

**DUF6 Conversion Facility  
Site Characterization Report,  
Portsmouth Lithium Warehouse Site,  
Portsmouth, Ohio**

**Tetra Tech, Inc.**

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

BJC/PORTS-191

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Site Characterization Report,  
Portsmouth Lithium Warehouse Site,  
Portsmouth, Ohio**

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Prepared by  
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Oak Ridge, Tennessee  
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# CONTENTS

FIGURES.....	v
TABLES .....	v
ACRONYMS.....	vii
EXECUTIVE SUMMARY .....	ix
1. INTRODUCTION .....	1-1
1.1 PURPOSE OF THE REPORT .....	1-1
1.2 SITE BACKGROUND.....	1-1
1.2.1 Site Description.....	1-1
1.2.2 Site History .....	1-7
1.2.3 Previous Investigations .....	1-8
1.3 REPORT ORGANIZATION.....	1-8
2. STUDY AREA INVESTIGATION .....	2-1
2.1 GEOPHYSICAL INVESTIGATION.....	2-1
2.2 SOIL SAMPLING.....	2-5
2.2.1 Surface Soil Sampling.....	2-5
2.2.2 Subsurface Soil Sampling .....	2-5
2.3 GEOTECHNICAL SAMPLING.....	2-7
2.4 QUALITY ASSURANCE/QUALITY CONTROL SAMPLING.....	2-7
3. PHYSICAL CHARACTERISTICS .....	3-1
3.1 GEOLOGY .....	3-1
3.2 GROUNDWATER.....	3-1
4. RESULTS.....	4-1
4.1 NATURE AND EXTENT OF CONTAMINATION.....	4-1
4.1.1 Data Evaluation.....	4-1
4.1.2 Surface Soil.....	4-7
4.1.3 Subsurface Soil .....	4-10
4.2 GEOTECHNICAL RESULTS.....	4-18
4.3 EXISTING BUILDING CHARACTERIZATION .....	4-18
4.3.1 Floor Loading and Structural Evaluation .....	4-18
4.3.2 Equipment Available in Buildings .....	4-23
4.3.3 Code Evaluation.....	4-23
4.3.4 Asbestos and PCB Contamination .....	4-23
4.3.5 Bird and Vermin Waste and Infestations .....	4-23
4.3.6 Radiological Survey .....	4-23
4.3.7 Lead Paint .....	4-23
5. SUMMARY.....	5-1
5.1 ENVIRONMENTAL DATA .....	5-1
5.2 GEOTECHNICAL DATA .....	5-1
5.3 CONCLUSIONS .....	5-1
6. REFERENCES .....	6-1

## FIGURES

1.1	The location of PORTS relative to major cities.....	1-3
1.2	DUF6 Conversion Facility Lithium Warehouse Site location map .....	1-5
2.1	Boreholes drilled at Lithium Storage Facility site .....	2-3

## TABLES

2.1.	Environmental soil sampling summary.....	2-6
2.2.	Geotechnical soil sampling summary .....	2-7
2.3.	Quality assurance/quality control sample summary .....	2-8
4.1.	Organic compounds analyzed.....	4-2
4.2.	Metal/radionuclide constituents analyzed.....	4-3
4.3.	Laboratory qualifiers.....	4-4
4.4.	Validation qualifiers .....	4-5
4.6.	Surface Soil Exceedance.....	4-8
4.7.	Surface Soil Hits .....	4-9
4.8.	Subsurface Soil Exceedance .....	4-11
4.9.	Subsurface Soil Hits.....	4-12
4.10	Current and Historical Data Summary – Surface Soil Detection.....	4-16
4.11	Current and Historical Data Summary – Subsurface Soil Detection .....	4-17
4.12.	Geotechnical sample parameters.....	4-20
4.13.	Soil classification results .....	4-21
4.14	Particle size analysis .....	4-21
4.15	Standard Proctor and California Bearing Ratio results.....	4-22
4.16	One-dimensional consolidation results.....	4-22
4.17	Tri-Axial shear test results.....	4-22
4.18	Atterberg Limits test results.....	4-23

## ACRONYMS

ACO	Administrative Consent Order
ASTM	American Society for Testing and Materials
bgs	below ground surface
BJC	Bechtel Jacobs Company LLC
BRA	baseline risk assessment
CAS	Chemical Abstracts Service
CAS/CMS	Cleanup Alternatives Study/Corrective Measures Study
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
DUF6	depleted uranium hexafluoride
EIS	Environmental Impact Statement
ELCR	excess lifetime cancer risks
EM	electromagnetic
EMEF	Environmental Management and Enrichment Facilities
EPA	U.S. Environmental Protection Agency
GC	gas chromatography
GCEP	Gas Centrifuge Enrichment Plant
GPR	ground-penetrating radar
HI	hazards indices
LCS	laboratory control sample
LEL/O <sub>2</sub>	lower explosive limit/oxygen level meter
LMES	Lockheed Martin Energy Systems, Inc.
LSC	liquid scintillation counting
MS	mass spectrometry
MSA	method of standard additions
MS/MSD	matrix spike/matrix spike duplicate
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
OBBC	Ohio Basic Building Code
OEPA	Ohio Environmental Protection Agency
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PEMS	Project Environmental Measurements System
PID	photoionization detector
PORTS	Portsmouth Gaseous Diffusion Plant
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act of 1976
RFI	RCRA Facility Investigation
RFP	Request for Proposal
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SQL	sample quantitation limit

SRC	site-related constituent
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCL	Target Compound List
TIC	Tentatively Identified Compound
TPE	Total Propagated Error
USEC	United States Enrichment Corporation
VOC	volatile organic compound

## EXECUTIVE SUMMARY

During the summer of 2000, a U.S. Department of Energy (DOE) site at the Portsmouth Gaseous Diffusion Plant (PORTS) was assessed and characterized in support of DOE. DOE plans to use the Lithium Warehouse site for constructing new facilities to convert its inventory of depleted uranium hexafluoride (DUF6) to a relatively stable form. The site was characterized to provide sufficient site information to support contractors submitting Request for Proposal bids and subsequent planning efforts. Use of existing site and plant documentation was maximized.

Existing environmental reports maintained by Bechtel Jacobs Company LLC (BJC), DOE's Environmental Management and Enrichment Facilities Contractor, document that prior investigations of nearby solid waste management units have been performed. Prior evaluations concluded that no further corrective action was required for solid waste management units within or adjacent to the DUF6 Conversion Facility Site. Nearby contaminated solid waste management units have little potential to impact the DUF6 Conversion Facility Site.

The existing data was supplemented with field investigations (i.e. surface and subsurface soil sampling) conducted by Tetra Tech, Inc., a BJC subcontractor. The DUF6 Conversion Facility Site characterization included additional sampling and analysis within the proposed site for VOCs, SVOCs, PCBs, and radionuclides. Radionuclides were the only constituents detected, but alpha and beta activity were determined to be within background levels.

Three on-site warehouse structures, Buildings X-744S, X-744T, and X-744U, are used for storing lithium. The buildings were characterized, and the only concern identified was paint contaminated with lead on the steel structure.

The field characterization also included geotechnical sampling and analysis that indicate the site is suitable for constructing industrial facilities. Geotechnical data are included in this report for use by bidders/contractors planning construction of the DUF6 Conversion Facility structures.

The environmental and geotechnical characterization data will also be used as input to the Environmental Impact Statement (EIS) for the DUF6 Conversion Facilities that will be prepared by Argonne National Laboratory. Additional EIS information and data have also been obtained and included in this report. Other EIS support information is in the appendixes of the report and includes site definition and mapping, cylinder yard drawings, air and biota monitoring data, wetlands delineation, vegetative cover and precipitation data, existing hydrogeologic information, groundwater and surface water usage patterns, PORTS waste management, site-specific seismic data, utility and transportation assessments, and future construction plans.

# 1. INTRODUCTION

## 1.1 PURPOSE OF THE REPORT

The U.S. Department of Energy (DOE) is preparing a Request for Proposal (RFP) for the disposition of the Department's depleted uranium hexafluoride (DUF6) inventory. Approximately 700,000 metric tons (1.4 million lb) of DUF6 is stored in approximately 57,700 cylinders (37,000 are in Paducah, Kentucky; 16,000 in Portsmouth, Ohio; and 4700 in Oak Ridge, Tennessee). DOE indicates that uranium conversion facilities will be designed, constructed, and operated at the Paducah Gaseous Diffusion Plant and Portsmouth Gaseous Diffusion Plant (PORTS). The uranium conversion facilities will involve chemical processing of DUF6 to create products that would present a lower long-term storage hazard, and provide materials that would be suitable for use and disposal.

Industry will be submitting bid proposals to perform the uranium conversion work defined in the planned RFP. The purpose of this report is to provide DOE and the bidders with site characterization information as input to the proposal/bid for designing, constructing, and operating uranium conversion facilities at PORTS (analogous reports were prepared for the Paducah site). Site characterization information includes topography/site definition, soil geotechnical characterization, radiological and hazardous contamination, hydrogeological characteristics, utility availability and capacity, and building characterization.

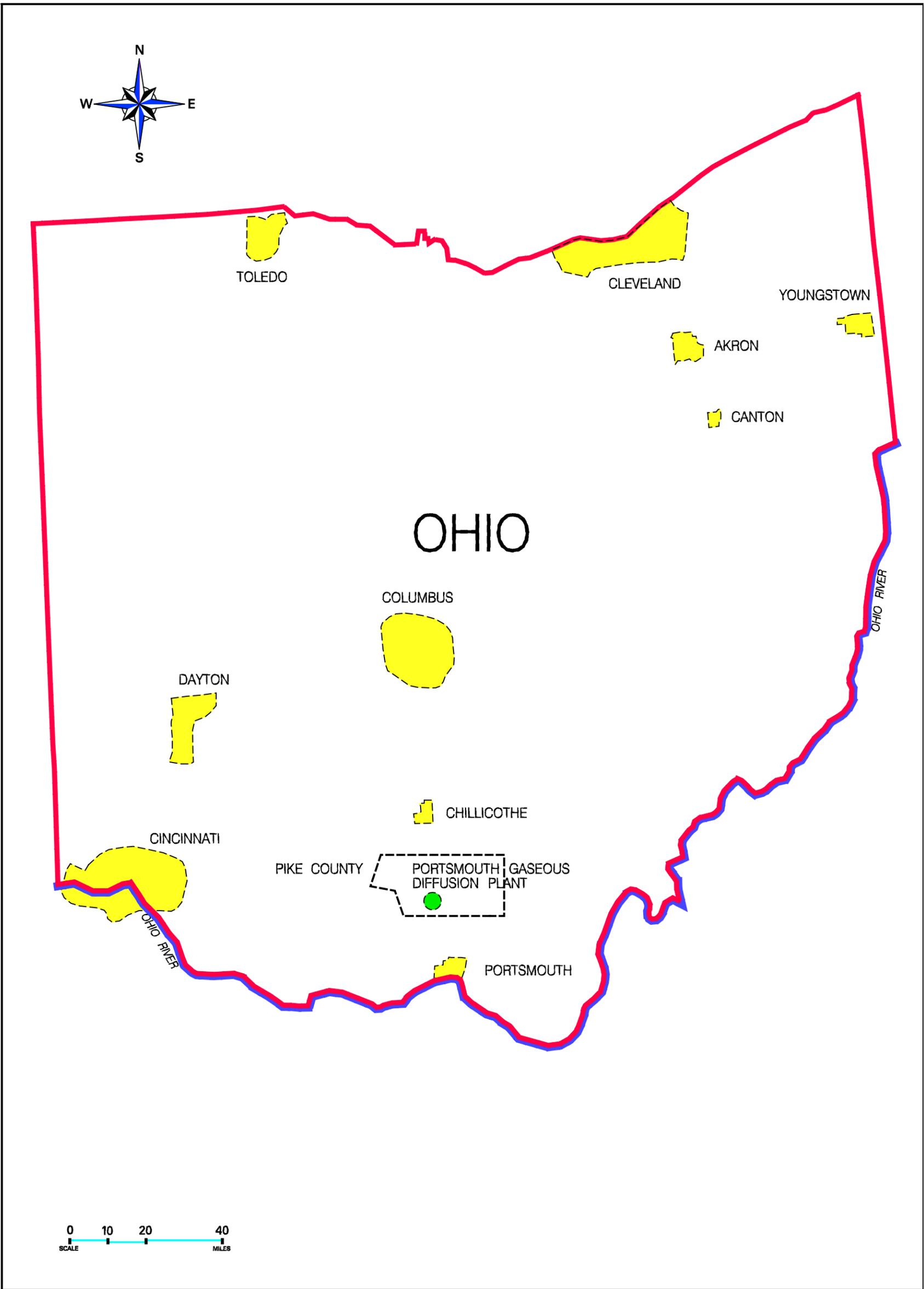
Site characterization data will also be provided as input to National Environmental Policy Act (NEPA) documentation. The site-specific Environmental Impact Statement (EIS) for Depleted Uranium Hexafluoride Conversion Facilities will be prepared by Argonne National Laboratory. Site environmental and geotechnical characterization data will be provided to Argonne National Laboratory to support the EIS. Other miscellaneous data required to support the EIS were obtained. The study maximizes use of existing characterization data to the extent practical and was supplemented with additional field characterization efforts.

## 1.2 SITE BACKGROUND

### 1.2.1 Site Description

PORTS is located in southern Ohio as shown in Fig. 1.1. The plant is in Piketon, Ohio, and is approximately 22 miles north of Portsmouth and 75 miles south of Columbus. The DOE PORTS reservation includes 3714 acres, of which 1200 are within the Perimeter Road. The proposed site for the DUF6 Conversion Facility is located on the west-central side of PORTS as shown in Fig. 1.2.

