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Hydraulic Containment of TCE Contaminated Groundwater at the DOE Portsmouth Gaseous Diffusion Plant - 8069

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ABSTRACT

This paper will describe the progress of a groundwater remedial action at the Portsmouth Gaseous Diffusion Plant (PORTS), a Department of Energy (DOE) facility that enriched uranium from the early 1950s until 2000. The X-749 southern boundary hydraulic containment system, combining a four-well extraction system with a previously constructed subsurface barrier wall, has been employed at PORTS. The hydraulic containment project has been implemented as part of containment and remediation of the X-749/X-120 area trichloroethylene (TCE) contaminant.

The X-749/X-120 groundwater contaminant plume is located in the south central section (Quadrant I) of the PORTS facility. The plume is associated with the former X-120 Goodyear Training Facility and a landfill known as the X-749 Contaminated Materials Disposal Facility. The principal contaminants of concern are chlorinated solvents (primarily TCE) and technetium-99 (Tc-99). A subsurface barrier wall (X-749 South Barrier Wall) was completed in 1994 at the PORTS southern reservation boundary as an interim remedial measure to slow the advancement of the leading edge of the contaminated groundwater plume or to prevent the plume from migrating off DOE property. Remedial measures identified by Ohio Environmental Protection Agency (Ohio EPA) included installation of a barrier wall around the eastern and southern portions of the X-749 landfill to provide source control and installation of a phytoremediation system to help contain groundwater flow and remove volatile organic compounds. Previous remedial measures that were implemented as elements of “closures” on the X-749 landfill included a multimedia cap, barrier walls, and a groundwater collection system. Despite these measures, the X-749/X-120 groundwater plume has migrated beyond the southern DOE property boundary. Current TCE concentrations in off-site groundwater monitoring wells are below the preliminary remediation goal and drinking water maximum contaminant level for TCE of 5 µg/kg, but continue to increase.

Hydraulic containment was selected as the method for controlling the plume at the southern DOE property boundary. Recent borings and pumping tests indicate that approximately a 400-foot section of the existing subsurface barrier wall near the DOE property boundary may been improperly keyed into the Sunbury Shale bedrock which underlies the unconsolidated uppermost Gallia sand and gravel aquifer (Gallia). This gap is reported to be as much as 4 vertical feet. In addition, the X-749 groundwater plume is migrating around the western end of the X-749 South Barrier Wall.

Four groundwater extraction wells were installed at the DOE property boundary to provide hydraulic control of the plume currently flowing under and around the existing subsurface barrier wall. Placement of the new extraction wells was based on groundwater modeling and data collected from pumping tests in the area. The extracted groundwater is being sent to the on-site X-622 Groundwater Treatment Facility via subsurface piping.

The hydraulic containment system began operation in June 2007. The preliminary water elevations from monitoring wells in the vicinity of two of the four extraction wells demonstrate a significant decrease in groundwater potentiometric head in the southern boundary area. The current extraction rates should be adequate to contain the leading edge of the contaminant plume. Monitoring wells in the area will continue to be sampled on a quarterly basis.

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INTRODUCTION

The X-749 southern boundary hydraulic containment system, which includes a four well extraction system, has been installed at the Portsmouth Gaseous Diffusion Plant (PORTS), a Department of Energy (DOE) facility that enriched uranium from the early 1950s until 2000. The hydraulic containment project has been implemented to assist in the removal of trichloroethylene (TCE) in the groundwater at and around the X-749/X-120 area at the PORTS facility.

A groundwater contaminant plume is located in the south central section (Quadrant I) of the PORTS facility, as shown in Figure 1. The plume is associated with the former X-120 Goodyear Training Facility and X-749 Contaminated Materials Disposal Facility. The principal contaminants of concern are TCE and technetium-99 (Tc-99). The leading edge of the contaminated groundwater plume emanating from the X-749 Contaminated Materials Disposal Facility has been approaching the southern boundary of the PORTS reservation.

A 1,077-foot long subsurface barrier wall (X-749 South Barrier Wall) was completed in 1994 at the PORTS southern reservation boundary as an interim remedial measure to slow the advancement of the leading edge of the contaminated groundwater plume or to prevent the plume from migrating off DOE property. In 2001, the Ohio Environmental Protection Agency issued the Decision Document for Quadrant I, which identified the selected remedial measures for the X-749 unit. These measures included installation of additional barrier walls around the eastern and southern portions of the X-749 unit and phytoremediation to control groundwater flow and remove volatile organic compounds. Other remedial measures were implemented previously as elements of "closures" on the X-749 unit, including a multimedia cap, barrier walls, and a groundwater collection system. Since the installation of these measures, the X-749/X-120 groundwater plume has migrated beyond the DOE property boundary. Current TCE concentrations in off-site groundwater monitoring wells are below the preliminary remediation goal and maximum contaminant level for TCE, but continue to increase.

