6. Groundwater Protection Programs

Groundwater monitoring at PORTS is required by a combination of state and federal regulations, legal agreements with Ohio EPA, and DOE Orders. Over 300 monitoring wells are used to track the flow of groundwater and to identify and measure groundwater contaminants.

Groundwater monitoring detects the nature and extent of contamination at PORTS, including the types and concentrations of contaminants, and determines the movement of groundwater at the plant. Data obtained from groundwater monitoring support the decision-making process for the ultimate disposition of the contaminants.

This chapter provides an overview of groundwater monitoring at PORTS and presents the results of the groundwater monitoring programs for 2021. Section 3.4 includes 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 Fluor-BWXT Portsmouth NPDES outfalls. Visit the PEGASIS website here to view historical data for monitoring wells and groundwater locations at PORTS.

6.1 Geology and Uses of Groundwater

Two water-bearing zones are present beneath the industrialized portion of PORTS that includes the former gaseous diffusion process buildings: 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. The *2021 Groundwater Monitoring Report* (DOE 2022a) includes additional information about the geology of the industrialized portion of PORTS and is available on the PEGASIS website here.

The On-Site Waste Disposal Facility is in an upland area in the northeast portion of PORTS. The Cuyahoga and Berea formations are the primary water-bearing zones in this area. The Gallia is not present beneath the On-Site Waste Disposal Facility. The Berea is deeper than the Cuyahoga, and the Sunbury shale impedes groundwater flow between the Cuyahoga and Berea formations. The *2021 On-Site Waste Disposal Facility Annual Project Status Report* (DOE 2022b), which includes additional information about the geology of the On-Site Waste Disposal Facility project area, is available on the PEGASIS website here.

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; it 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.

6.2 Groundwater Monitoring Programs

Monitoring wells are used extensively at PORTS to assess the effect of site operations on groundwater quality. Groundwater monitoring at PORTS began in the 1980s and has been conducted in response to

state and federal regulations, regulatory documents prepared by DOE, agreements between DOE and Ohio EPA or US EPA, and DOE orders. Groundwater monitoring to meet DOE order requirements includes exit pathway monitoring, which assesses the effect of PORTS on off-site groundwater quality. DOE orders are also the basis for radiological monitoring of groundwater at PORTS. The groundwater monitoring program consists of routine compliance and facility monitoring designed to protect public health and the environment.

Groundwater monitoring at PORTS involves collecting samples of water from groundwater monitoring wells and analyzing them to obtain information about contaminants and naturally-occurring compounds. Monitoring wells also provide 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 predict the movement of contaminants in the groundwater and this information can be used to develop ways to control or remediate groundwater contamination.

6.2.1 On-Site Waste Disposal Facility

Figure 6.1 shows the On-Site Waste Disposal Facility in the northeast portion of PORTS, which began operating in May 2021. Groundwater monitoring wells have been installed around the On-Site Waste Disposal Facility and are sampled in accordance with the *On-Site Waste Disposal Facility (OSWDF) Performance Standards Verification Plan* (DOE 2021b). This plan describes the monitoring program developed to ensure that operation of the On-Site Waste Disposal Facility meets performance standards for protection of human health and the environment. Ohio EPA concurred with the *On-Site Waste Disposal Facility (OSWDF) Performance Standards Verification Plan*.

6.2.2 Integrated Groundwater Monitoring

The PORTS *Integrated Groundwater Monitoring Plan* was developed during the 1990s to address the regulatory groundwater monitoring requirements applicable to PORTS at that time. 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, and an annual groundwater report is submitted to Ohio EPA in accordance with the plan.

The *Integrated Groundwater Monitoring Plan* (DOE 2021a) requires groundwater monitoring of 14 areas in the quadrants of the site designated by the RCRA Corrective Action Program. Figure 6.1 shows Quadrants I through IV and the groundwater monitoring areas. The *Integrated Groundwater Monitoring Plan* also requires surface water monitoring in creeks and drainage ditches at PORTS that receive groundwater discharge, along with water supply monitoring.

In general, samples are collected from wells or surface water locations and analyzed for metals, volatile organic compounds, and radionuclides. 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 cleanup goals developed early in the decision-making process that are protective of human health and the environment, and they comply with the applicable or relevant and appropriate requirements of state and federal agencies. Preliminary remediation goals are intended to satisfy regulatory cleanup requirements. Preliminary remediation goals for groundwater at PORTS are the maximum contaminant levels in the Ohio EPA drinking water standards.