The total area of the DUF6 Conversion Facility site, identified as the "Lithium Warehouse Site," is approximately 26 acres. The site is referred to as the "Lithium Warehouse Site" because the buildings on the site, X-744S, X-744T, and X-744U, have been used for storing containerized lithium hydroxide monohydrate. Some of the containers still remain in the warehouses but will be removed by mid-2001.



**Fig. 1.1. The location of PORTS relative to major Ohio cities.**

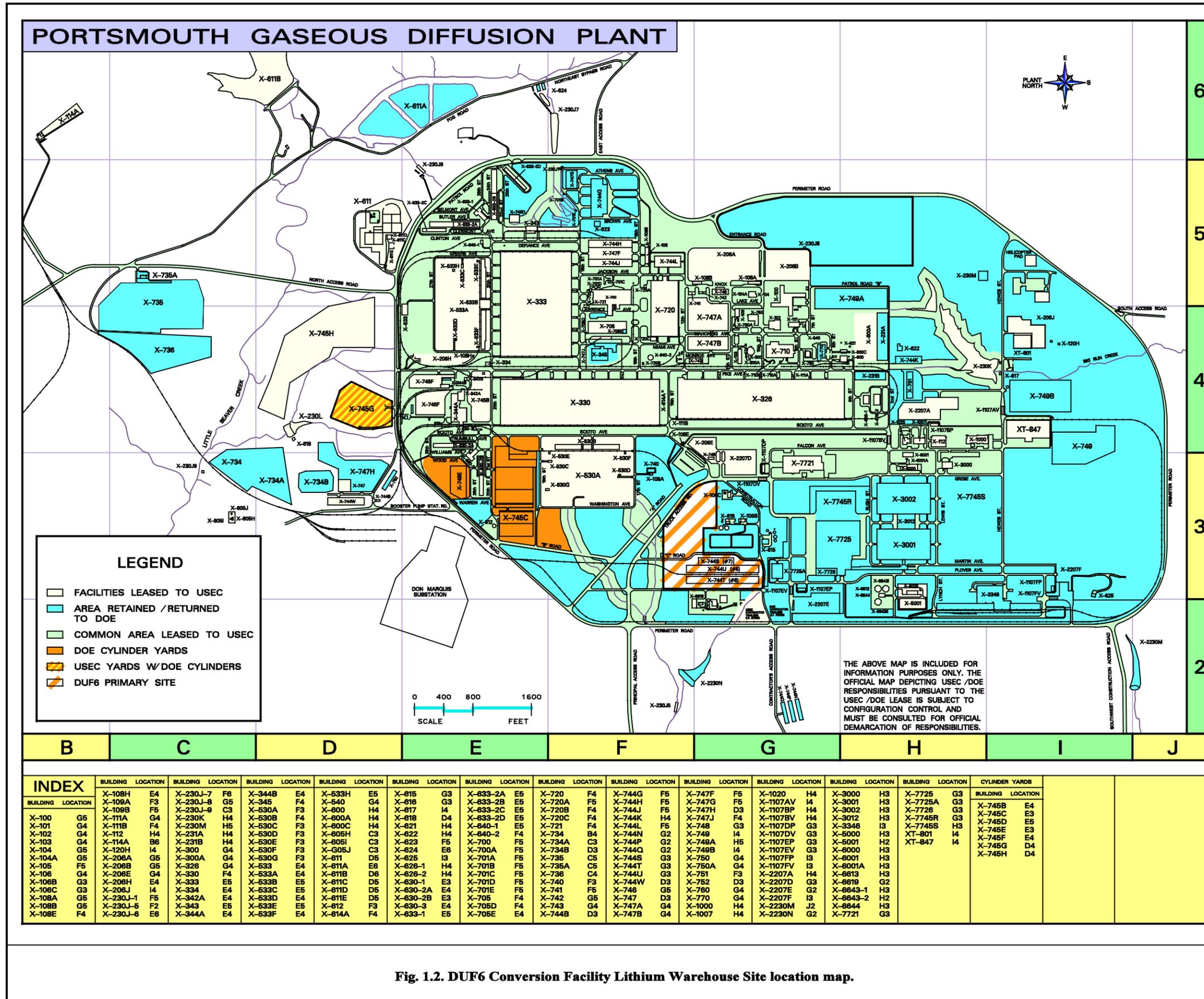


Fig. 1.2. DUF6 Conversion Facility Lithium Warehouse Site location map.

**U.S. DEPARTMENT OF ENERGY**  
DOE OAK RIDGE OPERATIONS  
PORTSMOUTH GASEOUS DIFFUSION PLANT

**BECHTEL JACOBS** BECHTEL JACOBS COMPANY, LLC  
managed for the DEPARTMENT OF ENERGY under  
U.S. GOVERNMENT CONTRACT DE-AC05-84OR21400  
Oak Ridge, Tennessee • Portland, Kentucky • Portsmouth, Ohio



FIGURE No. PORTFIG1-2.DGN  
DATE OCT. 3, 2000

This site is bounded on the west by a north-south asphalt road separating the site from the X-6619 Sewage Treatment Plant further west. On the north, the site limits follow a drainage gully generally west-east to the Truck Access Road to the PORTS site. The boundary then follows the Truck Access Road southeast to south to a location just north of the X-108B Fire Training Facility (Abandoned) and the X-108C Fire Training Facility. The limits then travel in a westerly direction north of the X-616 Sewage Treatment Plant (Abandoned) and the X-616 Lagoons (Remediated) to a point just west of the X-744S Warehouse. The boundary then follows a gravel roadway south to the Construction Road and then west on the Construction Road to the beginning.

### **1.2.2 Site History**

Since September 1954, PORTS has produced enriched uranium for the U.S. government. Enriched uranium is currently produced for commercial electrical power generation and until 1991 highly enriched uranium was provided to the U.S. Navy. The production facilities are owned by DOE and have been leased to the United States Enrichment Corporation (USEC) since July 1, 1993. DOE and USEC have employees and contractors on-site. Total site employment is approximately 1800 people with approximately 1600 USEC employees and 200 DOE contractor and subcontractor employees.

On April 1, 1998, Bechtel Jacobs Company LLC (BJC) replaced Lockheed Martin Energy Systems, Inc. (LMES) in implementing the Environmental Management and Enrichment Facilities (EMEF) Program. BJC is DOE's management and integration contractor, with responsibility for environmental remediation, waste management, and management of DUF6. The Environmental Management mission includes environmental cleanup and waste management; the Enrichment Facilities mission includes management of DUF6 generated before privatization of USEC in July 1998, completion of the highly enriched uranium shutdown and removal program, and maintenance of nonleased buildings and grounds.

The environmental restoration program at PORTS is in response to two enforcement actions. The State of Ohio issued a Consent Decree August 29, 1989, and the U. S. Environmental Protection Agency (EPA) Region V issued an Administrative Consent Order (ACO) September 29, 1989, and amended that order August 11, 1994, under the authority of Sect. 3008(h) of the Resource Conservation and Recovery Act (RCRA). A second amendment to the ACO executed August 11, 1997, relinquished day-to-day oversight of response action activities at PORTS to the Ohio Environmental Protection Agency (OEPA). The OEPA exercises its authority in accordance with RCRA and its implementing regulations, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan (NCP), and applicable U.S. EPA policy.

DOE and BJC have undertaken efforts to identify, investigate, and remediate, as necessary, potentially contaminated sites at PORTS. The plant was divided into four quadrants, and RCRA Facility Investigations (RFIs) and Cleanup Alternatives Study/Corrective Measures Study (CAS/CMS) of the solid waste management units (SWMUs) within the quadrants have been conducted. The DUF6 Conversion Facility Site (or Lithium Warehouse Site) has been characterized as a part of the Quadrant III investigations and studies.

The Lithium Warehouse Site contains three warehouses, X-744S, X-744T, and X-744U, built in 1954 elsewhere in the plant. These buildings were moved in 1978 to their present locations. They are constructed of steel frames, with concrete slab floors, galvanized steel siding, and roof panels. The remainder of the proposed site is a grassed field resulting from site grading at the time of the original plant construction.

The X-6619 Sewage Treatment Plant was constructed in the early 1980s to support the Gas Centrifuge Enrichment Plant (GCEP) and is currently in operation. The X-108C Fire Training was constructed in the mid-1990s and is operational. The X-108B Facility and the X-616 Facility are no longer used and are slated to be demolished. The X-616 Lagoons originally were sludge lagoons associated with the X-616 Facility. These lagoons were contaminated with chromium. The site was remediated and backfilled in 1989.

### **1.2.3 Previous Investigations**

The Lithium Warehouse Site is within Quadrant III. Environmental characterization of Quadrant III has been completed, and a summary of the characterization of the Lithium Warehouse Site area is addressed in Sect. 4.1 and in more detail in Appendix A. Sampling and analysis for metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and radioactivity were performed. As documented in the Quadrant III CAS/CMS Final Report, no further corrective action evaluation is required for the following SWMUs within/adjacent to the Lithium Warehouse Site:

- X-616 Effluent Control Facility/Former Chromium Sludge Lagoons
- X-744S, X-744T, and X-744U Warehouses
- X-6619 Sewage Treatment Facility

Nearby SWMUs, X-230J3 West Environmental Sampling Building/Intermittent Containment Basin and X-740 Waste Oil Handling Facility, have contamination. However, these sites pose little risk to the DUF6 Conversion Facility Lithium Warehouse Site.

Prior geotechnical characterization of the DUF6 site and surrounding area was performed as a part of the GCEP Program. GCEP site geotechnical characterization is also addressed in Appendix A.

## **1.3 REPORT ORGANIZATION**

The DUF6 PORTS site field characterization activities performed by Tetra Tech, Inc., during the summer of 2000 and the analytical results are included in this report. Geotechnical properties for soils, potential chemical and radiological contamination of soil, and building/warehouse characterization are addressed. The report includes the following chapters:

- Chapter 1 Introduction
- Chapter 2 Study Area Investigation
- Chapter 3 Physical Characteristics
- Chapter 4 Results
- Chapter 5 Summary
- Chapter 6 References

The appendixes include existing characterization information (information that existed before DUF6 site field characterization), detailed information supporting field characterization, and assessments and data that support preparation of an EIS. Contents of each appendix are as follows:

- Appendix A Historical Data
- Appendix B Site Definition and Mapping for DUF6 Conversion Facility
- Appendix C Miscellaneous Environmental Impact Statement Data

- Appendix D Utility Assessment
- Appendix E Transportation Assessment and Future Planning
- Appendix F Borehole Lithological Logs
- Appendix G Analytical Data
- Appendix H Quality Assurance/Quality Control Evaluation Results

## 2. STUDY AREA INVESTIGATION

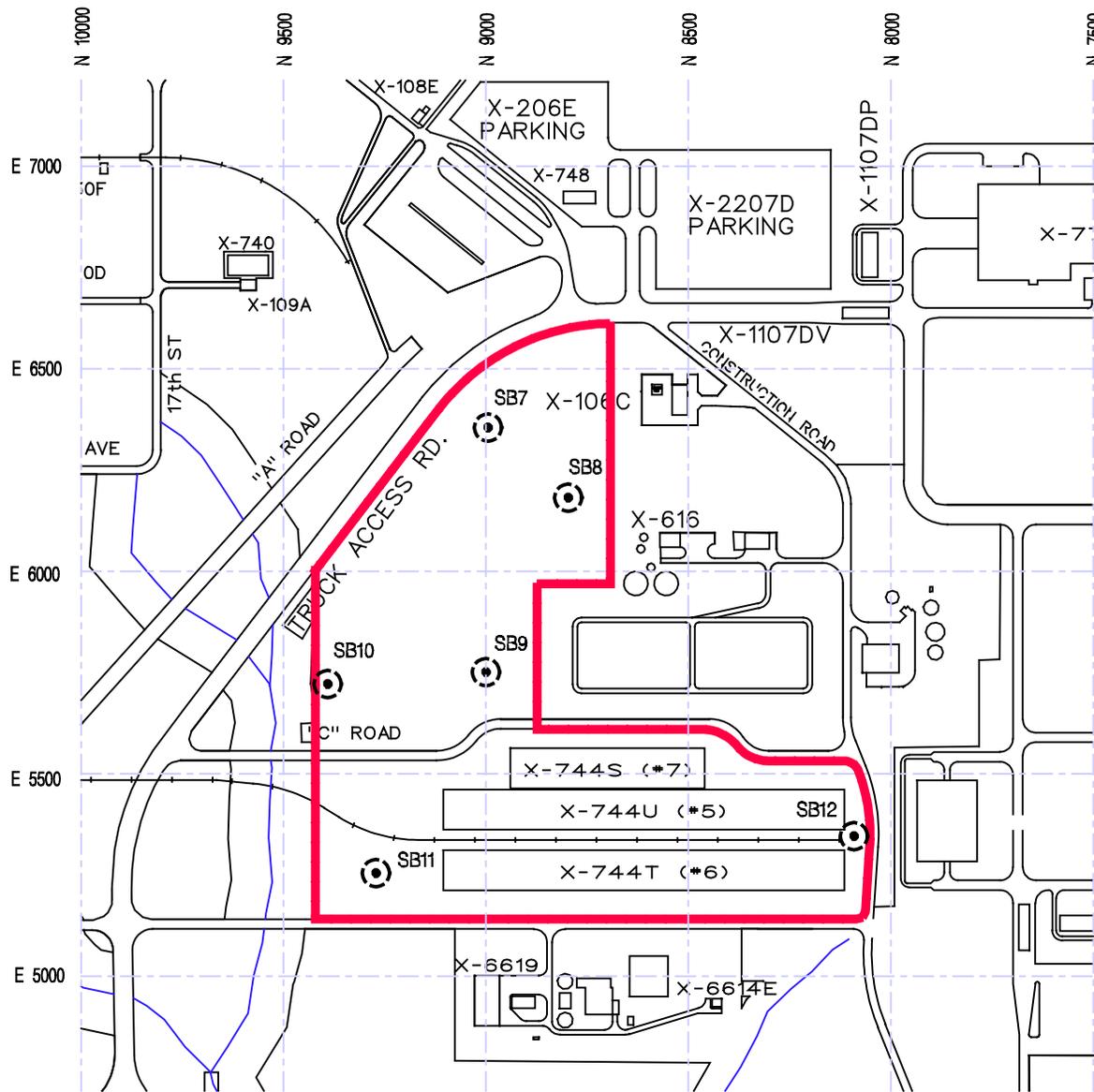
This chapter presents a description of the field investigation activities, methods, and laboratory analyses performed during the site characterization work at the proposed DUF6 Conversion Facility site. Field activities for the site characterization included geophysical surveys for the purpose of penetration permitting and surface and subsurface soil sampling for environmental and geotechnical characteristics. Six soil borings were completed during the characterization (SB-7 through SB-12). The borings were installed in the west-central portion of the Portsmouth facility near the Lithium Warehouses X-744S, X-744T, and X-744U. Soil boring locations are shown in Fig. 2.1. Because of the large historical database resulting from previous site characterization activities in the study area, no additional groundwater investigation or sampling, and no analyses of soils for inorganic/metal analytes were performed during this investigation. A summary of the previous investigations, along with the conclusions reached based on the previous analytical results, is provided in Appendix A.

