US DOE PORTSMOUTH

QUADRANT I DECISION DOCUMENT

PORTSMOUTH GASEOUS DIFFUSION PLANT

MARCH 2001

OhioEPA
State of Ohio Environmental Protection Agency

Southeast District Office

2195 Front Street
Logan, OH 43138

TELE: (740) 385-8501 FAX: (740) 385-6490

Bob Taft, Governor
Christopher Jones, Director

March 21, 2001

RE: US DOE-PORTS
PIKE COUNTY
OH ID# 466-0865

DERR CORRESPONDENCE

Sharon J. Robinson
Site Manager
U.S. Department of Energy
Portsmouth Enrichment Office
P.O. Box 700
Piketon, Ohio 45661-0700

RECEIVED
MAR 22 2001

Dear Ms. Robinson:

RE: The Quadrant I Decision Document

Enclosed is the Quadrant I Decision Document. Please review the document and prepare a CMI in accordance with the requirements of the Ohio consent Decree and paragraph 47 of the Three Party Administrative Order on Consent.

If you have any questions, please do not hesitate to contact me at (740) 380-5289.

Sincerely,

Maria Galanti
Site Coordinator
Division of Emergency and Remedial Response

MG/mg

Kristi Wiehle, US DOE (w/o enclosure)
Melda Rafferty, US DOE (w/o enclosure)
Gene Jablonowski, US EPA-Region V (w/o enclosure)
Jim King, Bechtel-Jacobs Company LLC (w/o enclosure)

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List of Acronyms

ACO:	Administrative Consent Order
ALARA:	As low as reasonably achievable
ARAR:	Applicable or Relevant and Appropriate Requirements
BAT:	Best Available Technology
bgs:	Below ground surface
BRA:	Baseline Risk Assessment
BTEX:	Benzene, toluene, ethylbenzene, and xylene
CERCLA:	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Law)
CAS/CMS:	Clean-up Alternatives Study/Corrective Measures Study
CDI:	Chronic daily intake
CFR:	Code of Federal Regulations
COC:	Chemical of concern
COPC:	Chemical of potential concern
DFF&Os:	Director's Final Findings and Orders
D&D:	Decontamination and Decommissioning
ELCR:	Excess Lifetime Cancer Risk
ft^2:	Square foot
GCEP:	Gas Centrifuge Enrichment Plant
gpd:	Gallon per day
HDPE:	High-density polyethylene
HI:	Hazard index
HQ:	Hazard quotient
HSWA:	Hazardous and Solid Waste Amendments
IGWMP:	Integrated groundwater monitoring plan
MCL:	Maximum contaminant level
mg/kg:	Milligram per kilogram
mg/kg/day:	Milligram per kilogram per day
NCP:	National Oil and Hazardous Substances Pollution Contingency Plan
NPDES:	National Pollutant Discharge Elimination System
OAC:	Ohio Administrative Code
O&M:	Operation and maintenance
Ohio EPA:	Ohio Environmental Protection Agency
PAH:	Polycyclic aromatic hydrocarbon
PCB:	Polychlorinated biphenyl
PCE:	Perchloroethene
pCi/kg:	Picocurie per kilogram
PORTS:	Portsmouth Gaseous Diffusion Plant
ppm:	Part per million
PRG:	Preliminary remediation goal
RCRA:	Resource Conservation and Recovery Act

RfD:	Reference dose
RFI:	RCRA facility investigation
SARA:	Superfund Amendments and Reauthorization Act
SVOC:	Semivolatile organic compound
SWMUs:	Solid waste management units
TCE:	Trichloroethene
TPH:	Total petroleum hydrocarbons
TSCA:	Toxic Substances Control Act
UF_6:	Uranium hexafluoride
US DOE:	United States Department of Energy
USEC:	United States Enrichment Corporation
US EPA:	United States Environmental Protection Agency
UST:	Underground storage tank
VER:	Vacuum extraction recovery
VOC:	Volatile organic compound
μg/kg:	Microgram per kilogram
μg/L:	Microgram per liter

PART 1: DECLARATION STATEMENT

DECLARATION STATEMENT

SITE NAME AND LOCATION

US Department of Energy
Portsmouth Gaseous Diffusion Plant (PORTS)
Quadrant I
Piketon, Ohio

STATEMENT OF BASIS AND PURPOSE

This Decision Document presents the selected remedial actions for the PORTS Quadrant I, on the US Department of Energy (US DOE) Reservation in Piketon, Ohio. These actions were chosen in accordance with the Resource Conservation and Recovery Act (RCRA) of 1976; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986; and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and the Hazardous and Solid Waste Amendments (HSWA) of 1984. These decisions are based on the administrative record for this response action. The PORTS Quadrant I site is being cleaned up under a Consent Decree between US DOE and the State of Ohio, an Administrative Consent Order (ACO) signed by US DOE and the United States Environmental Protection Agency (US EPA). Both legal agreements were signed in 1989. US DOE, US EPA and Ohio EPA signed an agreement in August 1997 giving the Ohio EPA lead agency status for the day-to-day activities at PORTS. For certain units at Quadrant I, the Ohio EPA Director's Final Findings & Orders (DFF&Os) for the integration units signed in March 1999 applies.

Documentation for the selection of these remedial actions are contained in the administrative record which is maintained at both the US DOE Environmental Information Center in Piketon, Ohio, and at the Ohio EPA Southeast District Office in Logan, Ohio. The specific documents include, but are not limited to, the Quadrant I Final RCRA Facility Investigation (RFI) report dated 1996, the Baseline Ecological Risk Assessment (BERA), the Air RFI Report, the Background Sampling Investigation Report for Soil and Groundwater, the Ohio EPA Preferred Plan, the Polycyclic Aromatic Hydrocarbon (PAH) Position Paper, the Polychlorinated Biphenyl (PCB) Position Paper, the Quadrant I Clean-up Alternative Study and Corrective Measures Study (CAS/CMS) Final report, and other documents contained in the administrative record file for this response action.

Technical Information about the site and the administrative record documents can be obtained from the following individuals:

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Project Coordinator
Ohio Environmental Protection Agency
2195 Front Street
Logan, Ohio 43138
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Chicago, Illinois 60604-3590
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ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from Quadrant I, if not addressed by implementing the response actions selected in this Decision Document, may present a current or future risk to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDIES

Quadrant I contains 24 Solid Waste Management Units (SWMUs) that were investigated as part of the RFI. The X-231B Southwest Oil Biodegradation Plot and the X-749 Contaminated Materials Disposal Facility were not investigated as part of the RFI because they were undergoing RCRA closure. The groundwater contaminant plumes from these units were addressed as part of the CAS/CMS process. The March 1999 DFF&Os for integration of units provided certain exemptions to closure requirements in order to unify all PORTS-wide groundwater remedial requirements in a timely and efficient manner.

For purposes of this Decision Document, the Solid Waste Management Units (SWMUs) were placed into the following four categories in the CAS/CMS report:

1. SWMUs requiring no further corrective action -- SWMUs that have been determined to fall within the risk goals outlined in RCRA and CERCLA;

2. SWMUs deferred to decontamination and decommissioning (D&D) -- SWMUs that will be addressed under the 1989 Ohio Consent Decree when the units are no longer used as they were originally intended, when the gaseous diffusion plant is no longer in operation, or earlier (if deemed appropriate); most of these SWMUs pose minimal risk, are still in operation, and are part of the operational plant infrastructure;

3. Creeks, streams, and ponds; and

4. SWMUs requiring remedial alternatives -- SWMUs that were evaluated as part of the CAS/CMS process; these SWMUs are considered to pose unacceptable risks to human health or the environment unless active remedy is implemented.

SWMUs Requiring No Further Corrective Action

These SWMUs do not pose an unacceptable risk to human health and environment as described in the Baseline Risk Assessment (BRA) in the approved RFI. These SWMUs are described in detail in the approved RFI Report for Quadrant I. The SWMUs listed below were determined to meet the risk guidelines for no further corrective action:

- Gas Centrifuge Enrichment Plant (GCEP) Underground Storage Tanks (UST)
- X-103 Auxiliary Office Building
- X-104A Indoor Firing Range
- X-120 Old Training Facility Site (soil only)
- X-710 Technical Services Building and Neutralization Pit (soil only)
- X-741 Oil Drum Storage Facility
- X-747F Miscellaneous Material Storage Yard
- X-749 Contaminated Materials Disposal Facility* (soil only)
- X-749A Classified Material Burial Ground*
- X-749B Peter Kiewit Landfill*
- X-750 Mobile Equipment Maintenance Shop, Fuel Station, and Waste Oil Tank
- X-751 Mobile Equipment Garage
- X-760 Pilot Investigation Building and Neutralization Pit (soil only)

* The landfill caps at these units will be maintained in accordance with the approved operation and maintenance (O&M) plans for these units. Groundwater will be monitored per the Integrated Groundwater Monitoring Plan (IGWMP).

SWMU'S Deferred to D&D

The D&D of the facility will require remediation in accordance with existing US DOE Orders and Internal Policies (and all applicable state and federal regulations, including the Ohio Consent Decree and ACO). It is Ohio EPA's intent to work with US EPA and US DOE to develop other legal and technical tools as necessary, to prepare the facility for future use. The D&D actions at each SWMU will further reduce or eliminate any residual contaminants to acceptable future risk levels in accordance with as low as reasonably achievable (ALARA) principles. Ongoing worker health and safety programs, routine monitoring in place at the facility, and the required implementation of the D&D program are intended to protect human health and the environment and provide an efficient approach to final disposition of the subject SWMUs. Should it become apparent that an imminent threat to human health and the environment is identified for units which are currently being deferred to D&D, immediate action will be taken to eliminate the threat.

- X-600 Coal-Fired Steam Plant
- X-600A Coal Pile Yard
- X-621 Coal Pile Runoff Treatment Facility
- X-626 Recirculating Cooling Water Pump House and Cooling Tower
- X-770 Mechanical Testing Facility

Creeks, Streams, and Ponds

These SWMUs do not require corrective action at this time but will be re-evaluated during D&D under the corrective action program.

- Big Run Creek
- X-230K South Holding Pond
- X-2230M Southwest Holding Pond

SWMUs Requiring Remedial Alternatives

The SWMUs in this section pose an unacceptable risk for contaminants of concern as described in the RFI. Three SWMUs in the quadrant required the development of alternatives for consideration due to volatile contaminants.

- X-231A and X-231B Oil Biodegradation Plots (soil only)*
- Five-Unit Groundwater Investigative Area
- X-749/X-120 Area Groundwater Plume

* The landfill caps at these units will be maintained in accordance with the approved O&M plans for these units. Groundwater will be monitored per the IGWMP.

STATUTORY DETERMINATIONS AND REMEDY SELECTION STANDARDS

The selected remedies meet the CERCLA statutory determination because they are protective of human health and the environment, comply with federal and State of Ohio requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost-effective. The remedies use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The remedies selected for the Five-Unit Groundwater Investigative Area and X-749/X-120 Area Groundwater Plume SWMUs satisfies the statutory preference in CERCLA and SARA for treatment as a principal element. However, remedies for the X-231A and X-231B Oil Biodegradation Plots do not satisfy the statutory preference for treatment as a principal element.

The selected remedies comply with RCRA remedial selection standards because they protect human health and the environment; control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment; and comply with applicable standards for management of wastes. Media cleanup levels were established for the Five-Unit Groundwater Investigative Area and X-749/A-X-120 Area Groundwater Plume.

Implementation of the no further corrective action alternative for those SWMUs within acceptable risk levels is protective of human health and the environment because those SWMUs fall into the risk goals outlined by CERCLA and RCRA. Those SWMUs which have been deferred (Please refer to Section 8 of this report) to D&D pose minimal risk to human health and the environment. These units are currently still operating and may become re-contaminated if remediated due to ongoing production of enriched uranium. Implementation of the selected remedies are readily accomplished, cost effective and is expected to provide both long and short term effectiveness. The selected remedies will reduce the toxicity, mobility and volume of groundwater contaminants. The mobility of the contaminants will be contained and through the ability of the selected remedial alternative reduce the levels of contaminants in groundwater. These remedies may result in some hazardous substances remaining on site above health-based levels for a period of time; therefore, a review will be conducted no less than every five years after commencement of the remedial actions to insure that the remedies selected continue to provide adequate protection of human health and the environment.

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DECISION SUMMARY

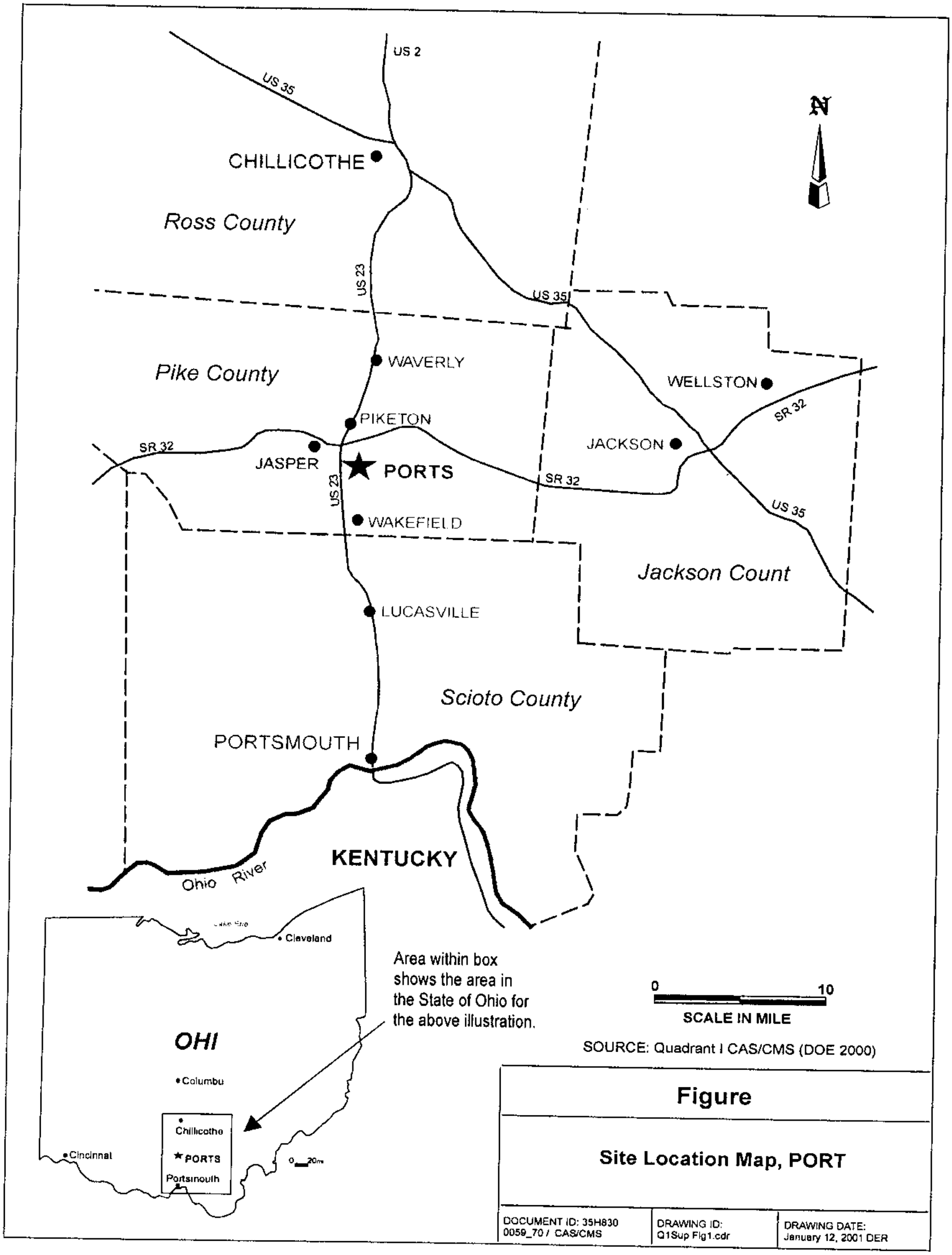
1.0 SITE NAME, LOCATION, AND DESCRIPTION

The PORTS facility was constructed between 1952 and 1956 and is owned by US DOE. The industrialized portion of the PORTS plant occupies approximately 1,000 acres of a 3,714-acre US DOE reservation in south central Ohio, approximately 80 miles south of Columbus, 20 miles north of Portsmouth, and 1 mile east of U.S. Route 23, near Piketon (Figure 1). The immediate region surrounding the site consists of Pike County, Scioto County, Jackson County, and Ross County. Approximately 24,250 people reside in Pike County (Energy Systems 1997), and scattered rural development is typical. Piketon is the nearest town, approximately five miles north of the facility on U.S. Route 23. Piketon had an estimated population of 1,717 in 1990. The county's largest community, Waverly, has approximately 4,500 residents and is situated 12 miles north of the facility.