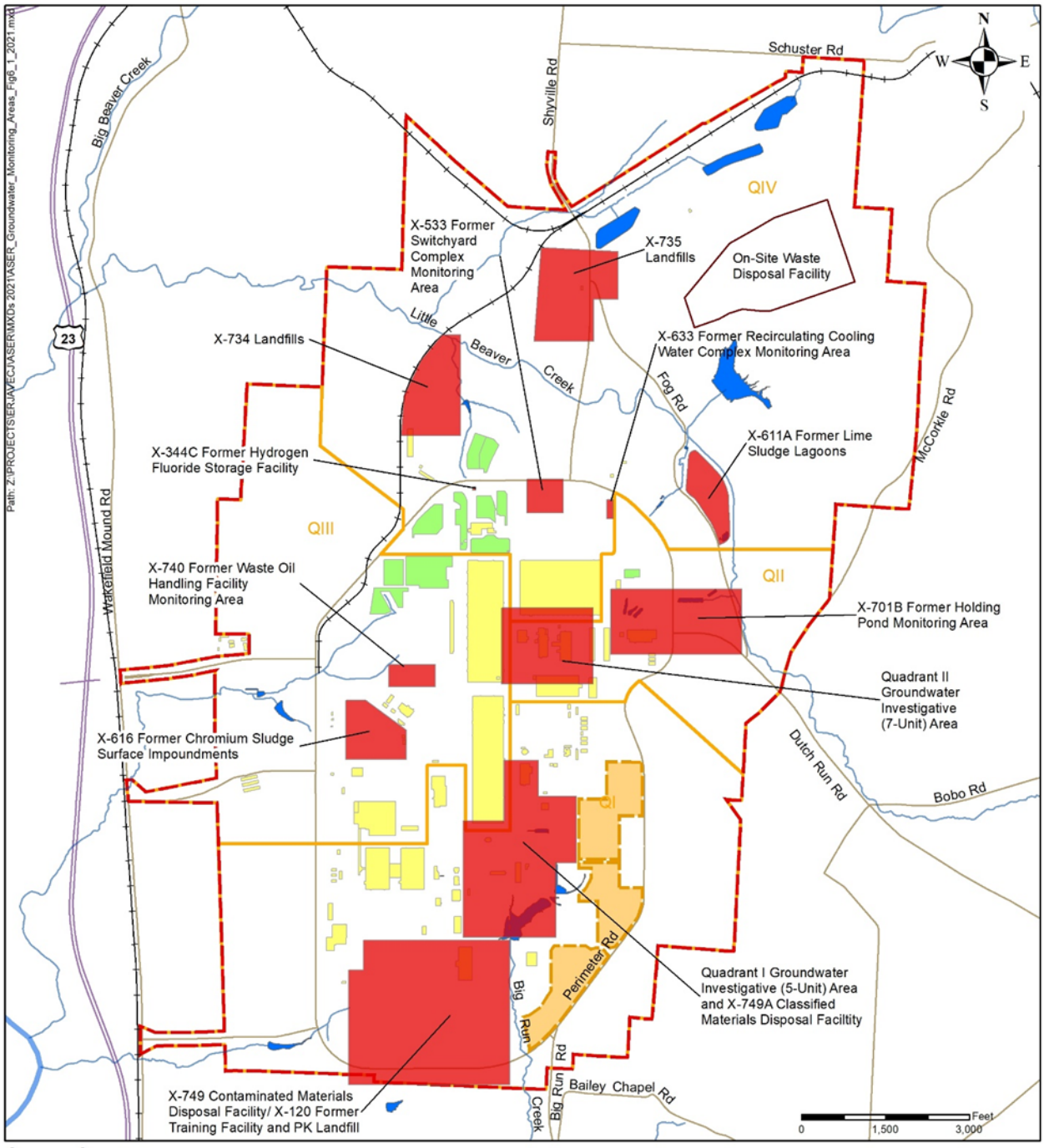

Figure 6.1. Groundwater monitoring areas

Groundwater contamination usually consists of trichloroethene and other volatile organic compounds. Five areas of groundwater contamination, or groundwater plumes, have been identified at PORTS: the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, the Quadrant I Groundwater Investigative (5-Unit) Area, the Quadrant II Groundwater Investigative (7-Unit) Area, and the X-701B Former Holding Pond. The fifth groundwater plume at PORTS, the X-740 groundwater plume, was excavated in 2021 in accordance with *The July 30, 2018 Director's Final Findings and Orders for CERCLA Actions to Restore Natural Resources* (Ohio EPA 2018). 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 assess the effectiveness of remediation that has taken place in the area.

6.2.3 Exit Pathway Monitoring

Exit pathway monitoring assesses the effect of the facility on off-site surface water and groundwater quality. The *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017c) specifies the groundwater monitoring wells and surface water sampling locations near the PORTS boundary that comprise the exit pathway monitoring program. 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. All but one of these sampling locations are also part of the integrated groundwater monitoring program.

6.3 Groundwater Monitoring Results

This section discusses groundwater monitoring results for 2021 for the On-Site Waste Disposal Facility, groundwater monitoring completed in accordance with the *Integrated Groundwater Monitoring Plan* (DOE 2021a), and the exit pathway monitoring program.

6.3.1 On-Site Waste Disposal Facility

Groundwater monitoring at the On-Site Waste Disposal Facility in 2021 was completed in accordance with the *On-Site Waste Disposal Facility (OSWDF) Performance Standards Verification Plan* (DOE 2021b). Twenty-two wells were sampled for organic compounds, statistical indicator parameters, and radionuclides. Data collected in 2021 did not identify any issues that affect the performance or operation of the On-Site Waste Disposal Facility. The *2021 On-Site Waste Disposal Facility Annual Project Status Report* (DOE 2022b) and data collected in 2021 are available on the PEGASIS website here.

6.3.2 Integrated Groundwater Monitoring

Groundwater monitoring in 2021 was completed in accordance with the *Integrated Groundwater Monitoring Plan* dated January 2021 (DOE 2021a). Over 300 wells were sampled for a variety of metals, organic compounds, statistical indicator parameters, water quality parameters, and radionuclides.

The following sections summarize results for the PORTS trichloroethene groundwater plumes, other monitoring areas, surface water monitoring required by the *Integrated Groundwater Monitoring Plan* (DOE 2021a), and water supply monitoring. The *2021 Groundwater Monitoring Report* (DOE 2022a) includes additional information about the monitoring areas and complete data for 2021. The report is available on the PEGASIS website here.

6.3.2.1 Quadrant I Groundwater Monitoring

Quadrant I groundwater monitoring includes investigation and monitoring of the X-749 Contaminated Disposal Facility/X-120 Former Training Facility, PK Landfill, Groundwater Investigative (5-Unit) Area, and X-749A Classified Materials Disposal Facility.

Quadrant I X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility

The most extensive and most concentrated constituents associated with the X-749/X-120 plume are volatile organic compounds, particularly trichloroethene. Figure 6.2 shows the trichloroethene groundwater plume for the X-749/X-120 area for 2021 and the 5-year trends in trichloroethene concentrations for selected wells. In general, the concentrations of trichloroethene in the plume wells and the overall extent of the plume are slowly decreasing.

Extraction wells in the X-749/X-120 groundwater plume continue to control the plume and remove trichloroethene. Volatile organic compounds were not detected in 2021 in any of the off-site monitoring wells at the southern edge of the monitoring area.

The southeastern portion of the plume shrank in 2021 based on the fourth quarter detection of trichloroethene in well X749-13G at 4.04 µg/L. Concentrations of trichloroethene in well X749-13G fluctuated just above and below 5 µg/L (the definition of the plume perimeter) in 2019, 2020, and 2021.

Trichloroethene decreased to less than 100 µg/L in two wells north of the X-749 Landfill: X749-04G and X749-115G. These are the first detections less than 100 µg/L in both of these wells. At the end of 2021, the only well in the area immediately north of the X-749 Landfill with concentrations of trichloroethene greater than 100 µg/L was well PK-09G at 353 µg/L.

On the northwestern perimeter of the plume, trichloroethene continued to increase in well X749-40G as shown on Figure 6.2. The area in the western portion of the plume where trichloroethene concentrations are less than 5 µg/L (the definition of the plume perimeter) changed in 2021. Trichloroethene increased to 10.8 µg/L in well X120-05G, which defines the northern edge of this area. Trichloroethene decreased to 4.79 µg/L in well X749-29G, which defines the eastern edge of the area, and this was the first detection less than 5 µg/L in this well. On the southern edge of the area, trichloroethene increased to 5.12 µg/L in well X749-36G. Concentrations of trichloroethene in well X749-36G have varied above and below 5 µg/L in the last five years.