### 2.1 GEOPHYSICAL INVESTIGATION

Geophysical methods were used (August 2–4, 2000) to investigate the presence of underground utilities at six boring locations near the Lithium Warehouse Site. The buildings at the site are used for storing containerized lithium hydroxide monohydrate. The remainder of the proposed site is a relatively flat, grassy field. Ground-penetrating radar (GPR) and electromagnetic (EM) metal detection (EM61) techniques were used at each location.

A GSSI System 2 GPR device equipped with a 400-MHz transducer was used to investigate the presence of metallic and nonmetallic pipes, utilities, and cables. GPR data were collected in a 25-ft radius around each boring location along north-south and east-west trending survey lines that were spaced approximately 12.5 ft apart. Some areas required additional data coverage to further define the site features. Data were collected by dragging the transducer across the area of interest at a slow walking pace. The color display was continuously monitored during data collection so that anomalously high amplitude reflections could be delineated. Anomalies were marked with pin flags and 6-in. wooden stakes with nails and large metal washers.

A Geonics EM61 High Sensitivity Metal Detector meter (EM61) was used to investigate the presence of underground utilities near the proposed boring locations. The EM61 is a high sensitivity, high resolution, time-domain metal detector which is used to detect both ferrous and nonferrous metallic objects. The EM61 data were collected in a 25-ft radius around the boring locations along north-south and east-west trending survey lines that were spaced approximately 12.5 ft apart. Some areas required additional data coverage to further define the site features. Data were collected with the instrument in automatic data collection mode. Measurements were made each second. Anomalies were marked with pin flags and 6-in. wooden stakes with nails and large metal washers. A more complete description of the geophysical survey and results are included in Appendix B.



**Fig. 2.1. Boreholes drilled at Lithium Storage Facility site.**

## **2.2 SOIL SAMPLING**

### **2.2.1 Surface Soil Sampling**

Surface soil samples were collected for analytical parameters at each soil boring using decontaminated, 24-in., stainless steel split-spoon samplers pushed or driven by the Mobile B-61 drill rig before the initiation of hollow stem auger drilling. Collection of surface soil samples was performed in accordance with the project Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) (BJC 2000), and in accordance with procedure TT-DE-PTSA-4201 for surface soil sampling.

Surface soil samples were collected from the ground surface to an approximate depth of 12 in. at each borehole location and analyzed for VOCs, SVOCs, and PCBs. In addition, soil samples were collected for the analysis of radioactive constituents: gross alpha/gross beta counts, 14 elements using alpha spectroscopy, 2 elements using beta liquid scintillation counting (LSC), and 13 elements using gamma spectroscopy. Generally, the soils collected for radioactive analyses were taken from the surface down to a depth of 24 in. Soil sampling was completed with either one or two split spoons, dependent upon soil recovery.

The drilling locations were staked and cleared of all utilities before penetrating the subsurface. The borehole area was prepared by laying plastic sheeting on the ground to collect soil cuttings from the drilling operation. A safe work or exclusion zone was established before work began at each drilling location. A stainless steel split-spoon was used to obtain the required sample volume. The soils contained in the split-spoon samplers were screened with a photoionization detector (PID) before collection for VOC analysis and immediately sealed with minimum headspace in the sample container. The remaining soil was placed in a stainless steel bowl, homogenized, and placed in the appropriate sample containers for nonvolatile parameters in accordance with procedure TT-DE-PTSA-4204, "Composite Sample Preparation."

### **2.2.2 Subsurface Soil Sampling**

Soil borings were completed at the proposed DUF6 Conversion Facility site using 4.25-in. ID hollow stem augers. Decontaminated split-spoon samplers were used to collect subsurface soil samples through the hollow stem augers. The Mobile B-61 drill rigs' 140-lb downhole hammer was used with a 30-in. drop as specified by the American Society for Testing and Materials (ASTM) Method D-1586. The number of blows required to drive the split-spoon soil sampler through each 6-in. increment was recorded (refusal occurred when little or no progress was made after 50 blows of the hammer). The contents of the spoon were described on field forms after split-spoon retrieval. Soil cuttings were placed on plastic sheeting located near the borehole and were returned downhole upon completion of the drilling activities at each individual borehole. Detailed notes were recorded in the field logbook concerning soil sample collection. A decontaminated split-spoon was used each time a sample was collected. Collection of subsurface soil samples was in accordance with Tetra Tech procedure TT-DE-PTSA-4202 for subsurface soil sampling with the exception that 125-mL glass jars were used to collect subsurface soil samples for VOC analysis.

Subsurface soil samples were collected at 5-ft-depth intervals down to the top of bedrock. The samples were collected in the same manner and analyzed for the same constituents as were the surface soil samples. Five intervals were sampled from each of the soil borings with the exception of SB-10 and SB-12, where only four intervals were sampled. This occurred as a result of bedrock refusal. In addition, an offset boring was installed at SB-12 to collect soil from an

intermediate sampling interval (7 to 9 ft). This was performed because PID recordings of ambient air at the borehole reached a level of approximately 95 ppm and soil headspace reached a level of approximately 65 ppm. No change occurred in the lower explosive limit/oxygen level meter (LEL/O<sub>2</sub>) during air monitoring activities at the borehole of SB-12.

All soil borings terminated at bedrock at depths ranging from 19 to 29 ft below ground surface (bgs). A thin, perched groundwater zone was encountered at four of the borings (SB-7, SB-10, SB-11, and SB-12) at depths ranging from 11 to 20 ft bgs. Table 2.1 summarizes all soil sampling performed in the DUF6 Site Characterization at the Lithium storage warehouses.

**Table 2.1. Environmental soil sampling summary**

<b>Borehole No.</b>	<b>Date collected</b>	<b>Sample interval (ft bgs)</b>	<b>PEMS<sup>a</sup> sample ID</b>
SB-7	08/09/00	0-2	UF00-SB7-0005
		5-7	UF00-SB7-0510
		10-12	UF00-SB7-1015
		15-17	UF00-SB7-1520
		20-22	UF00-SB7-2025
SB-8	08/10/00	0-2	UF00-SB8-0005
		5-7	UF00-SB8-0510
		10-12	UF00-SB8-1015
		15-17	UF00-SB8-1520
		20-22	UF00-SB8-2025
SB-9	08/10/00	0-2	UF00-SB9-0005
		5-7	UF00-SB9-0510
		10-12	UF00-SB9-1015
		15-17	UF00-SB9-1520
		20-22	UF00-SB9-2025
SB-10	08/11/00	0-2	UF00-SB10-0005
		5-7	UF00-SB10-0510
		10-12	UF00-SB10-1015
		15-17	UF00-SB10-1520
SB-11	08/11/00	2-4	UF00-SB11-0005
		5-7	UF00-SB11-0510
		10-12	UF00-SB11-1015
		15-17	UF00-SB11-1520
		20-22	UF00-SB11-2025
SB-12	08/12/00	0-2	UF00-SB12-0005
		5-7	UF00-SB12-0510
		7-9	UF00-SB12-0709
		10-12	UF00-SB12-1015
		15-17	UF00-SB12-1520

<sup>a</sup>Project Environmental Measurements System

### 2.3 GEOTECHNICAL SAMPLING

Soil samples were collected to determine geotechnical properties from three boring locations during the DUF6 Site Characterization. The geotechnical borings were performed at locations SB-7, SB-9, and SB-11 to provide the greatest spatial variation across the site and were installed as an offset boring from the original environmental borehole. Geotechnical soil samples were collected to determine standard soil classification, moisture content, soil plasticity, grain size analysis, California Bearing Ratio, and shear strength. Seven 3.5-gal pails of soil were collected from each of the three geotechnical borings. Five pails were collected from the surface (to a depth of about 2 ft) and two pails were collected from a deeper interval. The pails collected from the deeper intervals were collected using soil cuttings generated from hollow stem auger drilling. Generally, the deeper sample represented the interval with the most notable change in lithology.

In addition, two Shelby tubes were driven at each geotechnical borehole location. One tube was pushed from the surface to a depth of 30 in. and one was pushed from a deeper interval (the same interval used for collecting the soil cuttings for the pails). Table 2.2 summarizes the geotechnical sampling performed for the DUF6 Site Characterization at the Lithium storage warehouses at PORTS.

**Table 2.2. Geotechnical soil sampling summary**

Borehole No.	Date collected	Interval (ft bgs)	3.5-gal pails	Shelby tubes
SB-7	08/10/00	0-2	5	1
	08/10/00	5-7	2	1
SB-9	08/11/00	0-2	5	1
	08/11/00	12-14	2	1
SB-11	08/11/00	0-2	5	1
	08/11/00	7-9	2	1
<b>Totals</b>			<b>21</b>	<b>6</b>

### 2.4 QUALITY ASSURANCE/QUALITY CONTROL SAMPLING

Duplicate soil samples were collected from the stainless steel split spoons at a rate of 10%. Three soil sample intervals were duplicated and analyzed at the organics laboratory for VOC, SVOC, and PCB content. One matrix spike/matrix spike duplicate (MS/MSD) soil sample was collected for VOC, SVOC, and PCB analyses. Soil samples were also duplicated for the USEC laboratory for radioisotope analyses. However, MS/MSD samples were not required for the radioisotope analysis.

Rinsate samples were collected from decontaminated, stainless steel, split-spoon samplers on two separate occasions. High-performance liquid chromatography (HPLC) water provided by Fisher Scientific (Lot No. 000976) was poured over a decontaminated, open split-spoon sampler and into the sample containers. The rinsate samples were analyzed for the same parameters as the environmental samples.

A field blank, or source blank, was collected to ensure the quality of the potable water used during drill rig, auger, and spoon decontamination. A fire hydrant (Portsmouth Hydrant No. PL-H3S) located off Martin Avenue southeast of Building X-3346 was used for source potable water during the entire investigation. The field blank sample was collected through a garden hose connected to the poly tank located on the drilling contractor's support vehicle. One field blank was collected and analyzed for the same parameters as the environmental samples.

Trip blanks provided by the organics laboratory were used with all sample coolers containing VOC samples. Only one trip blank was needed for the field program. The number associated with the trip blank corresponds to the soil boring number where the trip blank was first used in the field. Table 2.3 summarizes all quality assurance (QA)/quality control (QC) samples associated with the DUF6 Site Characterization at the Lithium Warehouse Site.

**Table 2.3. Quality assurance/quality control sample summary**

<b>QA/QC sample</b>	<b>Date collected</b>	<b>PEMS sample ID</b>
Duplicate (soil)	08/10/00	UF00-SB8-0005D
Duplicate (soil)	08/10/00	UF00-SB9-0005D
Duplicate (soil)	08/11/00	UF00-SB10-0005D
MS/MSD (soil)	08/11/00	UF00-SB10-0005D <sup>a</sup>
Rinsate blank (aqueous)	08/11/00	RB03
Rinsate blank (aqueous)	08/12/00	RB04
Field blank (aqueous)	08/09/00	FB01
Trip blank (aqueous)	08/11/00	TB11

<sup>a</sup>Indicated on chain of custody as "MS/MSD"

### **3. PHYSICAL CHARACTERISTICS**

#### **3.1 GEOLOGY**

The geologic units in the Lithium storage warehouse area that influence the near-surface geology include the Berea Sandstone, the Sunbury Shale, the Gallia Sand, and the Minford Silt. The Berea Sandstone and the Sunbury Shale are the consolidated rock units that underlie most of PORTS. However, the Sunbury Shale is eroded and missing along the western portion of PORTS. Weathered shale, sandstone, and siltstone combine to form the Sunbury/Berea interface throughout much of the site. The Gallia Sand and the Minford Silt are the unconsolidated units that immediately underlie the ground's surface at PORTS facility.

The Gallia consists of coarse sand and some gravel in a matrix of finer clay and silt that grade into the Minford Silt. The Gallia and the Minford comprise the unconsolidated Gallia water-bearing zone at PORTS and generally occur to a depth of 15 to 25 ft throughout. Well-developed soil horizons are often not present, partly as a result of cut-and-fill practices. The predominant lithology of the Minford can be described as a reddish-brown to light-brown clay with varying amounts of silt. The clays present in the Minford varied from slightly plastic to medium plasticity resulting in large part to the moisture content present. The transition between the Minford and the Gallia is difficult to determine; the Gallia is a poorly sorted, silty, clayey sand, and gravel mixture.

