



**ENGINEERING REPORT FOR THE CONTAMINATION EVALUATION AT THE  
FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO**

**Submitted to:**

**Department of the Army  
Nashville District, Corps of Engineers  
Nashville, Tennessee**

**and**

**Huntsville Division, Corps of Engineers  
Huntsville, Alabama**

**DERP Project No. G050H001800**

**Prepared by:**

**IT Corporation  
Knoxville, Tennessee**

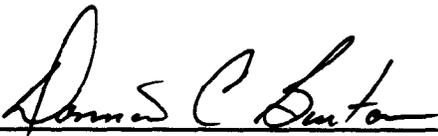
**IT Project No. 409658  
409**

**January 1991**

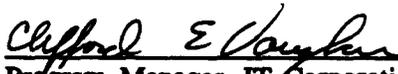
ENGINEERING REPORT FOR THE CONTAMINATION EVALUATION AT THE  
FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO

Prepared by:

IT Corporation  
312 Directors Drive  
Knoxville, Tennessee 37923  
615-690-3211

Approved:   
Project Manager, IT Corporation

Date: 1-29-91

Approved:   
Program Manager, IT Corporation

Date: 1/29/91

## CONTENTS

	<u>Page</u>
<b>LIST OF TABLES</b>	ii
<b>LIST OF FIGURES</b>	iii
<b>1.0 EXECUTIVE SUMMARY</b>	1-1
<b>2.0 GENERAL</b>	2-1
2.1 Introduction	2-1
2.2 Project Objectives and Scope of Work	2-2
2.3 Site Description	2-3
<b>3.0 SITE INVESTIGATION</b>	3-1
3.1 Introduction	3-1
3.2 Monitoring Well Installation and Development	3-2
3.3 Variances to the Work Plan	3-4
3.4 Sampling Program	3-5
3.5 Decontamination Procedures	3-7
<b>4.0 ANALYTICAL RESULTS</b>	4-1
4.1 Introduction	4-1
4.2 Analytical Results/Methodology	4-1
4.3 Soil Analytical Results	4-1
4.4 Groundwater Analytical Results	4-3
4.5 Surface Water Analytical Results	4-4
4.6 Geotechnical Analytical Results	4-5
4.7 Results of Hydraulic Conductivity Field Tests	4-5
4.8 Hazard Ranking Scoring	4-5
<b>5.0 REFERENCES</b>	5-1

## APPENDICES

- A. PROPERTY ACCESS AGREEMENTS
- B. SOIL AND MONITORING WELL BORING LOGS
- C. FIELD HYDRAULIC CONDUCTIVITY TEST DATA
- D. VARIANCES AND NONCONFORMANCES
- E. GEOTECHNICAL TEST RESULTS, CERTIFICATES OF ANALYSES
- F. HAZARDOUS RANKING SYSTEM (HRS) FORM

## TABLES

<u>Number</u>		<u>Follows Page</u>
2-1	Department of Defense Underground Storage Tank Inventory - Former Plum Brook Ordnance Works	2-2
3-1	Chronological Summary of Performance Periods and Field Activities	3-1
3-2	Well and Monument Locations	3-4
4-1	Analyses and Approved Methods for Samples	4-1
4-2	Plum Brook Ordnance Works, Soil Samples - Volatile and Semivolatile Organic Compounds	4-1
4-3	Plum Brook Ordnance Works, Soil Samples - Nitro-Aromatic Explosives	4-2
4-4	Plum Brook Ordnance Works, Soil Samples - Metals	4-2
4-5	Plum Brook Ordnance Works, Soil Samples - Sulfate, Nitrate, pH	4-3
4-6	Plum Brook Ordnance Works, Groundwater Samples - Volatile and Semivolatile Organic Compounds	4-3
4-7	Plum Brook Ordnance Works, Groundwater Samples - Nitro-aromatic Explosives	4-4
4-8	Plum Brook Ordnance Works, Groundwater Samples - Metals	4-4
4-9	Plum Brook Ordnance Works, Groundwater Samples - Sulfate, Nitrate, pH	4-4
4-10	Plum Brook Ordnance Works, Surface Water Samples - Volatile and Semivolatile Organic Compounds	4-4
4-11	Plum Brook Ordnance Works, Surface Water Samples - Nitro-Aromatic Explosives	4-4
4-12	Plum Brook Ordnance Works, Surface Water Samples - Metals	4-5
4-13	Plum Brook Ordnance Works, Surface Water Samples - Sulfate, Nitrate, pH	4-5
4-14	Plum Brook Ordnance Works, Soil Samples Geotechnical Results	4-5

## FIGURES

<u>Number</u>		<u>Follows Page</u>
2-1	Vicinity Map	2-2
2-2	Localized Physiography and Topography	2-3
2-3	Predominant Soil Types	2-4
2-4	Groundwater Resources	2-5
3-1	Site Plan and Sampling Locations	3-2
3-2	Well Construction Specifications	3-3
3-3	Rubbish Burning Ground at Taylor and Ransom Roads Sampling Locations	3-5
3-4	Scheid Road Burning Grounds Sampling Locations	3-5
3-5	Waste Disposal Area 2 Sampling Locations	3-5
3-6	Waste Disposal Area 1 Sampling Locations	3-5

## 1.0 EXECUTIVE SUMMARY

The U.S. Army is conducting a contamination evaluation at previously owned U.S. Department of Defense (DOD) properties under the Defense Environmental Restoration Program (DERP). This evaluation addresses possible chemical contamination, which includes contamination of the groundwater, surface water, and soils, caused by DOD activities at the former Plum Brook Ordnance Works (Plum Brook) site in Sandusky, Ohio.