Land within a five-mile radius of PORTS is primarily undeveloped, including cropland, woodlots, pasture, and forest. This distribution includes approximately 25,000 acres of farmland and 25,000 acres of forest. There is approximately 500 acres of urban land within the same radius (Energy Systems 1993).

The PORTS facility occupies an upland area of southern Ohio with an average land surface elevation of 670 feet above mean sea level. The terrain surrounding the plant site consists of marginal farmland and wooded hills, generally with less than 100 feet of relief. The plant is located within a mile-wide former river valley.

The geology of the PORTS plant site consists of unconsolidated material overlying bedrock formations. The unconsolidated material is known as the Teays formation. The Teays formation is composed of two members, the Minford silt and clay (Minford), and the Gallia sand and gravel


US 2
US 35
CHILLICOTHE
Ross County
US 23
US 35
Pike County
WAVERLY
WELLSTON
PIKETON
SR 32
SR 32
JASPER
JACKSON
PORTS
SR 32
US 23
WAKEFIELD
US 35
Jackson Count
LUCASVILLE
Scioto County
PORTSMOUTH
KENTUCKY
Ohio River
N
Cleveland
OHI
Columbu
Chillicothe
PORTS
Cincinnat
Portsmouth
Area within box shows the area in the State of Ohio for the above illustration.
0
10
SCALE IN MILE
SOURCE: Quadrant I CAS/CMS (DOE 2000)
Figure
Site Location Map, PORT
DOCUMENT ID: 35H830 0059_70 / CAS/CMS
DRAWING ID: Q1Sup Fig1.cdr
DRAWING DATE: January 12, 2001 DER

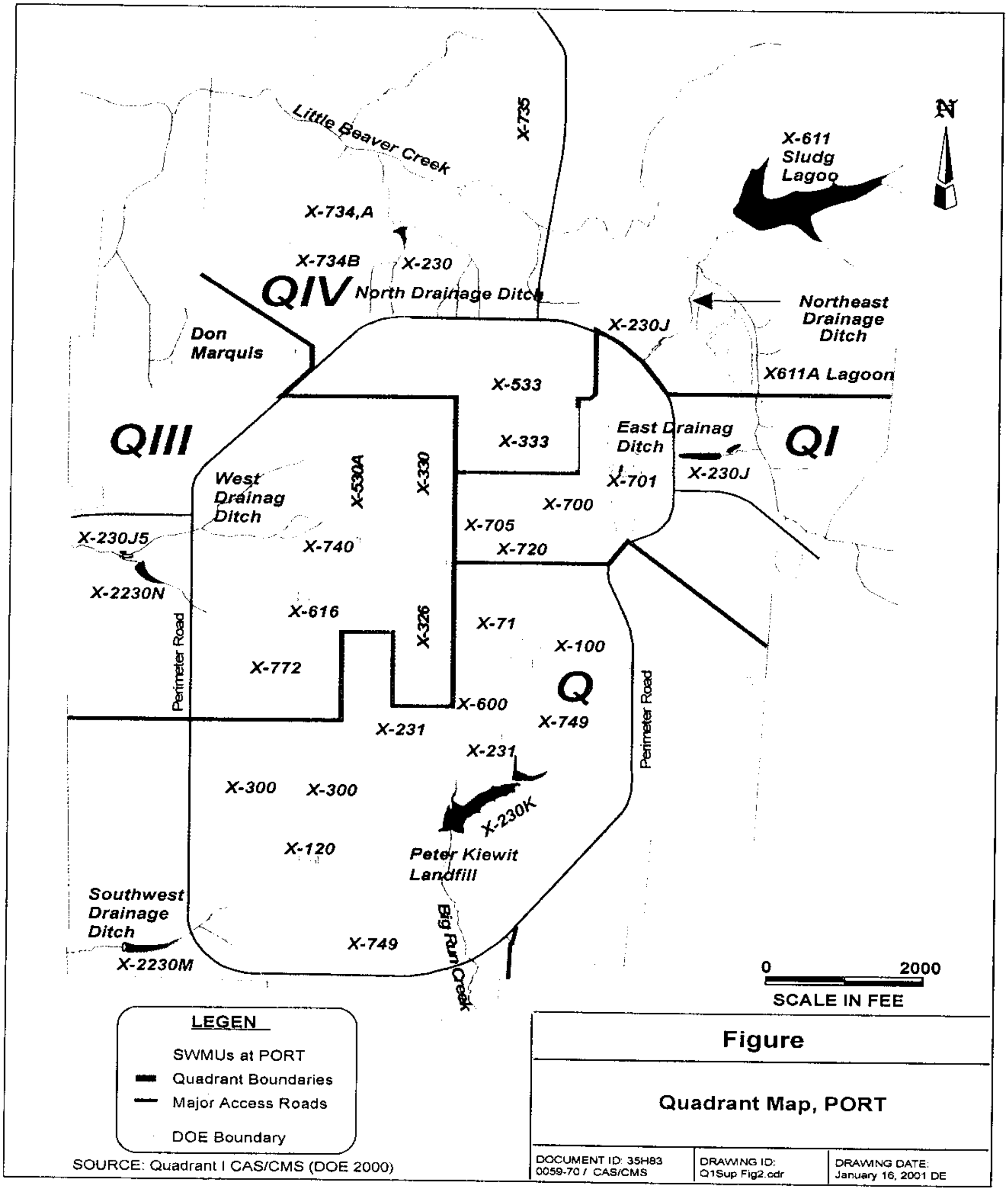
(Gallia). The bedrock formation underlying the Teays formation are, in descending order, the Sunbury shale, the Berea sandstone, and the Bedford shale.

For purposes of the RFI, the PORTS facility has been separated into quadrants (Figure 2). Each quadrant roughly corresponds to the uppermost groundwater flow paths beneath the site. The PORTS groundwater systems includes two water-bearing units, the Berea Sandstone bedrock and the unconsolodiated Gallia, and two aquitards, the Sunbury Shale (Sunbury) and the unconsolidated Minford. Although the Minford silt does not transmit groundwater as readily as the Gallia, the basal silt portion of the Minford is generally grouped with the Gallia as part of the uppermost water-bearing unit at the PORTS site.

Creeks and holding ponds are the most important surface water features at the PORTS plant site. The PORTS site is drained by Little Beaver Creek, Big Run Creek, the West Drainage Ditch, and the unnamed Southwest Drainage Ditch. Sources of water for the surface water flow system include precipitation run-off, groundwater discharge and effluent from plant processes. All surface water from the plant site eventually drains into the Scioto River which flows north to south approximately 1 mile west of the plant. The Scioto River is approximately 120 ft lower in elevation than the PORTS site.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The principal process at PORTS is the separation of uranium isotopes through gaseous diffusion. PORTS has been operating since 1954, enriching uranium for use in commercial reactors and in US Navy power reactors. Production of enriched uranium for the US Navy ceased in 1991. PORTS and all its production facilities are owned by US DOE and have been leased by the United States Enrichment Corporation (USEC) since 1993. The enrichment operation became private in July 1998. Other portions of PORTS are leased to the Ohio Army National Guard. US DOE remains the property owner.


Little Beaver Creek
X-735
X-611
Sludg
Lagoo
N
X-734,A
X-734B
X-230
QIV
North Drainage Ditch
Northeast
Drainage
Ditch
X-230J
Don
Marquis
X611A Lagoon
X-533
QIII
East Drainag
Ditch
QI
X-333
X-230J
West
Drainag
Ditch
X-530A
X-330
X-701
X-700
X-230J5
X-705
X-740
X-720
X-2230N
X-616
X-326
X-71
X-100
Perimeter Road
X-772
Q
X-600
X-749
X-231
X-231
X-300
X-300
X-230K
X-120
Peter Kiewit
Landfill
Southwest
Drainage
Ditch
Big Run Creek
X-749
X-2230M
0
2000
SCALE IN FEE
LEGEN
SWMUs at PORT
Quadrant Boundaries
Major Access Roads
DOE Boundary
SOURCE: Quadrant I CAS/CMS (DOE 2000)
Figure
Quadrant Map, PORT
DOCUMENT ID: 35H83
0059-70 / CAS/CMS
DRAWING ID:
Q1Sup Fig2.cdr
DRAWING DATE:
January 16, 2001 DE

Support operations for the production of enriched uranium include the feed and withdrawal of material from the primary process, decontamination of equipment removed from the primary process, water treatment for sanitary and cooling purposes, decontamination of equipment removed from the plant for maintenance or replacement, recovery of uranium from various waste materials, and treatment of sewage wastes and cooling water blowdown. The construction, operation, and maintenance of PORTS require the use of a wide range of commercially available chemicals. Continuous operation of PORTS since 1954 has resulted in the generation of inorganic, organic, and low-level radioactive wastes.

In 1989, US DOE and the State of Ohio entered into a Consent Decree that outlined the requirements for handling hazardous waste generated at the PORTS facility and for conducting investigation and corrective measures studies at the site. US EPA and US DOE entered into a similar agreement, the ACO, in September 1989. This agreement was negotiated between US EPA Region V and US DOE. The ACO requires that the PORTS facility conduct an RFI, a CMS, and develop a Corrective Measures Implementation (CMI) plan. A schedule is attached to each agreement outlining a submittal schedule to Ohio EPA and US EPA for documents pertaining to the investigation and corrective measures studies. A schedule for completion of remedial activities was approved by Ohio EPA on December 11, 1998.

The ACO and Consent Decree require corrective action based on the requirements of RCRA. In addition, the ACO states that CERCLA requirements must be incorporated into the corrective action process. In areas where the ACO and Consent Decree are not specific, regulations and guidance under RCRA statutes are used. In specific instances where RCRA provides no guidance, the provisions of CERCLA are used, as appropriate.

Ohio EPA and US EPA signed a three-party ACO in August 1997 which granted Ohio EPA the authority for oversight of the day-to-day activities at the PORTS facility. Under this agreement, US EPA must concur with all remedy selections.

3.0 HISTORY OF QUADRANT I REMEDIAL INVESTIGATION

For purposes of the RFI, PORTS was divided into quadrants. Each quadrant roughly corresponds to a distinct groundwater flow cell within the primary water-bearing unit beneath PORTS and has been investigated separately. Quadrant I occupies the southern portion of PORTS. The Quadrant I RFI was conducted in two phases. Phase I of the investigation was conducted from February to August 1991. Phase II was conducted from October to December 1993. The final version of the RFI report was submitted on January 2, 1997. The Quadrant I RFI report received final approval from Ohio EPA on September 5, 1997. The Quadrant I CAS/CMS report was approved on June 12, 2000.

4.0 RISK ASSESSMENT

The assessment of potential or current risks from wastes present in Quadrant I is based on guidance provided by the US EPA, in particular, the "Risk Assessment Guidance for Superfund" (RAGS) dated 1989 and "Guidelines for Exposure Assessment" dated 1992. These guidance documents are founded on well-established chemical risk assessment principles developed for the regulation of environmental contaminants.

The risk assessment for contaminated areas in Quadrant I consisted of a human health risk assessment and an ecological risk assessment. The ecological risk assessment was conducted separately. The initial risk assessment conducted for Quadrant I assumed that no future cleanup action would be taken and is referred to as the BRA. The methodology used to conduct each step of the risk assessment, starting from the BRA, is discussed below.

4.1 Identification of Chemicals of Potential Concerns

After data collected during the RFI were evaluated, chemicals detected during laboratory analysis were retained as chemicals of potential concerns (COPCs). Some data not appropriate for certain exposure pathways were excluded. For example, soil data for samples collected from greater than 10 feet below ground surface (bgs) are not expected to apply to the threat of possible ingestion of contaminated soil by children or adults but are expected to pose a threat to groundwater. Therefore, these data were not included in the assessment of soil ingestion risks.

4.2 Exposure Assessment

This step involves the evaluation of potential human exposure to site chemicals. There are basically four separate tasks necessary in the exposure assessment. These steps are: (a) The characterization of the exposure setting; (b) identification of exposure pathways; (c) estimation of environmental concentrations; and (d) estimation of human intake.

4.2.1 Characterization of the Exposure Setting

The exposure setting was characterized by modeling or simulating exposure scenarios considered possible in Quadrant I under both current and future land use scenarios.

4.2.1.1 Current Use Scenarios

- on-site worker
- off-site resident
- off-site recreational population
- on-site resident*

* (This scenario was no longer considered viable after the completion of the RFI report. Stakeholders and regulators determined it is likely that the area within the security fence at Quadrant I will remain industrial and that other areas within the reservation will be used for commercial or recreational purposes. Areas at the reservation boundary will still be evaluated as residential.)

The on-site worker scenario describes potential exposures to outdoor media at PORTS of a worker engaged in normal day-to-day activities throughout Quadrant I. The future worker scenario describes potential exposures to outdoor media at PORTS and includes the ingestion of groundwater. The off-site recreational population scenario assesses potential exposure to surface water bodies on the PORTS reservation and to fish and game eaten by local recreational anglers and hunters. To estimate exposure for both current off-site resident and recreational populations, significant direct access to media within the quadrant was considered unlikely. Exposures were assumed to result from contaminants that could potentially migrate off-site.

4.2.1.2 Future Use Scenarios

- on-site commercial use (evaluated after approval of the RFI and BRA)
- on-site recreational population
- on-site industrial worker
- off-site resident
- off-site recreational population

Future use scenarios were developed consistent with reasonable maximum exposure. The area within the security fence at Quadrant I is expected to remain industrial in the future. Areas outside the security fence within the reservation were evaluated under a future recreational and commercial use scenario.

In addition to the on-site worker involved in normal day-to-day activities, another exposure scenario modeled under both current and future use conditions involves the on-site industrial worker. This worker is assumed to be in contact with contaminated media during periodic intrusive activities such as construction or landscaping. The future industrial worker scenario describes potential exposures to outdoor media at PORTS and includes ingestion of groundwater.

4.2.2 Identification of Human Exposure Pathways

The exposure scenarios discussed above were developed to model or simulate possible exposure situations at Quadrant I. It was necessary to determine the most likely exposure pathways as well. An example of an exposure pathway is the ingestion of contaminated groundwater by future on-site industrial workers. The following exposure pathways were evaluated for both the current and future on-site industrial worker as well as for the off-site recreational population:

- Exposure to groundwater through ingestion of drinking water and dermal contact and inhalation of volatiles during showering (for future on-site industrial worker only);
- Exposure to soil through incidental ingestion and dermal contact and through external gamma radiation from radionuclides present in soil;
- Exposure to sediment through incidental ingestion and dermal contact;
- Exposure to surface water through incidental ingestion and dermal contact;
- Exposure to air through inhalation of vapors and particulates;
- Exposure through ingestion of local game contaminated by grazing on land affected by Quadrant I operations;
- Exposure through ingestion of fish affected by Quadrant I operations.