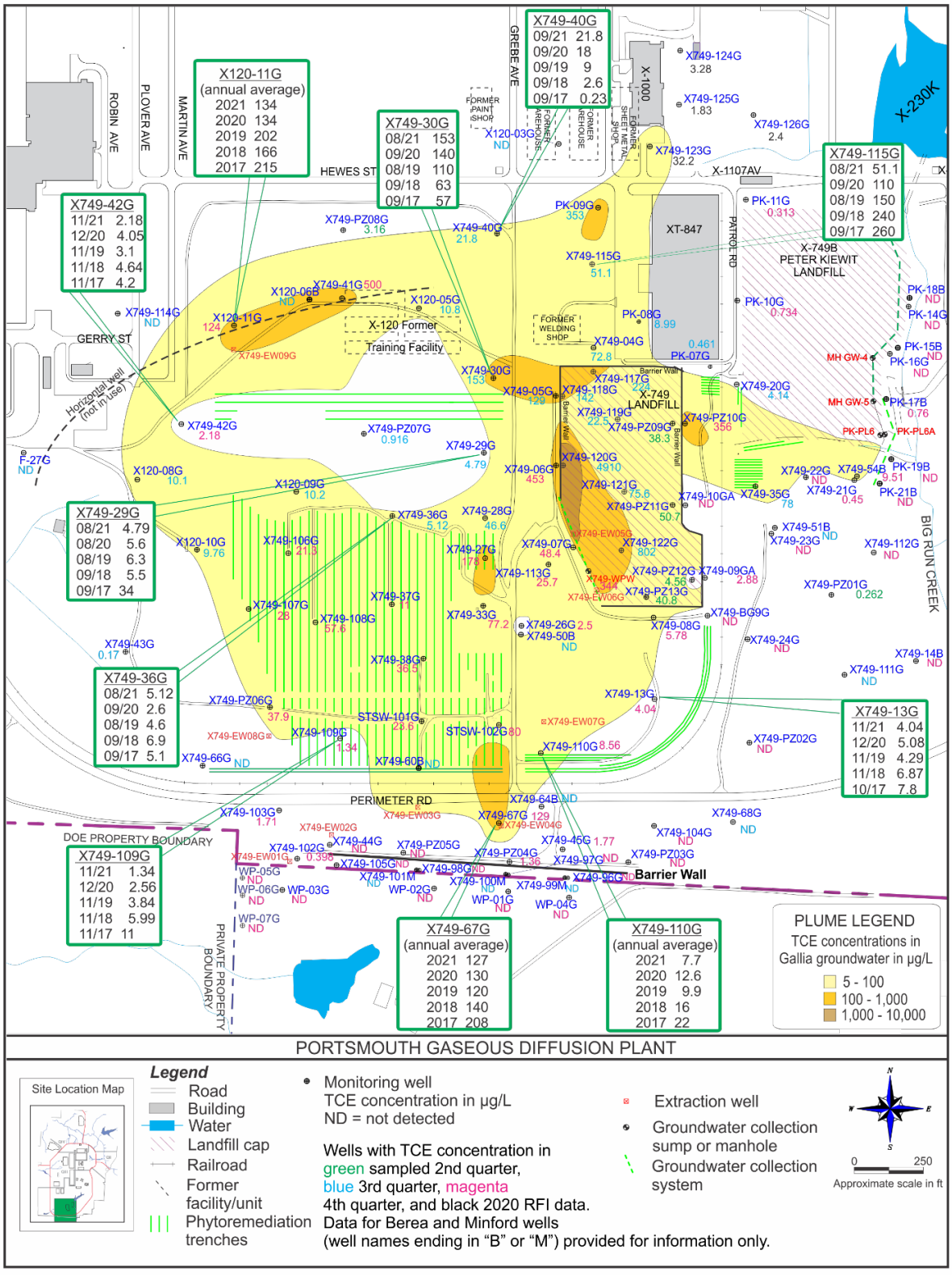

Figure 6.2. Gallia groundwater plume contaminated with trichloroethene at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility in 2021

Quadrant I PK Landfill

The PK Landfill is on the east side of the X-749/X-120 groundwater plume, but is not part of the plume (see Figure 6.2). DOE monitors groundwater at the PK Landfill for volatile organic compounds and selected metals. In 2021, vinyl chloride was detected in samples collected from two wells at concentrations that exceeded the preliminary remediation goal of 2 µg/L. These results were consistent with data collected in previous years.

Quadrant I Groundwater Investigative (5-Unit) Area

A contaminated groundwater plume is associated with the Quadrant I Groundwater Investigative (5-Unit) Area. The plume consists primarily of trichloroethene, though other volatile organic compounds are also present. Figure 6.3 shows the trichloroethene groundwater plume for the Quadrant I Groundwater Investigative (5-Unit) Area for 2021 and the 5-year trends in trichloroethene concentrations for selected wells.

Concentrations of trichloroethene continue to vary in wells that monitor the northern portion of the plume near the former X-760 and X-770 Buildings and the X-710 Technical Services Building. Trichloroethene in well X760-03G increased in 2021 to 159 µg/L from 60 µg/L in 2020. However, trichloroethene decreased in well X231B-36G, which monitors the northern portion of the plume on the south side of the X-710 Technical Services Building. Trichloroethene was detected at 643 µg/L in 2021, down from 1,100 µg/L in 2020. Trichloroethene also decreased in well X770-17GA in 2021.

Trichloroethene increased in well X231B-29G, which is located between the X-326 Process Building and the former X-770 Building and is sampled every two years. Trichloroethene was detected at 91.6 µg/L in 2021, an increase from 12 µg/L in 2019 and 4.5 µg/L in 2017.

No other significant changes in trichloroethene concentrations were identified in wells that monitor the Quadrant I Groundwater Investigative (5-Unit) Area in 2021. Groundwater monitoring in the area has been and will continue to be affected by decontamination and decommissioning of the X-326 Process Building and excavation of areas within the groundwater plume. Sections 3.3.1 and 3.4.1.3 provide more information about these activities.

Quadrant I X-749A Classified Materials Disposal Facility

The X-749A Classified Materials Disposal Facility, also known as the X-749A Landfill, is on the east side of the Quadrant I Groundwater Investigative (5-Unit) Area, but is not a part of the groundwater plume in this area (see Figure 6.3). The X-749A Landfill is assessed by a detection monitoring program that uses statistics to determine whether a release has occurred at the landfill. No releases were identified at the X749A Landfill in 2021.

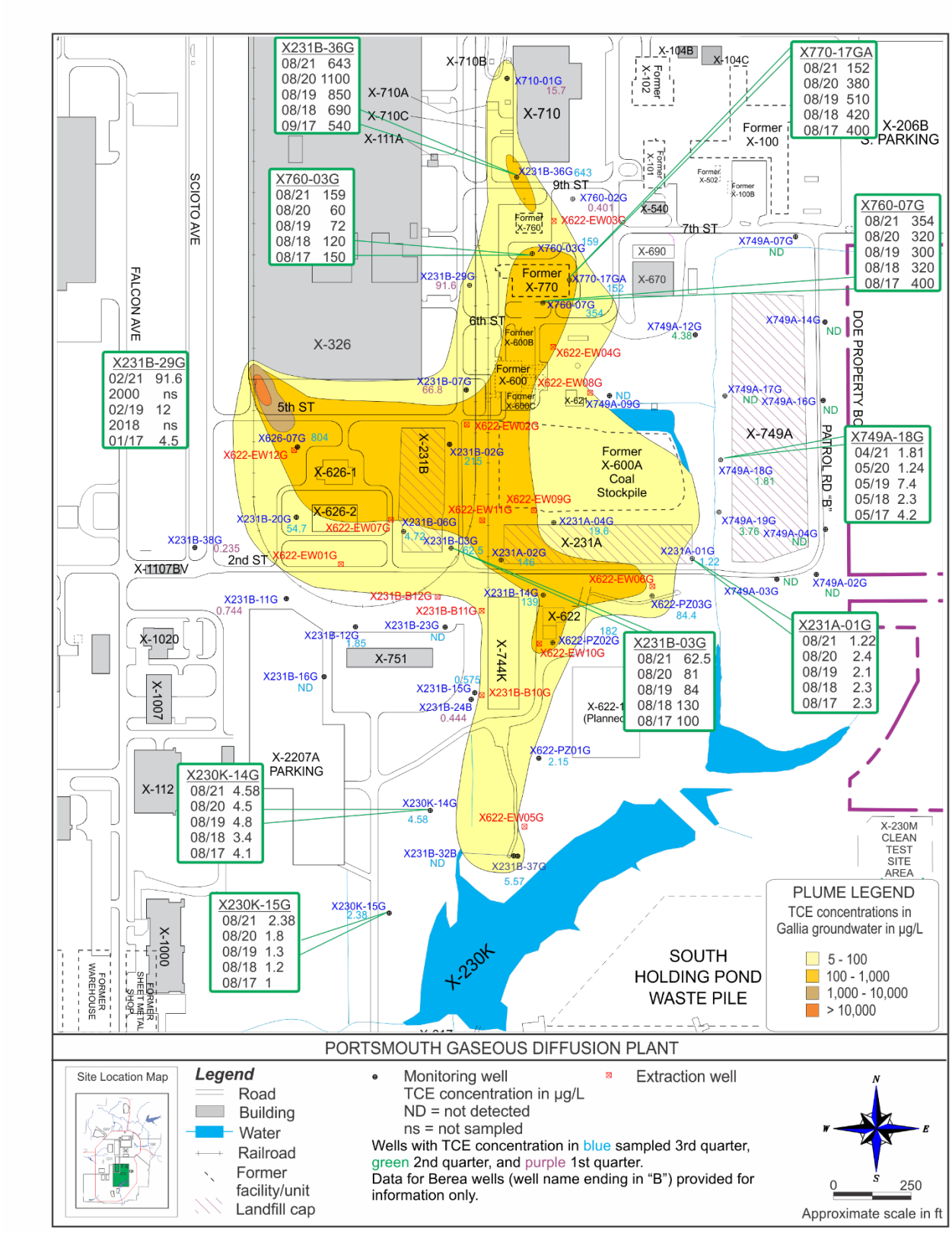

Figure 6.3. Gallia groundwater plume contaminated with trichloroethene at the Quadrant I Groundwater Investigative (5-Unit) Area in 2021

6.3.2.2 Quadrant II Groundwater Monitoring

Quadrant II groundwater monitoring includes investigation and monitoring of the Groundwater Investigative (7-Unit) area, X-701B Former Holding Pond, and X-633 Former Recirculating Cooling Water Complex.

