOCs from metal-cleaning operations. The X-701C Neutralization Pit was located within a TCE plume centered around the X-700 and X-705 buildings. The pit was removed in 2001. In 2010, Ohio EPA approved an IRM to remediate contaminant source areas within the southeastern portion of the groundwater plume, which was completed in 2013. Chapter 3, Section 3.3.2.1 provides additional information about the Quadrant II Groundwater Investigative (7-Unit) Area.

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 FBP NPDES Outfall 611, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). Twenty-four wells are part of the routine monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

#### **6.4.5.1 Monitoring results for the Quadrant II Groundwater Investigative (7-Unit) Area in 2018**

A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant II Groundwater Investigative (7-Unit) Area (see Figure 6.4).

Concentrations of TCE detected in the Quadrant II Groundwater Investigative (7-Unit) Area plume were generally stable or decreasing in 2018, with the exception of wells X705-03G and X705-04G in the western portion of the plume. TCE has increased in these wells since 2014, and the concentration of TCE detected in well X705-03G increased to over 100 µg/L (110 µg/L) in 2018 (see Figure 6.4). TCE also increased in well X700-06G to 3,300,000 µg/L in 2018 from approximately 1,000,000 µg/L in 2014-2017.

Groundwater in the western and northwestern portion of the monitoring area, beneath and adjacent to the X-333 and X-330 Process Buildings, was investigated in 2015 as part of the Deferred Units RCRA Facility Investigation. The results from the sampling locations that were part of this investigation have expanded the Gallia groundwater plume in the western and northwestern portion of the monitoring area.

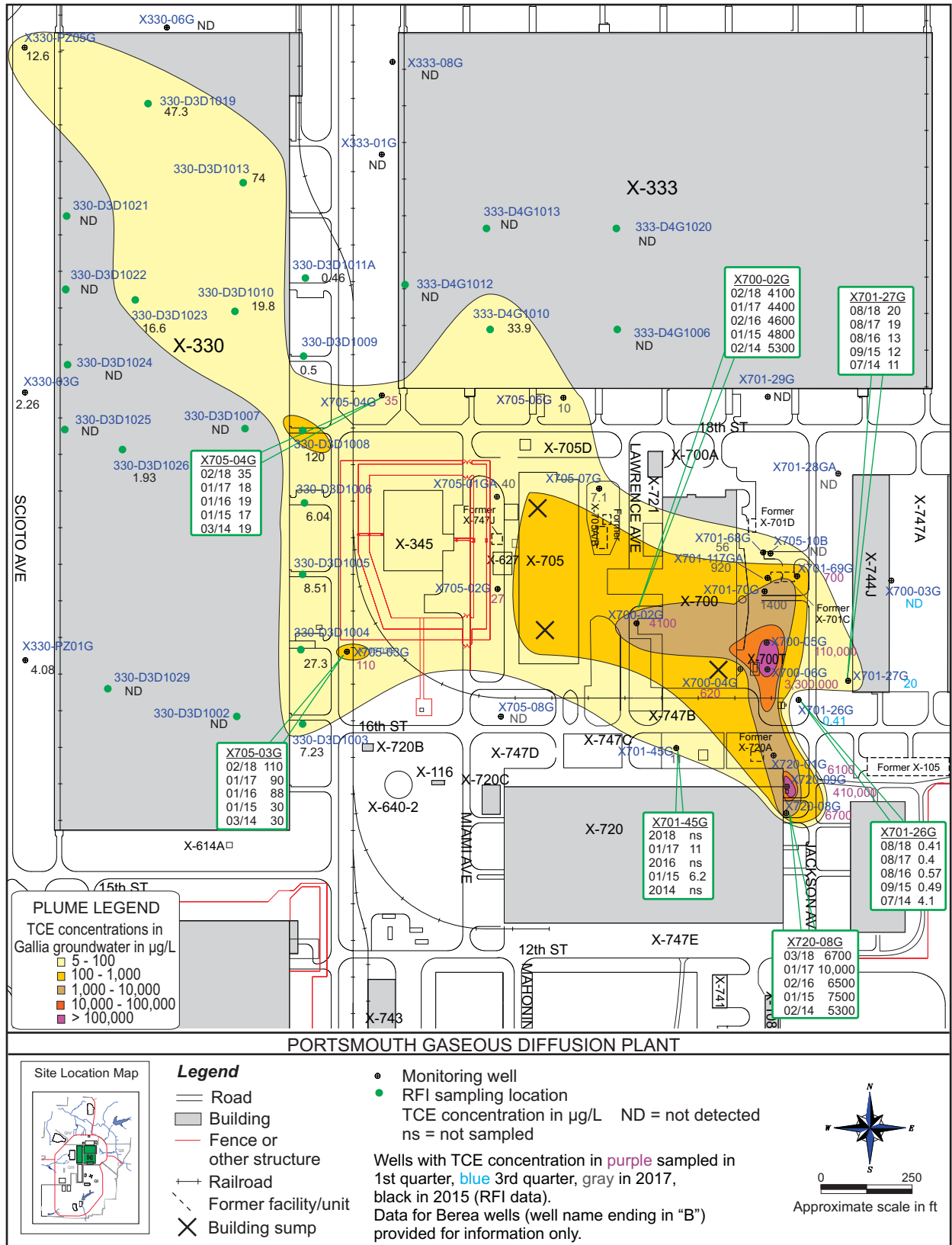


Figure 6.4. TCE-contaminated Gallia groundwater plume at the Portsmouth Gaseous Diffusion Plant (7-Unit) Area – 2018.

#### **6.4.6 X-701B Former Holding Pond**

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

The X-701B Former Holding Pond was used from the beginning of plant operations in 1954 until 1988. The pond was designed for neutralization and settlement of acid waste from several sources. TCE and other VOCs 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 Former Holding Pond. The X-744Y Waste Storage Yard is south of the X-701B Former Holding Pond. The yard was approximately 15 acres and surrounded the X-744G Bulk Storage Building. RCRA hazardous waste was managed in this area.

A contaminated groundwater plume extends from the X-701B Former Holding Pond towards Little Beaver Creek. Three groundwater extraction wells were installed in 1993 southeast of the X-701B Former Holding Pond and a sump was installed in 1995 in the bottom of the pond as part of the RCRA closure of the unit. These wells and sump were designed to intercept contaminated groundwater emanating from the holding pond area before it could join the existing groundwater contaminant plume. The extraction wells and sump were removed between 2009 and 2011 because of the X-701B IRM (see Chapter 3, Section 3.3.2.2).

Two groundwater interceptor trenches (French drains) are used to intercept TCE-contaminated groundwater in the eastern portion of the monitoring area. These interceptor trenches, called the X-237 Groundwater Collection System, control TCE 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 FBP NPDES Outfall 015, which flows to Little Beaver Creek.

Groundwater remediation in the X-701B Former Holding Pond Area was initiated in 2006 (see Chapter 3, Section 3.3.2.2). Oxidant was injected into the subsurface in the western portion of the area from 2006 through 2008 to remediate VOCs in soil and groundwater. The X-701B IRM was initiated in December 2009 and completed in 2011 to further address contaminants remaining in soil and groundwater following the oxidant injections. Contaminated soil in the X-701B IRM area was removed and mixed with oxidant, with additional oxidant mixed into soil remaining at the bottom of the excavation.

Sixty-three wells that monitor the X-701B Former Holding Pond area were sampled in 2018. Table 6.1 lists the analytical parameters for the wells that are part of the *Integrated Groundwater Monitoring Plan* (DOE 2017c).

##### **6.4.6.1 Monitoring results for the X-701B Former Holding Pond in 2018**

In general, concentrations of TCE detected in wells within the X-701B plume in 2018 were similar to previous years. TCE is decreasing in wells X701-20G and X701-EW121G, which are downgradient of the IRM treatment area. Over the last five years, TCE has decreased in well X701-20G from a high of 86,000 µg/L in the first quarter of 2014 to 49,000 µg/L in the third quarter of 2018. TCE has decreased in well X701-EW121G from 120,000 µg/L in the third quarter of 2014 to 49,000 µg/L in the third quarter of 2018 (see Figure 6.5).

The concentration of TCE detected in well X701-42G on the north edge of plume increased to 250 µg/L in 2018. Previous detections of TCE in this well have not exceeded 10 µg/L. TCE is also increasing in two wells in the southern portion of the plume: X701-23G and X701-79G. TCE has increased in X701-23G from 2.6 µg/L in 2014 to 7.1 µg/L in 2018. TCE has increased in X701-79G from 51 µg/L in 2014 to 330 µg/L in 2018 (see Figure 6.5).