4.2.3 Estimation of Environmental Concentrations

Concentrations of chemicals and radionuclides in various environmental media from which exposure may occur were estimated through the evaluation of sampling results and mathematical modeling. The Quadrant I RFI report provides detailed discussion of this estimation.

4.2.4 Estimation of Human Intake

Estimation of human intake involves calculating the amount of each chemical and radionuclide an individual is exposed to through the various environmental media. Chemical intakes (referred to as chronic daily intakes [CDI]) are typically expressed in terms of the amount of material in contact with the body for a certain time period and are calculated as functions of (1) chemical concentration in soil or water, (2) how often the exposure occurs and for how long (exposure frequency), (3) body weight, and (4) the portion of a lifetime that exposure occurs. The generic equation for calculating a CDI (along with example units of measure) is as follows:

$$CDI = \frac{C \times CR \times EF \times ED}{BW \times AT}$$

where

CDI = Chronic daily intake (milligram per kilogram per day [mg/kg/day])

C = Chemical concentration in soil or water, e.g. mg/kg soil

CR = Contact rate, e.g. (kg soil/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time; portion of lifetime over which exposure is averaged (days).

Variations of this equation are used to calculate air inhalation and radiological exposures.

4.3 Toxicological Assessment

The toxicological assessment involves identifying adverse health effects associated with exposure to a chemical or radionuclide and the relationship between the extent of exposure and the likelihood and/or severity of adverse effects. The US EPA has conducted such assessments of many frequently occurring environmental chemicals and radionuclides and has developed toxicity values based on these assessments for use in risk assessments. Further information regarding the toxicological assessment is presented in the Quadrant I RFI report.

4.4 Risk Characterization

Risk characterization involves calculating estimates of carcinogenic (cancer causing) and non-carcinogenic risks from chemicals of concern for different exposure pathways. CERCLA requires keeping cumulative residual excess cancer risks (ELCR) within the one in 1×10^{-4} to 1×10^{-6} range for all chemical carcinogenic contaminants (with 1×10^{-6} as the "point of departure") and hazard indicies (HI) of 1 or less for non-carcinogenic contaminants. Cancer risk is defined as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen <u>in addition</u> to the probability of cancer risks from all other causes. As a benchmark in developing cleanup goals at contaminated sites, an acceptable range of ELCR has been established of one in one million (1×10^{-6}) to one in ten thousand (1×10^{-4}). The point of departure or program goal for risk remaining after a site is cleaned up is 1×10^{-6} (that is, a one in one million excess lifetime cancer risk above and beyond risks from other unrelated causes). This is the risk goal for Quadrant I.

The "Hazard Quotient" (HQ) is used to determine the severity of non-carcinogenic hazards posed by a site. The HQ is determined by dividing the Chronic Dose Intake (CDI) by the reference dose (RfD). The reference dose is the amount of a chemical determined to cause a toxic effect. If the HQ is less than or equal to 1, the estimated exposure to a substance represented by the CDI is judged to be below the threshold that could result in a toxic effect. An HQ greater than one indicates that a toxic effect may result. To assess the cumulative effect of similar non-carcinogenic substances, the HQ for all substances being assessed at a site are added, and this result is the HI.

4.5 Conclusions

The risks estimated for substances evaluated at SWMUs and in Quadrant I are compared to preliminary remediation goals (PRGs), and general conclusions are made regarding potential risks associated with these substances. In general, if the risks are unacceptable, remedial alternatives are developed to prevent potential exposure of human and ecological receptors.

US DOE will adhere to RCRA and CERCLA guidance and has also agreed that the initial goal for each alternative in the CAS/CMS report is to achieve PRGs when practicable. The agreed-upon remedy may vary from the achievement of PRGs based on evaluation of ALARA and Best Available Technology (BAT) principles.

To select the remedial alternatives for Quadrant I, Ohio EPA considered ALARA principles. US DOE used BAT principles to develop alternatives for presentation in the CAS/CMS report. Under BAT principles, it may not have been feasible to achieve the initial risk goal of 1×10^{-6} throughout the area of contamination. Under the ALARA process, incremental levels of risk reduction resulting from implementation of a given remedial technology are evaluated as a function of project requirements. It may then be necessary to consider a cleanup target that equates to a higher risk level but is still within the 1×10^{-4} to 1×10^{-6} range. The use of ALARA principles provides a justification for lower cleanup levels if these levels can be achieved without appreciably more effort, expense, or social impact. Engineering or institutional controls can be implemented to offset additional incremental risk. In addition, review of the selected remedy performance will occur every five years after initial implementation to ensure that the selected remedy continues to be technically adequate and that new demonstrated technologies are evaluated for their potential to further reduce risks.

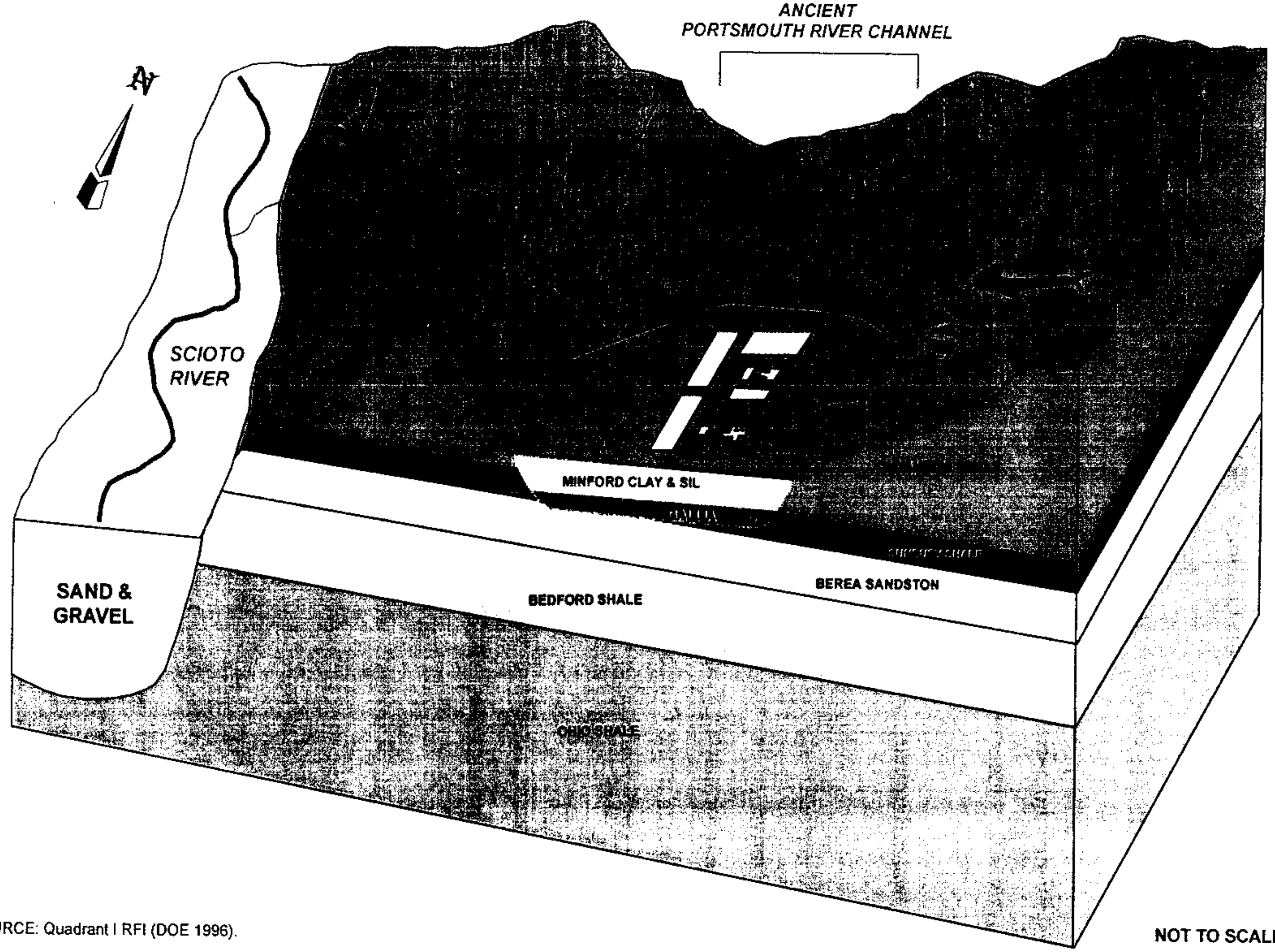
5.0 GEOLOGY/HYDROGEOLOGY

GEOLOGY

The geology (or site soil and bedrock) at PORTS has been characterized through the drilling of over 1,200 borings throughout the facility. The uppermost geologic layer (called the "unconsolidated material") consists of Minford member of the Teays Formation composed of silt and clay and Gallia member of the Teays Formation composed of sand and gravel. Where undisturbed, the Minford consists of an upper clay layer that grades into a silt layer. Generally, the upper clay layer comprises two-thirds of the Minford and consists of strong stiff clay. The silt portion of the Minford is more permeable but still contains a relatively high percentage of finer clay material. The Gallia is composed of poorly sorted sand and gravel with silt and clay. Below the Gallia sand and gravel is the Sunbury Shale and then the Berea Sandstone. The Sunbury Shale generally thins from east to west across PORTS and is generally absent on PORTS's western side (Figure 3). A more detailed description of the PORTS geology is provided in Section 2.0 of the Quadrant I RFI report.

HYDROGEOLOGY

The groundwater flow system at PORTS includes two aquifers: the bedrock Berea Sandstone and the unconsolidated Gallia sand and gravel. PORTS also has two aquitards: the Sunbury Shale and the unconsolidated Minford clay and silt. The basal silt portion of the Minford is generally



SOURCE: Quadrant I RFI (DOE 1996).

Figure 3	Schematic Block Diagram Showing Geology at PORTS	DOCUMENT ID: 35H830 0059-70 / CAS/CMS	DRAWING ID Q1Sup Fig3.cd	DRAWING DATE: January 12, 2001 DE

grouped with the Gallia as the uppermost primary aquifer at PORTS. The hydraulic properties of these units were well defined during the RFI. Groundwater flow maps for the Gallia and Berea are provided in Appendix A of the Quadrant I RFI report.

6.0 SUMMARY OF RISK MANAGEMENT DECISIONS

Discussed below are summaries of risk management decisions which were used to determine the clean-up objectives for Quadrant I.

6.1 Groundwater Summary

Groundwater and surface water monitoring at PORTS began in the 1980s. Since that time, numerous investigative studies and routine monitoring programs have provided much geologic and hydrogeologic information. Groundwater monitoring has been conducted in response to regulatory requirements of the Consent Decree, closure documents, the ACO between US DOE and Ohio EPA, and US DOE Orders.

Elevated levels of arsenic, beryllium, and other metals were detected in the groundwater during the Quadrant I RFI. Groundwater samples were collected during the RFI using a bailer that allowed collection of highly turbid samples. These samples were not filtered to remove sediments prior to laboratory analysis. Risk was determined based on the results of these highly turbid samples. US DOE completed additional sampling of groundwater using low-flow pumps from wells located in areas that have historically had high metals concentrations in groundwater. Based on the results, metals previously detected in groundwater appear to be the result of turbidity from previous sampling techniques. Numerous results indicate that the metals detected in groundwater samples using the low-flow technique were below Maximum Contaminant Levels (MCLs) and in some cases were below the analytical method detection limits. Therefore, risks calculated for exposure to metals in groundwater in the BRA for the RFI may be overestimated.

The IGWMP is designed to minimize the potential for conflicts in requirements and to maximize resources for collecting data needed for sound decision-making. Keeping the intent of the regulatory directives and objectives of various monitoring programs in mind, the IGWMP is designed to establish all groundwater monitoring requirements for PORTS. The requirements established for continued groundwater monitoring for the selected remedial alternatives will be incorporated into the IGWMP and will be revised as deemed necessary by Ohio EPA. Areas where elevated levels of inorganics are still detected, using the low-flow pumps, will continue to be monitored under the IGWMP. If necessary, a remedy will be installed to remediate inorganics in areas of concern.

6.2 Summary of the PAH Position Paper

PAHs, a common contaminant at PORTS, are introduced into the environment by both natural and anthropogenic combustion processes. PAHs are semivolatile organic compounds (SVOC) that consist of two or more fused aromatic rings and include chemicals such as anthracene, benzo(a)pyrene, fluoranthene, and naphthalene. PAHs are formed when hydrocarbons undergo incomplete combustion, such as when hydrogen is consumed in preference to carbon.

The purpose of the PAH position paper was to evaluate and demonstrate that the PAH contamination at PORTS was similar in concentration to areas outside of PORTS and therefore not related to site processes but rather resulting from the infrastructure of the Reservation (such as asphalt roofs, roadways, and automobile exhaust). The PAH position paper was approved by Ohio EPA on May 8, 1997. Risk goals were developed based on the most current PAH information available. The concentrations of PAH contamination were evaluated in unregulated areas (such as along roadways and community parks) as well as residential areas.

The report concluded that many of the elevated detections of PAHs appeared to result from sources such as tar-covered gravel lots, asphalt roads and parking lots, vehicle exhaust and possibly air emissions, and runoff from the coal-fired steam plant. The paper also concluded that areas containing PAHs at concentrations similar to PAH concentrations in nonregulated or residential areas should not be remediated at this time. Such an effort would not be cost-effective because these areas would likely become recontaminated. Areas such as drainage ditches, streams, and creeks will be deferred to D&D. The risk from PAHs will be evaluated at that time, and the proper remedial action will be taken.

6.3 Summary of the PCB Position Paper

The purpose of the PCB position paper, which was approved on September 11, 1997, was to evaluate the levels and extent of PCB contamination at Quadrant I and develop a risk goal protective of human health and the environment. At PORTS, PCBs have been used as cooling fluids in electrical transformers and capacitors; for heat transfer and hydraulic fluids; as dye carriers in carbonless copy paper; in paints, adhesives, and caulking compounds; and as sealants and road coverings to control dust. RFI and baseline ecological risk assessment sampling activities indicated that at least one PCB compound was detected at 98 of the 1,007 locations where soil was sampled at Quadrant I. PCB detections in soil appear to be distributed widely across PORTS. Of the 148 sediment samples analyzed for PCBs during the RFI and the baseline ecological risk assessment, 28 contained at least one PCB compound.

The PCB remedial goal for PORTS was based on the most probable future land use, which has been determined as industrial for Quadrant I within the perimeter road. In order to be consistent with risk goals, the cleanup goal for Quadrant I within the perimeter road is 25 parts per million (ppm). The 25-ppm goal for Quadrant I is consistent for an industrial site as cited in the Toxic Substances Control Act (TSCA) and CERCLA guidance as well as in the Federal Register, Proposed Rule, December 1996. Soil at the X-749B Peter Kiewit Landfill at Quadrant I is the only location where PCB concentrations exceed 25 ppm. This soil has been addressed as part of the remedial activity at the landfill.

7.0 SWMUs REQUIRING NO FURTHER CORRECTIVE ACTION

The SWMUs in this category were determined to require no further corrective action by the PORTS Decision Team, which consists of US EPA Region V, Ohio EPA, and US DOE personnel. Table 1 briefly summarizes risk for each SWMU. The location of each SWMU is shown on Figure 4.

7.1 X-120 Old Training Facility Site (soil only)

The X-120 Old Training Facility Site is located in the southern portion of Quadrant I. The former training facility, which included the Goodyear Training Center, two warehouses, a machine shop, a metal shop, and a paint shop, was located west of the X-749 Contaminated Materials Disposal Facility. The SWMU was used for training PORTS employees during the construction of the PORTS facility in the 1950s. All structures associated with the SWMU were demolished and removed in the 1970s during construction activities of an alternative method of uranium enrichment.