Quadrant II Groundwater Investigative (7-Unit) Area

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the Quadrant II Groundwater Investigative (7-Unit) Area. Figure 6.4 shows the trichloroethene groundwater plume for this area in 2021 and the 5-year trends in trichloroethene concentrations for selected wells. Concentrations of trichloroethene in the plume are stable or decreasing slightly, with one exception. Trichloroethene is increasing in well X701-45G, which monitors the southern perimeter of the plume, with a concentration of 24.9 µg/L in 2021.

Quadrant II X-701B Former Holding Pond

A contaminated groundwater plume of trichloroethene and other volatile organic compounds is located in the X-701B Former Holding Pond area. Figure 6.5 shows the trichloroethene groundwater plume for this area for 2021 and the 5-year trends in trichloroethene concentrations for selected wells.

Concentrations of trichloroethene are increasing on the north edge of the X-701B plume. The concentration of trichloroethene detected in well X701-42G remained high, at 3,990 µg/L, in 2021. Trichloroethene also increased in well X230J7-02GA, located immediately south of the X-230J7 Holding Pond. Typical detections in 2017, 2018, and 2019 were less than 600 µg/L. In 2021, trichloroethene was detected in well X230J7-02GA at 6,140 µg/L. Figure 6.5 shows the 5-year trends in trichloroethene in these two wells.

Trichloroethene is decreasing in many of the wells that monitor the western portion of the X-701B plume. Prior to 2019, trichloroethene was detected at concentrations greater than 100,000 µg/L in three wells: X701-130G, X701-TC28G, and X701-TC61G. Since 2019, trichloroethene decreased to less than 100,000 µg/L in each well, although concentrations have varied above and below 100,000 µg/L in the first and third quarter samples collected from well X701-TC28G.

Trichloroethene is increasing in three wells in the southern portion of the plume: X701-19G, X701-23G, and X701-79G. Trichloroethene was detected at 8.78 µg/L in the sample collected from well X701-19G, which monitors the southern edge of the plume. Trichloroethene was not detected in this well prior to the third quarter of 2018. Trichloroethene has increased in well X701-23G from 5.6 µg/L in 2017 to 15.2 µg/L in 2021. Trichloroethene has increased in well X701-79G from 230 µg/L in 2017 to 419 µg/L in 2021. Figure 6.5 shows the 5-year trends in trichloroethene in these three wells.

Technetium-99 was detected at 1,070 pCi/L in well X701-BW2G, which is immediately south of the former X-701B Holding Pond. This detection is above the Ohio EPA drinking water standard of 900 pCi/L for technetium-99, which is based on a 4 mrem/year dose from beta emitters. Uranium was detected at concentrations ranging from 33.6 to 63.4 µg/L in samples collected from three wells installed in the interim remedial measure treatment area. These detections are above the 30 µg/L Ohio EPA drinking water standard for uranium. These detections of technetium-99 and uranium were consistent with data collected in previous years.

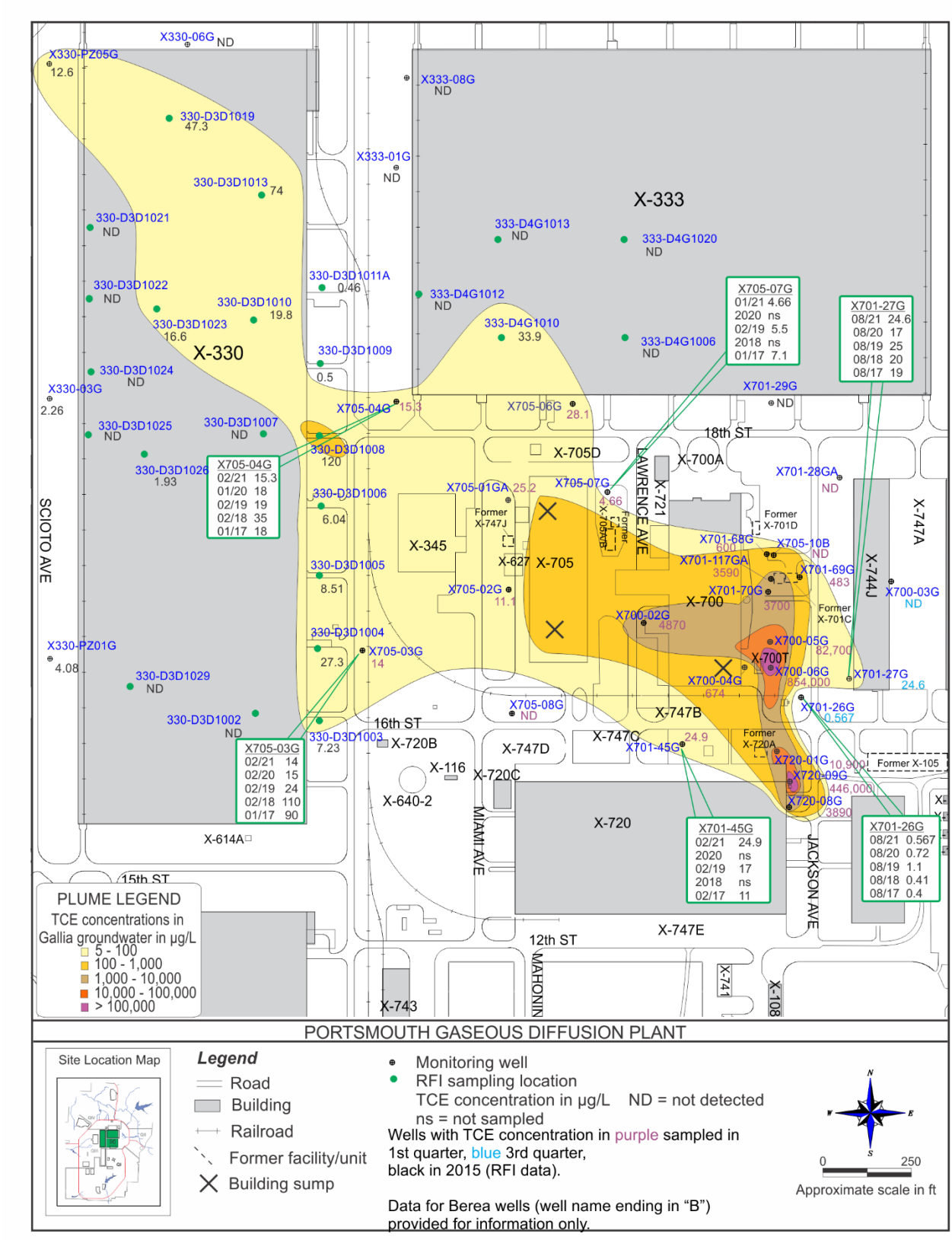

Figure 6.4. Gallia groundwater plume contaminated with trichloroethene at the Quadrant II Groundwater Investigative (7-Unit) Area in 2021