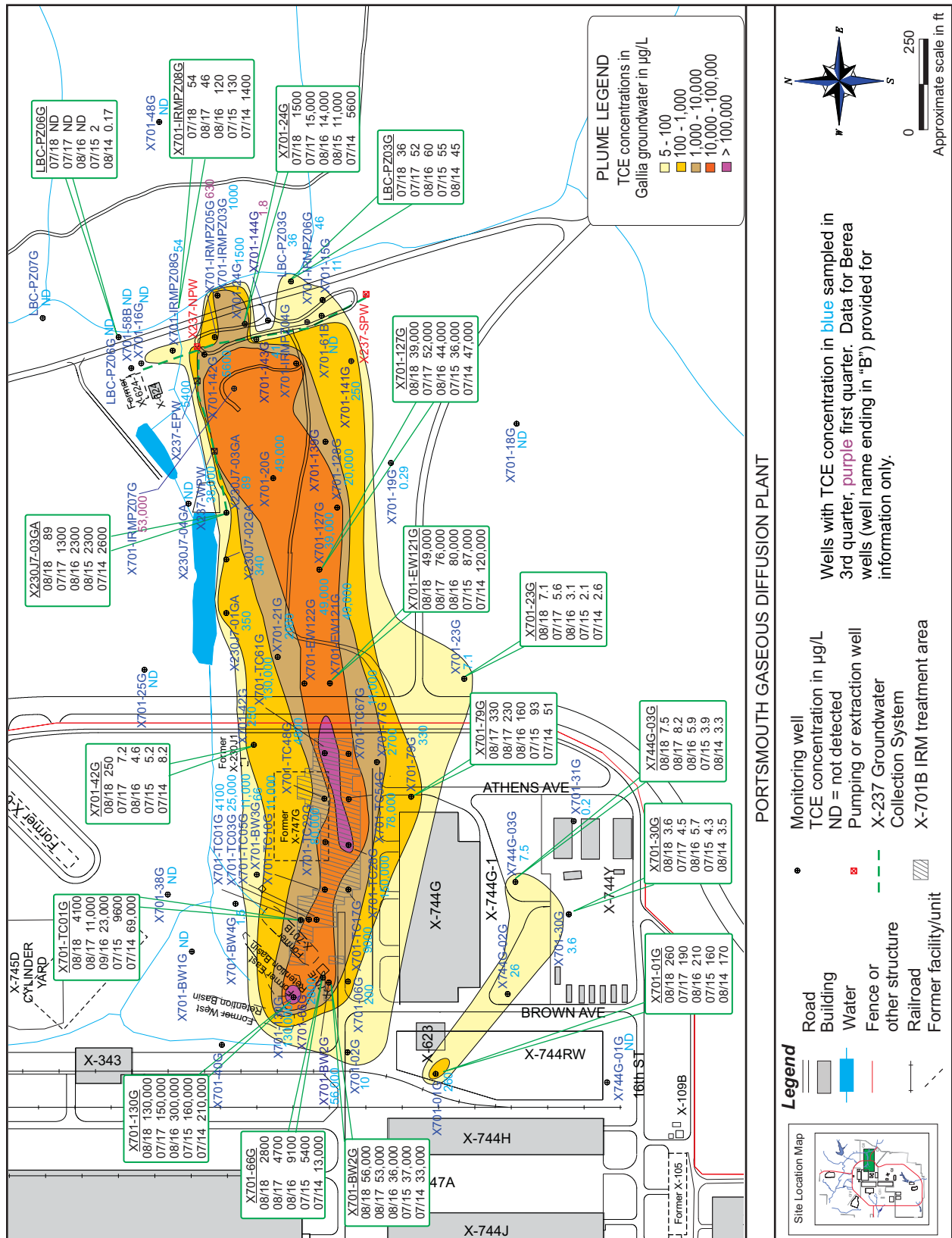


Figure 6.5. TCE-contaminated Gallia groundwater plume at the X-701B Former Holding Pond – 2018.



Samples from 49 wells that monitor the X-701B Holding Pond were analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and/or uranium-238). Technetium-99 or uranium were detected above Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium) in four wells near the former X-701B Pond and east retention basin and in wells installed within the IRM area. Concentrations of radionuclides present in groundwater in the X-701B area can be affected by the oxidant used in the X-701B IRM and the oxidant injections conducted in 2006 through 2008 that were part of the X-701B groundwater remedy. The oxidant, which affects the oxidation/reduction potential and pH of the soil and/or groundwater, temporarily causes metals in soil to be mobilized into the groundwater. It is expected that the metals will move downgradient with groundwater flow for a short distance and then be re-adsorbed into the soil matrix as the geochemistry of the soil and groundwater returns to ambient conditions.

Samples from five wells that monitor the area near the X-744G Bulk Storage Building and X-744Y Storage Yard were analyzed for cadmium and nickel, which were detected above preliminary remediation goals in three of the five wells (X701-01G, X744G-01G, and X744G-02G). These results are typical for the X-744 area wells. Nickel was also detected at concentrations above the preliminary remediation goal in samples collected from wells X701-20G and X701-127G, which monitor the center of the plume downgradient from the IRM treatment area and the area in which oxidant was injected from 2006 through 2008. This area is likely affected by the oxidant used in the X-701B IRM and the oxidant injections conducted in 2006 through 2008.

#### **6.4.7 X-633 Former Recirculating Cooling Water Complex**

The X-633 Former Recirculating Cooling Water Complex in Quadrant II consisted 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. D&D of the facilities was completed in 2010. Chapter 3, Section 3.3.2.3 provides additional information about the RCRA investigation of soils and groundwater in this area.

The X-633 Former Recirculating Cooling Water Complex 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 in 1998 and 1999 to assess the area for metals contamination. Based on detections of chromium above the preliminary remediation goal, 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.

##### **6.4.7.1 Monitoring results for the X-633 Former Recirculating Cooling Water Complex in 2018**

Chromium was detected in both of the X-633 monitoring wells in 2018. Samples collected from well X633-07G contained chromium at concentrations above the preliminary remediation goal of 100 µg/L: 1700 µg/L (second quarter) and 560 µg/L (fourth quarter). Samples collected from well X633-PZ04G also contained chromium but at concentrations below the preliminary remediation goal. These results are typical for these wells. Figure 6.6 shows the chromium concentrations detected in the X-633 Former Recirculating Cooling Water Complex wells.

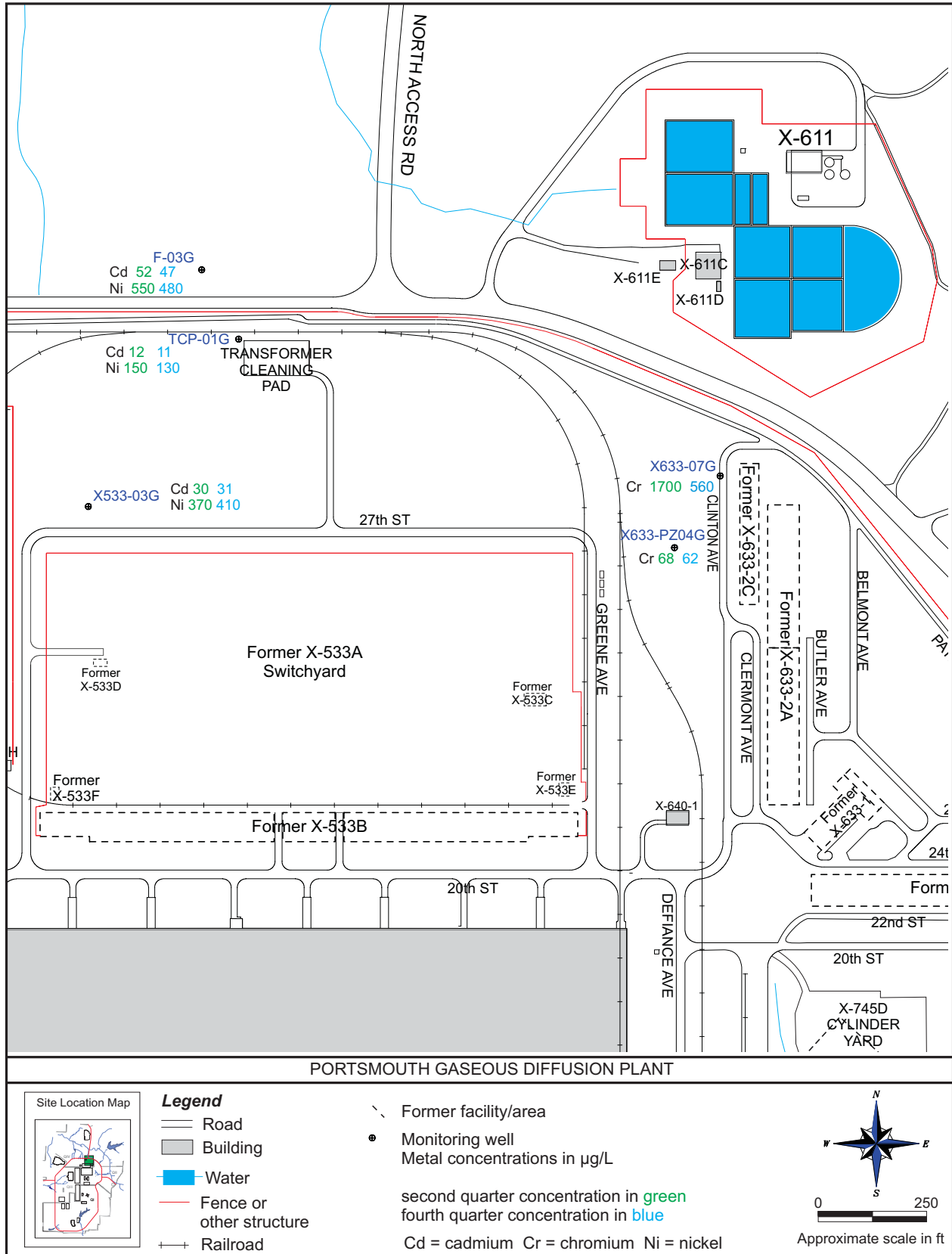


Figure 6.6. Metal concentrations in groundwater at the X-633 Former Recirculating Cooling Water Complex and X-533 Former Switchyard Complex – 2018.