7.2 X-710 Technical Services Building and Neutralization Pit (soil only)

The technical services building of this SWMU is located in the north-central portion of Quadrant I. The building was constructed in 1955 and contains laboratories and facilities that provide technical support and development activities for PORTS. A 5,000-gallon neutralization pit measuring approximately 9 by 15 feet and 8 feet deep is located just outside and west of the X-710 building. The neutralization pit, which is constructed of concrete and lined with acid-proof brick, was used to treat facility effluent (including organic solvents) with lime before discharge to the sanitary sewer system.

Table 1
Summary of RFI Risk Determination

	Soil						Groundwater				Combined Soil and Groundwater			
	Current On-Site Worker		Future On-Site Worker		Excavation Worker		On-Site Worker				Current On-Site Worker		Future On-Site Worker	
SWMU	HI	ELCR	HI	ELCR	HI	ELCR	Current HI	Current ELCR	Future HI	Future ELCR	HI	ELCR	HI	ELCR
No Further Corrective Action														
GCEP	NA	NA	NA	NA										
X-103	<1	NA	<1	NA	<1	NA								
X-104A	<1	NA	<1	NA	<1	$<1 \times 10^{-6}$								
X-750	Not evaluated in RFI.													
X-751	No risk associated with this unit.													
X-749	Closed Unit													
X-749A	Closed Unit													
X-749B	Closed Unit													
[ab]X-120 (soils only-NFA)					1 Sb and As	3×10^{-6} As					<1	$<1 \times 10^{-6}$	30 Sb,Cr, As, Tl, and V in GW	5×10^{-3} As, Be, and VOCs in GW; As in soil
[ab]X-710 (soils only - NFA)					<1	2×10^{-6} TCE					NA	NA	20 Sb, As, Cr, Th and V in GW	3×10^{-3} benzene, As, Be and chlorinated hydrocarbons in GW
X-741	<1	$<1 \times 10^{-6}$	<1	$<1 \times 10^{-6}$	<1	3×10^{-6} alpha BHC								
[ab]X-747F					<1	2×10^{-6} As					<1	$<1 \times 10^{-6}$	4 As in GW	3×10^{-4} As and Be in GW; As in soil

Table 1
Summary of RFI Risk Determination (Continued)

	Soil						Groundwater				Combined Soil and Groundwater			
	Current On-Site Worker		Future On-Site Worker		Excavation Worker		On-Site Worker				Current On-Site Worker		Future On-Site Worker	
SWMU	HI	ELCR	HI	ELCR	HI	ELCR	Current HI	Current ELCR	Future HI	Future ELCR	HI	ELCR	HI	ELCR
[a]X-760					<1	$<1 \times 10^{-6}$					<1	$<1 \times 10^{-6}$	20 Sb, As,Cr, Tl,and V in GW	3×10^{-3} chlorinated hydrocarbons benzene, As, Be in GW
Deferred to D&D														
[ab]X-230K					<1	$<1 \times 10^{-6}$					<1	$<1 \times 10^{-6}$	20 Sb,As, Cr,Tl, and V in GW	3×10^{-3} chlorinated hydrocarbons benzene, As, Be in GW; Be in soil
[ab]X-600, X-600A, X-621					<1	2×10^{-6} As					NA	NA	20 Sb,As, Cr,Tl, and V in GW	3×10^{-3} chlorinated hydrocarbons benzene, As, Be in GW; As in soil
[ab]X-626					<1	2×10^{-5} Be and Cr					<1	$<1 \times 10^{-6}$	<1	4×10^{-4} Chloroform, 1,1-DCE, TCE in GW; Be in soil
Big Run Creek	<1	$<1 \times 10^{-6}$	<1	$<1 \times 10^{-6}$	<1	$<1 \times 10^{-6}$								
X-2230M	NA	NA	<1	9×10^{-6} As	<1	2×10^{-6} As								

Table 1
Summary of RFI Risk Determination (Continued)

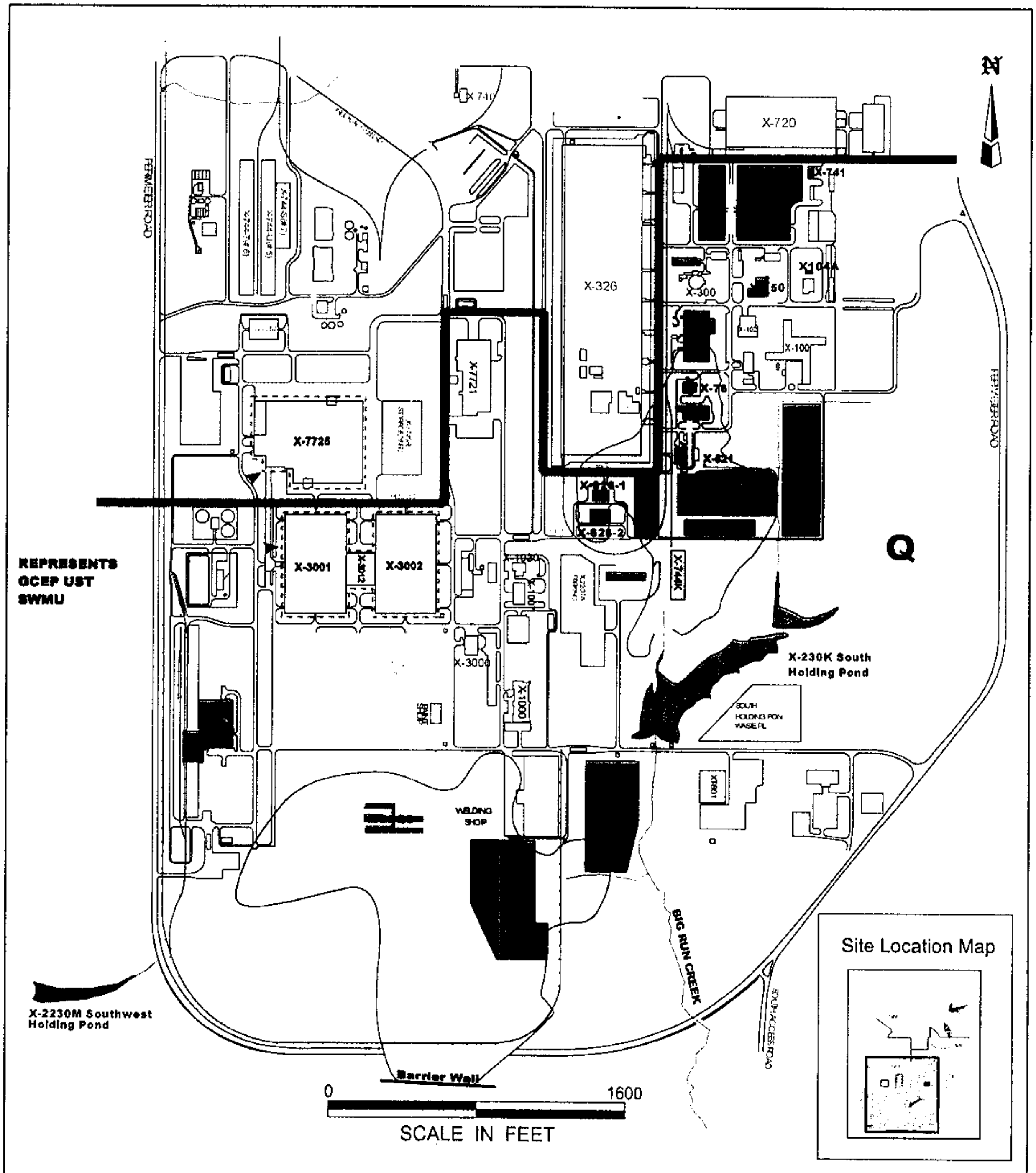
	Soil						Groundwater				Combined Soil and Groundwater			
	Current On-Site Worker		Future On-Site Worker		Excavation Worker		On-Site Worker				Current On-Site Worker		Future On-Site Worker	
SWMU	HI	ELCR	HI	ELCR	HI	ELCR	Current HI	Current ELCR	Future HI	Future ELCR	HI	ELCR	HI	ELCR
Alternatives Developed														
5-Unit Groundwater Investigative Area							<1	$<1 \times 10^{-6}$	20 Sb,As, Cr, Tl, and V	3×10^{-3} chlorinated hydrocarbons benzene, As, Be, chloroform, TCE and 1,1-dichloroethene				
X-231B	Not evaluated in RFI. Soil contamination will be remediated to eliminate source.													
X-231A					<1	3×10^{-5} gamma-chlordane and U					<1	2×10^{-5} PCBs, Be, Tc and U in soil	20 Sb, As, Cr, Tl, V in GW	3×10^{-3} chlorinated hydrocarbons benzene, As and Be in GW; PCBs, Be, Tc and U in soil
X-749/X-120 Area Groundwater							<1	$<1 \times 10^{-6}$	30 Sb, As, Cr, Tl, and V	5×10^{-3} As, Be, and VOCs				

Table 1
Summary of RFI Risk Determination (Continued)

Notes:

[a]Elevated levels of arsenic, beryllium, and other metals were detected in groundwater during the Quadrant I RFI. Groundwater samples were collected during the RFI using a bailer that allowed collection of highly turbid samples. These samples were not filtered to remove sediment prior to laboratory analysis. Risk was determined based on the results of these highly turbid samples. US DOE completed additional sampling of groundwater using low-flow pumps in wells located in areas that historically had high metals concentrations in groundwater. Based on the low-flow pump results, metals previously detected in groundwater appear to be the result of turbidity from previous sampling techniques. Numerous results indicate that the metals detected in groundwater samples using the low-flow technique were below MCLs and in some cases were below the analytical method detection limits. Therefore, risks calculated for exposure to metals in groundwater in the BRA for the RFI may be overestimated.

[b]In some instances for the SWMUs listed above, the total risk level may have fallen outside the acceptable risk range for current on-site workers based on BRA and RFI report data. US DOE has implemented administrative controls to ensure that workers do not excavate soil or come into contact with sediment or surface water without proper environmental and health and safety controls. Such controls include wearing of proper protective clothing prior to working in areas of concern and notification of US DOE personnel prior to soil excavation. US DOE has installed fencing in some areas to control entry of current on-site workers. Ohio EPA will continue to monitor these areas to ensure that workers are not exposed to potential contaminants in soil, sediment and surface water.



Legend

- SWMUs Requiring Alternatives Developed in the CAS/CMS and the Q1 Groundwater Investigative Area
- Quadrant I Boundary
- SWMUs Requiring No Further Corrective Action
- SWMUs Deferred to Decontamination and Decommissioning
- Creeks, Streams and Ponds

Figure 4

Disposition of SWMUs Investigated for Quadrant I

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Located on the west side of the technical services building directly north of the neutralization pit is the X-710 radioactive wastewater tank (also known as the "hot pit"). The tank is a buried steel, 500-gallon, radioactive wastewater storage tank installed in 1954 to collect effluent from the originally planned high-level radiological laboratory in the X-710 technical services building; however, this laboratory was never fully operational. The contents of the tank were removed in the mid-1980s, when the tank was taken out of service.

In 1989, approximately 500 gallons of 50/50 ethylene glycol-water antifreeze was discharged to a technical services building floor drain that discharged to Storm Sewer G. In addition, a recirculating water spill of 2,000 gallons was released into Storm Sewer G.

7.3 X-741 Oil Drum Storage Facility

The X-741 Oil Drum Storage Facility is located in the northern portion of Quadrant I. The SWMU has been in operation since 1954 and consists of an elevated concrete slab with a storage area of approximately 3,600 ft^2. The sides are open, and steel columns support a corrugated transit roof. Drums of waste oil are temporarily stored at this unit before their final disposal.

7.4 X-747F Miscellaneous Material Storage Yard

The X-747F Miscellaneous Material Storage Yard is located in the northern portion of Quadrant I. The storage yard measures 800 by 500 feet and consists of an open grassy area just south of the X-720 building. The yard is divided into two portions by Mahoning Avenue. This unit was used to burn refuse and as a material and equipment storage area. The period of operation of this SWMU is unknown.

7.5 X-760 Pilot Investigation Building and Neutralization Pit (soil only)

The X-760 Pilot Investigation Building is located in the central portion of Quadrant I. The building has been used for chemical and mechanical engineering pilot- and demonstration-scale investigations since 1955. Pilot and demonstration area sinks and floor drains discharge to a 2,000-gallon capacity underground neutralization pit north of the building. The neutralization pit is approximately 10 feet long, 8 feet wide, and 5 feet deep. Outfall from the pit discharges to the X-6619 Sewage Treatment Facility.

7.6 X-103 Auxiliary Office Building

The X-103 Auxiliary Office Building has been used since 1954 to house administrative offices. On March 24, 1982, an aboveground gasoline tank on the east side of the SWMU overflowed from overheating in the sun. An unknown quantity of gasoline spilled onto the asphalt and soil; the on-site fire department flushed the spill area into Storm Sewer F, which discharges to the X-230K South Holding Pond. No benzene, toluene, ethylbenzene, or xylene (BTEX) compounds were detected in soil samples collected during Phase I RFI at this SWMU.

7.7 X-104A Indoor Firing Range

The X-104A Indoor Firing Range is a building approximately 50 feet long and 20 feet wide located north of the X-100 building. The indoor firing range has been used since May 1954 as a practice range by the PORTS guards and police force. The building is equipped with exhaust fans that draw fumes and smoke associated with weapons-firing through a high-efficiency particulate air filter before discharging exhaust toward the ground directly east of the indoor firing range. In 1990, an improper filter was found to have been installed in the exhaust system. The use of this filter may have allowed particulates, especially lead, to discharge from the building to nearby soil. Samples collected near the area where the firing range vent exhausted contained lead above background levels, but the HI was less than 1.

7.8 X-751 Mobile Equipment Garage

The X-751 Mobile Equipment Garage measures approximately 350 feet by 60 feet. The unit was used for vehicle maintenance. The unit also had four fiberglass underground storage tanks (UST) installed in 1979. The UST capacities and contents are as follows:

- Two 15,000-gallon gasoline USTs located near the southeast corner of X-751; tanks operated from 1979 to 1991.

- One 15,000-gallon diesel UST located near the southeast corner of X-751; tank operated from 1979 to 1991.

- One 1,000-gallon waste-oil UST located on the west side of X-751; tank operated from 1985 to 1991.

An investigation was conducted at this unit in March 1991 to determine the possibility of environmental impact from the four USTs. SVOCs were detected above and below laboratory detection limits in wastewater samples. No volatile organic compounds (VOC) were detected in wastewater samples. No middle hydrocarbon distillates, gasoline, BTEX, or total petroleum hydrocarbons (TPH) were detected in soil samples. These tanks were filled with concrete and abandoned in place in 1996 per approval of the Ohio Bureau of Underground Storage Tank Regulations.

7.9 X-750 Mobile Equipment Maintenance Shop, Fuel Station, and Waste Oil Tank

This unit covers approximately 15,600 ft^2, most of which (8,400 ft^2) is used as a general repair area. The building houses a grease pit, wash area, tire and battery shop, spare parts storage, offices, and equipment.

Four USTs associated with the SWMU are as follows:

- One steel 500-gallon UST used to store waste oil from various mobile equipment; tank removed under RCRA closure; clean closure certification approved on January 1, 1995.

- One fiberglass 10,000-gallon UST designated as an alcohol storage tank but used instead for gasoline storage; tank has been removed.

- Two steel 18,000-gallon USTs used for gasoline and diesel fuel storage; tanks have been removed and replaced with two 20,000-gallon fiberglass tanks.

Investigations were conducted during tank removal actions under both the RCRA and the UST programs. As a result, these tanks were not investigated during the RFI.

During the RFI, SVOCs, VOCs, and gasoline were not detected in soil samples collected from the SWMU; therefore, it was concluded that no release to soil occurred from this unit.

7.10 X-749A Classified Materials Burial Ground

The X-749A Classified Materials Burial Ground has a total area of approximately 5.9 acres. This unit was used from 1955 until 1993 to bury classified nonhazardous materials in wooden boxes and steel or fiber drums deposited into 14-foot-deep trenches that were backfilled to the ground surface. Prior to backfilling, each burial site was mapped.