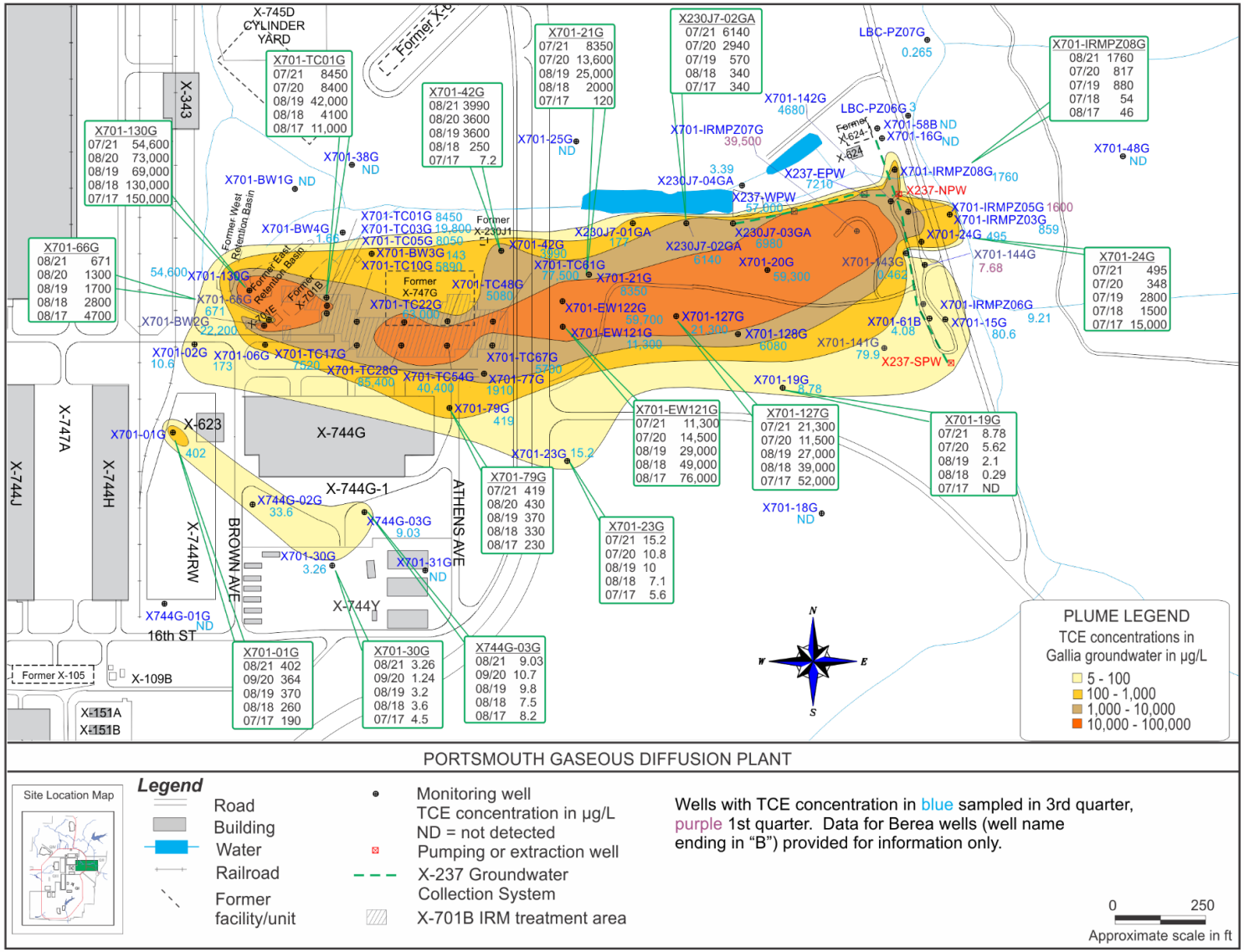

Figure 6.5. Gallia groundwater plume contaminated with trichloroethene at the X-701B Former Holding Pond in 2021

Quadrant II X-633 Former Recirculating Cooling Water Complex

Chromium is monitored in two wells near the X-633 Former Recirculating Cooling Water Complex because chromium was in additives used to treat the cooling water in the 1990s and earlier. Figure 6.1 shows the location of the X-633 Former Recirculating Cooling Water Complex monitoring area. Chromium was detected in both of the X-633 monitoring wells in 2021. These results were consistent with data collected in previous years.

6.3.2.3 Quadrant III Monitoring Areas

Chromium is of special concern at the X-616 Former Chromium Sludge Surface Impoundments because of the previous use of the area. In 2021, 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 its northeastern boundary. Chromium is typically detected above the preliminary remediation goal in this well. Nickel was detected above the preliminary remediation goal of 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 6.6 shows the concentrations of chromium and nickel in wells at the X-616 Former Chromium Sludge Surface Impoundments.

Trichloroethene was detected above the preliminary remediation goal of 5 µg/L in four wells west of the former surface impoundments: wells X616-09G, X616-13G, X616-14G, and X616-20B. Figure 6.6 shows the concentrations of trichloroethene detected in the X-616 wells in 2021.

A groundwater plume of trichloroethene was formerly present in the monitoring area for the X-740 Former Waste Oil Handling Facility (see Figure 6.1). The majority of the plume was excavated in 2021 in accordance with *The July 30, 2018 Director's Final Findings and Orders for CERCLA Actions to Restore Natural Resources*. Twenty groundwater monitoring wells were removed in 2020 to prepare for excavation of the groundwater plume. Of the three remaining wells in the X-740 monitoring area, trichloroethene was detected at 22.9 µg/L in one well in 2021. These results were consistent with data collected in previous years.