IT Corporation (IT) conducted the contamination evaluation at the former Plum Brook site under Contract DACA87-87-D-0089, Delivery Order 004 for the U.S. Army Corps of Engineers (COE), Engineering Management Support Branch, Nashville, Tennessee. The objective of this project was to conduct a preliminary investigation to confirm or deny the presence or absence of residual chemical contamination (if any) from operational activities conducted at the site during DOD control.

The scope of the contamination evaluation included a records review and evaluation, visual site inspection, preparation and completion of project work plans, completion of various field investigation activities, and the evaluation of analytical results from samples collected during the field investigation. The field investigation activities included: installing groundwater monitoring wells; drilling soil/subsoil borings; collecting soil, surface water, and groundwater samples for geotechnical or chemical analysis; and conducting a hydraulic conductivity test.

Four groundwater monitoring wells were drilled and installed at the Plum Brook site to intercept groundwater influenced by percolation from the red water retention ponds, to monitor quality of groundwater that is migrating toward the site boundary, and to provide a background control. Twenty-one soil samples were collected for chemical analysis from specific areas targeted as having potential for contamination associated with the operation, maintenance, and deactivation of the site. One upgradient soil boring sample (SB-19), located at the southern extreme of the property, was collected to determine the natural "background" concentration of compounds at the site. Additional soil samples were collected for geotechnical analysis.

Soil and water samples collected for chemical analyses were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds, nitro-aromatic explosive compounds, nitrates, sulfates, pH, and metals. Soil samples collected for geotechnical analyses were tested for moisture content, Atterberg limits, and grain size distribution (grain size plus hydrometer analyses). All samples (except split samples) were analyzed at the IT Analytical Services (ITAS) Laboratory in Knoxville, Tennessee. A

quality assurance (QA) program was administered by COE using its Missouri River Division laboratory in Omaha, Nebraska.

Results from field investigations and analytical testing indicate that there was no soil or groundwater contamination from VOCs. There is some soil and groundwater contamination from semivolatile organic compounds at Waste Disposal Area 1. Nitro-aromatic explosive compounds are present in the soil at Waste Disposal Area 1 and at the Scheid Road Burning Ground. Elevated metals (sodium and/or manganese) are present in soils at Waste Disposal Areas 1 and 2, and chromium is present in the groundwater at Waste Disposal Area 2. At the downgradient site edge location, sulfates and nitrates are also present at elevated levels at Waste Disposal Areas 1 and 2. Surface water samples were free from contamination with the exception of small amounts of butyl benzyl phthalate, some metals, and nitrate in isolated samples. The Hazard Ranking System (HRS) score for this site is 0.0 because there are no target users of groundwater in the vicinity of the site.

## 2.0 GENERAL

### 2.1 INTRODUCTION

#### Background

The U.S. Army is conducting a study of the environmental impact of suspected hazardous waste sites at previously owned DOD properties. This work is being pursued by the COE under the DERP. This project is being managed by the Nashville, Tennessee COE District Office.

The federal government entered into a contract with E. B. Badger and Sons Company (Badger) on December 21, 1940 to build the Plum Brook Ordnance Works. On December 28, 1940, a subsequent contract was signed with Trojan Powder Company (Trojan) for the purpose of manufacturing trinitrotoluene (TNT), dinitrotoluene (DNT), pentolite, and nitric and sulfuric acids. Badger started surveying the 9,009-acre site on February 3, 1941, with ground breaking activities following on April 15, 1941. The first TNT and DNT processing lines were completed and ready for operation on December 9, 1941. Operations for the manufacturing of TNT originally started on December 16, 1941. Production of explosives ceased two weeks after V-J Day, having manufactured in excess of one billion pounds of explosives during the four-year operating period.

Between V-J Day and September 22, 1945, the entire Ordnance Inspection Department was abolished. Decontamination of TNT, acid, pentolite, and DNT manufacturing lines was completed during the last quarter of 1945. On December 17, 1945, the physical custody of the plant was transferred from Trojan to the Ordnance Department. At this time, the Ordnance Department assumed liability and the U.S. Engineers assumed responsibility for maintenance and custodial duties. U. S. Engineers maintained stand-by operations from December 1945 to September 1946. The property was subsequently transferred to the War Assets Administration after it was certified by the U.S. Army to be decontaminated.