Wastes buried in this unit include metallic process scrap, floor sweepings from the X-700 Chemical Cleaning Facility and X-705 Decontamination Building, computer media, centrifuge scrap, aluminum dross (slag), ashes from classified document destruction, and miscellaneous scrap of a classified nature. In October 1979, part of a nickel processing plant that contained traces of nickel carbonyl was buried at this unit. The unit was capped in accordance with Ohio Solid Waste Regulations in 1994. The cap will continue to be maintained in accordance with the requirements of the approved closure plan. Groundwater monitoring wells at this unit continue to be monitored in accordance with the requirements of the March 1999 DFF&Os for integration and the monitoring data will be reported in the IGWMP.

7.11 GCEP USTs

The GCEP is located in the western portion of PORTS straddling the boundary between Quadrants I and III. The GCEP was intended to replace the diffusion process for separating U^{238} and U^{235} but was abandoned before being put to use. The GCEP has 27 USTs for liquid effluent installed from 1980 to 1983. These tanks were originally designed to contain floor drain effluent in case of spills and wash water. The buildings are currently used for office and warehouse space, and all effluent collected in these tanks is believed to be wash water. All of the tanks have capacities of less than 500 gallons each and are buried with their vents to the surface. All are also believed to be constructed of fiberglass or fiberglass-reinforced plastic. There is no evidence that these tanks are leaking.

7.12 X-749 Contaminated Materials Disposal Facility (soil only)

This unit was used for the disposal of solid wastes and low-level radioactive contaminated wastes and equipment. In general, wastes disposed of at the unit were placed in trenches approximately 15 feet deep and covered with earthen material. The landfill is divided into two areas, a northern and a southern portion. The northern portion occupies approximately 7.5 acres and was used from 1955 to 1989 to dispose of equipment and materials contaminated with low-level radioactivity (uranium and technetium). It has also received chlorinated solvents, metal hydroxide sludges from the raffinate treatment process at X-705, and low-level radioactive waste oils. The southern portion occupies approximately four acres and was used from 1986 to 1989 to dispose of various types of low-level radioactive demolition debris and scrap materials, including asbestos. Other radionuclide-contaminated materials disposed of at this SWMU include alumina, sodium fluoride, and incinerator ash.

The RCRA and solid waste closures for both the northern and southern portions of the unit were initiated in 1989. Closure activities included installing slurry walls and groundwater collection trenches to act as groundwater contamination source controls (completed March 1991) and installing a multilayer landfill cap over the entire unit (completed December 1992). Contaminated groundwater captured by the collection trench system is pumped to and treated at the X-622 Groundwater Treatment Facility. The PORTS Decision Team determined that no further corrective action is required for the wastes and soil at this unit other than the requirements outlined in the approved closure plan for the maintenance of the cap. Groundwater at the unit will continue to be monitored in accordance with the requirements of the IGWMP.

7.13 X-749B Peter Kiewit Landfill

The X-749B Peter Kiewit Landfill has a total area of approximately 11 acres and was operated from approximately 1953 until 1968. During plant construction, the landfill was used by the plant construction contractor, X-749B Peter Kiewit and Sons, as a salvage yard, burn pit, and trash disposal area. After plant construction, the landfill was used as a sanitary landfill.

During the Quadrant I RFI, several intermittent seeps were discovered along the eastern side of the landfill. An interim remedial measure was initiated in March 1994 to relocate a portion of Big Run Creek, install a seep collection system, and initiate treatment of the collected seep water at X-622 (completed November 1994). Seep discharge contaminants associated with the X-749B Peter Kiewit Landfill appear to pose the greatest risk to human health and the environment of all media considered in the X-749B Peter Kiewit Landfill CAS/CMS Report. A Decision Document for the landfill outlining the selected corrective measure for the unit, a RCRA Subtitle D cap, was received July 1996 from the Ohio EPA. The RCRA cap will limit recharge into and through the landfill, thereby, minimizing the potential for contaminants to infiltrate to groundwater or leach to surface water.

During a site inspection in April 1997, seeps were discovered in a shallow drainage ditch that empties into Big Run Creek near the southern slope of the X-749B Peter Kiewit Landfill. Because the groundwater flow in the X-749B Peter Kiewit Landfill area has the potential to transport contaminants from the X-749/X-120 plume to seeps at the drainage ditch, several actions were taken to prevent contamination from entering surface water. These actions included capping the landfill to prevent infiltration of precipitation and collecting water from the seeps to prevent potential contaminated water from entering Big Run Creek. A stormwater discharge pipe was installed to replace the eroded tributary channel.

A slurry wall was installed as part of an Interim Remedial Measure along the PORTS property line to the south of the X-749/X-120 groundwater plume. The slurry wall, completed in September 1994, was installed to prevent contaminated groundwater from migrating off site.

In 1999 a multi-media cap was installed over the X-749B Peter Kiewit Landfill. The cap will continue to be maintained in accordance with the requirements of the operation and maintenance plan. Groundwater monitoring wells of this unit continue to be monitored in accordance with the requirements of the March 1999 DFF&Os for integration and monitoring data will be reported according to the IGWMP.

8.0 SWMUs DEFERRED TO D&D PROGRAM

The SWMUs described in this section were identified by the PORTS Decision Team as appropriate for deferral to D&D (Figure 4). Under current uses, these SWMUs were determined to have media-specific, total non-carcinogenic cancer risks with HIs generally less than 1 and ELCR levels generally within the acceptable range of 1×10^{-6} to 1×10^{-4} based on available data. The contaminants responsible for risk concerns are believed to be mostly immobile. Under current-use scenarios, on-site worker health and safety programs and routine monitoring are required to be protective of human health and the environment. Further, these SWMUs are located in or adjacent to PORTS operational areas and it was not possible in all instances to fully investigate each SWMU, therefore warranting deferral to D&D. Remediation of some of these SWMUs before PORTS D&D would likely disrupt ongoing production activities and may not be cost-effective because of a strong potential for the SWMUs to become recontaminated. For example, stormwater runoff from asphalt pavement and roof tops containing PAHs may recontaminate drainage ditch sediments.

Consistent with the Energy Act of 1992, US DOE executed an agreement with USEC in 1993 to lease all facilities at PORTS necessary for the successful operation of the uranium enrichment enterprise. The lease requires USEC to provide a two-year notice to US DOE before the facilities are to be returned to US DOE for D&D. The D&D of PORTS will require remediation in accordance with US DOE Orders (and all applicable state and federal requirements, including the Ohio Consent Decree) to prepare the site for future use. D&D actions at each SWMU will further reduce or eliminate any residual contaminants to acceptable future-use risk levels in accordance with ALARA principles. Ongoing worker health and safety programs, routine monitoring, and the required implementation of the D&D program will protect human health and the environment and provide an efficient approach to the final disposition of these SWMUs.

8.1 X-600 Coal-Fired Steam Plant

The X-600 Coal-Fired Steam Plant provides steam to heat buildings, vaporize Uranium Hexafluoride (UF_6), clean equipment, and for various other purposes. It has a floor area of approximately 19,900 ft^2. Coal for the unit comes from the adjacent X-600A Coal Pile Yard. Steam generation at the plant produces coal ash and dust ash wastes. Boiler water blowdown consisting of water, phosphates, sulfite, and other chemicals is also produced and discharged to the X-230K South Holding Pond through the storm sewer system. The by-products of watersoftener regeneration, which consist of calcium, magnesium, sodium sulfates, sulfuric acid, and calcium chloride, are also discharged to the X-230K South Holding Pond.

8.2 X-600A Coal Pile Yard

The X-600A Coal Pile Yard measures approximately 800 feet long and 400 feet wide and is located 300 feet southeast of the X-600 Coal-Fired Steam Plant. It has a capacity of 50,000 tons of coal but typically holds about 10,000 tons. Coal from the unit has been used at the X-600 plant since 1954. The coal storage area is bordered by a retention pond on the northern and eastern sides. The western and southern boundaries consist of an earthen dike that diverts runoff east to a retention pond. Precipitation falling on the stored coal results in a flow of approximately 20,000 cubic feet per year to the retention pond. The runoff transports contaminants, including coal dust, sulfuric acid, sulfides, iron, zinc, and copper to the retention pond. The retention pond also receives discharge from the ash-washing silo at the X-600 plant. The ash wastewater solution, which has a pH of approximately 4.0, is discharged to the pond at a rate of about 3,600 gallons per day (gpd). Effluent from the retention pond is subsequently treated at the X-621 Coal Pile Runoff Treatment Facility. Before the X-621 Coal Pile Runoff Treatment Facility was constructed in 1984, runoff was directed to the X-230K South Holding Pond.

8.3 X-626 Recirculating Cooling Water Pump House and Cooling Tower

This SWMU consists of the X-626 Recirculating Cooling Water Pump House (X-626-1), a cooling tower (X-626-2) with an associated 2.2-million-gallon holding tank, and a network of piping that carries recirculating cooling water to and from process buildings. The cooling water removes heat from compression from process gas, along with waste heat from a few auxiliary processes, and dissipates this energy to the atmosphere in the form of water vapor. This unit has been in operation since February 1955.

Heated water entering the cooling tower is exposed to cool atmospheric air. Heat is removed from the water by the air, which exits the top of the tower under a forced drift The cooled water collects in a basin below the tower. Drift consisting of small water droplets is incidentally released with heated air from the top of the towers. The amount of drift depends on weather conditions and operating conditions in the X-326 Process Building.

8.4 X-621 Coal Pile Runoff Treatment Facility

The X-621 Coal Pile Runoff Treatment Facility was constructed in 1984 and includes processes to adjust pH and remove iron, zinc, and copper from the X-600A Coal Pile Yard surface water runoff. The sludge is removed up to twice a year and subsequently landfilled off site. An aboveground storage tank at the treatment facility contains 25,000 gallons of sodium hydroxide. After treatment, the water is discharged to the X-230K South Holding Pond.

8.5 X-770 Mechanical Testing Facility (soil only)

The X-770 Mechanical Testing Facility is located near the center of the Five-Unit Groundwater Investigative Area (see Figure 5). This building was not originally designated to have had a history of releases to environmental media. This unit was not investigated as part of the RFI. Subsequent investigations have revealed that past operations at the facility may have contributed to soil and groundwater contamination. Groundwater contamination will be addressed as part of the SWMU remedial activities.

The X-770 building housed test facilities that evaluated the performance and reliability of equipment and components used in the gaseous diffusion process. The facility, a steel frame building with a gravel roof and corrugated asbestos siding, was built in 1955. It is 84 feet wide, 102 feet long, and 30 feet high and is located between the X-760 laboratory building and the X-600 Coal-Fired Steam Plant. The superstructure covers a control room and several enclosed

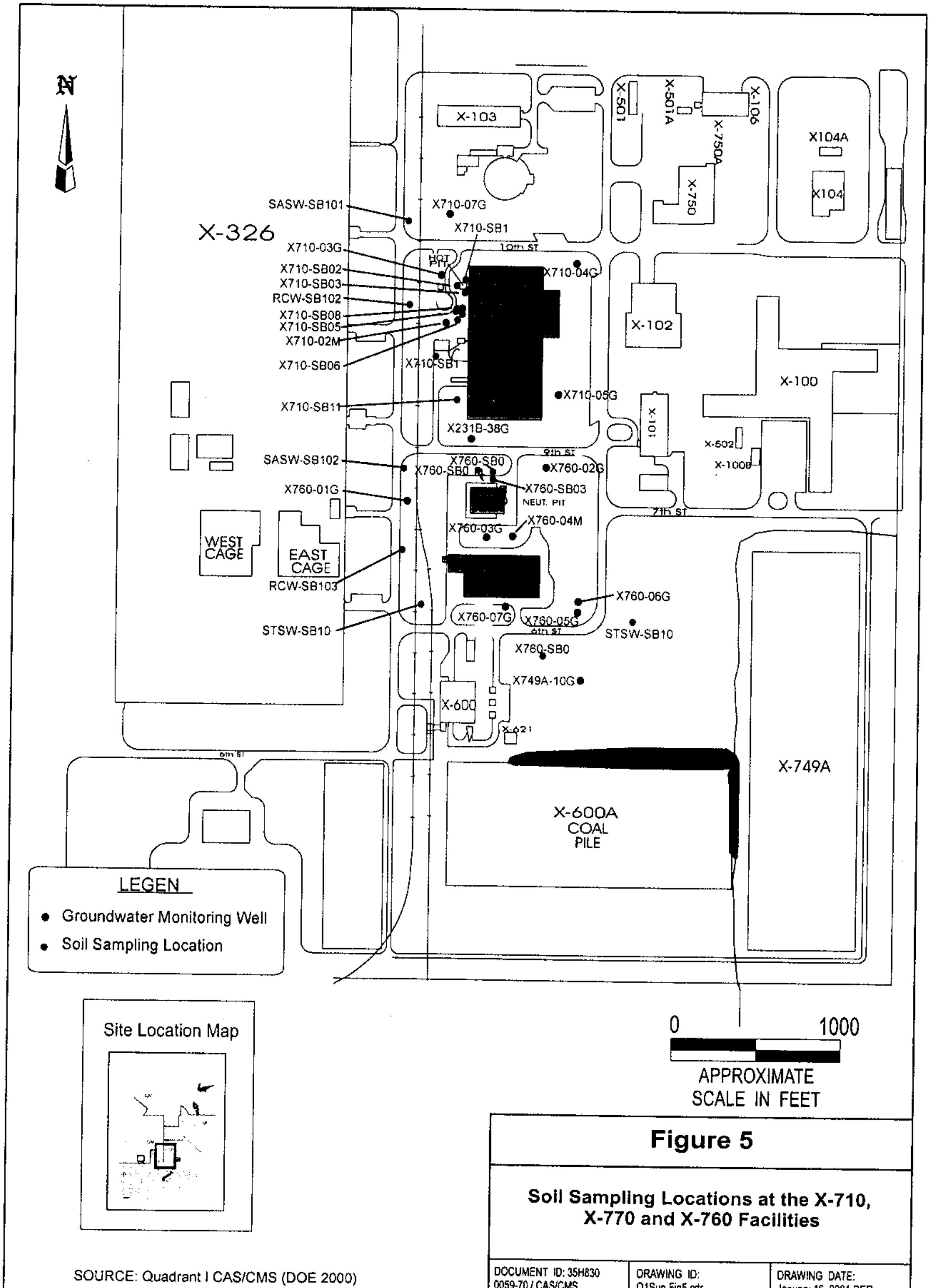

Figure 5

Soil Sampling Locations at the X-710, X-770 and X-760 Facilities

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test areas that were designed for evaluating equipment of various sizes by using UF_6 as the test gas. The actual components and arrangements used varied with each test. This facility contained many of the operations that would be found in a gaseous diffusion process building. These operations, as well as the frequent change-out of equipment at the facility, necessitated the use of industrial solvents in cold baths for UF_6 sampling purposes and as cleaning agents. Operations at the facility ceased in the mid-1980s.

Soil surrounding this unit may be re-investigated if the remedy selected for the Five-Unit Groundwater Investigative Area does not perform as expected. A review of the performance of the remedy for the Five-Unit area will take place within five years of implementation.

Potential contaminants associated with the X-770 building include TCE, uranium, and mercury. The primary release pathways for the facility are postulated to be spills to adjacent soil during handling operations in and around the building and discharges to the building's pits and drain systems. No releases have been documented, but because waste management practices were not rigorous during the years that the facility operated releases may have occurred.

Soil data reported for the X-770 facility are discussed in the Quadrant I RFI report under the X-760 Pilot Investigation Building summary. A single VOC detection was reported at one location north of the building (tetrachloroethene [PCE] at 5.8 micrograms per kilogram [μg/kg]). This concentration is less than the acceptable soil-leaching level of 270 μg/kg. All detections of radiological parameters reported for the unit were below background levels. Therefore, based on available data, no continuing sources of groundwater contamination from leaching from vadose soils are present at this SWMU. Groundwater data for the unit are evaluated as part of the Five-Unit Groundwater Investigative Area.