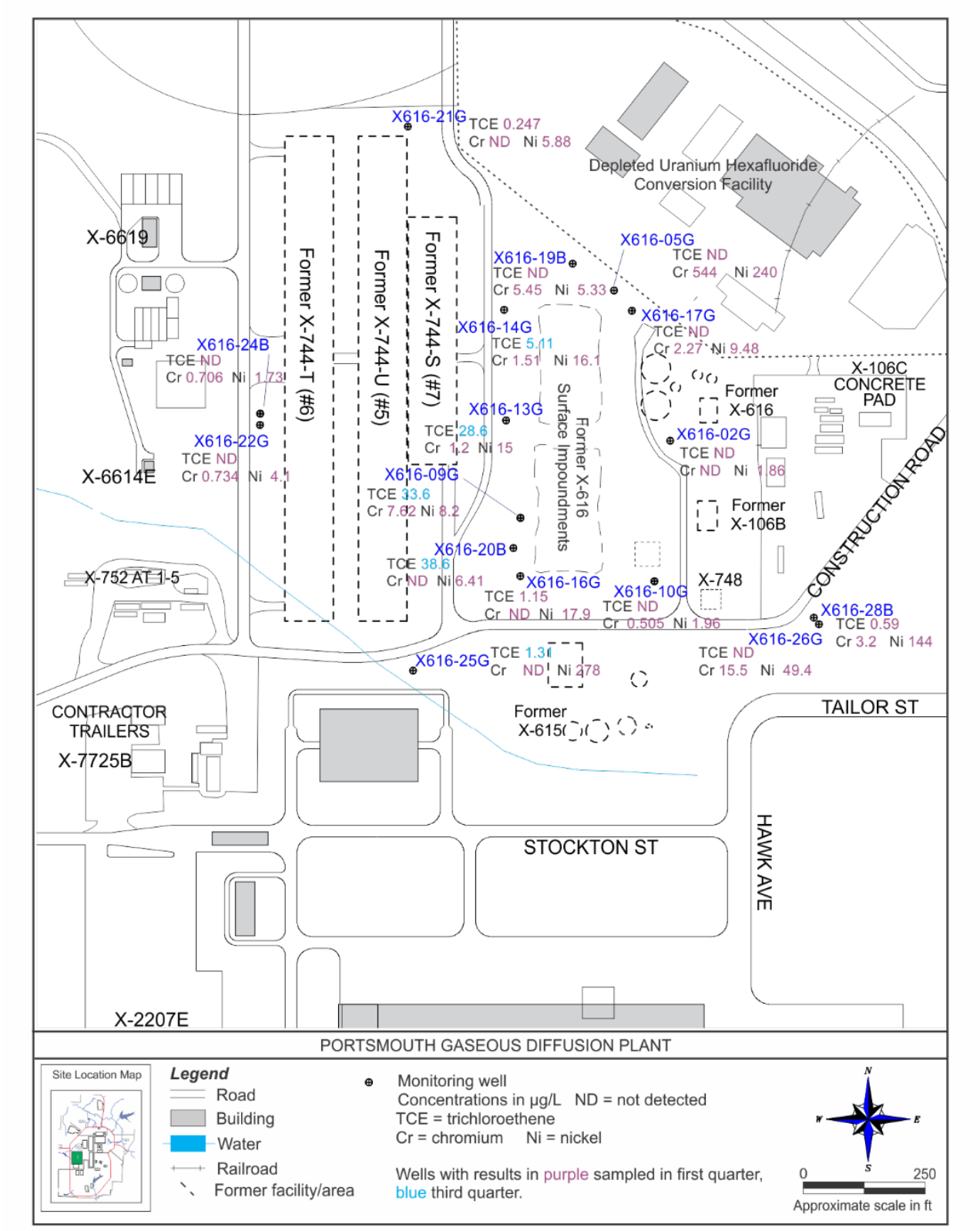

Figure 6.6. Trichloroethene and metal concentrations in groundwater at the X-616 Former Chromium Sludge Surface Impoundments in 2021

6.3.2.4 Quadrant IV Monitoring Areas

DOE monitors groundwater in five areas in Quadrant IV, which is the northern portion of PORTS, as shown in Figure 6.1.

The X-611A Former Lime Sludge Lagoons are in the northeast portion of PORTS next to Little Beaver Creek. 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. Beryllium and chromium are monitored at these locations. These metals were detected in the X-611A monitoring wells in 2021 at concentrations below preliminary remediation goals and consistent with data collected in previous years.

The X-735 Landfills, near the northern boundary of PORTS, use a detection monitoring program for Berea wells that applies statistics to determine whether a release has occurred at the landfill. No releases were identified at the X-735 Landfills in 2021. Monitoring data for Gallia wells at the X-735 Landfills are compared to concentration limits set by Ohio EPA. These limits were not exceeded in 2021.

The X-734 Landfills are in the northwest portion of PORTS. Volatile organic compounds, metals, and radionuclides are monitored at the X-734 Landfills. In 2021, no volatile organic compounds, metals, or radionuclides were detected at concentrations above the preliminary remediation goals in the samples collected from the X-734 monitoring wells.

Cadmium and nickel are monitored in three wells north of the X-533 Former Switchyard Complex. Both were detected in the X-533 monitoring wells in 2021. These results were consistent with data collected in previous years.

One well near the X-344C Former Hydrogen Fluoride Storage Building is monitored for volatile organic compounds. Low concentrations of trichloroethene and other volatile organic compounds are typically detected in this well and were detected in 2021 at concentrations below preliminary remediation goals, consistent with data collected in previous years.

6.3.3 Surface Water

Surface water monitoring is conducted in conjunction with groundwater monitoring to determine if contaminants present in groundwater are detected in surface water samples. Surface water is collected quarterly from 14 locations and analyzed for volatile organic compounds and radionuclides. Figure 6.7 shows the surface water monitoring locations.

In 2021, concentrations of trichloroethene detected in East Drainage Ditch and Little Beaver Creek were lower than in 2020. Concentrations of trichloroethene detected in East Drainage Ditch (EDD-SW01) ranged from 1.26 to 47 µg/L. The maximum concentration of trichloroethene detected in Little Beaver Creek was 28.3 µg/L in the second quarter sample collected at LBC-SW01. Trichloroethene was detected in only one of four samples collected from Little Beaver Creek at LBC-SW04, the furthest downstream sampling location on Little Beaver Creek. Trichloroethene was detected in this sample at 1.79 µg/L.

Since the 1990s, trichloroethene and other volatile organic compounds have been detected regularly at low levels in samples collected from the Southwestern Drainage Ditch at UND-SW01, located inside Perimeter Road. The concentrations of volatile organic compounds detected at this monitoring location were typical for this location. Volatile organic compounds were not detected in the samples collected from the Southwestern Drainage Ditch at UND-SW02. The detections of trichloroethene in Little Beaver Creek and the Southwestern Drainage Ditch were below 810 µg/L, which is the Ohio EPA non-drinking water quality criterion for trichloroethene for the protection of human health in the Ohio River drainage basin.