Matthew-Levio and Sons served as the protection and maintenance contractor from September 1946 to May 1949. The property was then transferred to the General Services Administration (GSA).

The National Aeronautics Space Administration (NASA) acquired the Plum Brook Ordnance Works on March 15, 1963 and is presently using the site. On April 18, 1978, NASA declared approximately 2,152 acres of land as excess. The Perkins Board of Education acquired 46 acres of the excess and utilizes its area as a bus transportation center. GSA retains the remaining acreage and currently has a use agreement with the Ohio National Guard for 604 acres of the land. NASA presently controls

6,453.5 acres and is currently using its site to conduct space research as a satellite operation of NASA's Lewis Research Center in Cleveland, Ohio.

Chemical contamination caused by DOD activities was expected to exist at the former Plum Brook site in Sandusky, Ohio (Figure 2-1). Interest was focused to address the possible chemical contamination at the wastewater (red water) retention areas and the suspect burial and burn areas site. The work effort involved the investigation of the remaining DOD structures and the contiguous groundwater, surface water, and soil for possible contamination by any hazardous substances associated with the operation, maintenance, and deactivation of the Plum Brook site.

### Records Review and Evaluation

Types of potential hazardous waste and disposal facilities associated with the operation, maintenance, and deactivation of the site are as follows:

- Containerized facilities
- Landfill disposals
- Seepage lagoons.

Four specific sites were targeted for investigation to confirm or deny the presence or absence of residual chemical contamination from operational activities during DOD control. These sites are:

#### Waste Disposal Area 1:

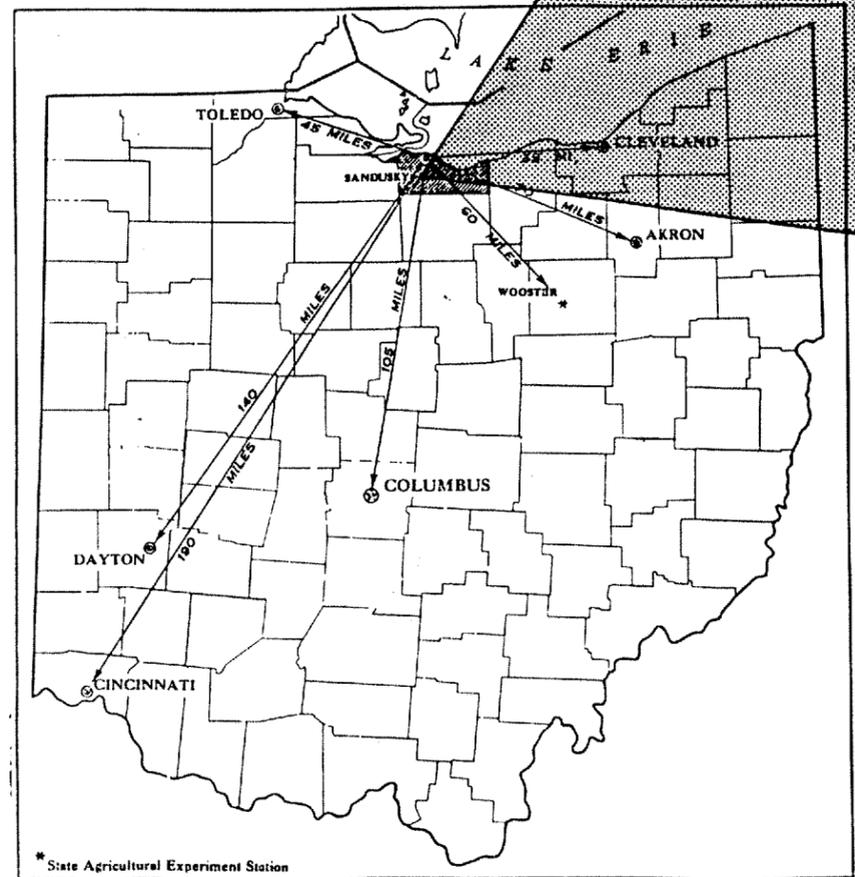
- Waste Disposal Area 2
- Scheid Road Burning Grounds
- Rubbish Burning Grounds.

With respect to the containerized facilities, a search of existing records of the Plum Brook site revealed that six underground storage tanks (USTs), installed during the period of DOD control, are inventoried. Three of the six tanks are currently in use and two of the three hold waste oil and solvents. Two tanks, installed in 1942, are permanently out of use and are located at the former vehicle service station, Building 7132. Current contents of the abandoned USTs are water and gasoline or diesel (Table 2-1).