Although most of PORTS has been affected by cut-and-fill grading activities, with reported depths ranging to about 10 ft, grading activities appear less prominent near the Lithium storage warehouses because the site is bordered along the northwest by what appears to be a natural, intermittent creek. Where present, the fill material is not distinguishable from the undisturbed Minford. During the investigation, the depth to shale and sandstone refusal occurred between 19 and to 29 ft bgs near the Lithium storage warehouses.

#### **3.2 GROUNDWATER**

Groundwater flow at PORTS occurs in two principle water-bearing units and two aquitards. One water-bearing unit is located in bedrock in the Berea Sandstone and the other is located in the overlying, unconsolidated material near the Minford Silt and Gallia Sand interface. The discontinuous Sunbury shale that overlies the Berea Sandstone is described as an aquitard (DOE 1998). This Sunbury aquitard is present under the eastern areas of PORTS but thins and is missing beneath the western side of the facility. Where it is present, strong vertical gradients exist as the intervening shale retards groundwater flow. Where it is missing, the two water-bearing units are hydraulically connected and an upward gradient exists in discharge areas. The unconsolidated clay and silt of the Minford, which is present across all of PORTS, is also known to have poor water-transmitting properties and is considered an aquitard.

The discontinuous, water-bearing unit in the unconsolidated material located near the Lithium storage warehouses ranges from about 14 to 21 ft bgs, and it appears to correlate with the Gallia water-bearing zone. The Gallia water-bearing zone generally exhibits a low average hydraulic conductivity of 3.4 ft/day (DOE 1998). However, much greater hydraulic conductivity has been measured at PORTS with values up to 150 ft/day. The higher values occur in regions where the Gallia sand and gravel thicken (DOE 1998). Groundwater flow direction in the unconsolidated Gallia and in the Berea Sandstone in the west-central portion of the facility near

the Lithium storage warehouses is toward the west as both aquifers discharge where they are incised by the West Drainage Ditch. Recharge to both aquifer zones is indicated by potentiometric highs located more to the east in the interior portion of PORTS.

Groundwater modeling was conducted for the Waste Oil Handling Facility, X-740, in the Quadrant III CAS/CMS Report (DOE 1998). This site is located just to the northeast of the proposed DUF6 site. The hydrologic model developed for site X-740 indicates that the Gallia aquifer zone is discontinuous and less than about 2 ft thick, and that the Sunbury aquitard is absent in the area. Recharge from precipitation in unpaved areas was initially assigned a range of 2 to 4 in./year (although previous empirical estimates ranged from 8.9 to 13.9 in./year). An effective porosity of 20% was assigned to the silt and sand units of the Minford and Gallia, and a value of 10% was used for the Sunbury and Berea units. A material bulk density of 1.65 g/cm<sup>3</sup> was assumed for the Gallia aquifer and the arithmetic mean organic carbon fraction for the aquifer matrix was reported to be 0.041 percent.

## 4. RESULTS

### 4.1 NATURE AND EXTENT OF CONTAMINATION

The purpose of this data evaluation is to supplement previous investigations conducted at the proposed DUF6 facility location. The data generated during the summer 2000 investigation are intended to identify potential contaminants likely to be related to former or current activities at the site that were not thoroughly evaluated during previous investigations at the site. On this basis, the analytical program described below was focused on a limited set of constituents.

#### 4.1.1 Data Evaluation

All samples were collected in accordance with the project work plan (BJC 2000). Soil collected from drilling and sampling operations during the DUF6 Site Characterization were analyzed at RECRA Environmental Inc. laboratory located in Lionville, Pennsylvania. In addition, aqueous samples associated with QA/QC protocol (rinse blanks, trip blanks, and field blanks) were analyzed at RECRA. Analyses were performed on the soil and water associated with the characterization following EPA SW-846, 3<sup>rd</sup> Edition (1986) methodologies. VOCs were analyzed according to criteria set forth in Method 8260B, SVOCs according to Method 8270C, and PCBs according to Method 8082. Radionuclides were analyzed using gross alpha/beta counts, alpha spectroscopy, beta LSC, and gamma spectroscopy, as appropriate. Tables 4.1 and 4.2 list the individual organic and metal/radionuclide constituents that were analyzed, respectively, and their Chemical Abstracts Service (CAS) registry numbers. The sampling procedures and results were evaluated for precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters and found to meet the criteria in the work plan (see Appendix H). The analytical methods and results were deemed appropriate and adequate for use in this site characterization report of the DUF6 Conversion Facility.

#### Quantitation Limit and Site-Related Constituents

Samples were collected from surface and subsurface soil media at the site. All samples from each medium were analyzed for VOCs, SVOCs, PCBs, uranium, and a broad spectrum of radionuclides common to the PORTS site. The sample quantitation limits (SQLs) reported by the laboratory met the project requirements; therefore, no uncertainty in the data analysis is associated with the reported SQLs.

The data were next examined to determine if organic compounds, metal analytes, or radionuclides were detected in any medium sampled (i.e., surface or subsurface soil). Because the SQLs were consistent with EPA methods used to analyze the samples and lower than background concentrations used to evaluate the site (i.e., site screening), any constituent that was not detected in a medium was not evaluated further in the nature and extent discussion. These constituents were therefore eliminated as potential site-related constituents (SRCs). If a constituent was detected in at least one environmental medium, it was considered to be a potential SRC and retained for further discussion in the nature and extent of contamination evaluation. The complete list of results for all constituents analyzed is presented in tables for each medium in Appendix G. Tables are presented in the following section only for potential SRCs.

**Table 4.1. Organic compounds analyzed**

Analytical fraction	CAS No.
<i>Volatiles</i>	
Vinyl Chloride	75-01-4
1,1-Dichloroethene	75-35-4
Chloroform	67-66-3
1,2-Dichloroethene	107-06-2
2-Butanone	78-93-3
Carbon Tetrachloride	56-23-5
Trichloroethene	79-01-6
Benzene	71-43-2
Tetrachloroethene	127-18-4
Chlorobenzene	108-90-7
<i>Semivolatiles</i>	
Pyridine	110-86-1
1,4-Dichlorbenzene	106-46-7
2-Methylphenol	95-48-7
3- and/or 4-Methylphenol	106-44-5
Hexachloroethane	67-72-1
Nitrobenzene	98-95-3
Hexachlorobutadiene	87-68-3
2,4,6-Trichlorophenol	88-06-2
2,4,5-Trichlorophenol	95-95-4
2,4-Dinitrotoluene	121-14-2
Hexachlorobenzene	118-74-1
Pentachlorophenol	87-86-5
<i>PCBs</i>	
Aroclor-1016	12674-11-2
Aroclor-1221	11104-28-2
Aroclor-1232	11141-16-5
Aroclor-1242	53469-21-9
Aroclor-1248	12672-29-6
Aroclor-1254	11097-69-1
Aroclor-1260	11096-82-5

**Table 4.2. Metal/radionuclide constituents analyzed**

<b>Metal/isotope</b>	<b>CAS No.</b>
Uranium	
Alpha activity	
Beta activity	
Actinium-227	014952-40-0
Actinium-228	014331-83-0
Americium-241	014596-10-2
Bismuth-212	014913-49-6
Bismuth-214	014733-03-0
Cesium-134	013967-70-9
Cesium-137	010045-97-3
Cobalt-60	010198-40-0
Lead-210	014255-04-0
Lead-212	014255-04-0
Lead-214	015067-28-4
Neptunium-237	013994-20-2
Plutonium-238	013981-16-3
Plutonium-239/240	015117-48-3/014119-33-6
Protactinium-231	014331-85-2
Protactinium-234	015100-28-4
Potassium-40	013966-00-2
Radium-223	015623-45-7
Radium-224	013233-32-4
Radium-226	013982-63-3
Radium-228	015262-20-1
Strontium-90	010098-97-2
Technetium-99	014133-76-7
Thallium-208	014913-50-9
Thorium-228	014274-82-9
Thorium-229	015594-54-4
Thorium-230	014269-63-7
Thorium-231	014932-40-2
Thorium-232	07440-29-1
Thorium-234	015065-10-8
Uranium-233/234	013968-55-3/013966-29-5
Uranium-235	015117-96-1
Uranium-238	007440-61-1

**Data Qualifier Summary**

All sample data used in this characterization were generated by an approved laboratory and approximately 10% of all samples were third-party validated by NFT, Inc., in accordance with EPA Functional Guidelines for Organic and Inorganic Data (EPA 1994a, 1994b). The samples that were validated include the surface and subsurface samples from borings SB7, SB8, and SB12. Both the laboratory and the independent data validation processes used a system of codes and data qualifiers (hereafter referred to as qualifiers) that pertain to QA/QC issues and may indicate questions regarding constituent identity, concentration, or both. Nonvalidated results were provided with only laboratory-applied qualifiers (Table 4.3).

**Table 4.3. Laboratory qualifiers**

<b>Qualifier</b>	<b>Definition</b>
<i>Metal</i>	
<b>B</b>	Method blank not statistically different from sample at 95% level of confidence.
<b>J</b>	Indicates an estimated value.
<b>R</b>	Tracer recovery is <30% or >150%.
<b>U</b>	Analyte analyzed for but not detected.
<i>PCBs</i>	
<b>U</b>	Indicates that the compound was analyzed for but not detected. The minimum detection limit for the sample (not the method detection limit) is reported with the U (e.g., 10U).
<b>J</b>	Indicates an estimated value. This flag is used in cases where a target analyte is detected at a level less than the lower quantification level. If the limit of quantification is 10 µg/L and a concentration of 3 µg/L is calculated, it is reported as 3J.
<b>B</b>	This flag is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination.
<b>E</b>	Indicates that the compound was detected beyond the calibration range and was subsequently analyzed at a dilution.
<b>I</b>	Interference.
<i>Semivolatiles</i>	
<b>U</b>	Compound was analyzed for but not detected. The associated numerical value is the estimated sample quantitation limit which is included and corrected for dilution and percent moisture.
<b>J</b>	Indicates an estimated value. This flag is used under the following circumstances: (1) when estimating a concentration for tentatively identified compounds (TICs) where a 1:1 response is assumed, or (2) when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the specified detection limit but greater than zero. For example, if the limit of detection is 10 µg/L and a concentration of 3 µg/L is calculated, it is reported as 3J.
<b>B</b>	This flag is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination. This flag is also used for a TIC as well as for a positively identified Target Compound List (TCL) compound.
<b>E</b>	Indicates that the compound was detected beyond the calibration range and was subsequently analyzed at a dilution.
<b>D</b>	Identifies all compounds identified in an analysis at a secondary dilution factor.
<b>I</b>	Interference.
<b>NQ</b>	Result qualitatively confirmed but not able to quantify.
<b>N</b>	Indicates presumptive evidence of a compound. This flag is only used for TICs, where identification is based on a mass spectral library search. It is applied to all TIC results. For generic characterization of a TIC, such as chlorinated hydrocarbon, the N code is not used.
<b>X</b>	This flag is used for a TIC which is quantified relative to a response factor generated from a daily calibration standard (rather than quantified relative to the closest internal standard).
<b>Y</b>	Additional qualifiers used as required are explained in the case narrative.
<i>Volatiles</i>	
<b>U</b>	Indicates that the compound was analyzed for but not detected. The minimum detection limit for the sample (not the method detection limit) is reported with the U (e.g., 10U).
<b>J</b>	Indicates an estimated value. This flag is used under the following circumstances: (1) when estimating a concentration for TICs where a 1:1 response is assumed, or (2) when the mass spectral data indicate the presence of a compound that meets the identification criteria but the result is less than the specified detection limit but greater than zero. For example, if the limit of detection is 10 µg/L and a concentration of 3 µg/L is calculated, it is reported as 3J.

**Table 4.3. (continued)**

<b>Qualifier</b>	<b>Definition</b>
<b>B</b>	This flag is used when the analyte is found in the associated blank as well as in the sample. It indicates possible/probable blank contamination. This flag is also used for a TIC as well as for a positively identified TCL compound.
<b>E</b>	Indicates that the compound was detected beyond the calibration range and was subsequently analyzed at a dilution.
<b>D</b>	Identifies all compounds identified in an analysis at a secondary dilution factor.
<b>I</b>	Interference.
<b>NQ</b>	Result qualitatively confirmed but not able to quantify.
<b>N</b>	Indicates presumptive evidence of a compound. This flag is only used for TICs, where identification is based on a mass spectral library search. It is applied to all TIC results. For generic characterization of a TIC, such as chlorinated hydrocarbon, the N code is not used.
<b>X</b>	This flag is used for a TIC which is quantified relative to a response factor generated from a daily calibration standard (rather than quantified relative to the closest internal standard).
<b>Y</b>	Additional qualifiers used as required are explained in the case narrative.

The following qualifiers (Table 4.4) were attached to the validated data by the independent data validation team that reviewed approximately 10% of all the data as described above.

**Table 4.4. Validation qualifiers**

<b>Qualifier</b>	<b>Definition</b>
<b>U</b>	The material was analyzed for, but was not detected. The associated numerical value is the quantitation limit.
<b>J</b>	Estimated value, either because QC criteria were not met or because the amount detected is below the documented quantitation limit.
<b>UJ</b>	Undetected but the number reported as the quantitation limit is an estimated value.
<b>NJ</b>	Presumptively present at an estimated quantity.
<b>R</b>	Rejected, so data are of "information only" quality and should be supplemented with additional data for decision making.
<b>=</b>	Data were validated; however, no qualifier was added.
<b>X</b>	Data were not validated.