Hydraulic containment was selected as the method for controlling the plume at the southern DOE property boundary. Recent borings and pumping tests indicate that approximately a 400-foot section of the existing subsurface barrier wall near the DOE property boundary may have been improperly keyed into the Sunbury Shale bedrock which underlies the unconsolidated uppermost Gallia sand and gravel aquifer (Gallia). This gap is reported to be as much as 4 vertical feet. In addition, the X-749 groundwater plume is migrating around the western end of the X-749 South Barrier Wall.

X-749/X-120 AREA HISTORY

The former X-120 Goodyear Training Facility was in operation in the early 1950s as a machine shop, paint shop, and warehouse space. The X-120 facilities were demolished and removed in the late 1970s, prior to the more recent construction of the Gas Centrifuge Enrichment Plant. Remedial investigations conducted in the early 1990s detected various VOCs (volatile organic compounds), primarily TCE, in the groundwater.

Located approximately 500 feet to the southeast of the X-120 Goodyear Training Facility is the X-749 Landfill, as shown in Figure 1. The X-749 Landfill comprises northern and southern segments. Currently, the X-749 Landfill is treated as a single unit due to the groundwater plume which lies under both segments of the landfill. In 1989, the 11.5-acre landfill underwent closure in compliance with the Resource Conservation and Recovery Act (RCRA). The closure activity included the installation of slurry walls along the north and west sides of the landfill and the installation of a multi-layered landfill cap over the complete facility. These installed features serve as source control for groundwater contamination. The captured contaminated groundwater is treated at an on-site groundwater treatment facility. Additionally, remedial actions selected by Ohio EPA in 2000 for the X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility groundwater plume included construction of a barrier wall on the south and east sides of the X-749 Contaminated Materials Disposal Facility and phytoremediation.

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The leading edge of the contaminated groundwater plume emanating from the X-749 Contaminated Materials Disposal Facility has been approaching the southern boundary of the PORTS reservation. In 1994, a subsurface barrier wall was constructed across a portion of this southern boundary. The X-749 South Barrier Wall was designed to inhibit migration of the plume off plant property; however, VOCs, including TCE, have been detected in wells downgradient from this barrier wall and beyond the plant boundary.

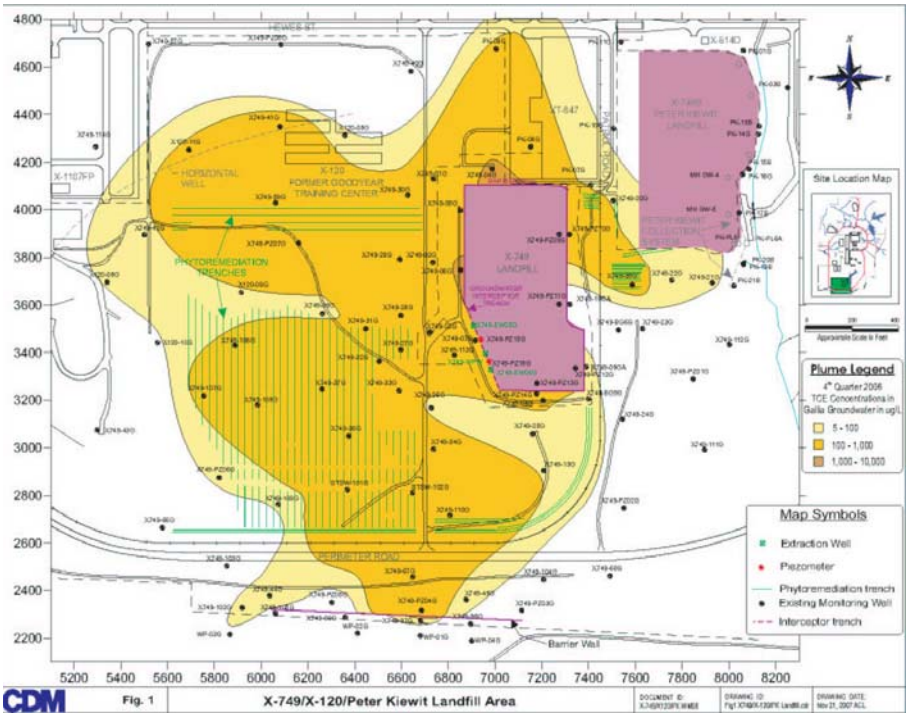

Fig. 1. This is an overview of the X-749/X-120/PK Landfill Area, TCE Plume Extent, and Tree Planting Locations.