#### **6.4.8 X-616 Former Chromium Sludge Surface Impoundments**

The X-616 Former Chromium Sludge Surface Impoundments in Quadrant III 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. Sixteen wells are sampled 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-616 Former Chromium Sludge Surface Impoundments in 2018**

Chromium is of special concern at X-616 because of the previous use of the area. In 2018, chromium was detected above the preliminary remediation goal of 100 µg/L in one well that monitors the X-616 area: well X616-05G (on the northeastern boundary of the area). Chromium is typically detected above the preliminary remediation goal in this well. Nickel was 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. Figure 6.7 shows the concentrations of chromium and nickel in wells at the X-616 Former Chromium Sludge Surface Impoundments.

TCE was detected above the preliminary remediation goal of 5 µg/L in three wells west of the former surface impoundments: wells X616-09G, X616-13G, and X616-20B. TCE has been detected above 5 µg/L in wells X616-09G and X616-20B since 2004 or earlier. Concentrations of TCE increased to above 5 µg/L in well X616-13G in 2013. Figure 6.7 shows the concentrations of TCE detected in the X-616 wells in 2018.

#### **6.4.9 X-740 Former Waste Oil Handling Facility**

The X-740 Former Waste Oil Handling Facility, which was demolished in 2006, was located on the western half of PORTS south of the X-530A Switchyard in Quadrant III. 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. A sump within the building was used between 1986 and 1990 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 Former 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.

In 1999, poplar trees were planted in a 2.6-acre phytoremediation area above the groundwater plume near the X-740 Former Waste Oil Handling Facility. Because phytoremediation did not work as anticipated to reduce the concentrations of VOCs in groundwater in this area, three rounds of oxidant injections were completed during 2008. Additional alternatives for groundwater remediation in this area were evaluated in 2009, and a pilot study of enhanced anaerobic bioremediation took place from 2010 through 2015. Chapter 3, Section 3.3.3, provides additional information about the remedial activities for the X-740 area.

Nineteen wells that monitor the X-740 Former Waste Oil Handling Facility were sampled during 2018.

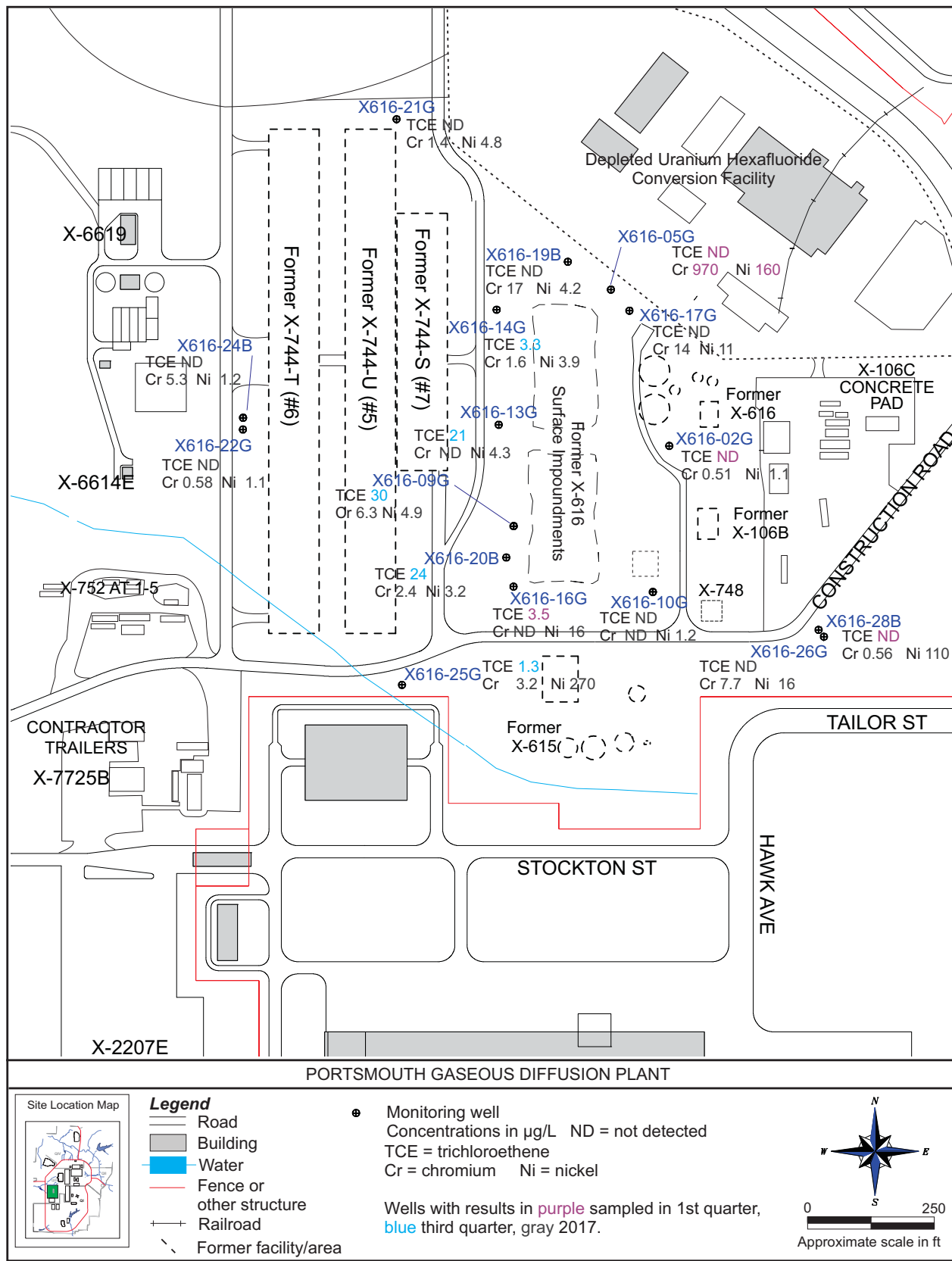


Figure 6.7. TCE and metal concentrations in groundwater at the X-616 Former Chromium Sludge Surface Impoundments – 2018.

#### **6.4.9.1 Monitoring results for the X-740 Former Waste Oil Handling Facility in 2018**

In general, concentrations of TCE continue to decrease in the TCE plume near the X-740 facility due to the bioremediation project that took place in this area (see Chapter 3, Section 3.3.3). The plume perimeter changed slightly in 2018 based on detections of TCE in the samples collected from four wells that define the northeastern portion of the plume. TCE detected in wells X740-02G and X740-03G increased to just over the preliminary remediation goal of 5 µg/L in 2018; TCE is typically detected in these wells at concentrations just above or below 5 µg/L. TCE decreased to less than 5 µg/L in wells X740-21G and X740-PZ10G, which are the first detections of TCE that are less than the preliminary remediation goal. TCE continued to decrease in the Berea well (X740-09B) within the plume. Figure 6.8 shows the Gallia groundwater plume and decreasing TCE concentrations in selected wells for the X-740 Former Waste Handling Facility.

#### **6.4.10 X-611A Former Lime Sludge Lagoons**

The X-611A Former Lime Sludge Lagoons in Quadrant IV 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 were 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 3.3.4.1, 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.

##### **6.4.10.1 Monitoring results for the X-611A Former Lime Sludge Lagoons in 2018**

The six monitoring wells at X-611A are sampled and analyzed semiannually for beryllium and chromium. In 2018, chromium was detected in the samples collected from three of the six wells in this area at concentrations between 0.51 and 23 µg/L, which are below the preliminary remediation goal (100 µg/L). This data range includes results for duplicate samples (DOE 2019).

In 2018, beryllium was detected in two of the six wells in this area at concentrations of 0.72 µg/L or less, which are less than the preliminary remediation goals (6.5 µg/L for Gallia wells and 7 µg/L for Berea wells). Figure 6.9 shows the concentrations of beryllium and chromium detected in the X-611A wells in 2018.

#### **6.4.11 X-735 Landfills**

Several distinct waste management units are contained within the X-735 Landfills area in Quadrant IV. The main units consist of the hazardous waste landfill, referred to as the X-735 RCRA Landfill, 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 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 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 1991, and Ohio EPA determined that the area