Three groundwater sampling wells are located adjacent to the X-770 building, wells X760-03G, X760-07G, and X760-04M (Figure 5). These wells were used to assess residual contamination. There was only a single detection of a contaminant from these wells (5.8 μg/kg PCE at well

X760-03G). Based on available data, no further corrective action with respect to soil remediation is necessary at this SWMU. The required implementation of the D&D program will provide an efficient approach to the final disposition of this unit.

9.0 CREEKS, STREAMS, AND PONDS

Evaluation of the data for these units indicates that total human non-carcinogenic risks and ELCRs are acceptable for all exposure scenarios and that carcinogenic risks are within target levels for soil at these units. Creeks, streams, and ponds have a potential for future contamination from operational incidents. These SWMUs do not require corrective action at this time but will be re-evaluated during D&D under the corrective action program. Effluent from the holding ponds will continue to be monitored under the conditions of National Pollutant Discharge Elimination System (NPDES) permits before discharge into creeks and streams.

9.1 X-230K South Holding Pond

The X-230K South Holding Pond is located in the central portion of Quadrant I. The holding pond is approximately 900 feet long and 300 feet wide at its widest point and has an average depth of approximately 15 feet. The pond was constructed in 1956 to control sedimentation resulting from stormwater runoff from Storm Sewers F, G, and H. Effluent from the holding pond is monitored under USEC's NPDES permit before it is discharged into Big Run Creek. Major contributors to the X-230K South Holding Pond are treated coal pile and coal-ash runoff from the X-600 Coal-Fired Steam Plant, water from the recirculating cooling water system, and air-conditioning system cleaning and condensate-discharge water. The X-230K waste pile, an 800- by 1,500-foot open area adjacent to the holding pond to the east, was used to dispose of sediment dredged from the holding pond in 1980 and 1993.

9.2 X-2230M Southwest Holding Pond

The X-2230M Southwest Holding Pond covers approximately 1.1 acres and is in direct contact with bedrock. The holding pond was constructed in 1978 to control sedimentation resulting from stormwater runoff and now receives runoff from Storm Sewers N and O, which drain the GCEP area and the southernmost portion of the Southwest Drainage Sector. Effluent from the holding pond is monitored at US DOE's outfall before it flows into the unnamed Southwest Drainage Ditch. Past discharges into the X-2230M Southwest Holding Pond include 700 gallons of cleaning solution (containing sodium nitrate, boric acid, sodium silicate, and trinitromethane) and chromated water discharge from the aboveground X-6643 firewater tanks.

9.3 Big Run Creek

Big Run Creek is located east of the X-749B Peter Kiewit Landfill and south of the X-230K South Holding Pond. The primary source of flow in Big Run Creek is direct discharge from the X-230K South Holding Pond; Big Run Creek also receives some recharge from shallow groundwater in the area. Big Run Creek drains the southern end of the site and discharges into the Scioto River approximately four miles southwest of PORTS. Big Run Creek has been investigated as part of a site-wide drainage ditch radiological survey. Data presented in US DOE's "Data Assessment and Risk Evaluation Report for Big Run Creek and the unnammed Southwest Drainage Ditch" (dated 1997) show that the ELCR at Big Run Creek and the unnamed Southwest Drainage Ditch from radionuclides in sediment and surface soil is not currently of concern because the risk is acceptable for all exposure scenarios. This unit will be re-evaluated at the time of D&D.

10.0 SWMUs REQUIRING DEVELOPMENT OF REMEDIAL ALTERNATIVES

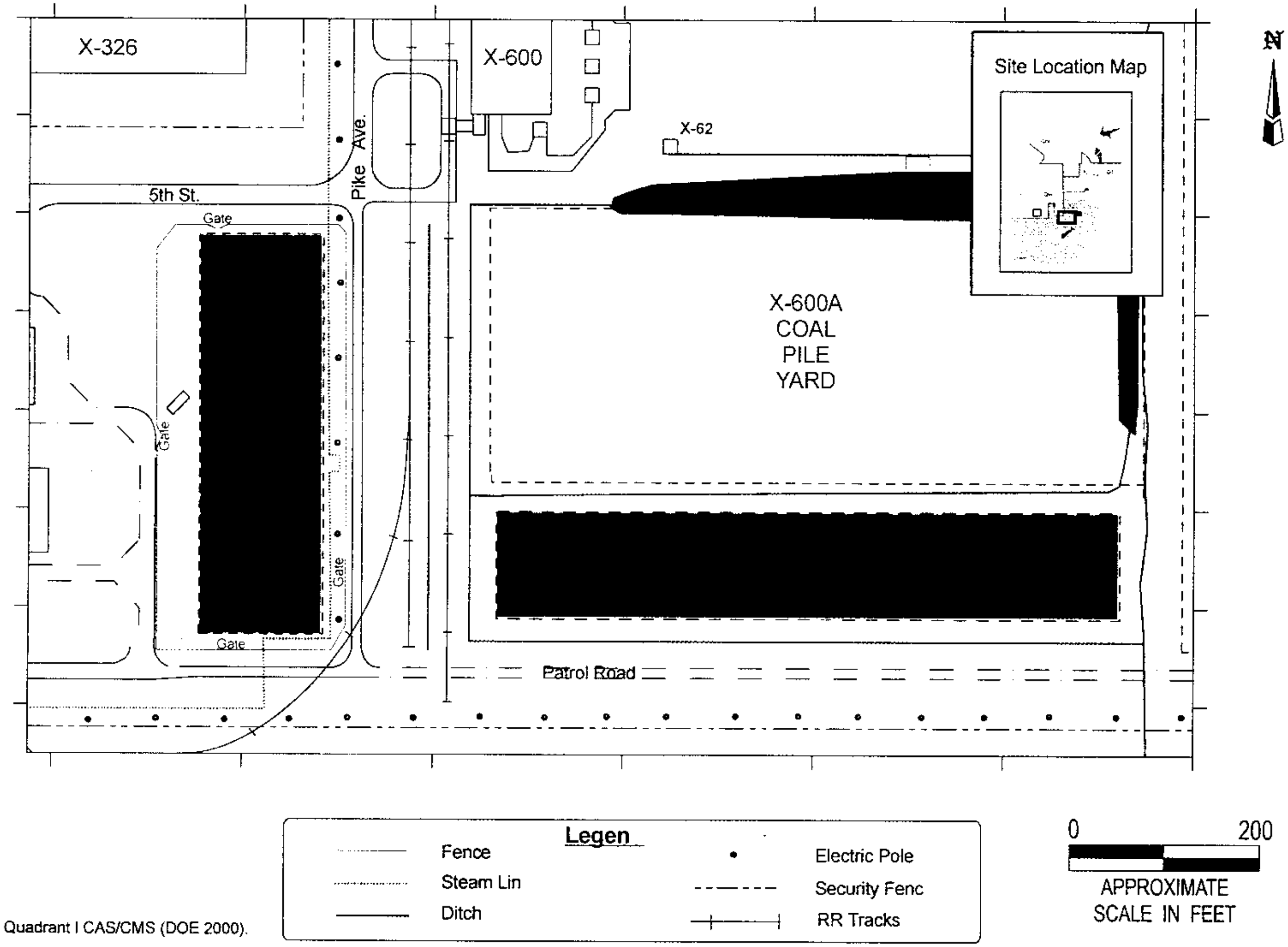
The three SWMUs requiring the development of remedial alternatives in the CAS/CMS are described below, including descriptions of alternatives considered for each SWMU.

10.1 X-231A and X-231B Oil Biodegradation Plots (soil only)

Remedial activities are planned for the X-231A and X-231B Oil Biodegradation Plots (see Figure 6) because both plots are potential sources of continuing groundwater contamination. The plots were used in the 1970s and early 1980s to dispose of waste contaminated with VOCs (primarily TCE) and low levels of uranium and technetium. Data from investigation of the SWMU indicate that TCE and technetium concentrations in soil exceed leaching levels established by Ohio EPA, and uranium is present above its background concentration. TCE was detected at various depths in the soil plots, but uranium and technetium were generally confined to depths of less than six feet bgs.

The X-231A plot covers approximately 48,000 ft^2, and the X-231B plot covers approximately 37,000 ft^2. Source removal actions at the X-231B plot in 1994 associated with RCRA closure of the unit removed a significant portion of the VOC contamination in soil, but TCE remains at concentrations exceeding its soil leaching level. Thus, completion of RCRA (substantive) requirements are necessary as outlined in the March 1999 DFF&Os for integration.

Potentially viable remedial alternatives have been assembled for soil at this SWMU. These alternatives are discussed below. Alternatives have been evaluated for effectiveness, implementability, and cost. All alternatives were evaluated for their abilities to meet PRGs, address all environmental problems, reduce overall risks, and protect human health and the environment. PRGs for the SWMU are listed in Table 2.



SOURCE: Quadrant I CAS/CMS (DOE 2000).

Figure 6	**X-231A / X-231B Detailed Area Map**	DOCUMENT ID: 35H830 0180-40 / CAS/CMS	DRAWING ID: Q1Sup Fig6.cdr	DRAWING DATE: January 16, 2001 DER

Table 2
Soil PRGs for X-231A and X-231B Oil Biodegradation Plots

COC	PRG (mg/kg)
TCE	0.048
Beryllium	1.4
Cadmium	2.0
Manganese	2,012
Nickel	34
Chromium	52.7
1,1,1-Trichloroethane	1.3
1,1-Dichloroethene	0.24
Chloroform	0.35
Technetium	11,400 pCi/kg
Uranium	7.4

Note:
COC = Chemical of concern
pCi/kg = Picocurie per kilogram

10.1.1 Alternative 1 - Institutional Controls

This alternative includes access and use restrictions, general maintenance, and groundwater monitoring activities.

10.1.2 Alternative 2 - Synthetic Covers

This alternative combines the institutional controls and groundwater monitoring of Alternative 1 with covers over both plots, each consisting of a 40-mil-thick synthetic liner overlain by a 12-inch-thick soil protective layer and a 6-inch-thick vegetative layer.

10.1.3 Alternative 3 - Vacuum Extraction Recovery (VER) Wells and Synthetic Covers

This alternative combines all aspects of Alternative 2 with soil remediation at the X-231A and X-231B plots using VER wells (9 at X-231A and 10 at X-231B) in conjunction with soil vapor collection systems.

10.1.4 Alternative 4 - Multimedia Cap

Alternative 4 consists of a multimedia cap and the deed restrictions discussed under Alternative 1 to prevent development of capped areas and limit future land use to commercial and industrial activities within the security fence. The cap would be constructed over both plots, consist of a 80-mil-thick, textured, high-density polyethylene (HDPE) geomembrane over an engineered fill base, drainage layer, a 24-inch-thick soil layer, and a 6-inch-thick vegetative soil layer.

10.1.5 Summary of Alternatives

Alternatives 3 and 4 are predicted to meet all remedial action objectives for the X-231A and X-231B Oil Biodegradation Plots. Alternatives 2, 3, and 4 minimize long-term risks to human health and environmental receptors. However, Alternatives 2 and 3 do not meet RCRA performance standards and therefore do not meet ARARs. All four alternatives are readily implementable and have been proven to be reliable and effective. Table 3 summarizes the relative effectiveness and cost for each of the remedial alternatives evaluated.

10.2 Five-Unit Groundwater Investigative Area

The Five-Unit Groundwater Investigative Area contains a contaminant plume in the Berea Sandstone and Gallia sand and gravel consisting primarily of TCE. The plume extends south from the X-710 Technical Services Building to the X-230K South Holding Pond and east from the southwest corner of the X-326 Process Building Facility to the X-749A Classified Materials

Table 3
Summary of Alternatives Analysis for X-231A and X-231B Oil Biodegradation Plots

Alternative	Technical Analysis	Human Health Analysis	Environmental Analysis	Institutional Analysis	Capital Cost Analysis (Present Worth - $1,000s)	O&M Cost (Present Worth - $1,000s)
1 - Institutional Controls	Readily implementable; deed restrictions and existing fencing would be reliable if site controls maintained	No short-term risk; long-term exposure of on-site workers	No risk to environmental indicators	Does not meet all remedial action objectives	No cost	155
2 - Synthetic Covers	Readily implementable; caps are effective and proven technology for preventing infiltration of water	Short-term risk to remediation workers; long-term risk to on-site workers eliminated through elimination of migration pathway	No risk to environmental indicators; could initially disrupt ecological receptors but not expected to result in permanent effects	Does not meet all remedial action objectives	1,019	918
3 - VER Wells and Synthetic Covers	Readily implementable: VER wells an effective and proven technology for removing VOC contamination in soil	Short-term risk to remediation workers; long-term risk to on-site workers decreased through remediation of VOC contamination in soil	No risk to environmental indicators; could initially disrupt ecological receptors but not expected to result in permanent effects	Meets all soil remedial action objectives	2,633	4,192
4 - Multimedia Cap	Readily implementable; caps are effective and proven technology for preventing infiltration of water	Short-term risk to remediation workers; long-term risk to on-site workers eliminated through elimination of migration pathway	No risk to environmental indicators; could initially disrupt ecological receptors but not expected to result in permanent effects	Substantive RCRA requirements met when multimedia cap is installed; meets all soil remedial action objectives	3,244	956

Burial Ground (see Figure 7). Continuing sources of groundwater contamination in this area include soil at the X-231A and X-231B Oil Biodegradation Plots discussed in Section 10.1.

Various remedial alternatives have been evaluated for groundwater in the area. These alternatives are discussed below. All the alternatives presented except the "no action" and the "no further corrective action" alternatives were selected for their abilities to meet PRGs, address environmental problems, reduce overall risks, and protect human health and the environment. The PRGs for groundwater in the Berea Sandstone and Gallia sand and gravel at PORTS are summarized in Table 4.