### **Blank Contaminant Evaluation**

Rinsate, field, and trip blank samples were collected during the field sampling event. The blank samples were collected, preserved, shipped, and handled by the field team and the laboratory in the same manner as the environmental media samples with which they are associated. Blank samples were also analyzed along with and in the same manner as the environmental samples as part of the sampling and analysis QC program.

Blank samples analyses provided a measure of contamination that may have been introduced into a sample either (1) in the field while the samples were being collected or transported to the laboratory or (2) in the laboratory during sample preparation or analysis. Therefore, constituents detected in the blank samples were compared with the constituents detected in the environmental media samples to prevent the inclusion of non-SRCs in the evaluation.

The EPA (1989) has identified several constituents that are considered to be common laboratory contaminants: acetone, methyl ethyl ketone, methylene chloride, toluene, and phthalate esters. Therefore, unless there was compelling evidence that these chemicals had been released at the site, these constituents were not considered to be SRCs.

## Background Comparisons

In some circumstances, concentrations of certain constituents may be present in environmental media that are not SRCs. These “background” concentrations may arise from two conditions: (1) naturally occurring constituents that have not been influenced by humans and (2) constituents that are present due to anthropogenic sources. Therefore, a comparison of the concentrations of constituents in environmental samples to background concentrations was included in this site characterization. Comparison with naturally occurring background concentrations was only performed for uranium and radiological constituents in soil. All organic constituents detected at the site are considered to be contaminants unless they can be attributed to anthropogenic sources or are investigation induced (e.g., blank contamination, laboratory contaminants).

Background samples were not specifically collected from the DUF6 Conversion Facility site during the summer 2000 site characterization field investigation; however, background concentrations for soil at PORTS have been published (DOE 1996). The published surface and subsurface soil background concentrations used in this report are the 95 percent confidence upper tolerance limits, and represent the maximum concentration of naturally occurring constituents that would be expected in background at a 95 percent level of confidence. The background report did not present separate background concentrations for surface and subsurface soils; rather, soils from less than 2 ft depth (i.e., surface soil), and from 10 ft depth (i.e., subsurface soil) were used together in the background calculations. A summary table of the PORTS background concentrations for surface soil and subsurface soil is presented in Appendix G.

## Summary of Previous Investigations

The proposed site for the DUF6 facility encompasses the area of the existing Lithium Storage Warehouses (X-744S, T, and U) and an open area to the north and northeast of these facilities. The X-744S, T, and U facilities, and several other surrounding facilities were each investigated as part of the Quadrant III RI and CAS/CMS activities. The RI and CAS/CMS recommendations for these sites are summarized in Table 4.5. The locations of these sites with respect to the proposed DUF6 facility are shown in Fig. 2.1.

**Table 4.5 Summary of RI and CAS/CMS Recommendations**

<b>SWMUs Referred to Decontamination and Decommissioning</b>	<b>SWMUs Requiring No Further Action</b>	<b>SWMUs Requiring Alternatives Developed in the CAS/CMS</b>
X-230J3 West Environmental Sampling Building and Intermittent Containment Basin	X-616 Effluent Control Facility/Former Chromium Sludge lagoons  X-744S, T & U Warehouses	X-740 Waste Oil Handling Facility (groundwater only)

X-230J3 was recommended for D&D because under current use scenarios the site was determined to have media-specific total noncancer risks with hazard indices (HI) generally less than 1.0 and excess lifetime cancer risks (ELCR) levels within the acceptable range of 1E-04 to 1E-06. In addition, contaminants at the site responsible for risk concerns are immobile, and on-site worker health and safety programs and routine monitoring are regarded as protective of human health and the environment. Furthermore, the site is located in an operational area in which remediation would be likely to disrupt ongoing production activities and would not be cost

effective due to the potential for recontamination. Therefore, it was concluded that site conditions at X-230J3 have little potential to impact the proposed DUF6 facility site under investigation.

The RFI baseline risk assessment (BRA) data (DOE 1996b) were carefully utilized by the PORTS Decision Team to evaluate the need for further corrective action. Their evaluation of the HI and the ELCR for cumulative cancer risks led to a finding that no further action was required for soil and groundwater at the X-616 and X-744S, T, and U facilities. Therefore, it was concluded that the existing site conditions have little potential to impact the proposed DUF6 facility for the same worker exposure scenarios developed in the BRA (i.e., current on-site worker, future on-site worker, and excavation worker).

As is implied by Table 4.5, only the X-740 site that is located approximately 1200 feet to the northeast of the Lithium Storage Warehouses was recommended for evaluation in the CAS/CMS, and only for groundwater. Contaminated soils at the site were removed during the site closure performed in 1993. PCB contamination in the soil was found to be below the proposed cleanup goal of 25 ppm (for areas within the Perimeter Road) and did not pose an undue health threat to the current on-site worker; therefore, PCB remediation was not required. Because the direction of groundwater flow from X-740 is westward toward the West Drainage Ditch (see Fig. 2.1) in both the Gallia and Berea aquifers, it is unlikely that the plume will at any point in the future extend beneath the proposed DUF6 Facility location.

A more detailed summary of the CAS/CMS findings, including contaminants of potential concern, chemical specific concentrations, and BRA characterizations, is provided for each of the sites discussed above in Appendix A. Summary tables listing the detections of constituents in surface soil, subsurface soil, and groundwater, collectively for the sites discussed above, are also presented in Appendix A. A summary of the constituents detected during the previous RI and CAS/CMS activities at the above sites are presented along with constituents detected during the current site characterization in Sect. 4.1.4.

#### **4.1.2 Surface Soil**

A total of six surface soil samples and three duplicate samples was collected from six soil borings located across the site (see Fig. 2.1). Surface soil samples were collected from the 0- to 2-ft depth interval at each soil boring location. All nine samples were analyzed for volatiles and semivolatiles, PCBs, uranium, and radionuclides. The complete listing of laboratory results is provided in Appendix G. Table 4.6 provides summary statistics for the detected constituents and lists PORTS background concentrations that were used for comparison with the detected concentrations of each constituent. Table 4.7 provides analytical results for all constituents detected in surface soil at the site; results that exceeded the PORTS background values are indicated in the table.

##### **Volatile Organic Compounds**

No VOCs were detected in the surface soil samples above the SQLs.

##### **Semivolatile Organic Compounds**

No SVOCs were detected in the surface soil samples above the SQLs.

**Table 4.6. Surface Soil Exceedance  
Proposed DUF6 Conversion Facility  
DUF6 Conversion Facility Site Characterization  
Portsmouth, OH**

Parameter	Frequency of Detections <sup>a</sup>	Minimum	Maximum	Minimum Non-detects	Maximum Non-detects	Background <sup>b</sup>	Exceedance Yes/No
<b>Metals (µg/g)</b>							
Uranium	8/9	1.5	2.9	2.1	2.1	4.8	No
<b>Radionuclides (pCi/g)</b>							
Actinium-228	3/9	1.5	1.6	0.15	2		NA
Alpha activity	9/9	2.7	5.2			4.79	Yes
Americium-241	1/9	0.054	0.054	-0.035	0.091		NA
Beta activity	9/9	4.4	7.5			8.5	No
Bismuth-212	1/1	1.8	1.8				NA
Bismuth-214	7/7	0.62	0.97				NA
Lead-210	4/4	1.3	2				NA
Lead-212	8/8	0.72	1.4				NA
Lead-214	1/1	0.67	0.67				NA
Potassium-40	7/7	6.9	12				NA
Radium-226	1/9	0.67	0.67	-0.16	1.5		NA
Radium-228	3/9	1.5	1.6	0.15	2		NA
Technetium-99	9/9	0.1	0.4				NA
Thallium-208	4/4	0.29	0.56				NA
Thorium-228	9/9	0.51	0.78				NA
Thorium-229	1/9	0	0	-0.0057	0.051		NA
Thorium-230	9/9	0.53	0.87				NA
Thorium-232	9/9	0.49	0.9				NA
Thorium-234	1/9	2.6	2.6	-0.0057	0.051		NA
Uranium-233/234	9/9	0.48	1.1				NA
Uranium-235	1/9	0.038	0.038	0.007	0.025		NA
Uranium-236	1/9	0.035	0.035	-0.0068	0.029		NA
Uranium-238	9/9	0.51	0.96				NA

NA - Criteria not available.

<sup>a</sup>Frequency of detection includes duplicate samples.

<sup>b</sup>PORTS background for soil taken from DOE 1996.

**Table 4.7. Surface Soil Hits**  
**Proposed DUF6 Conversion Facility**  
**DUF6 Conversion Facility Site Characterization**  
**Portsmouth, OH**

Sample ID	UF00-SB7-0005	UF00-SB8-0005	UF00-SB8-0005D	UF00-SB9-0005	UF00-SB9-0005D	UF00-SB10-0005	UF00-SB10-0005D	UF00-SB11-0005	UF00-SB12-0005
Sample Date	08/09/2000	08/10/2000	08/10/2000	08/10/2000	08/10/2000	08/11/2000	08/11/2000	08/11/2000	08/12/2000
<b>Metals (µg/g)</b>									
Uranium	2.1		1.9	1.5	2.1	2.8	2.9	1.6	1.6
<b>PCBs (µg/kg)</b>									
Decachlorobiphenyl	104	108	114	115	78	91	99		94
Tetrachloro-m-xylene	95	98	105	90	58	88	95		100
<b>Radionuclides (pCi/g)</b>									
Actinium-228	1.6		1.6 J						1.5 J
Alpha activity	3.4	5.2	3.9	3.7	3.5	3	3	3.3	2.7 J
Americium-241							.054 B		
Beta activity	4.5	7.5	6	6.4	6.1	6.8	4.4	6.5	6.5
Bismuth-212								1.8	
Bismuth-214	0.65	.87 J	.62 J	.81			.97	.87	.84 J
Lead-210	1.5 J	2 J	1.3 J						1.5 J
Lead-212	0.79	1	1	.72	1.4		.81	.99	0.91
Lead-214			.67 J						
Potassium-40	6.9 J	12	9.5	9.2	9.4		10	9.4	
Radium-226			.67 J						
Radium-228	1.6		1.6 J						1.5 J
Technetium-99	.2 J	.2 J	.1 J	.1	.1	.2	.4	.3	.1 J
Thallium-208	.29 J		.46 J		.35				.56 J
Thorium-228	0.75	0.78	0.7	.51 R	.57	.63	.57	.56	0.67
Thorium-229				0					
Thorium-230	0.87	0.53	0.69	.83 R	.77	.74	.74	.66	0.69
Thorium-232	0.49	0.68	0.72	.65 R	.9	.51	.64	.54	0.65
Thorium-234									2.6 J
Uranium-233/234	0.72	0.55	0.56	.48	.67	.89	1.1	.48	0.76
Uranium-235						.038			
Uranium-236				.035					
Uranium-238	0.69	0.7	0.63	.51	.72	.94	.96	.53	0.54

## Polychlorinated Biphenyls

No PCBs were detected in the surface soil samples above the SQLs.

## Uranium/Radionuclides

Uranium was detected in surface soil samples from all boring locations. The maximum concentration of uranium (2.9 µg/g) occurred at SB10 which is located in the north-central portion of the site (see Fig. 2.1). As shown in Table 4.6, none of the uranium detections in surface soil exceeded the background concentration of 4.8 µg/g.

Twenty-one radionuclides, alpha activity, and beta activity were detected in surface soils. As indicated in Table 4.6, eight of the isotopes (<sup>241</sup>Am, <sup>212</sup>Bi, <sup>214</sup>Pb, <sup>226</sup>Ra, <sup>229</sup>Th, <sup>232</sup>Th, <sup>235</sup>U, and <sup>236</sup>U) were infrequently detected (one out of nine samples); four isotopes (<sup>228</sup>Ac, <sup>210</sup>Pb, <sup>228</sup>Ra and <sup>208</sup>Tl) were detected in about one-third of the samples (three to four out of nine samples); and nine isotopes (<sup>214</sup>Bi, <sup>212</sup>Pb, <sup>40</sup>K, <sup>99</sup>Tc, <sup>228</sup>Th, <sup>230</sup>Th, <sup>232</sup>Th, <sup>233/234</sup>U, and <sup>238</sup>U) were detected in nearly all samples (e.g., seven or more out of nine samples). Alpha and beta activities were also detected in all surface soil samples. The maximum activity detected was 12 pCi/g of <sup>40</sup>K at location SB8.

As shown in Table 4.6, PORTS background values are only available for three of the constituents analyzed: uranium, alpha activity, and beta activity. Only one detection of alpha activity (5.2 pCi/g at SB8) exceeded the alpha background concentration of 4.79 pCi/g; none of the uranium or beta activity detections exceeded the soil background concentrations. The exceedance of alpha activity occurred at soil boring location SB8 located in the north-central portion of the site. It was noted that the alpha exceedance of 5.2 pCi/g at SB8 was within the range of alpha activity detected (i.e., 1 to 7 pCi/g) during the background characterization study (DOE 1996). Therefore, the alpha concentrations detected during the DUF6 site characterization are considered representative of background concentrations.

### 4.1.3 Subsurface Soil

A total of 23 subsurface soil samples was collected from 6 soil borings located across the site (see Fig. 2.1). Four samples were collected at each boring location with the exception that only three samples were collected at location SB-10. Subsurface soil samples were collected at approximate 5-ft-depth intervals down to a maximum depth interval of 20 to 25 ft. All 23 samples were analyzed for volatiles and semivolatiles, PCBs, uranium, and radionuclides. The complete listing of laboratory results is provided in Appendix G. Table 4.8 provides summary statistics for the detected constituents and lists PORTS background concentrations that were used for comparison with the detected concentrations of each constituent. Table 4.9 provides analytical results for all constituents detected in surface soil at the site; results that exceeded the PORTS background values are indicated in the table.