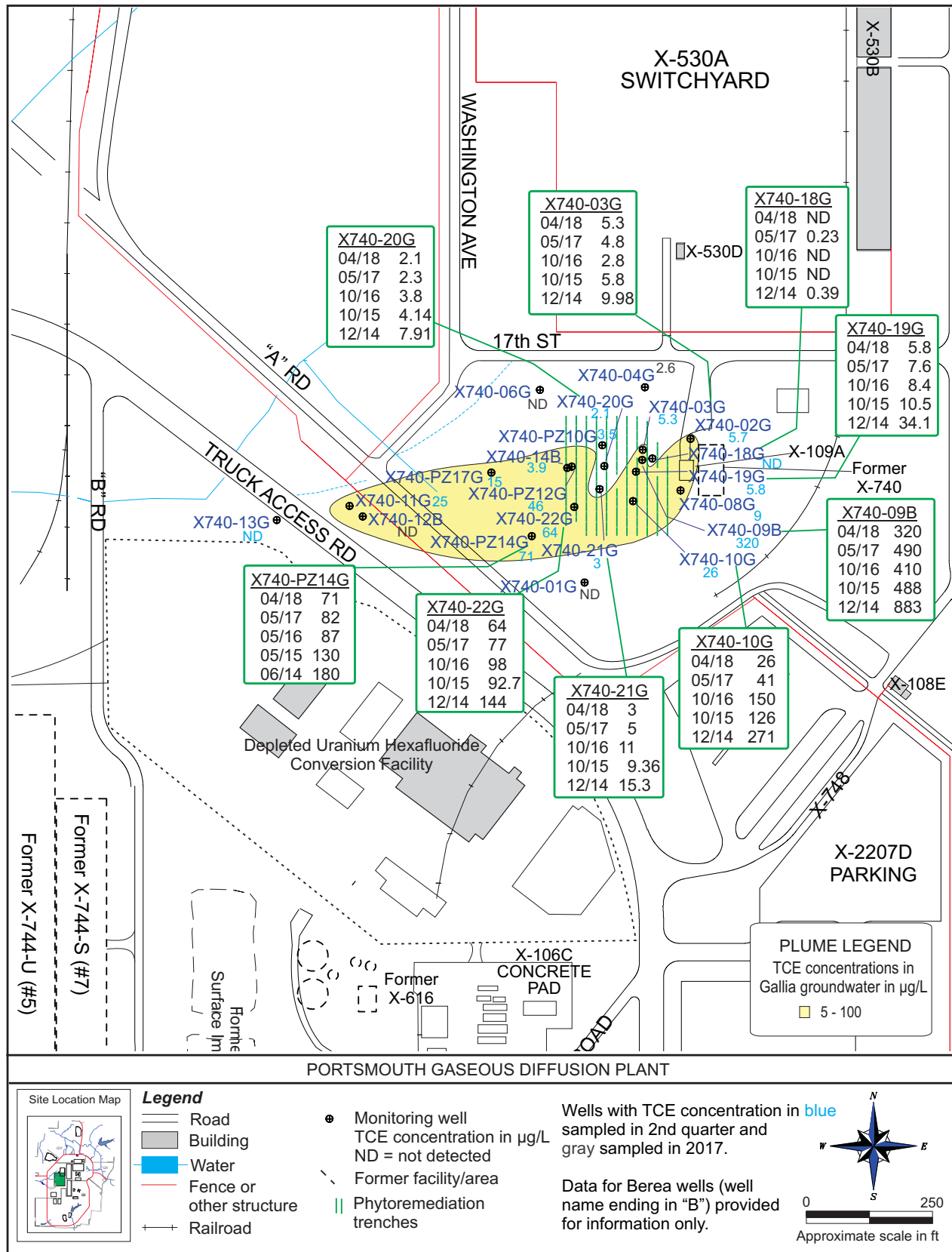
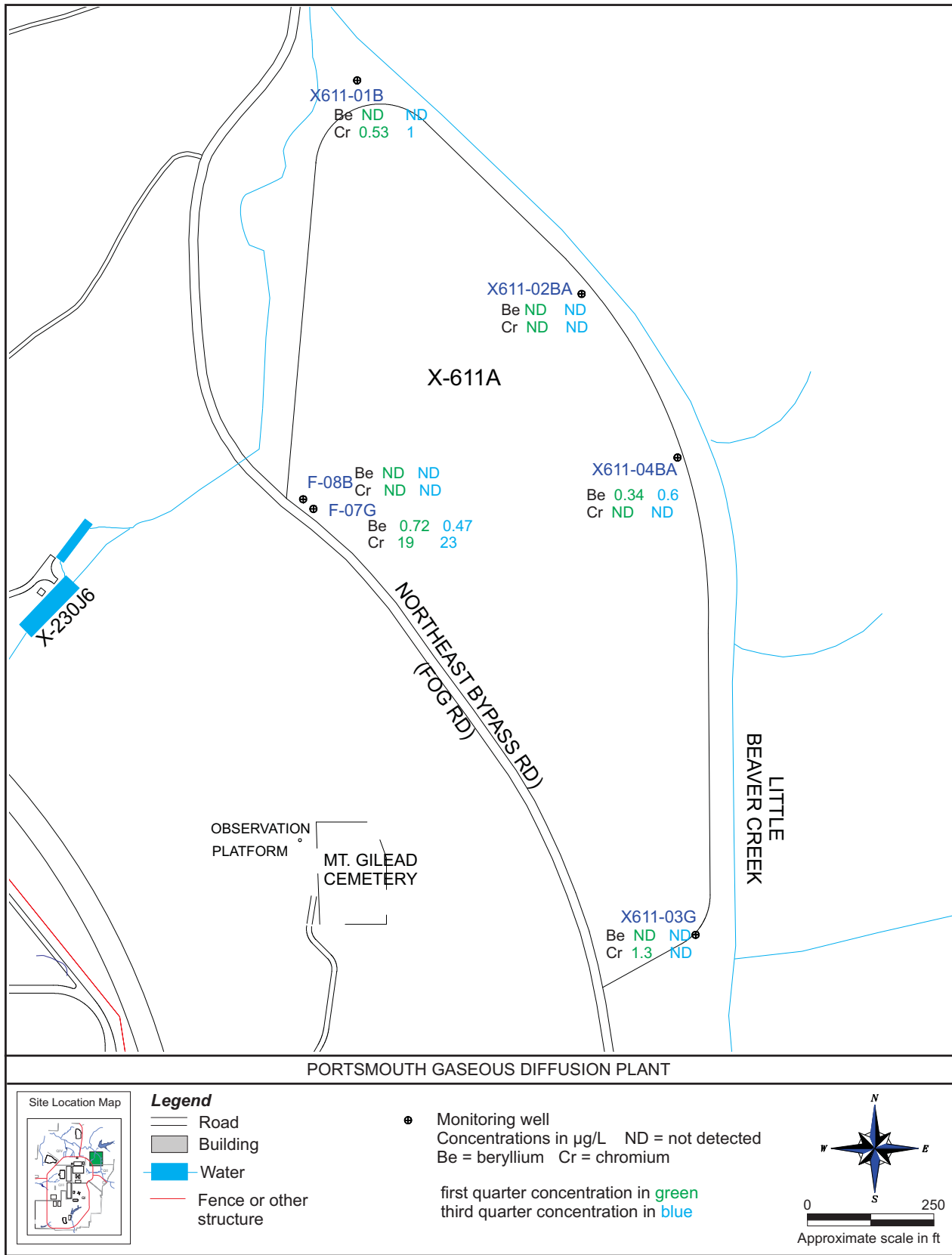


Figure 6.8. TCE-contaminated Gallia groundwater plume near the X-740 Former Waste Oil Handling Facility – 2018.



**Figure 6.9. Metal concentrations in groundwater at the X-611A Former Lime Sludge Lagoons — 2018.**

required closure as a RCRA hazardous waste landfill. Consequently, this unit of the sanitary landfill was identified as the X-735 RCRA Landfill.

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 (DOE 2017c). In addition, the *Corrective Measures Plan for the X-735 Landfill* was approved by Ohio EPA in 2008 (DOE 2007a). This plan provides the monitoring requirements for Gallia wells that monitor the X-735 Landfill. Corrective measures monitoring was implemented because Ohio EPA determined that assessment monitoring of the landfill, completed between 2005 and 2007, identified that a small release of leachate constituents is occurring or has occurred from the X-735 Landfills. Seventeen wells were sampled in 2018 as part of the monitoring programs for this area. Table 6.1 lists the analytical parameters and Figure 6.10 shows the monitoring wells in this area.

#### **6.4.11.1 Monitoring results for the X-735 Landfills in 2018**

The monitoring program at the X-735 Landfills includes corrective measures monitoring for Gallia wells and detection monitoring for Berea wells. As required by the corrective measures monitoring program, concentrations of three metals (cobalt, mercury, and nickel) and five indicator parameters (alkalinity, chloride, sodium, sulfate, and total dissolved solids) detected in downgradient Gallia wells are compared to concentration limits based on drinking water standards or site background concentrations. None of these concentration limits were exceeded in 2018.

The detection monitoring program for X-735 Berea wells continued in 2018. Concentrations of alkalinity, ammonia, calcium, chloride, iron, nitrate/nitrite, potassium, sodium, and sulfate in downgradient Berea wells were evaluated to monitor potential impacts to groundwater and trends in concentrations of these parameters. In the fourth quarter of 2018, the Shewhart control limit for iron was exceeded in well X735-17B. If this control limit had been exceeded again in the second quarter of 2019, Ohio EPA would have been notified; however, the control limit was not exceeded therefore notification was not necessary. No other control limits used to determine a statistically significant change in the indicator parameters requiring Ohio EPA notification were exceeded in the X-735 Berea wells in 2018.

#### **6.4.12 X-734 Landfills**

The X-734 Landfills in Quadrant IV 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 Landfills were closed in accordance with regulations in effect at that time, and no groundwater monitoring of the area was required. However, the RCRA Facility Investigation conducted in the early 1990s identified the presence of VOCs, metals, and radionuclides in soil and/or groundwater in the area. The X-734 Landfills were capped in 1999-2000 as part of the remedial actions required for Quadrant IV. Chapter 3, Section 3.3.4.2, provides more information about the remedial actions for this area.