DESIGN/RESULTS

The Southern Boundary Hydraulic Containment Project consisted of installing four groundwater extraction wells (6-inch diameter) to provide hydraulic control of the southern boundary of the X-749 plume. Placement of the new extraction wells was determined from groundwater modeling and data recently collected from a pumping test in the area. Figure 2 shows the locations of the four extraction wells (X749-EW01G, X749-EW02G, X749-EW03G, and X749-EW04G).

The monitoring wells were designed and located in a step-back fashion to contain the leading edge of the contaminant plume migrating southward beneath the center portion and around the western end of the South Barrier Wall. Extraction well X749-EW01G was installed west of the South Barrier Wall, very close to the DOE property boundary. X749-EW01G was designed to extract enough groundwater so that the cone of depression would extend beyond the leading edge of the plume observed at off-site monitoring well WP-03G. Extraction well X749-EW04G was located so that, when the well was pumped, the cone of depression would reach the center portion of the South Barrier Wall at monitoring well X749-PZ04G. Extraction wells X749-EW02G and X749-EW03G were installed up-gradient of X749-EW01G and X749-EW04G, respectively, to prevent the more highly contaminated

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portions of the plume from being "pulled" closer to the DOE property boundary. These extraction wells are expected to create a gradient preventing further migration of the plume off-site and eventually to remove the contaminated groundwater that has already migrated beyond the DOE property boundary.

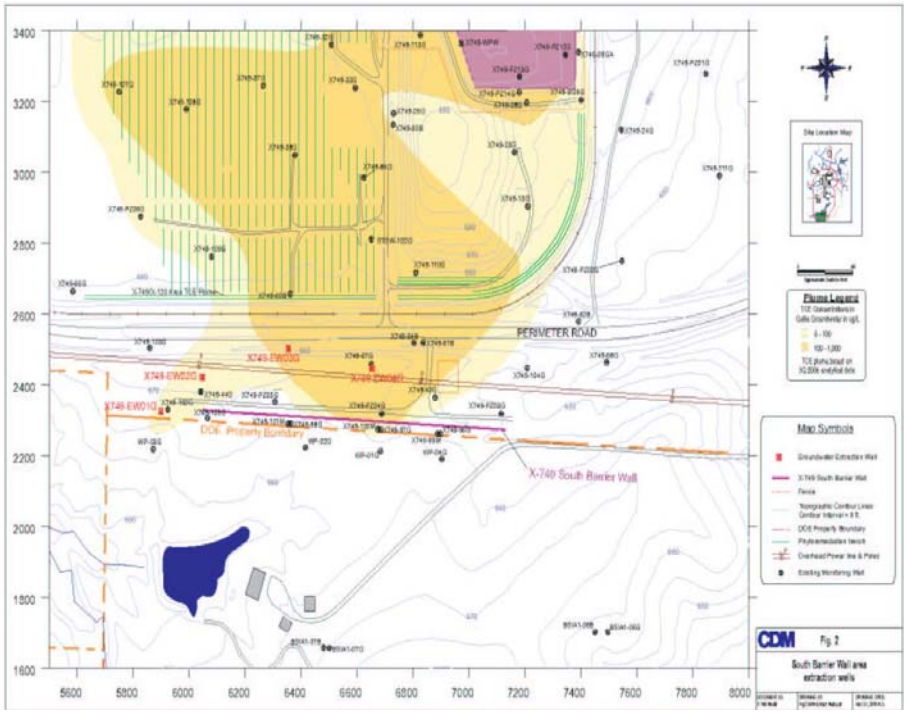

Fig. 2. This is an overview of the X-749 South Barrier Wall and newly installed extraction wells.

Beginning in June 2007, automatic water level measurements were collected using in-well, electronic data logger/pressure transducers. The pressure transducers were placed in six monitoring wells at the X-749 south boundary to determine the effects the extraction wells were having on the groundwater potentiometric surface elevation in the X-749 area. Data loggers were placed in monitoring wells X749-44G, X749-102G, and WP-03G to monitor the effects of extraction well X749-EW01G. Data loggers were also placed in monitoring wells X749-67G, X749-97G, and X749-PZ04G to monitor the effects of extraction well X749-EW04G. The water level data were collected every 15 minutes for the months of June through August. The data collected from these data loggers were used to demonstrate the relationship between the pumping rate of the extraction wells and the water levels at the X-749 southern boundary.