## Volatile Organic Compounds

No VOCs were detected in the subsurface soil samples above the SQLs.

## Semivolatile Organic Compounds

No SVOCs were detected in the subsurface soil samples above the SQLs.

**Table 4.8. Subsurface Soil Exceedance  
Proposed DUF6 Conversion Facility  
DUF6 Conversion Facility Site Characterization  
Portsmouth, OH**

PARAMETER	FREQUENCY OF DETECTIONS <sup>(a)</sup>	MINIMUM	MAXIMUM	MINIMUM NON-DETECTS	MAXIMUM NON-DETECTS	BACKGROUND <sup>(b)</sup>	EXCEEDANCE YES/NO
<b>Metals (µg/g)</b>							
Uranium	21/22	0.76	4.3	1.2	1.2	4.8	No
<b>Radionuclides (pCi/g)</b>							
Actinium-228	9/22	0.92	1.6	-0.15	1.6		NA
Alpha activity	22/22	1.6	5.2			4.79	Yes
Americium-241	9/22	0.028	0.41	0.0072	0.12		NA
Beta activity	22/22	3.3	7.8			8.5	No
Bismuth-212	1/1	3	3				NA
Bismuth-214	18/18	0.61	1.5				NA
Lead-210	6/6	1.2	2.3				NA
Lead-212	19/19	0.62	1.4				NA
Lead-214	9/9	0.82	2.2				NA
Potassium-40	21/21	5.3	15				NA
Radium-224	1/22	2.6	2.6	1.4	25		NA
Radium-226	10/22	0.88	2.2	-0.23	1.2		NA
Radium-228	9/22	0.92	1.6	-0.15	1.6		NA
Strontium-90	1/22	1	1	0	0.8		NA
Technetium-99	17/22	0.1	0.3	0.1	0.1		NA
Thallium-208	17/17	0.24	0.51				NA
Thorium-228	21/22	0.13	0.57	0.13	0.13		NA
Thorium-230	21/22	0.24	0.79	0.12	0.12		NA
Thorium-231	1/22	0.72	0.72	-3.3	0.57		NA
Thorium-232	22/22	0.2	0.56				NA
Thorium-234	5/22	1.5	2.3	-9.5	17		NA
Uranium-233/234	22/22	0.24	1.3				NA
Uranium-235	3/22	0.047	0.084	0	0.041		NA
Uranium-235 <sup>c</sup>	4/5	0.23	0.81	0.16	0.16		NA
Uranium-238	22/22	0.26	1.4				NA

NA - Criteria not available

<sup>a</sup>Frequency of detection includes duplicate samples

<sup>b</sup>PORTS background for soil taken from DOE 1996

<sup>c</sup>Uranium-235 analysis by gamma spectroscopy

**Table 4.9. Subsurface Soil Hits  
Proposed DUF6 Conversion Facility  
DUF6 Conversion Facility Site Characterization  
Portsmouth, OH**

<b>Sample ID</b>	<b>UF00-SB7-0510</b>	<b>UF00-SB7-1015</b>	<b>UF00-SB7-1520</b>	<b>UF00-SB7-2025</b>	<b>UF00-SB8-0510</b>	<b>UF00-SB8-1015</b>	<b>UF00-SB8-1520</b>	<b>UF00-SB8-2025</b>
<b>Sample Date</b>	08/09/2000	08/09/2000	08/09/2000	08/09/2000	08/10/2000	08/10/2000	08/10/2000	08/10/2000
<b>Sample Depth</b>	5' - 10'	10' - 15'	15' - 20'	20' - 25'	5' - 10'	10' - 15'	15' - 20'	20' - 25'
<b>Metals (µg/g)</b>								
Uranium	1.3	1.2	2.3	1.6	1.7 J	1.3	1.5	2.2
<b>PCBs (mg/kg)</b>								
Decachlorobiphenyl	107	109	103	94	103	97	112	90
Tetrachloro-m-xylene	80	85	105	92	90	80	102	72
<b>Radionuclides (pCi/g)</b>								
Actinium-228				1.1 J				
Alpha activity	3.4	3.7	3.8	3.3	3.5	2.1	1.9 J	3.9
Americium-241					0.061			0.1 J
Beta activity	4.4	6	4	5.3	7.8	5.6	4.3	5.3
Bismuth-212								
Bismuth-214		1.2 J	1.1 J	1.5	0.82 J	0.94 J	1.3	0.88 J
Lead-210		1.5 J	2.3 J	1.2			1.4	
Lead-212	1.3	0.87	0.84	1.1	0.95	1.1	1.2	1.2
Lead-214		1	0.88		1.2 J	0.82	1.3	
Potassium-40	14 J	15	15	9.3	13	12	13	13
Radium-224								
Radium-226		1 J	0.88 J		1.2 J	0.92 J	1.3 J	
Radium-228				1.1 J				
Strontium-90							1 J	
Technetium-99				0.2 J	0.2 J	0.2 J	0.2 J	
Thallium-208	0.51	0.41 J	0.32 J	0.34 J			0.43 J	0.46 J
Thorium-228	0.3	0.27 J	0.31	0.45	0.4	0.39	0.45	0.51
Thorium-230	0.29		0.79	0.52	0.46	0.27	0.43	0.7
Thorium-231								
Thorium-232	.22 J	0.2 J	0.4	0.44	0.38	0.34	0.33	0.49
Thorium-234	1.5 J	.			2.3 J		1.8 J	1.8 J
Uranium-233/234	0.39	0.36	0.89	0.39	0.6 J	0.29	0.51	0.63
Uranium-235								
Uranium-235 <sup>a</sup>					0.23			
Uranium-238	0.44	0.39	0.78	0.53	0.56 J	0.43	0.49	0.74

**Table 4.9. Subsurface Soil Hits**  
**Proposed DUF6 Conversion Facility**  
**DUF6 Conversion Facility Site Characterization**  
**Portsmouth, OH**  
**(Continued)**

<b>Sample ID</b>	<b>UF00-SB9-0510</b>	<b>UF00-SB9-1015</b>	<b>UF00-SB9-1520</b>	<b>UF00-SB9-2025</b>	<b>UF00-SB10-0510</b>	<b>UF00-SB10-1015</b>	<b>UF00-SB10-1520</b>	<b>UF00-SB11-0510</b>
<b>Sample Date</b>	08/10/2000	08/10/2000	08/10/2000	08/10/2000	08/11/2000	8/11/2000	08/11/2000	08/11/2000
<b>Sample Depth</b>	5' - 10'	10' - 15'	15' - 20'	20' - 25'	5' - 10'	10' - 15'	15' - 20'	5' - 10'
<b>Metals (µg/g)</b>								
Uranium	0.76	1.6	1.2	1.5	3.6	4.3	1.7	
<b>PCBs (mg/kg)</b>								
Decachlorobiphenyl	109	93	99	119		117	111	
Tetrachloro-m-xylene	95	72	75	105		108	98	
<b>Radionuclides (pCi/g)</b>								
Actinium-228	0.96	1.4			1.6	1.5	1	
Alpha activity	3.6	3.2	2.4	3.4	2.4	3.8	3.8	2.3
Americium-241			0.11 B	0.23				0.043 B
Beta activity	5.3	7.5	5.3	6.4	5.1	4.9	4.7	4.1
Bismuth-212								
Bismuth-214	0.89	1.3	0.72	1.1	0.61		0.81	1.2
Lead-210								
Lead-212	0.81		0.98	0.98			0.62	0.86
Lead-214					1.4		2.2	
Potassium-40	9.8	11	12	13	10	10	13	5.3
Radium-224								
Radium-226					1.4 J		2.2 J	
Radium-228	0.96	1.4			1.6	1.5	1	
Strontium-90								
Technetium-99	0.1	0.2	0.2	0.3	0.2	0.1		0.2
Thallium-208	0.44	0.37	0.34	0.37	0.36			0.45
Thorium-228		0.48	0.48	0.27	0.57	0.35	0.13	0.32
Thorium-230	0.24 B	0.35 B	0.44	0.46 B	0.77	0.43	0.36	0.36
Thorium-231								
Thorium-232	0.28	0.41	0.4	0.32	0.53	0.43	0.25	0.32
Thorium-234								
Uranium-233/234	0.24	0.44	0.52	0.58	1.2	1.3	0.47	0.39
Uranium-235		0.047				0.084	0.059	
Uranium-235 <sup>a</sup>					0.5		0.81	
Uranium-238	.26	.53	.41	.49	1.2	1.4	0.57	0.4

**Table 4.9. Subsurface Soil Hits**  
**Proposed DUF6 Conversion Facility**  
**DUF6 Conversion Facility Site Characterization**  
**Portsmouth, OH**  
(Continued)

Sample ID	UF00-SB11-1015	UF00-SB11-1520	UF00-SB11-2025	UF00-SB12-0510	UF00-SB12-0709	UF00-SB12-1015	UF00-SB12-1520
Sample Date	08/11/2000	08/11/2000	08/11/2000	8/12/2000	8/12/2000	8/12/2000	08/12/2000
Sample Depth	10' - 15'	15' - 20'	20' - 25'	5' - 10'	7' - 9'	10' - 15'	15' - 20'
<b>Metals (µg/g)</b>							
Uranium	1.8	2.1	2.3	1.3		1.5	0.8
<b>PCBs (mg/kg)</b>							
Decachlorobiphenyl				85	94	81	80
Tetrachloro-m-xylene				90	90	72	70
<b>Radionuclides (pCi/g)</b>							
Actinium-228	1	.92		1.1 J			
Alpha activity	1.6	2.6	3.5	2.6 J		5.2	2.2
Americium-241	0.028 B		0.036 B			0.41	0.091 B
Beta activity	3.3	7.5	4.3	5.8		6.5	4.1
Bismuth-212				3			
Bismuth-214		.79	1.4	0.91 J		0.97 J	
Lead-210				2.1 J		1.6 J	
Lead-212	0.94	1.4	0.81	0.65		0.75	0.99
Lead-214		1.3				0.96 J	
Potassium-40	8.2	12	6.4	11			10
Radium-224				2.6 J			
Radium-226	1.6 J	1.3 J				0.96 J	
Radium-228	1	.92		1.1 J			
Strontium-90							
Technetium-99	0.2	0.3	0.3	0.2 J		0.3	0.1
Thallium-208	0.4	0.34		0.24 J		0.32	0.49
Thorium-228	0.55	0.52	0.32	0.51		0.54	0.23
Thorium-230	0.45	0.51	0.49	0.72		0.69	0.38 B
Thorium-231						0.72 J	
Thorium-232	0.56	0.35	0.35	0.51		0.38	0.31
Thorium-234				2 J			
Uranium-233/234	0.49	0.43	0.81	0.54		0.57	0.27
Uranium-235							
Uranium-235 <sup>a</sup>		0.58					
Uranium-238	0.6	0.71	0.77	0.44		0.51	0.26

<sup>a</sup>U235 analysis by gamma-spec

Refer to Tables 4.3 and 4.4 for the explanation of qualifies.

Shading and bold denotes exceedance of background.

## Polychlorinated Biphenyls

No PCBs were detected in the subsurface soil samples above the SQLs.

## Uranium/Radionuclides

Uranium was detected in 21 out of 22 subsurface soil samples and was detected at all boring locations. The maximum concentration of uranium (4.3 µg/g) occurred at the 10- to 15-ft depth interval at SB10 which is located in the north-central portion of the site (see Fig. 2.1). As shown in Table 4.8, none of the uranium detections in surface soil exceeded the background concentration of 4.8 µg/g.

Twenty-two radionuclides, alpha activity, and beta activity were detected in subsurface soils. As indicated in Table 4.8, seven of the isotopes ( $^{212}\text{Bi}$ ,  $^{210}\text{Pb}$ ,  $^{224}\text{Ra}$ ,  $^{90}\text{Sr}$ ,  $^{231}\text{Th}$ ,  $^{234}\text{Th}$ , and  $^{235}\text{U}$ ) were infrequently detected (6 or less out of 22 samples); five isotopes ( $^{228}\text{Ac}$ ,  $^{241}\text{Am}$ ,  $^{214}\text{Pb}$ ,  $^{226}\text{Ra}$ , and  $^{228}\text{Ra}$ ) were detected in about one-half of the samples (9 to 10 out of 22 samples); and ten isotopes ( $^{214}\text{Bi}$ ,  $^{212}\text{Pb}$ ,  $^{40}\text{K}$ ,  $^{99}\text{Tc}$ ,  $^{208}\text{Tl}$ ,  $^{228}\text{Tn}$ ,  $^{230}\text{Th}$ ,  $^{232}\text{Th}$ ,  $^{233/234}\text{U}$ , and  $^{238}\text{U}$ ) were detected in all or nearly all of the 22 subsurface soil samples. Alpha and beta activities were also detected in all subsurface soil samples. The maximum activity detected was 15 pCi/g of  $^{40}\text{K}$  in the 10- to 15- and 15- to 20-ft-depth intervals at location SB-7. Uranium-235 was also detected in four out of five samples that were analyzed using the gamma-spectroscopy analysis method; the concentrations detected using this method were consistently higher than the alpha-spectroscopy method.

As shown in Table 4.8, PORTS background values are only available for three of the constituents analyzed: uranium, alpha activity, and beta activity. Only one detection of alpha activity (5.2 pCi/g at SB12) exceeded the background concentration of 4.79 pCi/g; none of the uranium or beta activity detections exceeded the soil background concentrations. It was noted that the alpha exceedance of 5.2 pCi/g at SB12 was within the range of alpha activity detected (i.e., 1 to 7 pCi/g) during the background characterization study (DOE 1996). Therefore, the alpha concentrations detected during the DUF6 site characterization are considered representative of background concentrations.