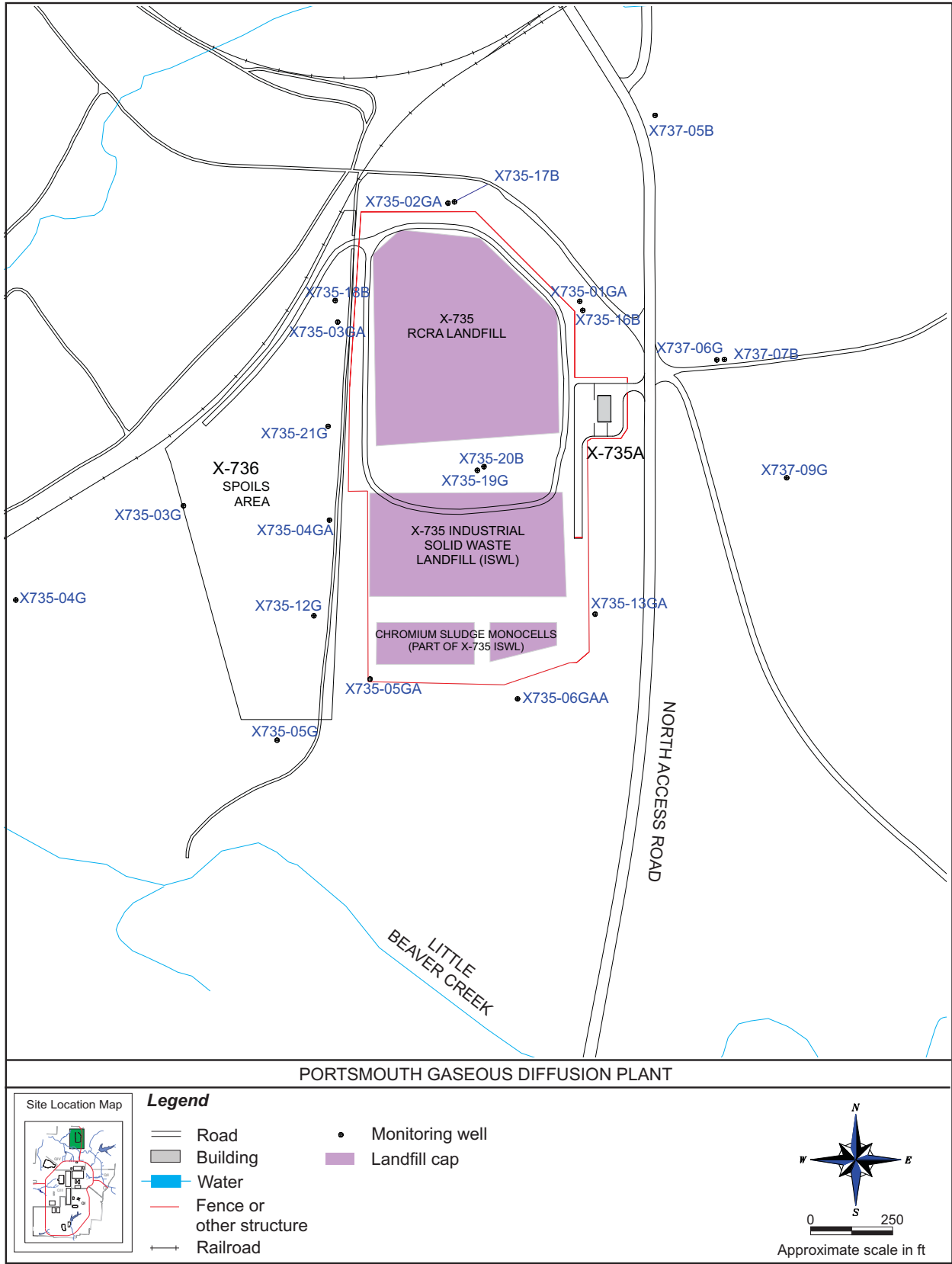


Figure 6.10. Monitoring wells at the X-735 Landfills.

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.

#### **6.4.12.1 Monitoring results for the X-734 Landfills in 2018**

VOCs are routinely detected in a number of the wells that monitor the X-734 Landfills, but generally at concentrations below preliminary remediation goals. In 2018, no VOCs were detected at concentrations above the preliminary remediation goals in the samples collected from the X-734 monitoring wells.

Samples from the nine of the X-734 monitoring wells were also analyzed for five metals (beryllium, cadmium, chromium, manganese, and nickel). None of the samples contained metals at concentrations above the respective preliminary remediation goal.

#### **6.4.13 X-533 Former Switchyard Complex**

The X-533 Former Switchyard Complex in Quadrant IV consisted 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. D&D of the facilities began in 2010 and was completed in 2011. Soil contaminated with PCBs or metals was removed from three areas within the complex in 2010; however, none of the soil removal areas were located near the groundwater area of concern (the north side of the area near the transformer cleaning pad).

The X-533 Former Switchyard Complex 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 in 1998 and 1999 to assess the area for metals contamination. The area was added to the PORTS groundwater monitoring program because the sampling identified metals that may have contaminated groundwater in this area. Three wells are sampled semiannually for cadmium and nickel.

##### **6.4.13.1 Monitoring results for the X-533 Former Switchyard Complex in 2018**

Three wells that monitor the X-533 Former Switchyard Complex (F-03G, TCP-01G, and X533-03G) were sampled in the second and fourth quarters of 2018 and analyzed for cadmium and nickel. Each of the wells contained these metals at concentrations above the preliminary remediation goals (6.5 µg/L for cadmium and 100 µg/L for nickel). Concentrations of cadmium detected in the wells ranged from 11 to 52 µg/L, and concentrations of nickel detected in the wells ranged from 130 to 550 µg/L. Figure 6.6 shows the concentrations of metals detected in the X-533 wells in 2018.

#### **6.4.14 X-344C Former Hydrogen Fluoride Storage Building**

The X-344C Former Hydrogen Fluoride Storage Building and associated hydrogen fluoride storage tanks were demolished and removed in 2006. In 2009, an investigation of soils and groundwater near the former building determined that groundwater in one monitoring well south of the former building contained two VOCs (*cis*-1,2-dichloroethene and *trans*-1,2-dichloroethene) at concentrations well below the preliminary remediation goals.

This area was added to the PORTS groundwater monitoring program in 2010. One well is sampled annually for VOCs under the monitoring program for this area (see Figure 6.12).

##### **6.4.14.1 Monitoring results for the X-344C Former Hydrogen Fluoride Storage Building in 2018**

Three VOCs, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, and TCE, were detected in the sample collected in the first quarter of 2018 at low concentrations less than 2.2 µg/L, which are below the preliminary remediation goals. These detections are consistent with the data collected at this well in 2009 through 2017.

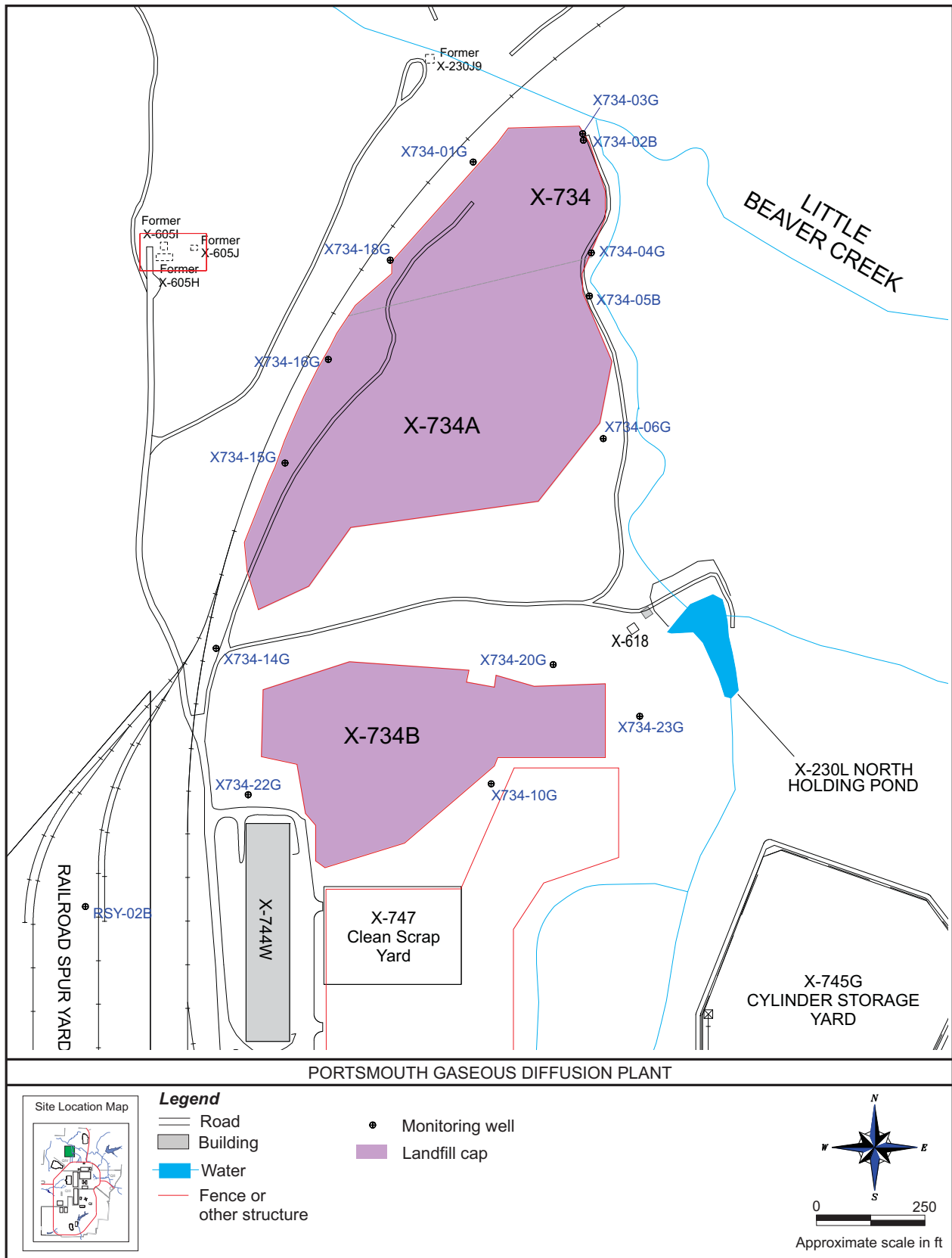


Figure 6.11. Monitoring wells at the X-734 Landfills.