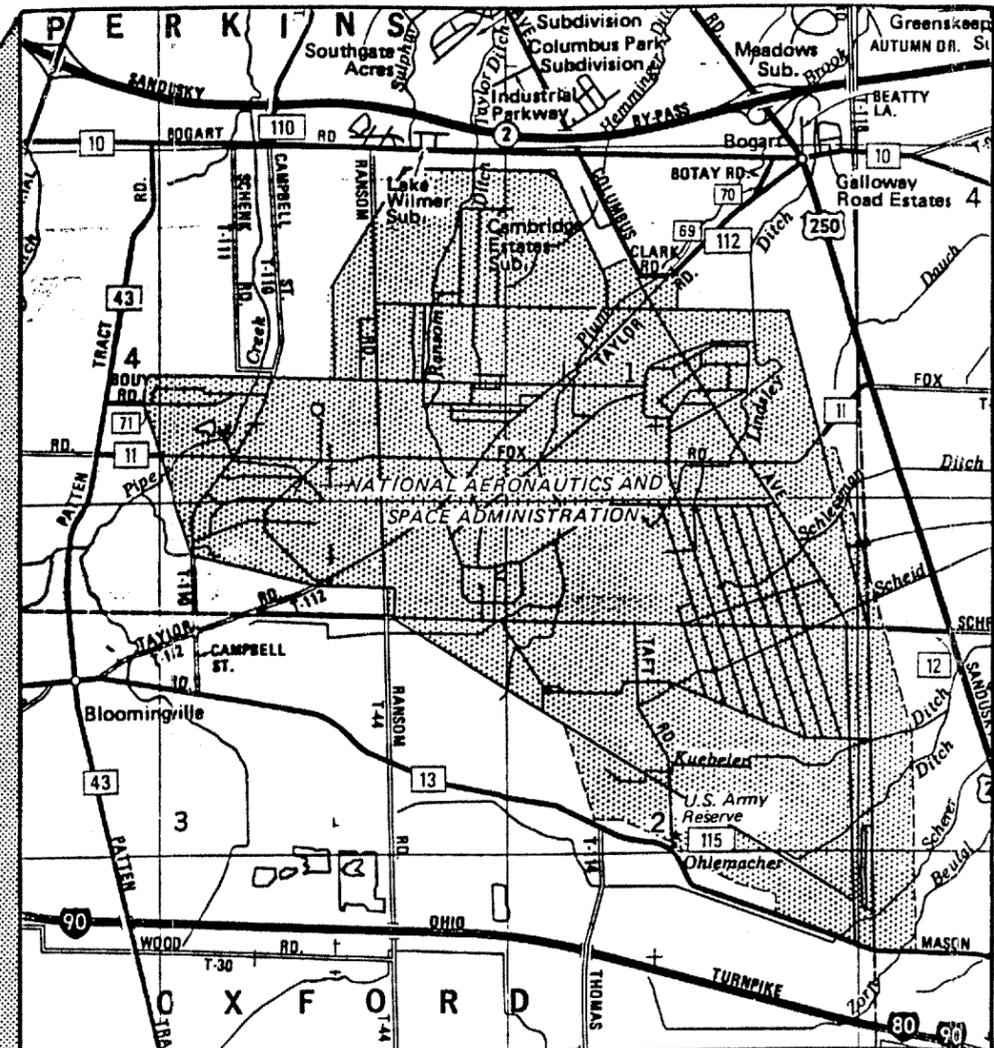
## 2.2 PROJECT OBJECTIVES AND SCOPE OF WORK

The purpose of this project is to conduct a preliminary investigation to confirm or deny the presence or absence of residual chemical contamination from operational activities conducted at the site during DOD control. This work is being done under Delivery Order 004 of COE Contract No. DACA87-87-D-0089.

DRAWING NO.: 409658 - B - WPO8  
 PROJECT NO.: 409658  
 INITIATOR: D. BURTON  
 PROJ. MGR.: D. BURTON  
 DATE LAST REV.: 2-27-90  
 DRAWN BY: P.L. SUAREZ  
 STARTING DATE: 4-26-89  
 DRAWN BY: S. MOORE  
 BRUNING 72425



\* State Agricultural Experiment Station



FORMER PLUM BROOK ORDNANCE WORKS BOUNDARY

FIGURE 2-1  
VICINITY MAP

FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO



**Table 2-1. Department of Defense Underground Storage Tank Inventory\*  
Former Plum Brook Ordnance Works**

<b>Tank ID</b>	<b>Status of Tank</b>	<b>Bldg</b>	<b>Location</b>	<b>Date Installed</b>	<b>Capacity</b>	<b>Construction Material</b>	<b>Current Contents</b>	<b>Previous Contents</b>	<b>Interior Protection</b>	<b>Exterior Protection</b>
7121-1	Currently in use	7121	E side of bldg between roads	1942	3,000	Steel	Waste oil and solvent	Waste oil and solvent	None	None
7131-1	Currently in use	7131	NE side of bldg	1942	1,500	Steel	Waste oil and solvent	Waste oil and solvent	None	None
7132-1	Permanently out of use	7132	North tank	1942	9,000	Steel	Water and gasoline	Gasoline	None	None
7132-2	Permanently out of use	7132	Center tank	1942	9,000	Steel	Water and diesel fuel	Diesel fuel	None	None
7132-3	Currently in use	7132	South tank	1942	9,000	Steel	Gasoline	Gasoline	None	None
8133-2	Permanently out of use	8133	W side	1942	250	Steel	Water	Unknown, gasoline, possibly a waste oil	None	None

\*Current as of December 1988.