### 4.1.4 Soil Results Summary

The current DUF6 site characterization investigation was conducted in areas around and proximal to the exiting Lithium Storage Warehouses (X-744S, T, and U). Previous investigations performed during the Quadrant III RI showed little to no concern for VOCs, SVOCs, PCBs, inorganic, or radionuclide constituents in surface soils in the area under consideration. The limited soil analytical program conducted for the current site characterization focused on limited VOC, SVOC, or PCB constituents, and investigated the presence of a broad spectrum of radionuclides that were not previously evaluated. Collectively, the previous and current data provide a thorough evaluation of constituents that are present in soils at the proposed DUF6 Facility Site. A summary of the constituents detected in surface and subsurface soils during the current and historical phases of the investigations is provided in Tables 4.10 and 4.11. As shown in these tables there was little overlap in the analytical programs, with the exception of alpha and beta activity, uranium isotopes, and total uranium metal. For surface soils, the range of detection of alpha and beta activity, uranium isotopes, and total uranium metal fall within the range of non-detects and detects for the previous investigation (see Table 4.10). Therefore, the results are considered consistent, and as previously discussed, the maximum concentrations detected are

**Table 4.10**  
**Current and Historical Data Summary - Surface Soil Detection**  
**Proposed DUF6 Conversion Facility**  
**DUF6 Conversion Facility Site Characterization**  
**Portsmouth, OH**

Parameter	Current data <sup>(a)</sup>				Historical data <sup>(b)</sup>			
	Minimum non-detects	Maximum non-detects	Minimum detects	Maximum detects	Minimum non-detects	Maximum non-detects	Minimum detects	Maximum detects
<b>Radionuclides (pCi/g)</b>								
Actinium-228	0.15	2	1.5	1.6	(d)	(d)	(d)	(d)
Alpha activity	---	---	2.7	5.2	2	14	---	---
Americium-241	-0.035	0.091	0.054	0.054	(d)	(d)	(d)	(d)
Beta activity	---	---	4.4	7.5	1	11	---	---
Bismuth-212*	(c)	(c)	1.8	1.8	(d)	(d)	(d)	(d)
Bismuth-214*	(c)	(c)	0.62	0.97	(d)	(d)	(d)	(d)
Lead-210*	(c)	(c)	1.3	2	(d)	(d)	(d)	(d)
Lead-212*	(c)	(c)	0.72	1.4	(d)	(d)	(d)	(d)
Lead-214*	(c)	(c)	0.67	0.67	(d)	(d)	(d)	(d)
Neptunium-237	(d)	(d)	(d)	(d)	---	---	0	0
Plutonium-238	(d)	(d)	(d)	(d)	---	---	0	0
Plutonium-239/240	(d)	(d)	(d)	(d)	---	---	0	0
Potassium-40	(c)	(c)	6.9	12	(d)	(d)	(d)	(d)
Radium-226	-0.16	1.5	0.67	0.67	(d)	(d)	(d)	(d)
Radium-228	0.15	2	1.5	1.6	(d)	(d)	(d)	(d)
Technetium-99	---	---	0.1	0.4	(d)	(d)	(d)	(d)
Thallium-208*	(c)	(c)	0.29	0.56	(d)	(d)	(d)	(d)
Thorium-228	---	---	0.51	0.78	(d)	(d)	(d)	(d)
Thorium-229	-0.0057	0.051	0	0	(d)	(d)	(d)	(d)
Thorium-230	---	---	0.53	0.87	(d)	(d)	(d)	(d)
Thorium-232	---	---	0.49	0.9	(d)	(d)	(d)	(d)
Thorium-234	-0.0057	0.051	2.6	2.6	(d)	(d)	(d)	(d)
Uranium-233/234	---	---	0.48	1.1	13.9	13.9	---	---
Uranium-235	0.007	0.025	0.038	0.038	0.04	0.04	---	---
Uranium-236	-0.0068	0.029	0.035	0.035	(d)	(d)	(d)	(d)
Uranium-238	---	---	0.51	0.96	0.75	0.75	---	---
<b>Inorganics (mg/kg)</b>								
Aluminum	(d)	(d)	(d)	(d)	---	---	7100	19000
Arsenic	(d)	(d)	(d)	(d)	---	---	6.6	14
Barium	(d)	(d)	(d)	(d)	---	---	46	170
Beryllium	(d)	(d)	(d)	(d)	0.53	0.61	0.59	0.9
Cadmium	(d)	(d)	(d)	(d)	0.53	0.68	0.57	0.57
Calcium	(d)	(d)	(d)	(d)	---	---	1400	88000
Chromium	(d)	(d)	(d)	(d)	---	---	10	25
Cobalt	(d)	(d)	(d)	(d)	---	---	5.8	18
Copper	(d)	(d)	(d)	(d)	---	---	7.2	22
Fluoride	(d)	(d)	(d)	(d)	4.7	5.5	4.3	7.1
Iron	(d)	(d)	(d)	(d)	---	---	13000	34000
Lead	(d)	(d)	(d)	(d)	---	---	10	25
Lithium	(d)	(d)	(d)	(d)	11	11	13	64
Magnesium	(d)	(d)	(d)	(d)	---	---	1700	51000
Manganese	(d)	(d)	(d)	(d)	---	---	150	800
Mercury	(d)	(d)	(d)	(d)	---	---	0.012	0.059
Nickel	(d)	(d)	(d)	(d)	---	---	8.4	27
Potassium	(d)	(d)	(d)	(d)	---	---	550	1700
Sodium	(d)	(d)	(d)	(d)	55	61	77	260
Uranium	2.1	2.1	1.5	2.9	---	---	2.7	3.7
Vanadium	(d)	(d)	(d)	(d)	---	---	20	41
Zinc	(d)	(d)	(d)	(d)	---	---	31	290
<b>Pesticides/PCBs (µg/kg)</b>								
Aroclor-1260	38	51	(d)	(d)	86	110	100	190
<b>Semivolatiles (µg/kg)</b>								
Benzo(a)anthracene	(d)	(d)	(d)	(d)	360	460	9.5	46
Benzo(a)pyrene	(d)	(d)	(d)	(d)	360	420	5.7	57
Benzo(b)fluoranthene	(d)	(d)	(d)	(d)	360	420	4.6	93
Benzo(g,h,i)perylene	(d)	(d)	(d)	(d)	360	460	21	31
Benzo(k)fluoranthene	(d)	(d)	(d)	(d)	360	460	22	67
Benzoic acid	(d)	(d)	(d)	(d)	1800	2300	45	45
Bis(2-ethylhexyl)phthalate	(d)	(d)	(d)	(d)	23	460	19	1400
Butylbenzylphthalate	(d)	(d)	(d)	(d)	370	460	14	22
Chrysene	(d)	(d)	(d)	(d)	360	460	53	91
Di-n-butylphthalate	(d)	(d)	(d)	(d)	21	420	10	10
Di-n-octylphthalate	(d)	(d)	(d)	(d)	360	460	23	23
Fluoranthene	(d)	(d)	(d)	(d)	390	400	7.2	97
Indeno(1,2,3-cd)pyrene	(d)	(d)	(d)	(d)	360	460	21	34
Phenanthrene	(d)	(d)	(d)	(d)	360	460	20	40
Pyrene	(d)	(d)	(d)	(d)	390	400	6	84
<b>Volatiles (µg/kg)</b>								
1,1-Dichloroethene	5	8	(d)	(d)	5.4	6.8	4.7	4.7
Acetone	(d)	(d)	(d)	(d)	3.4	140	6.2	6.2
Chlorobenzene	5	8	(d)	(d)	5.4	6.8	8.7	8.7
Ethylbenzene	(d)	(d)	(d)	(d)	5.4	6.3	1.1	5
Methylene chloride	(d)	(d)	(d)	(d)	2.1	6.8	2.5	2.5
Tetrachloroethene	5	8	(d)	(d)	5.6	10	2.3	5.5
Trichloroethene	5	8	(d)	(d)	5.4	6.8	5.5	5.5
Xylenes	(d)	(d)	(d)	(d)	1.5	6.3	1.3	1.3

<sup>(a)</sup> Data results from Summer 2000 site characterization.

<sup>(b)</sup> Historical data results from Quadrant III CAS/CMS (DOE 1998).

<sup>(c)</sup> Only positive detections reported from gamma-spec.

<sup>(d)</sup> Analyses not performed.

--- Indicates there were no results.

\* Analysis by gamma spec.

**Table 4. 11**  
**Current and Historical Data Summary - Subsurface Soil Detections**  
**Proposed DUF6 Conversion Facility**  
**DUF6 Conversion Facility Site Characterization**  
**Portsmouth, OH**

Parameter	Current data <sup>(a)</sup>				Historical data <sup>(b)</sup>			
	Minimum non-detects	Maximum non-detects	Minimum detects	Maximum detects	Minimum non-detects	Maximum non-detects	Minimum detects	Maximum detects
<b>Radionuclides (pCi/g)</b>								
Actinium-228	-0.15	1.6	0.92	1.6	(d)	(d)	(d)	(d)
Alpha activity	---	---	1.6	5.2	2	2	---	---
Americium-241	0.0072	0.12	0.028	0.41	(d)	(d)	(d)	(d)
Beta activity	---	---	3.3	7.8	0	0	---	---
Bismuth-212*	(c)	(c)	3	3	(d)	(d)	(d)	(d)
Bismuth-214*	(c)	(c)	0.61	1.5	(d)	(d)	(d)	(d)
Lead-210*	(c)	(c)	1.2	2.3	(d)	(d)	(d)	(d)
Lead-212*	(c)	(c)	0.62	1.4	(d)	(d)	(d)	(d)
Lead-214*	(c)	(c)	0.82	2.2	(d)	(d)	(d)	(d)
Potassium-40	---	---	5.3	15	(d)	(d)	(d)	(d)
Radium-224	1.4	25	2.6	2.6	(d)	(d)	(d)	(d)
Radium-226	-0.23	1.2	0.88	2.2	(d)	(d)	(d)	(d)
Radium-228	-0.15	1.6	0.92	1.6	(d)	(d)	(d)	(d)
Strontium-90	0	0.8	1	1	(d)	(d)	(d)	(d)
Technetium-99	0.1	0.1	0.1	0.3	(d)	(d)	(d)	(d)
Thallium-208*	(c)	(c)	0.24	0.51	(d)	(d)	(d)	(d)
Thorium-228	0.13	0.13	0.13	0.57	(d)	(d)	(d)	(d)
Thorium-230	0.12	0.12	0.24	0.79	(d)	(d)	(d)	(d)
Thorium-231	-3.3	0.57	0.72	0.72	(d)	(d)	(d)	(d)
Thorium-232	---	---	0.2	0.56	(d)	(d)	(d)	(d)
Thorium-234	-9.5	17	1.5	2.3	(d)	(d)	(d)	(d)
Uranium-233/234	---	---	0.24	1.3	(d)	(d)	(d)	(d)
Uranium-235	0	0.041	0.047	0.084	(d)	(d)	(d)	(d)
Uranium-235*	0.16	0.16	0.23	0.81	(d)	(d)	(d)	(d)
Uranium-238	---	---	0.26	1.4	(d)	(d)	(d)	(d)
<b>Inorganics (mg/kg)</b>								
Aluminum	(d)	(d)	(d)	(d)	---	---	5500	5500
Arsenic	(d)	(d)	(d)	(d)	---	---	2.3	5
Barium	(d)	(d)	(d)	(d)	---	---	38	54
Beryllium	(d)	(d)	(d)	(d)	0.61	0.61	0.91	0.91
Cadmium	(d)	(d)	(d)	(d)	0.61	0.61	0.58	0.58
Calcium	(d)	(d)	(d)	(d)	---	---	760	840
Chromium	(d)	(d)	(d)	(d)	---	---	9.6	11
Cobalt	(d)	(d)	(d)	(d)	---	---	8	19
Copper	(d)	(d)	(d)	(d)	---	---	6.6	15
Iron	(d)	(d)	(d)	(d)	---	---	25000	42000
Lead	(d)	(d)	(d)	(d)	---	---	5.6	7.4
Magnesium	(d)	(d)	(d)	(d)	---	---	750	1200
Manganese	(d)	(d)	(d)	(d)	---	---	190	470
Nickel	(d)	(d)	(d)	(d)	---	---	13	36
Potassium	(d)	(d)	(d)	(d)	---	---	620	660
Sodium	(d)	(d)	(d)	(d)	---	---	190	220
Uranium	1.2	1.2	0.76	4.3	---	---	3.3	4.4
Vanadium	(d)	(d)	(d)	(d)	---	---	24	34
Zinc	(d)	(d)	(d)	(d)	---	---	41	87
<b>Pesticides/PCBs (µg/kg)</b>								
Aroclor-1254	38	43	---	---	75	97	130	130
Aroclor-1260	38	43	---	---	93	97	140	1100
<b>Volatiles (µg/kg)</b>								
Acetone	(d)	(d)	(d)	(d)	---	---	9.8	18

(a) Data results from Summer 2000 site characterization.

(b) Historical data results from Quadrant III CAS/CMS (DOE 1998).

(c) Only positive detections reported from gamma-spec.

(d) Analyses not performed.

--- Indicates there were no results.

\* Analysis by gamma spec.

within the background range for alpha activity. In addition, Aroclor-1260, 1,1-dichloroethene, chlorobenzene, tetrachloroethene, and trichloroethene that were previously detected in surface soils were not detected during the current investigation. For subsurface soils, the range of detection of total uranium metal falls within the range of detects for the previous investigation and is considered consistent with that data (see Table 4.11). The range of alpha and beta activity detected are somewhat higher than the non-detect concentrations reported during the previous investigations. However, as previously discussed, the maximum activity of alpha and beta detected are within the background range.