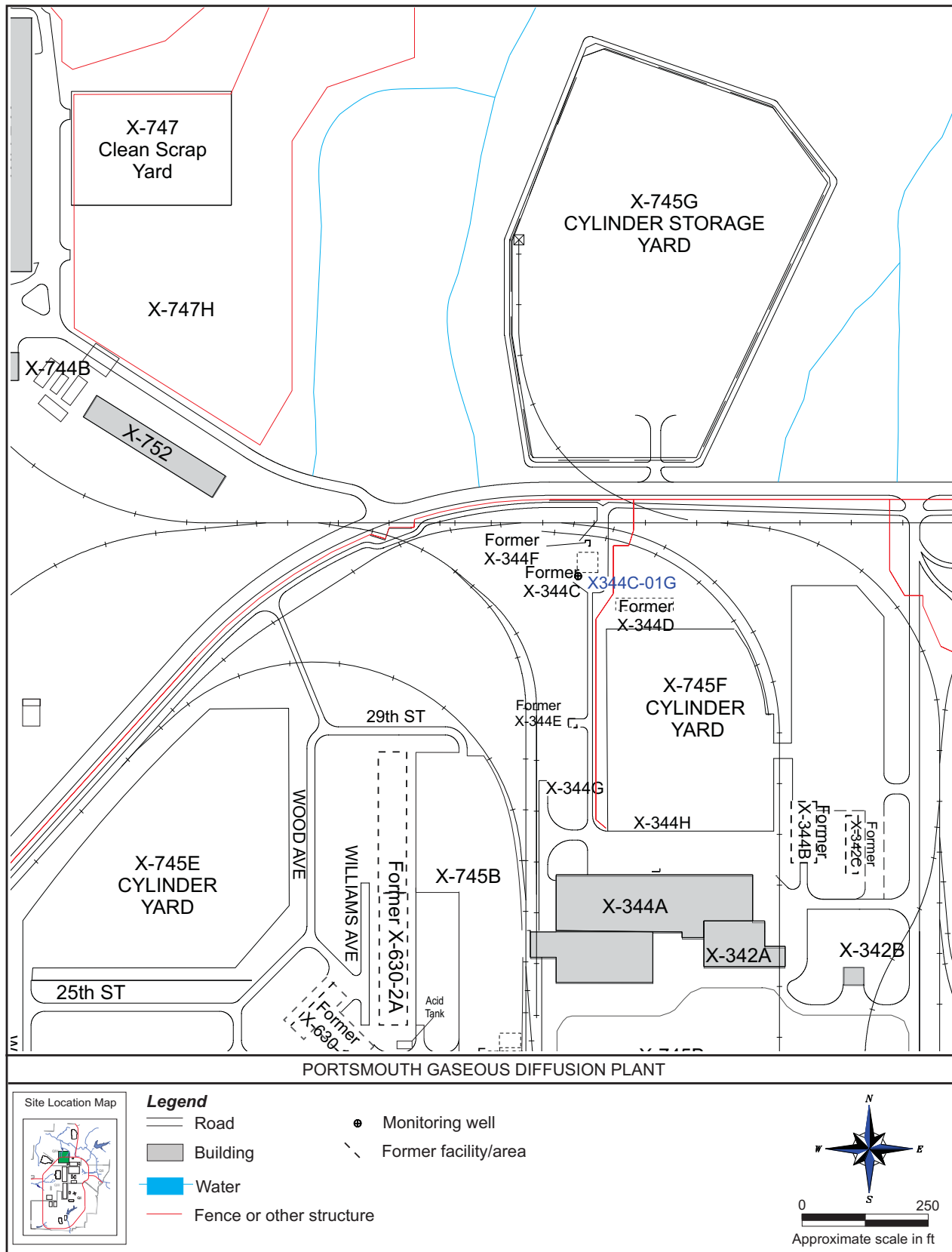


Figure 6.12. Monitoring well at the X-344C Former Hydrogen Fluoride Storage Building.

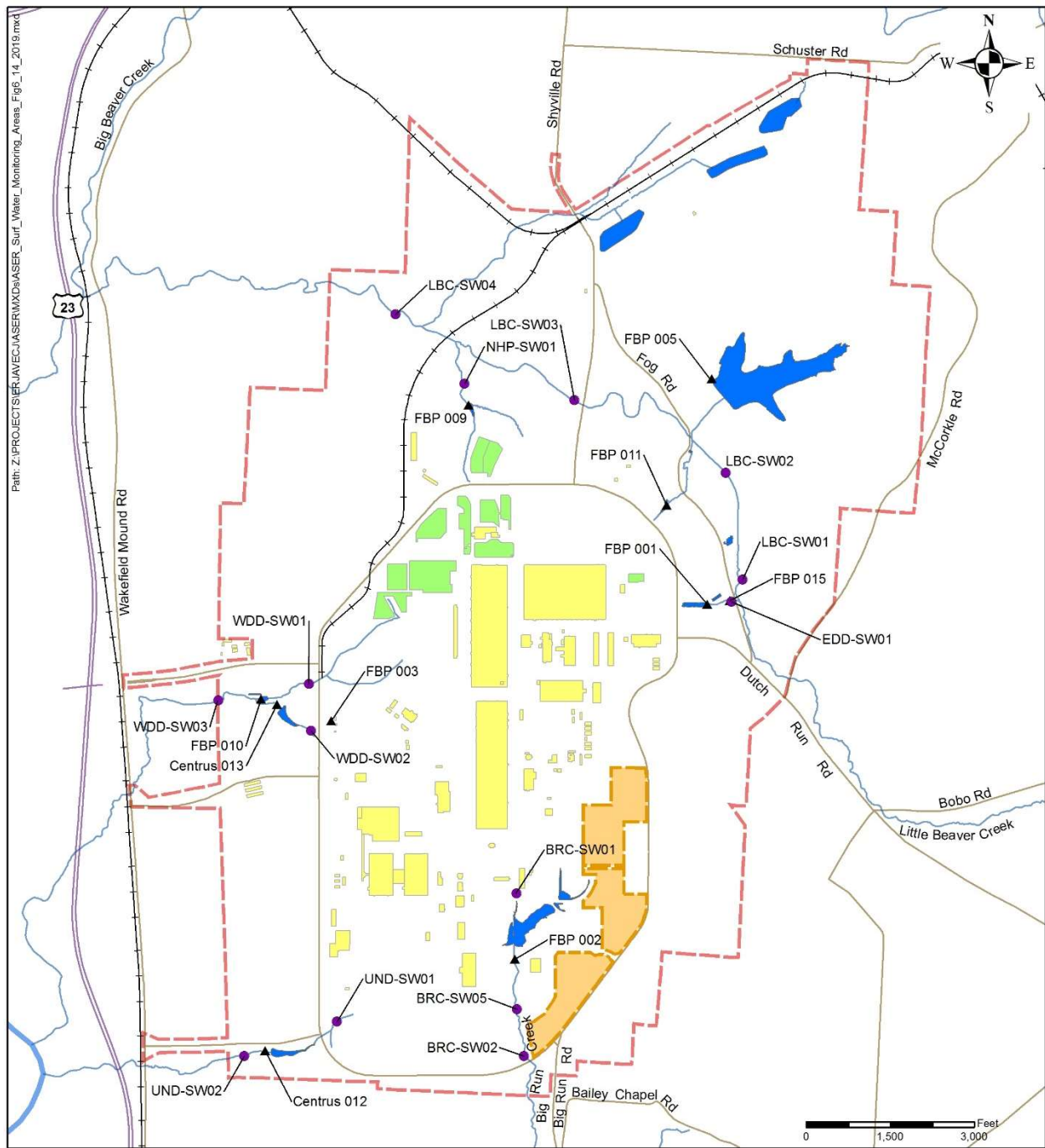
#### **6.4.15 Surface Water Monitoring**

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 14 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 groundwater discharges.
- Little Beaver Creek sample locations LBC-SW02 and LBC-SW03 assess potential contamination from the X-611A Former Lime Sludge Lagoons.
- Big Run Creek sample location BRC-SW01 assesses potential groundwater discharges from the Quadrant I Groundwater Investigative (5-Unit) Area.
- Big Run Creek sample location BRC-SW05 monitors potential discharges from the X-749/PK Landfill groundwater collection system on the east side of the landfills, as well as the Quadrant I Groundwater Investigative (5-Unit) Area.
- Big Run Creek sample location BRC-SW02 (downstream from BRC-SW01 and BRC-SW05) monitors potential discharges from the Quadrant I Groundwater Investigative (5-Unit) Area, X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, and PK Landfill.
- Southwestern Drainage Ditch sample locations UND-SW01 and UND-SW02 assess potential groundwater releases to this creek and the X-2230M Southwest Holding Pond from the western portion of the X-749/X-120 groundwater plume.
- 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.
- Western Drainage Ditch sample locations WDD-SW01, WDD-SW02, and WDD-SW03 assess potential groundwater discharges from the X-616 and X-740 areas to the Western Drainage Ditch and the X-2230N West Holding Pond.