10.2.1 Alternative 1 - No Action

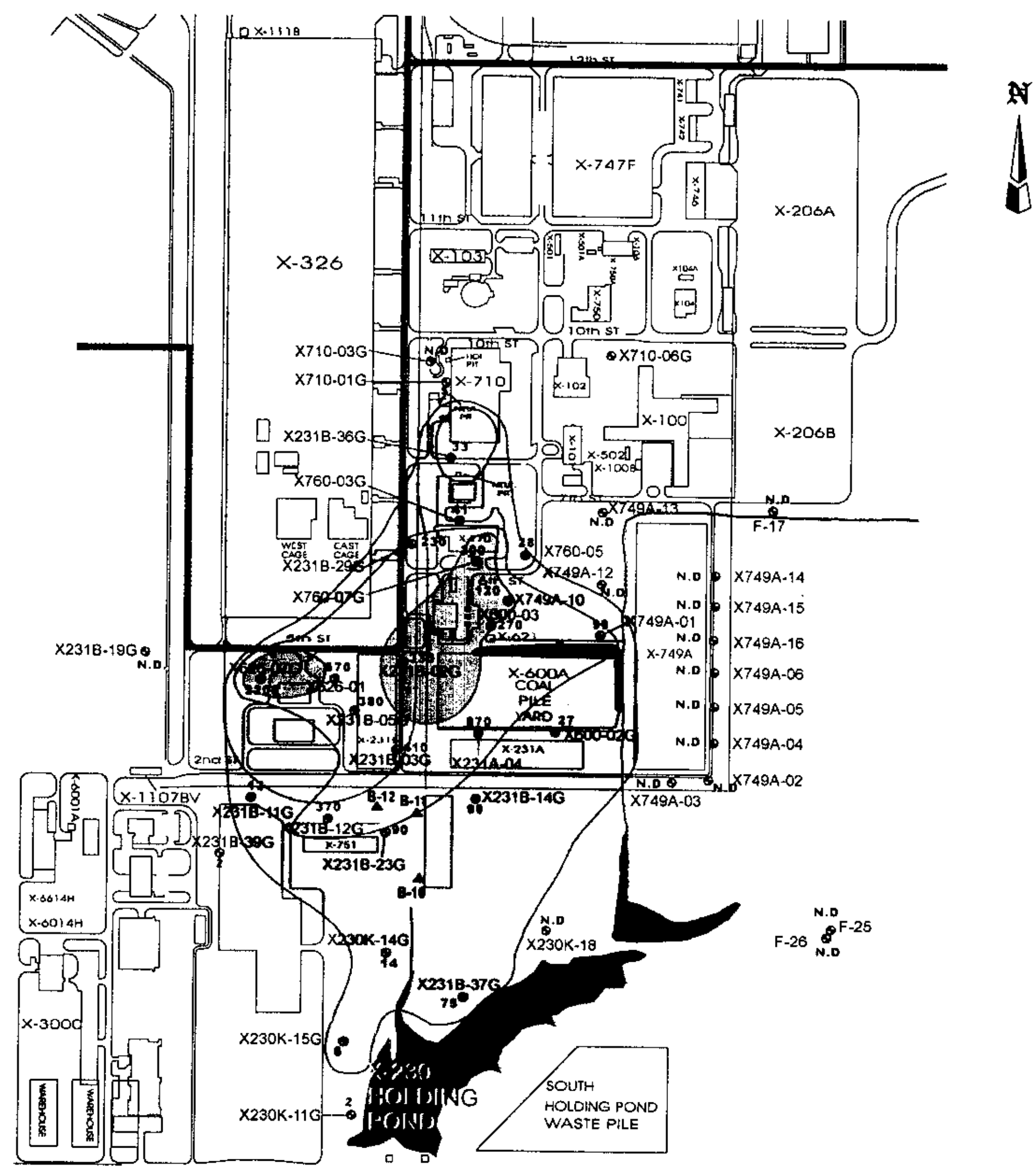
No actions are assumed to be taken under this alternative. No access or use restrictions maintenance, or monitoring would be conducted.

10.2.2 Alternative 2 - No Further Corrective Action

This alternative includes institutional controls, continued operation of the existing three-well extraction system, and groundwater monitoring. Institutional controls include access and use restrictions and maintenance.

10.2.3 Alternative 3 - Groundwater Extraction

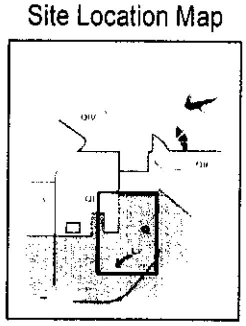
This alternative includes institutional controls, a conventional 14-well groundwater extraction system, and groundwater monitoring. Institutional controls include access and use restrictions, maintenance, and groundwater monitoring.



LEGEN

- Over 1,000 ug/L TCE
- Over 100 ug/L TCE
- Over 5 ug/L TCE
- Quadrant Boundary
- ▲ Existing Extraction Wells
- Groundwater Monitoring Wells
- 120 TCE Concentrations in ug/L

Site Location Map



200

APPROXIMATE
SCALE IN FEET

SOURCE: Quadrant I CAS/CMS (DOE 2000)

Figure 7

Five-Unit Groundwater Investigative Area, 1997 TCE Plume

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Table 4
Groundwater PRGs for Five-Unit Groundwater Investigative Area

COC	Gallia Groundwater PRG (μg/L)
Manganese	14,300
Benzene	5
Bis(2-ethylhexyl)phthalate	6
1,2-Dibromo-3-chloropropane	0.2
1,2-Dichloroethane	5
1,1-Dichloroethene	7
Chloroform	100
cis-1,2-Dichloroethene	70
Methylene chloride	5
Tetrachloroethene	5
1,1,2,2-Tetrachloroethane	0.8
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	5
TCE	5
Vinyl chloride	2
COC	**Berea Sandstone PRG (μg/L)**
TCE	5

Note:
μg/L = Microgram per liter

10.2.4 Alternative 4 - Groundwater Extraction and Oxidant Injection

This alternative includes institutional controls, a conventional 14-well groundwater extraction system, initial contaminant reduction using oxidant injection, and groundwater monitoring. Initial contaminant reduction using oxidants in conjunction with groundwater extraction and reinjection will eliminate large areas of contamination in the first year of operation and will minimize the amount of extracted groundwater requiring treatment at on-site facilities. Institutional controls include access and use restrictions, maintenance, and groundwater monitoring.

10.2.5 Alternative 5 - VER Wells at X-231A and X-231B Oil Biodegradation Plots and Groundwater Extraction

This alternative consists of institutional controls, 19 VER wells installed in the X-231A and X-231B Oil Biodegradation Plots as described in Section 10.1.3, and a conventional nine-well groundwater extraction system. VER wells will dewater the Gallia sand and gravel aquifer and remove vadose zone contaminants beneath the X-231A and X-231B Oil Biodegradation Plots. Institutional controls include access and use restrictions, maintenance, and groundwater monitoring.

10.2.6 Alternative 6 - VER Wells at X-231A and X-231B Oil Biodegradation Plots, Oxidant Injection, and Groundwater Extraction

This alternative consists of institutional controls, multimedia caps over the X-231A and X-231B Oil Biodegradation Plots as discussed in Section 10.1.4, the 19 VER wells installed in the X-231A and X-231B Oil Biodegradation Plots as described in Section 10.1.3, oxidant injection, and a conventional nine-well groundwater extraction system. VER wells will dewater the Gallia sand and gravel aquifer and remove vadose zone contaminants beneath the X-231A and X-231B plots. Initial contaminant reduction using oxidants in conjunction with groundwater extraction and reinjection will eliminate large areas of contamination in the first year of operation and will minimize the amount of extracted groundwater requiring treatment at on-site facilities. Institutional controls include access and use restrictions, maintenance, and groundwater monitoring.

10.2.7 Summary

Table 5 summarizes the relative effectiveness for each of the remedial alternatives evaluated, including the estimated TCE concentration and ELCR at 30 years and the remaining plume area exceeding PRGs after 30 years.

10.3 X-749/X-120 Area Groundwater Plume (groundwater only)

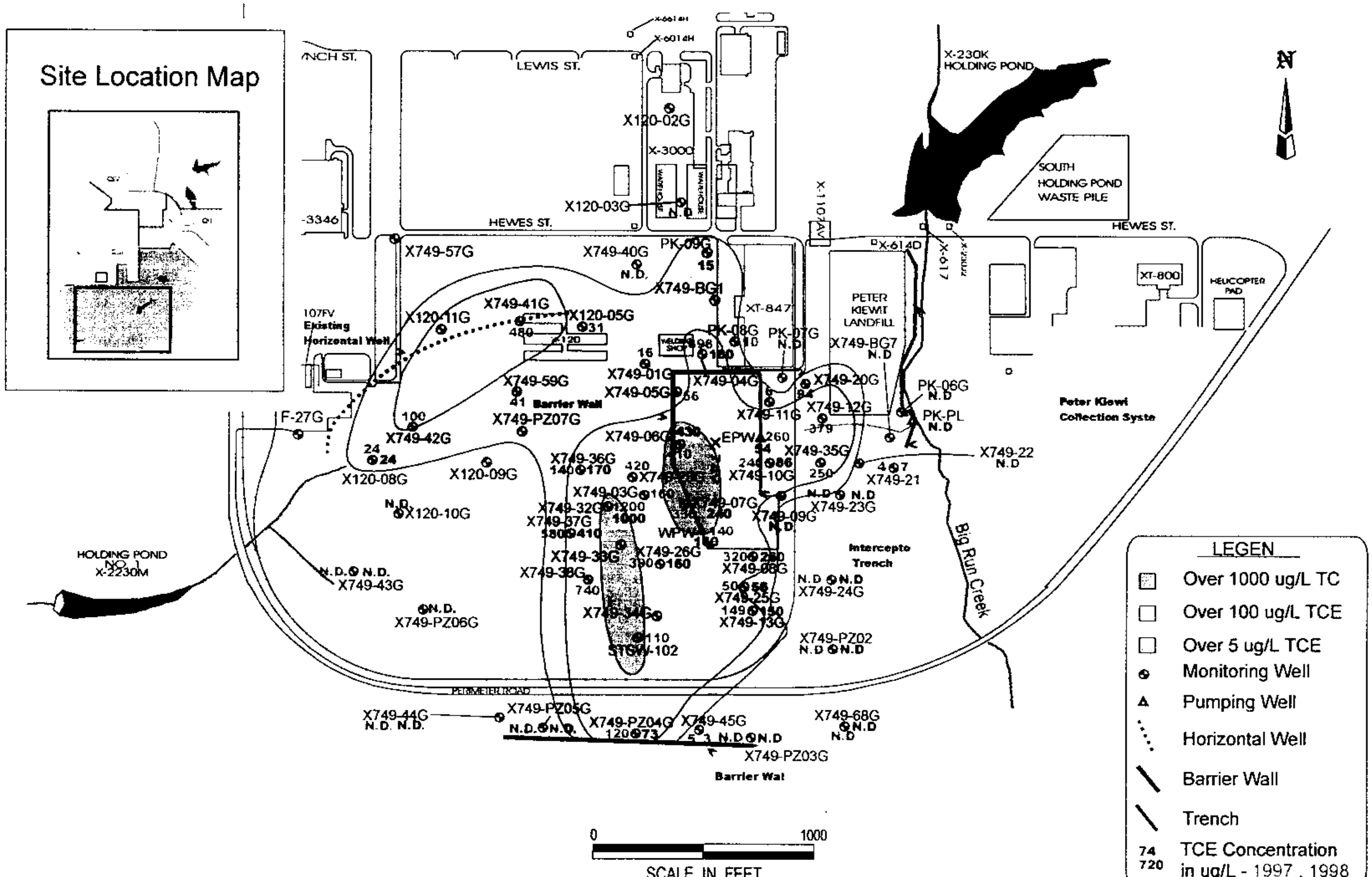
The X-749/X-120 Groundwater Plume consists mainly of TCE in the Gallia (see Figure 8). The plume extends from Hewes Street to immediately south of the reservation boundary, where it is contained by a barrier wall that extends to bedrock. The plume also extends east from the unnamed Southwest Drainage Ditch to the X-749B Peter Kiewit Landfill area. Two sources of groundwater contamination formerly existed, the X-749 Landfill and the X-120 Goodyear Training Facility. The X-120 facility is no longer in existence. The X-749 Landfill was closed in accordance with Ohio Hazardous and Solid Waste Regulations in 1993. The X-120 housed training facilities used during plant construction and startup. Solvents used during maintenance training activities may have been released. Soil samples collected in the X-120 area during the RFI show that contaminants are no longer present at concentrations above leaching levels established by the Ohio EPA, indicating that soil in this area is no longer a source of groundwater contamination.

A range of alternatives have been evaluated for groundwater in the X-749/X-120 Area. Model simulations indicate that it is not practicable to remediate the Gallia sand and gravel groundwater and associated saturated soil to concentrations less than PRGs in all areas of the plume area

Table 5
Summary of Alternatives for Five-Unit Groundwater Investigative Area

Alternative	Technical Analysis	Human Health Analysis	Environmental Analysis	Institutional Analysis	Estimated Maximum TCE Concentration at 30 Years (μg/L)	Estimated Maximum ELCR at 30 Years	Estimated Remaining Plume Area Above PRGs (ft²)[a]	30-Year Present Worth Costs Capital/ O&M ($1,000s)
1 - No Action	No implementation required	No short-term risk; long-term exposure of on-site workers	Risk to environmental receptors if contaminated groundwater infiltrates to surface water	Does not meet remedial action objectives	258	5.0×10^{-5}	2,601,500	0/0
2 - No Further Corrective Action	Readily implementable; deed and land-use restrictions reliable if site controls maintained; three-well groundwater extraction system and treatment facility currently operating	No short-term risk	Risk to environmental receptors if contaminated groundwater infiltrates to surface water	Meets remedial action objectives for on-site personnel and recreational visitors	167	3.2×10^{-5}	1,687,400	0/4,983
3 - Groundwater Extraction	Readily implementable; institutional controls will be retained	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors; no long-term risk to environmental receptors	Meets all remedial action objectives	<5	$<1.0 \times 10^{-4}$	0	1,056/6,429
4 - Groundwater Extraction and Oxidant Injection	Extraction wells and upgrades to treatment facility readily implementable; oxidant injection less reliable; institutional controls will be retained	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors; no long-term risk to environmental receptors	Meets all remedial action objectives	<5	$<1.0 \times 10^{-4}$	0	2,674/14,176
5 - VER Wells at X-231A and X-231B Oil Biodegradation Plots and Groundwater Extraction	Extraction wells and upgrades to treatment facility readily implementable; oxidant injection less reliable; institutional controls will be retained	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors; no long-term risk to environmental receptors	Meets all remedial action objectives	<5	$<1.0 \times 10^{-4}$	0	2,212/17,404
6 - VER Wells at X-231A and X-231B Oil Biodegradation Plots, Oxidant Injection, and Groundwater Extraction	VER wells, conventional extraction wells, and upgrades to treatment facility readily implementable	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors; no long-term risk to environmental receptors.	Meets all remedial action objectives except achieving groundwater PRGs	8	1.5×10^{-4}	11,444	3,989/27,529

Note: at the end of 30 years



SOURCE: Quadrant I CAS/CMS (DOE 2000).

Figure 8	**X-749/X-120 Area and Groundwater Plum**	DOCUMENT ID: 35H830 0131-95 / CAS/CMS	DRAWING ID: Q1Sup Fig8.cdr	DRAWING DATE: January 16, 2001 DER

within the targeted 30-year timeframe. PRGs for the COC detected in the Gallia sand and gravel in the X-749/X-120 Area are summarized in Table 6. Even with extensive application of BATs, hydrogeologic conditions indicate that groundwater contaminant levels would not reach the risk target level of 1 x 10^{-6} within 30 years. However, model simulations indicate that groundwater contaminant levels can be reduced to a risk level of 1 x 10^{-5}. This concentration is ALARA given hydrogeologic system constraints and the targeted timeframe for remediation. Various remedial alternatives have been evaluated for groundwater in the X-749/X-120 Area. These alternatives are discussed below. All of the alternatives evaluated except the "no action" and "no further corrective action" alternatives were selected for their abilities to achieve or meet PRGs, address environmental problems, reduce overall risks, and protect human health and the environment. Alternatives for the X-749/X-120 Area Groundwater Plume are summarized in Table 7.

10.3.1 Alternative 1 - No Action

No actions are assumed to be taken under this alternative. No access or use restrictions, maintenance, or monitoring would be conducted.

10.3.2 Alternative 2 - No Further Corrective Action

This alternative includes institutional controls and groundwater monitoring. Institutional controls include access and use restrictions and maintenance. This alternative includes continued operation of the existing X-120 horizontal well, the X-749 southwest and east trenches, and the X-749B Peter Kiewit collection trench.