## **4.2 GEOTECHNICAL RESULTS**

Surface soil samples were collected and analyzed for both disturbed and nondisturbed geotechnical properties. Loose material was collected in 3 1/2-gal buckets for determining the California Bearing Ratio and the Optimum Moisture Content using Standard Proctor Effort. The California Bearing Ratio was determined for surface soils at soil borings SB-7, SB-9, and SB-11. Additional material was collected using Shelby tubes to determine various in situ soil properties. Table 4.12 lists the types of geotechnical analyses by sample identification number. Samples were collected from two distinct soil strata which typically consist of lean clays underlain by silty clays containing sands and some gravel. Table 4.13 lists the soil classification results for the two clay layers. Table 4.14 summarizes the particle size analysis completed for the proposed site, including a hydrometer analysis. The optimum moisture content was computed for each geotechnical sample using the Standard Proctor Method. Table 4.15 summarizes the results from each Standard Proctor test specimen. Table 4.16 lists the results from one-dimensional consolidation testing. The compression ratio for the mid-level soils (i.e., 5-10 ft) ranges from 0.09 to 0.14. Table 4.17 summarizes the shear strength of the in situ soils as determined by triaxial shear testing using both unconsolidated and undrained samples, and consolidated undrained samples. Table 4.18 lists the Atterberg Limits for each of the three sample locations. Detailed geotechnical data is included in Appendix G.

## **4.3 EXISTING BUILDING CHARACTERIZATION**

Three buildings exist on the proposed site: the X-744S, X-744T, and X-744U warehouses. These warehouses are metal-sided, steel frame structures with concrete floors. These buildings were originally constructed in the early 1950s. They were relocated to their current location in 1978 at which time new siding and roofing were installed. The roof was also coated with exterior urethane foam on insulation. No utilities were in service in the buildings.

These warehouses are used for lithium hydroxide monohydrate storage. In 1999, a vendor purchased the material and began removal from the warehouses. X-744T is now empty, X-744S is 60% empty, and removal work has just started in X-744U. The vendor is scheduled to complete removal of the remaining lithium hydroxide monohydrate by mid-2001.

### **4.3.1 Floor Loading and Structural Evaluation**

The warehouse floors are slab on grade concrete rated at 150 psf. The concrete floors are in good condition overall.

The building structure consists of two 45-ft-wide, free span steel arches side by side to yield a 90-ft-wide facility. The steel structure is what is today known in industry as a "Pre-Engineered

Metal Building.” The steel structure is in good condition. The steel structure is covered with painted metal siding and galvanized metal roofing. The current siding and roofing were installed new during the 1978 relocation and remain in good condition. Leakage is evident in several locations in all three buildings and results from the lack of routine repairs. The metal roofing was coated with exterior urethane foam on insulation. This product has failed on the X-744T Building. The remaining buildings exhibit indications of minor failure, which is cosmetic in nature. Roof loading is rated at 50 psf and sidewall wind loading is rated at 80 mph.

**Table 4.12. Geotechnical sample parameters**

<b>Sample ID No.</b>	<b>Sample depth (bgs)</b>	<b>D2216-92 Moisture content</b>	<b>D2435 Soil bearing capacity</b>	<b>D2487-90 Soil classification</b>	<b>D2850 Triaxial shear strength</b>	<b>D422-63 Particle size</b>	<b>D4318-95 Atterberg limits</b>	<b>D4767 Triaxial shear strength</b>	<b>D1883 California Bearing Ratio</b>	<b>D698-91 Standard Proctor Test</b>
UF00-SB7-GEO	0-2 ft.								X	X
UF00-SB7-GEO	5-7 ft.	X	X	X	X	X	X	X		X
UF00-SB9-GEO	0-2 ft.								X	X
UF00-SB9-GEO	12-14 ft.	X	X	X	X	X	X	X		X
UF00-SB11-GEO	0-2 ft.								X	X
UF00-SB11-GEO	7-9 ft.	X	X	X	X	X	X	X		X

Table 4.13. Soil classification results

Sample ID No.	UF00-SB7-GEO	UF00-SB9-GEO	UF00-SB11-GEO
% Retained on #200 sieve	2.9	2.9	8.0
% Passing #200 sieve	97.1	97.1	92.0
% Gravel	0.1	0.1	2.1
% Sand	2.7	2.7	5.9
D60 (Diameter at 60% passing)	0.01772	0.01772	0.0160
D30 (Diameter at 30% passing)	0.00400	0.00400	0.00374
D10 (Diameter at 10% passing)	0.00071	0.00071	n/a
Cc	24.96	24.96	n/a
Cu	1.27	1.27	n/a
Liquid limit	25	33	33
Plastic limit	17	19	20
Plasticity Index	8	14	13
USCS Symbol	CL	CL	CL

Table 4.14 Particle size analysis

Sample ID No.	UF00-SB7-GEO	UF00-SB9-GEO	UF00-SB11-GEO		
Specific gravity	2.65	2.65	2.65		
Moisture content	14.7	21.9	20.1		
	Sieve No.	Diameter (mm)	Percent finer		
Coarse	3"	75.000	100	100	100
	1.5"	37.500	100	100	100
	0.75"	19.000	100	100	100
	0.375"	9.500	100	100	98.5
	#4	4.750	99.9	100	97.9
	#10	2.000	99.0	98.6	96.8
Fine	#20	0.850	98.4	97.8	95.7
	#40	0.425	98.2	96.9	94.8
	#60	0.250	98.0	96.2	93.9
	#100	0.149	97.9	95.5	93.1
	#140	0.106	97.8	95.0	92.7
	#200	0.075	97.1	94.1	92.0
Hydrometer analysis	0.05322	n/a	87.4	85.6	
	0.03956	77.8	82.8	80.9	
	0.02912	70.4	74.4	72.6	
	0.01911	62.1	63.3	65.1	
	0.01158	50.9	47.4	52.1	
	0.00843	43.5	40.9	43.7	
	0.00603	37.0	36.3	38.1	
	0.00435	31.5	32.6	32.6	
	0.00304	25.9	26.0	27.0	
0.00131	18.5	22.3	20.5		

**Table 4.15 Standard Proctor and California Bearing Ratio results**

Sample ID No. (UF00-XX-GEO)	SB7	SB9	SB11
<b>Borehole</b>	7	9	11
<b>Sample depth</b>	0-2 ft.	0-2 ft.	0-2 ft.
<b>Maximum dry density (lb/ft<sup>3</sup>)</b>	103.5	102.7	109.1
<b>Optimum moisture content</b>	18.4%	18.2%	15.5%
<b>Specific gravity</b>	2.65	2.65	2.65
<b>California Bearing Ratio @ 90%</b>	3.00	4.71	2.03
<b>California Bearing Ratio @ 95%</b>	4.94	10.58	4.47
<b>Borehole</b>	7	9	11
<b>Sample depth</b>	5-7 ft.	12-14 ft	7-9 ft.
<b>Maximum dry density (lb/ft<sup>3</sup>)</b>	110.6	110.2	112.4
<b>Optimum moisture content</b>	15.4%	14.7%	14.0%
<b>Specific gravity</b>	2.65	2.65	2.65
<b>California Bearing Ratio @ 90%</b>	N/A	N/A	N/A
<b>California Bearing Ratio @ 95%</b>	N/A	N/A	N/A

**Table 4.16 One-dimensional consolidation results**

Sample ID No.	UF00-SB7-GEO	UF00-SB9-GEO	UF00-SB11-GEO
<b>Borehole</b>	7	9	11
<b>Sample depth</b>	5-7 ft.	12-14 ft.	7-9 ft.
<b>Natural saturation</b>	90.2%	101.6%	100.5%
<b>Natural moisture</b>	23.6%	19.3%	20.1%
<b>Dry density</b>	97.7 pcf	110.0 pcf	108.1 pcf
<b>Specific gravity</b>	2.65	2.65	2.65
<b>Compression index</b>	0.14	0.11	0.09
<b>Void ratio</b>	0.6930	0.5041	0.5309

**Table 4.17 Tri-Axial shear test results**

Sample ID No. (UF00-XX-GEO)	SB7	SB9	SB11
<b>Type of test</b>	UU	UU	UU
<b>Sample type</b>	Undisturbed	Undisturbed	Undisturbed
<b>Description</b>		Lean Clay	
<b>Cohesion (lb/in<sup>2</sup>)</b>	59.9	15.2	8.3
<b>Angle of internal friction</b>	0 <sup>a</sup>	14.8	12.3

<sup>a</sup> Insufficient sample quantity for three points.

**Table 4.17 Tri-Axial shear test results (cont.)**

Sample ID No. (UF00-XX-GEO)	SB7		SB7		SB9		SB11	
<b>Type of test</b>	CU		CU		CU		CU	
<b>Sample type</b>	Undisturbed		Undisturbed		Undisturbed		Undisturbed	
<b>Description</b>	Lean Clay		Lean Clay		Lean Clay		Lean Clay	
	<b>Total</b>	<b>Eff.</b>	<b>Total</b>	<b>Eff.</b>	<b>Total</b>	<b>Eff.</b>	<b>Total</b>	<b>Eff.</b>
<b>Cohesion (lb/in<sup>2</sup>)</b>	5.2	5.6	6.4	6.5	8.3	1.0	16.1	7.8
<b>Angle of internal friction</b>	11.1	15.7	10.1	14.7	23.1	30.1	25.4	29.8

<sup>a</sup> Insufficient sample quantity for three points.

**Table 4.18 Atterberg Limits test results**

<b>Sample ID No. (UF00-XX-GEO)</b>	<b>Liquid Limit</b>	<b>Plastic Limit</b>	<b>Plasticity Index</b>	<b>USCS Symbol</b>
<b>SB07</b>	25	17	8	CL
<b>SB09</b>	33	19	14	CL
<b>SB11</b>	33	20	13	CL

#### **4.3.2 Equipment Available in Buildings**

There is no equipment in the buildings.

#### **4.3.3 Code Evaluation**

The three warehouses fundamentally are in code conformance. Exceptions are as listed:

- No compliance with American Disabilities and Handicap Act
- Buildings do not conform to DOE Natural Phenomena Hazards per UCRL-15910
- No sprinklers or fire alarms per Ohio Basic Building Code (OBBC)
- Emergency exits insufficient per OBBC
- Illumination not to OBBC minimum for warehousing

#### **4.3.4 Asbestos and PCB Contamination**

Detailed inspection of the accessible portions of the three warehouses yielded no indication of asbestos or PCB contamination in the facilities. Note that two of the warehouses have containerized lithium hydroxide monohydrate stacked wall to wall prohibiting access to 40% of the X-744S building and 95% of the X-744U building.

#### **4.3.5 Bird and Vermin Waste and Infestations**

Sufficient bird waste has accumulated under the roof structure and in limited areas of the floors to warrant clearing before reuse. No other issues were noted.

#### **4.3.6 Radiological Survey**

The X-744S, T, and U were surveyed for total and removable alpha & beta-gamma contamination. No total or removable contamination was found. Only one count exceeded Lc by one count, which is expected from counting no net activity from almost 800 results (192 total survey points for total and removable – alpha and beta gamma).

The exterior of all three buildings were surveyed on October 7, 2000. The interior (floor) of X744S, T, & U were surveyed on October 12-13, 2000. The survey forms are included in Appendix A. The raw readings from the rafters in X-744T were similar to the survey results above.

#### **4.3.7 Lead Paint**

Paint surfaces of the X-744S, X-744T, and X-744U Buildings were screened for lead paint contamination. The paint on the metal siding of the buildings were determined to be lead free.

However, screening results for steel structure paint detected the presence of lead. Confirmatory sampling and analysis of paint chips obtained from a column of each building confirmed the presence of lead paint on columns and girts. Total lead concentrations in each of three samples are 455 mg/kg (X-744S), 384 mg/kg (X-744T), and 1130 mg/kg (X-744U).

## **5. SUMMARY**

### **5.1 ENVIRONMENTAL DATA**

Soil sampling was performed at the Portsmouth Lithium Warehouse Site, and samples were analyzed for VOCs, SVOCs, PCBs, and radionuclides. No VOCs, SVOCs, or PCBs were detected above SQLs. Radionuclides were detected and were compared to background levels (alpha and beta activity only). The maximum alpha activity was 5.2 pCi/g, which was slightly above background (4.8 pCi/g). However, the 5.2 pCi/g of alpha is within the overall range of background results reported for PORTS soils (1–7 pCi/g).

The field sampling and analysis data obtained as a part of this investigation complements the historical data. Prior sampling and analysis results performed at adjoining/nearby SWMUs are included in the Quadrant III CAS/CMS Final Report (see Section 4.1 for a summary and Appendix A for detectable constituents). The report concluded that no further corrective action was required for SWMUs within or adjacent to the Lithium Warehouse Site. Nearby SWMUs pose little risk to activities occurring at the Lithium Warehouse Site.

The building characterization included inspection of Buildings X-744S, X-744T, and X-744U for asbestos, PCB contamination, bird/vermin waste, paint sampling, and radiological survey. Paint sampling and analysis performed determined the presence of lead contamination in the steel structure paint.

### **5.2 GEOTECHNICAL DATA**

In general, the data indicate the site consists primarily of lean clayey soils. The lean clayey soils extend down 11-17 ft and display favorable soil properties (i.e., low to moderate plasticity index, moderate to high bearing capacity) capable of supporting industrial facilities.

### **5.3 CONCLUSIONS**

The environmental data provide a basis for evaluating the presence of potential contamination, managing soil removed from the site, determining appropriate health and safety approaches during construction activities, and establishing a baseline for follow-on activities. The geotechnical results indicate that the site soil characteristics are suitable for constructing industrial facilities. Geotechnical data included in this report provide a basis for planning buildings, roads, and other structures that will be constructed on-site.

## 6. REFERENCES

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