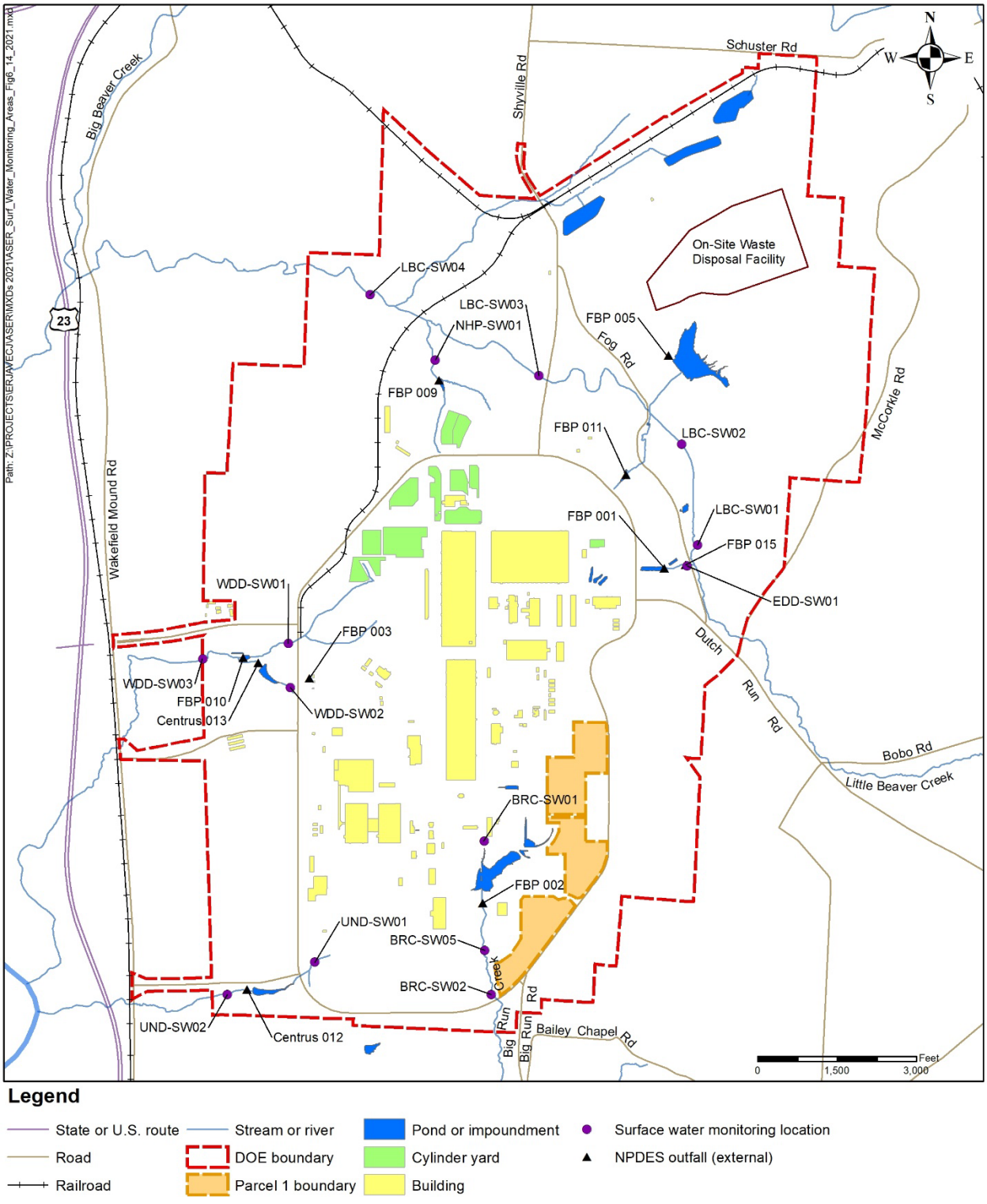

Figure 6.7. Surface water monitoring locations

In 2021, technetium-99 and uranium were detected at measurable levels in the third and fourth quarter samples collected from Big Run Creek. Figure 6.7 shows these monitoring locations. Table 6.1 summarizes sampling results for Big Run Creek and the discharge from the X-230K South Holding Pond (NPDES Outfall 002).

Table 6.1. Technetium-99 and uranium in Big Run Creek and the discharge from the X-230K South Holding Pond

Location	Date	Tc-99	U	U-233/234	U-235/236	U-238
BRC-SW01	7/29/2021	11.7	0.845UJ[a]	0.778UJ[a]	0.00764UJ[a]	0.283UJ[a]
	10/18/2021	199	2.73	9.03	0.361	0.863
NPDES Outfall 002 (X-230K Holding Pond)	Jan-Jun	-0.0966U - 4.04UJ	0.617-1.31	0.43-1.09	0.0113UJ-0.0526UJ	0.203-0.437
	Jul-Dec	7.94-16.1	0.365UJ-0.946	0.462-1.31	0.0114UJ-0.126	0.118UJ-0.313
BRC-SW05	7/29/2021	1710	8.21	86.1	2.83	2.31
	10/18/2021	8.51	0.884	1.21	0.065U[a]	0.287
BRC-SW02	7/29/2021	9.18	0.693	0.666UJ[a]	0.0154UJ[a]	0.23
	10/18/2021	7.71	0.591UJ[a]	0.978	0.0314U[a]	0.194UJ[a]

Note:
Radionuclides measured in picocuries per liter (pCi/L) except uranium in micrograms per liter.
[a]The reported result is undetected (U) or undetected and estimated (UJ). Negative results may be reported due to a statistical determination of the counts seen by a detector, minus a background count.

Acronyms and abbreviations:
NPDES = National Pollutant Discharge Elimination System
Tc-99 = technetium-99 U = uranium

The detection of uranium-233/234 at BRC-SW05 in July 2021 (86.1 pCi/L) is 7 percent of the DOE derived concentration standard of 1,200 pCi/L for uranium-234 (DOE 2021f). Levels of technetium-99, uranium-235/236, and uranium-238 detected in the samples from Big Run Creek and the X-230K South Holding Pond (NPDES Outfall 002) are less than 0.5 percent of the DOE derived concentration standards of 390,000 pCi/L for technetium-99, 1,300 pCi/L for uranium-235, and 1,400 pCi/L for uranium-238 (DOE 2021f).

6.3.4 Water Supply

The water supply monitoring program was developed to determine whether PORTS has had any impact on the quality of private residential drinking water sources. Although this program may indicate whether contaminants were transported off site, it should not be interpreted as an extension of the on-site groundwater monitoring program, which is responsible for detecting contaminants and determining the rate and extent of their movement. Data from the water supply monitoring program are not used in environmental investigations because investigators cannot know how residential wells were constructed, and the types of pumps the wells use may not be ideal for sampling.

Four residential drinking water sources participated in the program in 2021. The PORTS water supply 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. Wells are sampled semiannually and samples are analyzed for volatile organic compounds and radionuclides.

Chlorination byproducts called trihalomethanes (bromodichloromethane, chloroform, and dibromochloromethane), which are common residuals in treated drinking water, are routinely detected at low concentrations at some of the residential sampling locations. The total concentration of these trihalomethanes was below the Ohio EPA drinking water standard of 80 µg/L.

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). Neither transuranics nor technetium-99 were detected in any of the water supply samples collected in 2021. 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.

6.3.5 Exit Pathway Monitoring

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 shown in Figure 6.8. Trichloroethene was detected in one of the samples collected from Little Beaver Creek (LBC-SW04) at 1.79 µg/L. This detection was below the Ohio EPA non-drinking water quality criterion of 810 µg/L for the protection of human health in the Ohio River drainage basin.

No transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) were detected in samples collected at the surface water exit pathway monitoring locations. Technetium-99 was detected at levels ranging from 7.71 to 25.1 pCi/L in samples collected from Big Run Creek and the Western Drainage Ditch. These detections were 0.006 percent or less of the derived concentration standard of 390,000 pCi/L for technetium-99 in water (DOE 2021f). 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 percent of the derived concentration standard would equal a dose at the DOE limit of 100 mrem/year (DOE 2021f).

Volatile organic compounds were also detected in on-site groundwater monitoring wells that are part of the exit pathway monitoring program. Trichloroethene and other volatile organic compounds were detected in two wells that monitor the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility (see Section 6.3.2.1). Trichloroethene was detected in on-site well X749-45G at concentrations ranging from 1.77 to 11.4 µg/L, with results above the Ohio EPA drinking water standard of 5 µg/L in the first and second quarter samples collected from the well. All other detections of trichloroethene and other volatile organic compounds in the exit pathway monitoring wells were below Ohio EPA drinking water standards.

Exit pathway groundwater monitoring wells were sampled for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and uranium-238) in 2021. Only uranium and uranium isotopes were detected in the wells, at levels below the Ohio EPA drinking water standard of 30 µg/L for uranium.