The scope of this investigation, performed by IT in accordance with the Final Work Plan dated September 1989 (IT, 1989), included the following tasks:

- Constructing six shallow (approximately 25 feet deep) groundwater monitoring wells
- Collecting groundwater samples from the six new groundwater monitoring wells for analysis
- Collecting 36 soil/subsoil samples (six per well) during monitoring well construction for physical testing for engineering properties
- Collecting composite soil/subsoil samples at 19 locations to a depth of 2 feet for chemical contaminant analytical testing (one of these locations will be for a background sample; the other 18 will be for contamination evaluation)
- Calculating in situ hydraulic conductivity for the monitoring well zones
- Collecting individual surface water samples from each of the four streams that drain the site
- Analyzing soil, groundwater, and surface water samples and QA samples
- Evaluating laboratory analysis of field and QA samples
- Preparing the site investigation report, including completion of the HRS form.

## 2.3 SITE DESCRIPTION

### Location and General Description

The Plum Brook site is located approximately four miles south of Sandusky, Ohio and is specifically located in the Perkins and Oxford Townships. The site is bounded on the north by Bogart Road, on the south by Mason Road, on the east by U.S. Highway 250, and on the west by County Road 43 (Figure 2-1). The former Plum Brook site consists of 9,009 acres and lies in an area that is primarily rural and agricultural with low population density.

### Topography and Physiography

The Plum Brook site is located on what was originally a flat lake bottom from glacial melt waters. The ground surface slopes gradually northward toward Lake Erie at an average slope of less than six percent. Elevations at the site range from 675 feet above mean sea level (msl) at the southwest edge of the site to 625 feet msl in the northern portion of the property at Bogart Road. A topographic map of the site is presented in Figure 2-2.

The Plum Brook site derives its name from the major stream passing through its boundaries. Eleven streams, six of which originate within the site boundaries, flow northerly or northeasterly into Lake Erie. Plum Brook and Pipe Creek originate south of the site and flow independently into Lake Erie, east and

DRAWING NO.: 409658-B-WP09  
PROJECT NO.: 409658

INITIATOR: D. BURTON  
PROJ. MGR.: D. BURTON

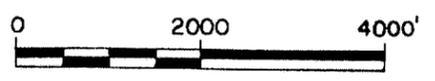
DATE LAST REV.: 2-27-90  
DRAWN BY: P.L. SUAREZ

STARTING DATE: 4-26-89  
DRAWN BY: S. MOORE

BRUNING 72425



SOURCE: USGS SANDUSKY QUADRANGLE  
OHIO 7.5 MINUTE SERIES  
(TOPOGRAPHIC) REVISED 1979  
  
USGS KIMBALL QUADRANGLE  
OHIO 7.5 MINUTE SERIES  
(TOPOGRAPHIC) 1969



**FIGURE 2-2**  
**LOCALIZED PHYSIOGRAPHY**  
**AND TOPOGRAPHY**

FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO



west of the airport, respectively. Kuebeler Ditch, Ohlemacher Ditch, Scherer Ditch, and Zorn Beutal Ditch originate at the southwest edge of the property and connect into Harris Ditch south of Fox Road.

### Soil Characterization

Most of the soils at the Plum Brook site were formed from deposits from glaciers or from glacial melt waters. The dominant soil material was deposited as glacial till, outwash, and lacustrine deposits.

Glacial till is material laid down directly from glaciers with minimum water action. Typically, it consists of particles of different sizes. Some smaller pebbles in glacial till have sharp corners, indicating that they have not been rounded or worn by water.

Outwash materials were deposited by running water from melting glaciers. The size of the particles that make up the outwash material varies according to the speed of the water in which particles were carried. Outwash deposits generally consist of layers of particles of similar size, such as sand and gravel.

Lacustrine deposits, material settled from still, ponded glacial melt water, contain only the finer particles such as very fine sand, silt, and clay because the coarser material dropped out as outwash.

The U.S. Department of Agriculture (USDA) Soil Conservation Service Soil Survey (1971) identifies the majority of soils at the site as being from the Arkport-Galen association (Figure 2-3). Arkport soils consist of gently sloping to moderately sloping, well-drained soils formed in the sandy material deposited at the edge of a glacial lake. Arkport soils are generally loamy fine sand and fine sand. Galen soils are mostly level and moderately well-drained formed as small sandy deposits on outwash plains and deltas. Galen soils have a fine sand or sandy loam surface layer, a subsurface of fine sand and loamy fine sand that is underlain by silt or clay. Runoff is slow, permeability is rapid, and the available moisture capacity is low. Wind erosion is a problem in this soil association.