Water levels were collected in June before pumping began to demonstrate a baseline relationship between the water levels and the daily cycle of water use by the area vegetation. Water levels collected in the month of July are intermittent as the extraction wells were pumping only during the day. During August, the extraction wells began pumping continuously, demonstrating evident draw-down in the six monitoring wells (including the off-site well WP-03G) as shown in Figure 3 and 4. Extraction wells X749-EW01G and X749-EW02G exhibited an average pumping rate of 0.3 gallons/minute while extraction wells X749-EW03G and X749-EW04G exhibited an average pumping rate of 0.5 gallons/minute. Water levels in the six monitoring wells will continue to be collected through 2009.

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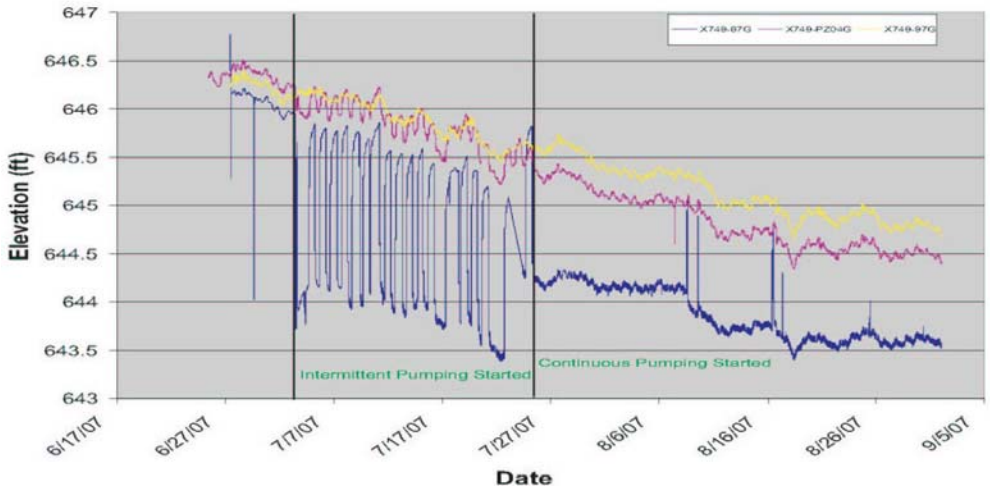

Fig. 3. Monitoring Wells X749-67G, X749-PZ04G, and X749-97G Continuous Pumping for Extraction Well X749-EW04G

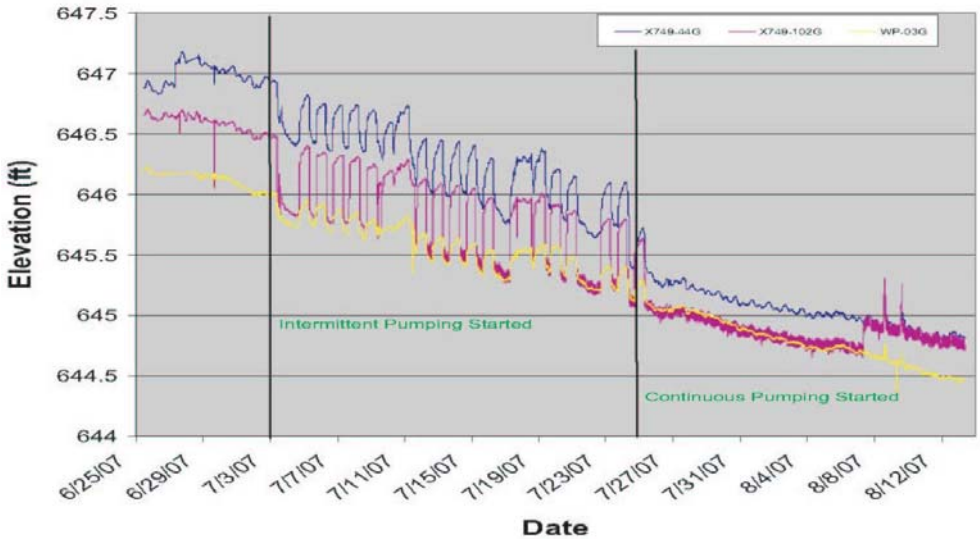

Fig. 4. Monitoring Wells X749-44G, X749-102G, and WP-03G Continuous Pumping for Extraction Well X749-EW01G

CONCLUSION

The preliminary water elevations from monitoring wells in the vicinity of two of the four extraction wells demonstrate a significant decrease in groundwater potentiometric head in the southern boundary area. The current extraction rates should be adequate to contain the leading edge of the contaminant plume. Water levels in the six monitoring wells will continue to be collected until 2009 to evaluate the water level draw-

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down. Groundwater sampling of monitoring wells in the X-749 area began in the fourth quarter of 2007 and will continue through 2009.

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