##### **6.4.15.1 Monitoring results for surface water in 2018**

Trihalomethanes are a category of VOCs 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 Ohio EPA non-drinking 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).



**Legend**

- State or U.S. route
- Road
- Railroad
- Stream or river
- DOE boundary
- Parcel 1 boundary
- Pond or impoundment
- Cylinder yard
- Building
- Surface water monitoring location
- ▲ NPDES outfall (external)

**Figure 6.13. Surface water monitoring locations.**

Since the 1990s, TCE has been detected regularly at low levels in samples collected from the Southwestern Drainage Ditch (UND-SW01, located inside Perimeter Road). In 2018, TCE was detected at 0.76 to 3.6 µg/L in each of the four samples collected from the Southwestern Drainage Ditch at UND-SW01. *Cis*-1,2-dichloroethene and 1,1-dichloroethene were also detected at estimated concentrations less than 0.32 µg/L in samples collected at UND-SW01. VOCs were not detected in the samples collected from the Southwestern Drainage Ditch at UND-SW02. The detections of TCE were well below the Ohio EPA non-drinking water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin.

TCE and *cis*-1,2-dichloroethene were detected at elevated concentrations of 79.6 and 208 µg/L, respectively, in the fourth quarter sample collected from the East Drainage Ditch (EDD-SW01). *Trans*-1,2-dichloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, and vinyl chloride were also detected at concentrations up to 1.25 µg/L in the fourth quarter EDD-SW01 sample. TCE and other VOCs are routinely detected in the East Drainage Ditch. The detections of TCE were well below the Ohio EPA non-drinking water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin.

TCE and *cis*-1,2-dichloroethene were detected in samples collected from Little Beaver Creek at a maximum concentration of 6.93 µg/L. TCE and other VOCs are routinely detected in Little Beaver Creek at low concentrations. All detections of TCE were well below the Ohio EPA non-drinking water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin.

In the first quarter of 2019, it was discovered that samples for LBC-SW01 had inadvertently been collected from a location upstream from the identified location for LBC-SW01 throughout 2018 (beginning in the second quarter of 2017). VOCs were not detected at this monitoring location. Data collected from Little Beaver Creek sampling locations LBC-SW02, LBC-SW03 and LBC-SW04 (downstream from the identified LBC-SW01 sampling location) provide water quality monitoring data for Little Beaver Creek for 2018 (see previous paragraph). Samples were collected at the appropriate location in 2019.

Samples collected in the second and fourth quarters of 2018 were analyzed for selected transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). No transuranics were detected in the surface water samples collected during 2018.

Technetium-99 was detected at levels up to 112 pCi/L in samples collected from the East Drainage Ditch (EDD-SW01) and Little Beaver Creek (LBC-SW02, LBC-SW03, and LBC-SW04). The maximum level of technetium-99 detected is a duplicate sample collected in the first quarter of 2018 (DOE 2019). These detections are within the historical range of technetium-99 detected in surface water at PORTS, and are 0.25% or less of derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011b).

The concentrations of uranium detected in the surface water samples were 1.8% or less of the DOE derived concentration standards for uranium isotopes (680 pCi/L for uranium-233/234, 720 pCi/L for uranium-235, and 750 pCi/L for uranium-238) (DOE 2011b). The detections of uranium and uranium isotopes in surface water during 2018 were within the historical range of uranium detected in surface water at PORTS.

#### **6.4.16 Water Supply Monitoring**

Routine monitoring of private 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 *Integrated Groundwater Monitoring Plan* (DOE 2017c).

The purpose of the program is to determine whether PORTS has had any impact on the quality of the private residential drinking water sources. 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).

Four residential drinking water sources participated in the program in 2018. Two residential drinking water sources that are included in the water supply monitoring program (RES-004 and RES-005) were not able to be sampled in 2018 because the well pumps were not operable. The PORTS water supply is also sampled as part of this program. Figure 6.14 shows the drinking water sources that were part of the monitoring program in 2018. 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. Wells are sampled semiannually with samples analyzed for the parameters listed in Table 6.1. The *2018 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides data for the water supply monitoring program (DOE 2019).

In the first and third quarters of 2018, TCE was detected at estimated concentrations ranging from 0.28 to 0.49 µg/L in the samples collected from RES-017, which is south of PORTS on Big Run Road. No other VOCs were detected in the samples at this location. Since this residential water supply was added to the monitoring program in 2009, TCE has routinely been detected in the water supply samples at concentrations up to 1 µg/L. These detections are less than the drinking water standard for TCE (5 µg/L). Big Run Creek is located between RES-017 and the affected water-bearing formation (i.e., Gallia groundwater) located in the southern portion of the plant site west of Big Run Creek. The Gallia groundwater drains into Big Run Creek.

Chlorination byproducts called trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in treated drinking water, were detected in the first and third quarter samples collected from residential sampling location RES-015. Trihalomethanes were also detected in the third quarter sample from RES-012 (the PORTS water supply). The total concentration of these trihalomethanes was less than the Ohio EPA drinking water standard (80 µg/L for total trihalomethanes).

Each sample was analyzed for transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). No transuranics or technetium-99 were detected in any of the water supply samples collected in 2018. 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.

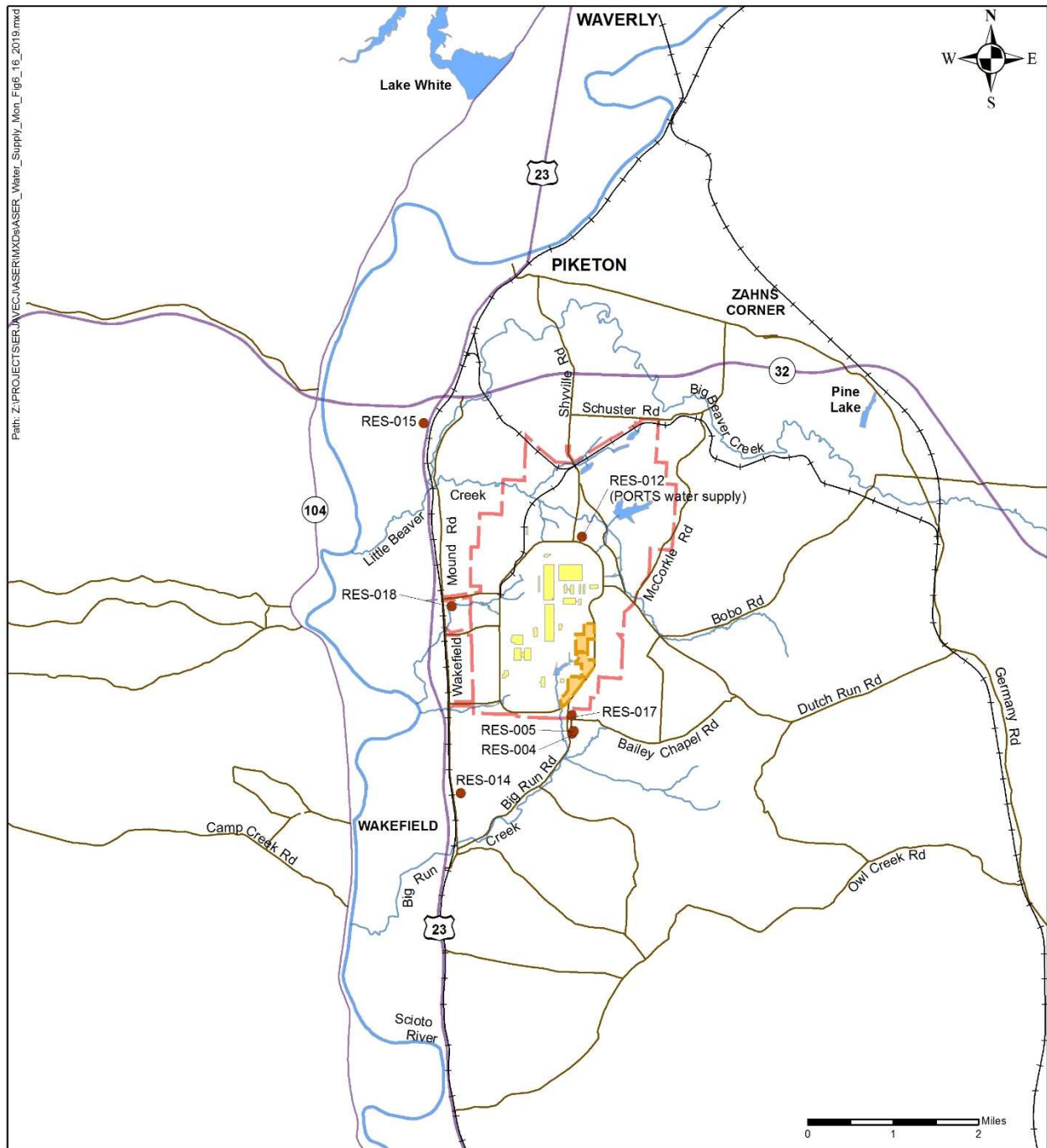
## **6.5 DOE ORDER MONITORING PROGRAMS**

One of the DOE surveillance monitoring programs at PORTS is 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 6.15 shows the sampling locations for exit pathway monitoring and Table 6.1 lists the analytical parameters.