The southern portion of the site has soils in the Prout association. Prout soils are moderately deep to deep, nearly level to gently sloping, somewhat poorly drained soils that have a subsoil of heavy silt loam to silty clay loam. These soils are commonly on uplands, with runoff and permeability slow (USDA, 1971).

The Lewisburg association occupies a small isolated part of the Plum Brook site. The soils are moderately deep to deep, nearly level in depressions, and are narrow strips along natural drainageways. Runoff is slow, permeability is moderately slow (USDA, 1971), and the available moisture capacity is high.

DRAWING NO.: 409658-B - WPIC  
PROJECT NO.: 409658  
INITIATOR: D. BURTON  
PROJ. MGR.: D. BURTON  
DATE LAST REV.: 2-27-90  
DRAWN BY: P. SUAREZ  
STARTING DATE: 5-2-89  
DRAWN BY: S. MOORE  
BRUNING 72425

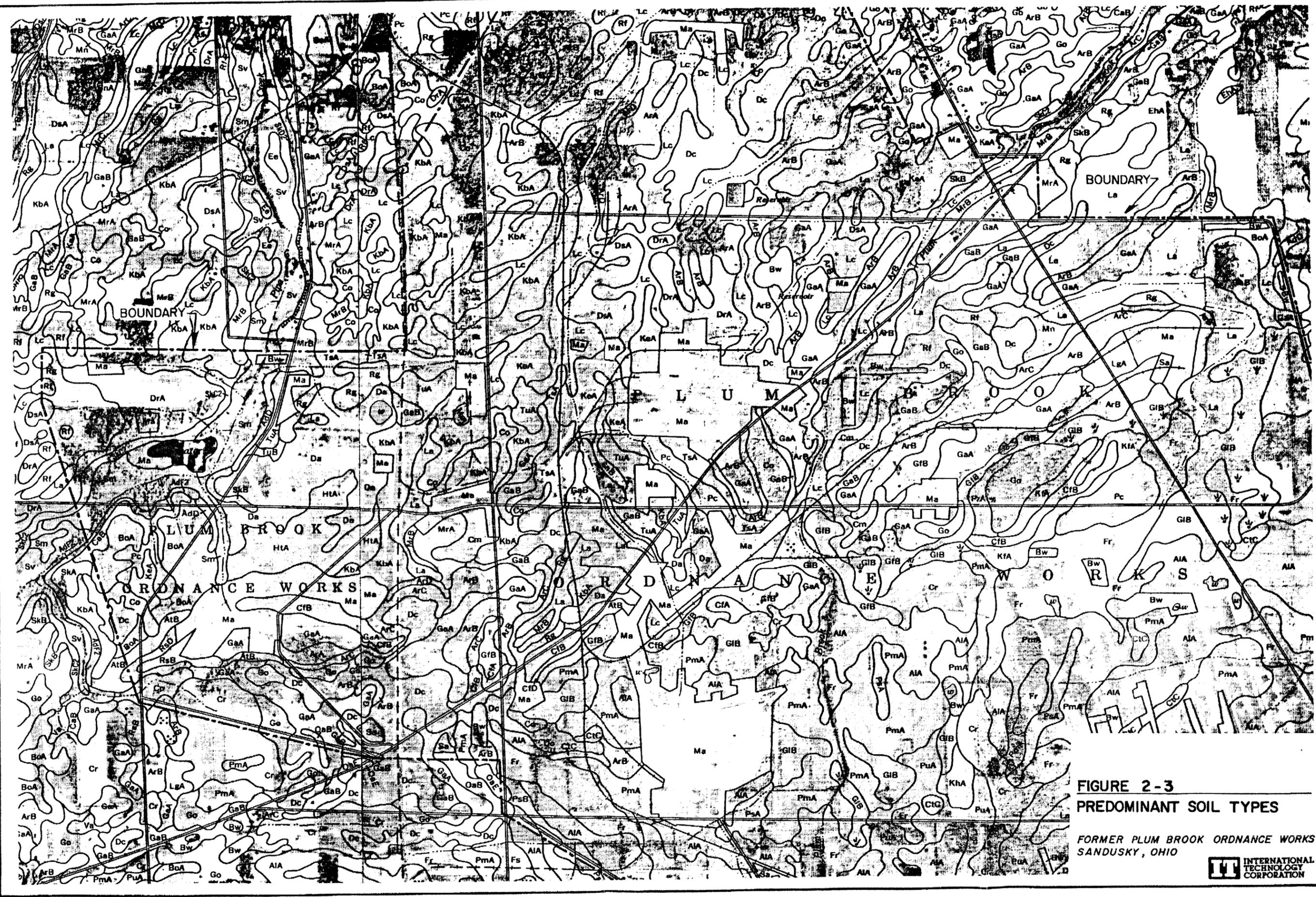


FIGURE 2-3  
PREDOMINANT SOIL TYPES

FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO



### Geologic Setting

In the Paleozoic Era, large tropical inland seas covered the Plum Brook site. As the seas began to recede, deposits of carbonate material slowly lithified into thick layers of limestone and dolomite. Likewise, deposits of mud and clay formed shales and quartz, while other silicate materials formed sandstone.