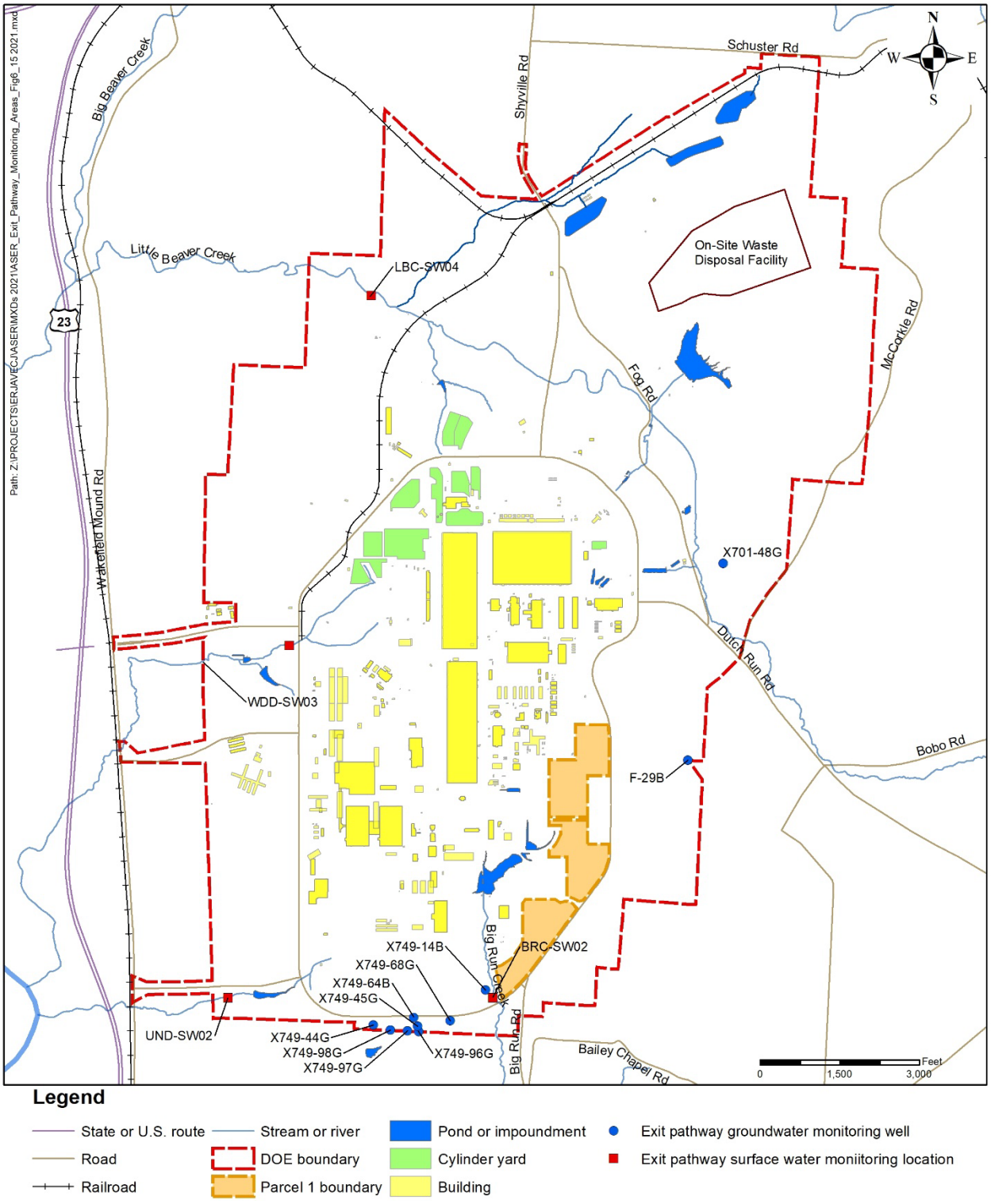

Figure 6.8. Exit pathway monitoring locations

6.4 Emerging Contaminants

Federal and state regulators are interested in emerging contaminants of concern that may be present at DOE sites. These emerging contaminants are chemicals that have been detected in drinking water supplies around the United States, but their risk to human health and the environment may not be fully understood.

PORTS collects samples every two years at selected groundwater monitoring wells for selected emerging contaminants 1,4-dioxane, 1,2,3-trichloropropane, 2,4-dinitrotoluene, and N-nitrosodimethylamine. The most recent sampling conducted in 2021 detected only 1,4-dioxane, though it is routinely detected in the trichloroethene groundwater plumes at PORTS. Concentrations of 1,4-dioxane detected in groundwater in 2021 ranged from 3.62 to 27.8 µg/L. This contaminant is a common component of chlorinated solvents like 1,1,1-trichloroethane and trichloroethene, which were historically used at PORTS.

Perfluoroalkyl substances and polyfluoroalkyl substances, collectively known as PFAS, are another emerging contaminant. The release of PFAS into the environment is a topic of growing public health and environmental concern. PFAS are a class of man-made chemicals that have been manufactured and used in a variety of industries since the 1940s. Since then, thousands of chemical formulations have been developed and widely used in manufacturing and processing facilities due to their resistance to grease, water, oil, and heat. PFAS are often found in commercial products such as stain-resistant carpeting, water-resistant clothing, non-stick and grease-resistant food contact materials such as cookware and food packaging, and aqueous film forming foams used in firefighting. These chemicals are very persistent in the environment and tend to bioaccumulate in food chains.

PORTS groundwater is not currently monitored for these contaminants. Section 2.4.2 discusses sampling for PFAS in the PORTS water supply.

6.5 Groundwater Treatment Facilities

In 2021 the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities treated a combined total of approximately 26.7 million gallons of water and removed approximately 7 gallons of trichloroethene. All processed water is discharged through NPDES outfalls before exiting PORTS. Table 6.2 summarizes the groundwater treatment facility information for 2021.

Table 6.2. Summary of groundwater treatment facility information for 2021

Facility	Gallons of water treated	Gallons of trichloroethene removed
X-622	18,762,400	2.08
X-623	1100	< 0.0001
X-624	215,800	0.19
X-627	7,725,800	4.71

Note:
Source: *2021 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2022a)

6.5.1 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
- Fifteen extraction wells located in the Quadrant I Groundwater Investigative (5-Unit) Area

In December 2021, three extraction wells in the Quadrant I Groundwater Investigative (5-Unit) Area (X622-EW01, X622-EW03, and X622-EW07) were removed from service in support of the X-231B soil excavation project and the associated utility isolations that were necessary to complete excavation.

The facility processed approximately 18.8 million gallons of groundwater during 2021 and removed approximately 2.08 gallons of trichloroethene from the water. Treated water from the facility discharges through NPDES Outfall 608, which flows to the X-6619 Sewage Treatment Plant (NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 608 in 2021.

6.5.2 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 interim remedial measure in 2009, the X-623 Groundwater Treatment Facility treated groundwater contaminated with trichloroethene from a sump in the bottom of the X-701B Former Holding Pond and three groundwater extraction wells east of the holding pond. The sump and extraction wells were removed in 2009–2011 to facilitate implementation of the interim remedial measure. The X-623 Groundwater Treatment Facility operated only in January 2021 to treat miscellaneous water associated with site activities in accordance with the NPDES permit.

The facility treated 1,100 gallons of water in January 2021, removing less than 0.0001 gallon of trichloroethene from the water. Treated water from the facility discharges through NPDES Outfall 610, which flows to the X-6619 Sewage Treatment Plant (NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 610 in 2021.

6.5.3 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 groundwater contaminated with trichloroethene 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 or pumping wells (see Figure 6.5).

The X-624 Groundwater Treatment Facility treated approximately 215,800 gallons of water in 2021, removing approximately 0.19 gallon of trichloroethene from the water. Treated water from the facility discharges through NPDES Outfall 015, which discharges to Little Beaver Creek. No NPDES permit limitations were exceeded at Outfall 015 in 2021.

6.5.4 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 7.7 million gallons of groundwater were processed during 2021, removing approximately 4.71 gallons of trichloroethene from the water. Treated water from the facility discharges through NPDES Outfall 611, which flows to the X-6619 Sewage Treatment Plant (NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 611 in 2021.