10.3.3 Alternative 3 - Groundwater Pumping and Treatment

This alternative includes conventional groundwater extraction with treatment at on-site facilities. The existing X-120 horizontal well, the X-749B Peter Kiewit collection trench, and the southwest X-749 trench would continue operating. A barrier wall would be installed at the south

Table 6
Groundwater PRGs for X-749/X-120 Area Groundwater Plume

COC	Gallia Groundwater PRG (μg/L)
Chromium	100
1,1,1-Trichloroethane	200
1,1,2,2-Tetrachloroethane	0.83
1,1,2-Trichloroethane	5
1,1-Dichloroethene	7
1,2,3-Trichloropropane	0.0379
1,2-Dibromo-3-chloropropane	0.2
1,2-Dichloroethane	5
1,2-Dichloroethene	900
Acrylonitrile	0.431
Benzene	5
Bromoform	100
Carbon tetrachloride	5
Chloroform	100
cis-1,2-Dichloroethene	70
Methylene chloride	5
Tetrachloroethene	5
trans-1,2-Dichloroethene	100
TCE	5
Vinyl chloride	2
1,4-Dioxane	25.9

Note: ug/L = Microgram per liter

Table 7
Summary of Alternatives for the X-749/X-120 Area Groundwater Plume

Alternative	Technical Analysis	Long Term Risks	Environmental Analysis	Institutional Analysis	Estimated Highest TCE Concentration Remaining After 30 Years ($\mu g/L$)	Estimated Remaining Plume Area Above MCLs[a] (Million ft^2)	30-Year Present Worth Costs Capital/O&M ($1,000s)
1 - No Action	No implementation required	No short-term risk; long-term exposure of on-site workers	No risk to environmental indicators	Does not meet remedial action objectives	2,788	5.72	0/0
2 - No Further Corrective Action	Readily implementable; deed and land-use restrictions reliable if site controls maintained	No short-term risk	No risk to environmental indicators	Does not meet remedial action objectives	1,343	4.06	0/5,974
3 - Groundwater Pumping and Treatment	Readily implementable; installation of wells required	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors	Meets all remedial action objectives	43	0.250	2,564/12,749
4 - Pumping and Treatment with Phytoremediation	Readily implementable; installation of wells and planting of trees required	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors	Meets all remedial action objectives	16	0.638	2,564/11,623
5 - Phytoremediation	Readily implementable; planting of trees required	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors	Meets all remedial action objectives	48	0.273	602/5,433
6 - Enhanced Bioremediation and Phytoremediation	Readily implementable; installation of wells and planting of trees required	Short-term risk to on-site workers	Minimal short-term risk to environmental receptors	Meets all remedial action objectives	50	1.2	5,228/10,182

Note: at the end of 30 years

end of X-749 and where the existing east X-749 collection trench is located, thereby effectively containing contamination within the landfill. Institutional controls include access and use restrictions, maintenance, and groundwater monitoring.

10.3.4 Alternative 4 - Pumping and Treatment with Phytoremediation

This alternative includes conventional groundwater extraction for 20 years and treatment of extracted groundwater at on-site facilities. A barrier wall would be installed on the south end of X-749 and where the existing east X-749 collection trench is located, thereby effectively containing contamination within the landfill. The existing X-120 horizontal well, the X-749B Peter Kiewit trench, and the southwest X-749 trench would continue operating. Implementation of phytoremediation would begin in the 21^{st} year. Phytoremediation would involve planting approximately 27.5 acres of hybrid poplars. Upon implementation of phytoremediation, all active remedial measures except those at the southwest X-749 and X-749B Peter Kiewit collection trenches would be removed from operation. Institutional controls include access and use restrictions, maintenance, and groundwater monitoring.

10.3.5 Alternative 5 - Phytoremediation

Approximately 27.5 acres of hybrid poplar trees would be planted under this alternative, and a barrier wall would be installed on the south end and east side of X-749 and where the existing east X-749 collection is located, thereby effectively containing contamination within the landfill. The southwest X-749 and X-749B Peter Kiewit collection trenches would continue operating. Institutional controls include access and use restrictions, maintenance, and groundwater monitoring.

10.3.6 Alternative 6 - Enhanced Bioremediation and Phytoremediation

Alternative 6 combines planting hybrid poplar trees in selected portions of the X-749/X-120 area plume and injection of a compound into groundwater to enhance bioremediation. The X-749B

Peter Kiewit collection trench and the southwest X-749 trench would continue operating, but the X-120 horizontal well would operate for two years only and then be discontinued. A barrier wall would be installed on the south end of the X-749 area and where the existing east X-749 trench is located. Monitoring and deed restrictions are also part of this alternative.

11.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Ohio EPA relies on the public to ensure that the remedial alternative selected for a site meets the needs of the local community in addition to being an effective solution to the environmental problem. Ohio EPA formally presented the Preferred Plan for Quadrant I at a public availability session on November 30, 2000. At this meeting, representatives from Ohio EPA discussed the RFI, CAS/CMS, and the Preferred Plan. In addition, Ohio EPA answered questions and received comments. Comments were solicited on all alternatives summarized in the Preferred Plan and evaluated in the CAS/CMS report. Responses to significant comments, criticisms, or new data received during the comments period and public meeting are included in the "Responsiveness Summary," which is attached to this document as Appendix II.

This Decision Document presents the selected remedial actions for Quadrant I of the US DOE Portsmouth Facility. These actions are chosen in accordance with RCRA, CERCLA, and SARA, and to the extent practicable, the NCP, the HWSA of 1984, and applicable and appropriate State regulations. This decision is based on the administrative record for this response action.

All documents leading up to the Decision Document have been available for public review and comment prior to selection of the chosen remedies. Documents issued before the Decision Document include, but are not limited to Quadrant I Final RFI Report (DOE 1996), BERA, the AIR RFI (DOE 1997), the Background Sampling Investigation (DOE 1996), the Quadrant I CAS/CMS Final Report (DOE 2000), and the Quadrant I Preferred Plan (Ohio EPA 2000).

All documents regarding Quadrant I are available at the following locations:

U.S. Department of Energy
Environmental Information Center
3930 US Route 23
P. O. Box 693
Piketon, Ohio 45661
Telephone No.: (740) 289-3317

Ohio Environmental Protection Agency
2195 Front Street
Logan, Ohio 43138
Telephone No.: (740) 385-8501

12.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Under CERCLA, remedial alternatives are required to be evaluated against eight criteria. To select remedial alternatives for Quadrant I, Ohio EPA considered these eight criteria, which are described below.

1. Overall protection of human health and the environment addresses whether a remedy provides adequate protection through the elimination, reduction, or control of risks by treatment, engineering controls, or institutional controls.

2. Compliance with state, federal, and local laws and regulations addresses whether a remedy will meet all applicable state, federal, and local environmental statutes (ARARs). ARARs include chemical-, action-, and location-specific ARARs.

3. Long-term effectiveness and permanence refers to a remedial alternative's ability to protect human health and the environment over time once cleanup goals have been met.

4. Reduction of toxicity, mobility, or volume of contaminants through treatment is the anticipated performance of the treatment technologies to either (1) reduce the toxic characteristics of the COCs, (2) remove quantities of COCs to acceptable risk concentrations or regulatory limits, or (3) decrease the ability of contaminants to migrate through the environment.

5. Short-term effectiveness involves the period of time needed to achieve protection and considers adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

6. Implementability is the technical and administrative feasibility of an alternative, including the availability of goods and services needed to implement the chosen remedial alternative.

7. Cost includes consideration of the capital and O&M costs.

8. Community acceptance includes review of the public comments received on the RFI report, the CAS/CMS report, and the Preferred Plan.

Alternatives selected reflect the scope and purpose of the actions being undertaken at Quadrant I and how the remedies relate to long-term comprehensive response. The following discussion summarizes the compliance of the alternatives with these criteria. SWMUs that require no further corrective action and those deferred to D&D are discussed first, followed by discussion of each area requiring remedial alternatives.

12.1 No Further Corrective Action and Deferral to D&D Alternatives

12.1.1 Overall Protection of Human Health and the Environment

The no further corrective action alternative is protective of human health and the environment for the 13 SWMUs for which this alternative was selected. These SWMUs do not pose unacceptable risks to human health or the environment. For some of the no further corrective action SWMUs, only soil requires no further corrective action because of completed remedial actions such as capping. SWMUs deferred to D&D, including the creeks, streams, and ponds, do not pose risks that warrant remedial action at this time. Remediation at the D&D deferred SWMUs at this time would not be prudent because these units are still in use and could therefore become recontaminated. In some cases, exposure controls will be in place for workers until D&D. Administrative controls will limit or prevent exposure of on-site workers and visitors.

12.1.2 Compliance with State, Federal, and Local Laws and Regulations

The no further corrective action alternative complies with all identified ARARs for the 13 SWMUs for which this alternative was selected. A list of federal and state preliminary ARARs is provided in Appendix I. ARARs will be developed for SWMUs deferred to D&D at the time of remedial action selection.

12.1.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence is not presently applicable to SWMUs deferred to D&D. These SWMUs will be evaluated for remedial alternatives when D&D commences or sooner, if feasible. Because cleanup objectives are met for SWMUs under the no further corrective action alternative, long-term effectiveness and permanence are expected to be met by this alternative.

12.1.4 Reduction of Toxicity, Mobility, or Volume

This criterion is not applicable to SWMUs requiring no further corrective action because the SWMUs were determined to meet risk guidelines. This criterion will apply to SWMUs deferred to D&D.

12.1.5 Short-Term Effectiveness

This criterion is applicable to SWMUs requiring no further corrective action and deferred to D&D because the SWMUs were determined to meet risk guidelines and therefore are protective in the short-term.

12.1.6 Implementability

Both the no further corrective action and D&D alternatives are easily implemented for Quadrant I SWMUs.

12.1.7 Cost

No additional costs are associated with the no further corrective action alternative. Costs for future remediation for SWMUs deferred to D&D will be evaluated at the time of plant closure.

12.1.8 Community Acceptance

Ohio EPA and US EPA evaluated state and local community acceptance during the public comment period. All comments pertinent to the preferred alternatives are addressed in the responsiveness summary of this Decision Document (Appendix II).

12.2 X-231A and X-231B Oil Biodegradation Plots

12.2.1 Overall Protection of Human Health and the Environment

Alternative 1, Institutional Controls, would not be protective of human health and the environment because it remains unclear if long-term land-use restrictions could be implemented at the SWMUs. In addition, contaminants are not prevented from leaching into groundwater, creating an exposure pathway for potential future users and leading to migration of contaminated groundwater to Big Run Creek.

Alternative 2, Synthetic Covers, would be protective of human health and the environment because the covers would prevent contact with contaminants and infiltration of surface water as long as the synthetic covers remain intact. The synthetic covers would also reduce leaching of contaminants to groundwater, thus preventing contaminant migration to surface water and reducing exposure of potential environmental receptors as long as the covers are not compromised. This alternative does not meet the RCRA substantive requirements noted in the March 1999 DFF&Os for integration and therefore does not meet ARARs.

Alternative 3, VER Wells and Synthetic Covers, would be protective of human health and the environment. The synthetic covers would reduce infiltration of surface water and contaminant leaching into groundwater. The VER wells would remediate contaminated soil and groundwater at the oil biodegradation plots. Both the synthetic covers and VER wells would also greatly reduce potential exposure of human and environmental receptors.

Alternative 4, Multimedia Caps, would be protective of human health and the environment. The multimedia cap system would prevent contact with contaminants and infiltration of surface water. The synthetic covers, along with the 30-inch-thick soil layers, would reduce or eliminate contaminants leaching into groundwater, thus preventing contaminant migration to surface water and reducing exposure of potential environmental receptors.

12.2.2 Compliance with State, Federal, and Local Laws and Regulations

Chemical-Specific ARARs: Alternative 1 would not comply with chemical-specific ARARs. Alternative 2 would not comply with RCRA ARARs and may not comply with chemical-specific ARARs if the viability of the synthetic covers are compromised in any way. Alternatives 3 and 4 are expected to comply with chemical-specific ARARs and would require US DOE to obtain an air permit to operate the VER wells.

Action-Specific ARARs: Under Alternative 3, an action-specific ARAR for this SWMU is the requirement that VOC-contaminated drill cuttings from installation of the VER wells be disposed of in a solid waste landfill or, if necessary, a hazardous waste facility.

Location-Specific ARARs: None of the alternatives evaluated would trigger location-specific ARARs. Therefore, these ARARs are not applicable for this SWMU.

12.2.3 Long-Term Effectiveness and Permanence

Alternative 1 may be effective in reducing exposure of future on-site workers if institutional controls can be maintained. Alternative 1 would not prevent potential exposure of environmental receptors or continuing contamination of groundwater.

Alternative 2 would not reduce contaminant mass but would eliminate infiltration of groundwater to surface water if the synthetic covers remain intact.

Alternatives 3 and 4 are both expected to meet the long-term effectiveness and permanence criterion. Alternative 3 would reduce the contaminant mass and prevent contaminant infiltration of surface water.

Alternative 4 would not reduce the contaminant mass but would prevent infiltration of groundwater to surface water.

12.2.4 Reduction of Toxicity, Mobility, or Volume of Contaminants

Alternative 1 would not reduce the toxicity, mobility, or volume of the soil contaminants. Alternatives 2 and 4 are containment options that also would not reduce the toxicity or volume of contaminants. Alternative 3 is expected to remove the contaminant mass, thereby reducing the toxicity, mobility, or volume of contaminants.

12.2.5 Short-Term Effectiveness

Alternative 1 would pose no short-term human exposure risks other than continued risks to on-site workers. Alternatives 2 and 4 may pose exposure risks to on-site personnel and workers during synthetic cover installation through fugitive dust emissions. Exposure could be controlled and greatly reduced by implementation of a site-specific health and safety plan. ALARA principles would be observed to limit and prevent exposure of workers to contaminants. Alternative 3 would involve the same potential exposure risks noted above for installation of the synthetic covers. In addition, on-site workers could be exposed to contaminants during monitoring of the VER wells. Implementation of a health and safety plan as well as ALARA principles should greatly reduce or prevent the exposure of on-site workers.

12.2.6 Implementability

Alternative 1 requires no remedial activities and could therefore be easily implemented. Alternative 2 requires the installation of synthetic covers. The time required to implement Alternative 2 is 9 to 11 months. This alternative is readily implementable. Alternative 3 requires the installation of VER wells and synthetic covers. This alternative could be implemented in

12 months. Alternative 4 requires the installation of an 80-mil-thick HDPE geomembrane liner over an engineered base with a drainage layer and 30 inches of additional soil, including a 6-inch-thick vegetative soil layer. This alternative would take 9 to 11 months to implement.

12.2.7 Cost

The cost for each alternative is broken down below. Costs are presented in descending order.

Alternative 3	Present worth capital cost	$2,633,000
	Present worth O&M cost	$4,192,000
	Total Cost	$6,825,000
Alternative 4	Present worth capital cost	$3,244,000
	Present worth O&M cost	$ 956,000
	Total Cost	$4,200,000
Alternative 2	Present worth capital cost	$1,019,000
	Present worth O&M cost	$ 918,000
	Total Cost	$1,937,000
Alternative 1	Present worth capital cost	$ 0
	Present worth O&M cost	$ 155,000
	Total Cost	$ 155,000

12.2.8 Community Acceptance

Ohio EPA and US EPA evaluated state and local community acceptance during the public comment period. All comments pertinent to the preferred alternatives were addressed in the responsiveness summary of this Decision Document (Appendix II).

12.3 Five-Unit Groundwater Investigative Area

The remedial action objectives for Five-Unit Groundwater Investigative Area are as follows:

- Achieve PRGs for groundwater whenever practicable
- Prevent migration of COCs at concentrations exceeding PRGs (human health and ecological) from groundwater to surface water
- Prevent exposure of future off-site residents to COCs in groundwater at concentrations exceeding residential PRGs
- Prevent exposure of on-site workers to COCs in groundwater at concentrations exceeding future on-site worker PRGs

12.3.1 Overall Protection of Human Health and the Environment

Alternative 1, No Action, would not be protective of human health and the environment and would not meet any of the cleanup objectives for this SWMU.

Alternative 2, No Further Corrective Action, includes deed and land-use restrictions with groundwater extraction and treatment. This alternative may reduce the likelihood of exposure of current and future on-site workers and the general public to contaminated groundwater. However, environmental receptors may be affected if contaminated groundwater enters the X-230K South Holding Pond.

Alternative 3, Groundwater Extraction, would significantly reduce both the size and concentration of the contaminant plume within a 30-year timeframe. This alternative is predicted to reduce the areal extent of the TCE plume exceeding the PRG to 3,600 ft^2 and the maximum