In recent geologic time, glacial ice scoured the area, cutting out the river valleys. The resistant bedrock that covers most of the area was not deeply cut by the glaciers.

The majority of the site is underlain by lacustrine glacial deposits making up the Huron shale. The shale is grayish black, hard, dense and abundantly carbonaceous. The area is also underlain by Plum Brook shale and Delaware and Prout limestones. The shales are low in porosity, while the limestones are massive with calcareous shale partings and are moderately porous. The bedrock is limestone in the western part of the site and shale in the eastern part. The regional dip is easterly, and younger rocks crop out progressively from west to east (U.S. Geological Survey, 1954).

### Hydrogeologic Setting

Groundwater in the area of the Plum Brook site has its source in local precipitation. The limestone beds underlying the site are the principal aquifer. Yields from limestone deposits range generally between 5 and 25 gallons per minute (Figure 2-4). Water in limestone beds occurs principally in joint cracks along bedding planes and in other openings. Most wells in the limestone deposits in the vicinity of the station range between 50 and 80 feet in depth. The quality of the water deteriorates rapidly with increased depth, and wells deeper than approximately 100 feet generally yield sulfur water. There are no wells used as a source of water supply within the Plum Brook site.

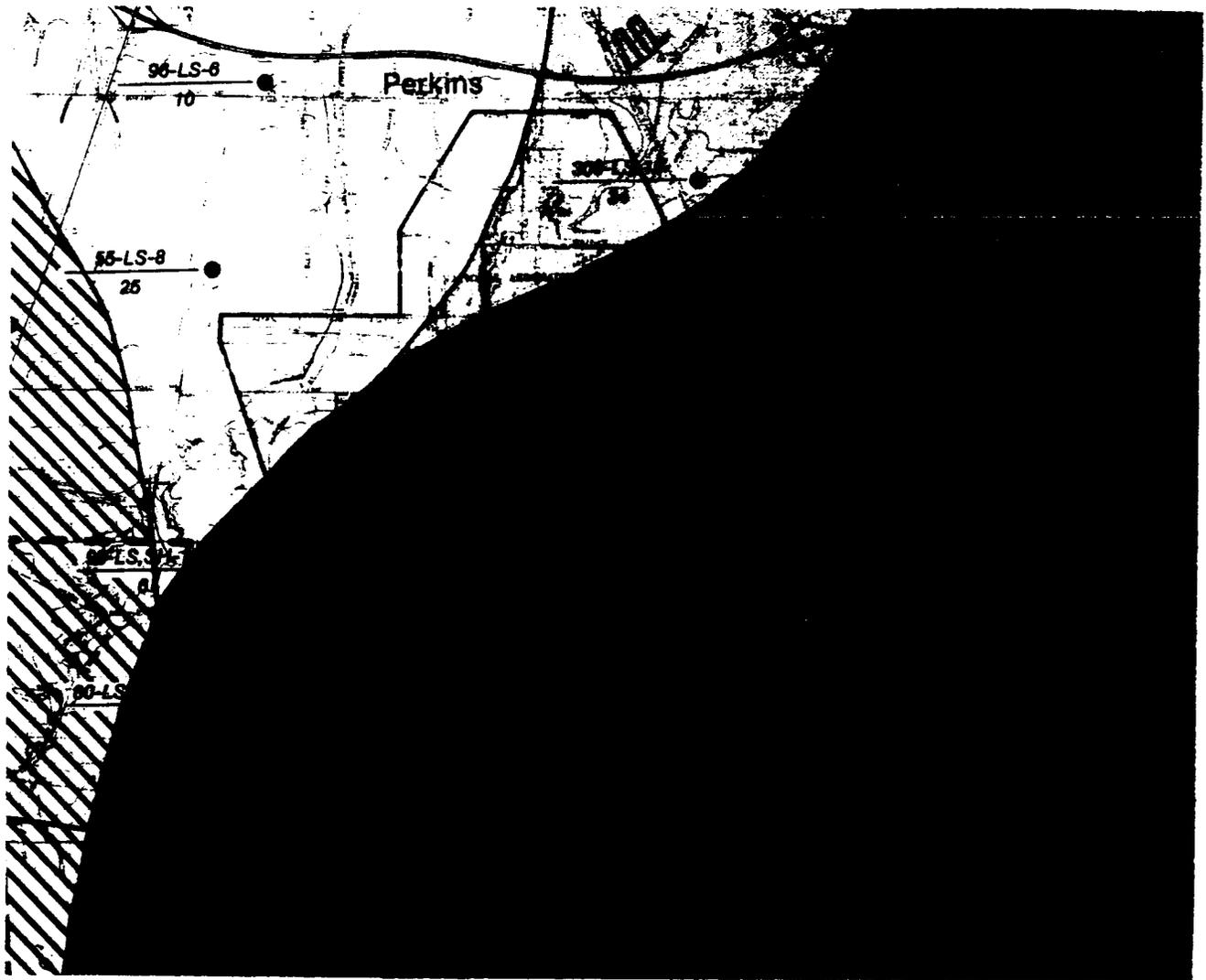
Surface water leaves the site through naturally occurring surface creeks. All streams may have zero flow in severe winter freezes and extended summer droughts. NASA currently monitors three streams for National Pollutant Discharge Elimination System (NPDES) discharge limits at the Plum Brook site. The three streams are Plum Brook, Ransom Brook, and Kuebeler Ditch. The impacts on the surface or groundwater hydrology resulting from the operations of the Plum Brook site are minimal. The existence of buildings, roads, parking lots, and other impervious areas has caused an insignificant increase in the amount of storm water runoff during rainfall events.