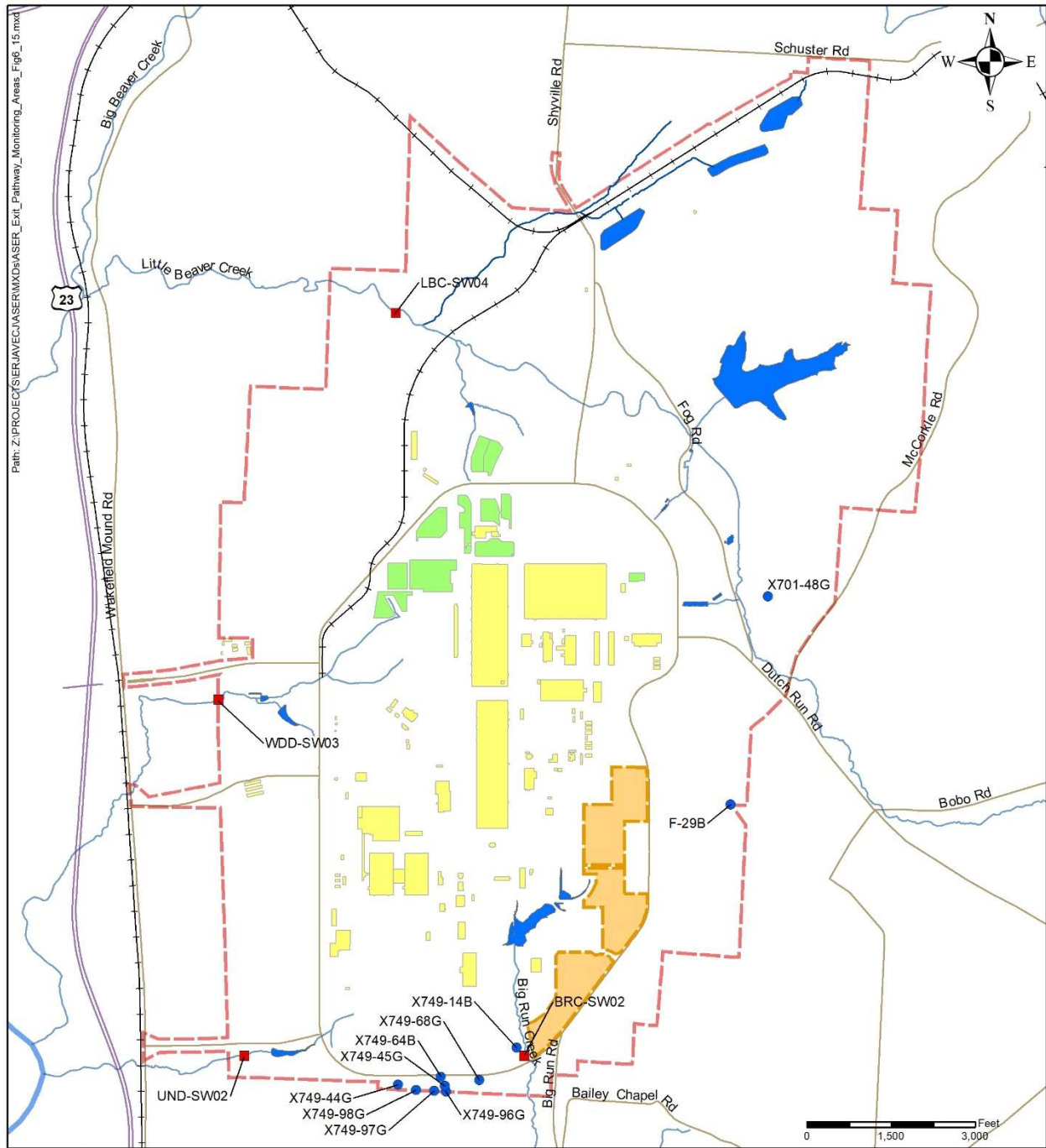


**Legend**

- State or U.S. route
- Road
- +— Railroad
- Stream or river
- DOE boundary
- Parcel 1 boundary
- Pond or impoundment
- Sampling location

Note: (RES-001, RES-002, RES-003, RES-006, RES-007, RES-008, RES-009, RES-010, RES-011, RES-013, and RES-016 have been deleted from the program)

**Figure 6.14. Water supply monitoring locations.**



**Legend**

- |                       |                     |                       |  |
|-----------------------|---------------------|-----------------------|--|
| — State or U.S. route | — Stream or river   | ■ Pond or impoundment | ● Exit pathway groundwater monitoring well       |
| — Road                | — DOE boundary      | ■ Cylinder yard       | ■ Exit pathway surface water monitoring location |
| — Railroad            | ■ Parcel 1 boundary | ■ Building            |  |

**Figure 6.15. Exit pathway monitoring locations.**

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 (see Figure 6.15). 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 6.4.15.1). TCE was detected in first and second quarter samples collected from Little Beaver Creek (LBC-SW04) at 0.19 to 0.2 µg/L. These detections were also below the Ohio EPA non-drinking water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin.

Technetium-99 was detected at 11.9 pCi/L in the first quarter sample collected at the surface water exit pathway monitoring location on Little Beaver Creek (LBC-SW04). This detection was less than 0.03% of the derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011b). The derived concentration standard is the concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (ingestion of water or inhalation of air) would result in a dose of 100 mrem. A concentration of 100% of the derived concentration standard would equate to a dose at the DOE limit of 100 mrem/year (DOE 2011b).

VOCs were also detected in several on-site groundwater monitoring wells that are part of the exit pathway monitoring program. TCE and other VOCs were detected in several wells that monitor the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility (see Section 6.4.1.3). TCE was detected in on-site well X749-45G at concentrations ranging from 5.81 to 16 µg/L in the second, third, and fourth quarter samples collected from the well. These detections are above the Ohio EPA drinking water standard (5 µg/L). All other detections of TCE and other VOCs in the exit pathway monitoring wells were below Ohio EPA drinking water standards.

Well X701-48G was the only exit pathway groundwater monitoring well sampled for radionuclides in 2018 (most exit pathway monitoring wells are sampled for radionuclides every two years in odd-numbered years). No radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and uranium-238) were detected in well X701-48G in 2018.

## 6.6 GROUNDWATER TREATMENT FACILITIES

In 2018, a combined total of approximately 32.8 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 18.4 gallons of TCE 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 TCE removed by PORTS groundwater treatment facilities in 2018<sup>a</sup>**

Facility	Gallons of water treated	Gallons of TCE removed
X-622	20,681,480	2.0
X-623	6150	< 0.0001
X-624	2,155,300	7.0
X-627	9,941,200	9.4

<sup>a</sup>Source: 2018 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant (DOE 2019)

### **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 (see Figures 6.2 and 6.3):

- groundwater collection system with associated sump (X749-WPW) and extraction wells X749-EW05G and X749-EW06G on the southwest boundary of the X-749 Landfill;
- groundwater extraction wells X749-EW01G, X749-EW02G, X749-EW03G, and X749-EW04G installed in 2007 in the X-749 South Barrier Wall area;
- groundwater extraction wells (X749-EW07G, X749-EW08G, and X749-EW09G) installed in 2010 in the X-749/X-120 groundwater plume;
- groundwater collection system and associated sumps (PK-PL6 and PK-PL6A) on the eastern boundary of the PK Landfill; and
- fifteen extraction wells located in the Quadrant I Groundwater Investigative (5-Unit) Area.

The facility processed approximately 20.7 million gallons of groundwater during 2018, thereby removing approximately 2.0 gallons of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 608, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 608 in 2018.

### **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. Prior to implementation of the X-701B IRM in 2009, the X-623 Groundwater Treatment Facility treated TCE-contaminated groundwater from a sump in the bottom of the X-701B Former Holding Pond and three groundwater extraction wells (X623-EW01G, X623-EW02G, and X623-EW03G) east of the holding pond. The sump and extraction wells were removed in 2009-2011 to facilitate implementation of the IRM.

During 2018, the X-623 Groundwater Treatment Facility operated only during October to treat miscellaneous water associated with site activities in accordance with the NPDES permit.

The facility treated 6150 gallons of water during 2018, thereby removing less than 0.0001 gallon of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 610, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 610 in 2018.

### **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 TCE-contaminated groundwater from the X-237 Groundwater Collection System on the east side of the X-701B groundwater plume. The X-237 Groundwater Collection System consists of north-south and east-west collection trenches and two sumps/pumping wells (see Figure 6.5).

The X-624 Groundwater Treatment Facility treated approximately 2.2 million gallons of water in 2018, thereby removing approximately 7.0 gallons of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 015, which discharges to Little Beaver Creek. No NPDES permit limitations were exceeded at Outfall 015 in 2018.

#### **6.6.4 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 (7-Unit) Area plume, and contaminated water is collected in the sumps located in the basement of each building (see Figure 6.4).

Approximately 9.9 million gallons of groundwater were processed during 2018, thereby removing approximately 9.4 gallons of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 611, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 611 in 2018.