DRAWING NO.: 409658 - A - WP11  
PROJECT NO.: 409658

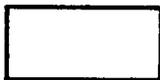
INITIATOR: D. BURTON  
PROJ. MGR. D. BURTON

DATE LAST REV.: 2-27-90  
DRAWN BY: P.L. SUAREZ

STARTING DATE: 4-26-89  
DRAWN BY: S. MOORE



### LEGEND



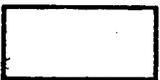
AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE MAY BE DEVELOPED.

Yields of more than 500 gallons per minute have been developed at depths of less than 200 feet in cavernous limestone and dolomite. Domestic supplies are generally obtained at depths of around 100 feet.

Hydrogen sulfide, in varying amounts, may be encountered in the bedrock.



Areas in which there is a potential concentration of contamination due to the underground disposal of storm wastes from Bellevue.



AREAS IN WHICH YIELDS OF 5 TO 25 GALLONS PER MINUTE MAY BE DEVELOPED.

Yields of 15, or less, gallons per minute are developed from wells drilled into the limestone. Hydrogen sulfide may be present in varying amounts.



AREAS IN WHICH YIELDS SELDOM EXCEED 3 GALLONS PER MINUTE

Limited quantities of ground water are obtained from thin, discontinuous sand and gravel deposits interbedded in fine, sandy clay or from the underlying shale. Drilling deeper than 30 feet into the shale is not recommended. Occasional gas or salt noted in the eastern half of the county.

Larger yields may be obtained in western Huron and Oxford townships and southeastern Perkins Township. Wells may encounter water-bearing limestone beneath as much as 60 feet of impervious shale.

● Existing Domestic Wells

SCALE

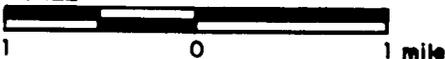


FIGURE 2 - 4

### GROUND WATER RESOURCES

FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO



## 3.0 SITE INVESTIGATION

### 3.1 INTRODUCTION

#### General

The former Plum Brook site was investigated for possible contamination by hazardous materials associated with disposal of explosive manufacturing wastes, and out-of-specification ordnance. Field investigations at Plum Brook were conducted in accordance with the approved Final Work Plan prepared and submitted by IT, September 1989, except where noted. Where field procedures vary from the Final Work Plan, variances were previously approved by COE to accommodate site conditions. Table 3-1 provides a chronological summary of the performance periods and field activities accomplished during the field site investigation.

#### Summary of Field Activities

The field work was performed from October 16 through October 25. Permission to proceed with the field work was given verbally by John Hall, Chief Engineering Management Support Branch, COE, Nashville, Tennessee Division.

The property is presently administered by NASA. Permission to access the site was given in a letter from Robert P. Kozar, Chief, Plum Brook Management Office (see Appendix A). Harry McCune, Plum Brook Facilities Engineer, acted as the project contact and approved well drilling permits and extended work hours during the course of the project.

Field investigations at the former Plum Brook site consisted of:

- Installation of monitoring wells
- Shallow soil sampling for chemical analysis
- Sampling of surface water collected from NPDES points and standing water at former red water retention lagoons
- Groundwater sampling
- One hydraulic conductivity test.

A calibrated photoionization detection (PID) device (HNu brand) was used to screen soil samples, drill cuttings, and borehole gases for organic vapors during drilling and soil sampling activities.

A variance allowing discharge of decontamination wastewaters on the site was given by COE.

**Table 3-1. Chronological Summary of Performance Periods and  
Field Activities  
Former Plum Brook Ordnance Works Site**

---

10/16	Mobilize to Plum Brook. Meet Mateco drilling crew and H. McCune at NASA office building to locate decontamination area. Set up and drill MW-05 at Waste Area 1.
10/17	Complete MW-05; decontaminate drill rig and augers. Mobilize to MW-06 site drill and complete MW-06. Decontaminate drill rig; mobilize to MW-02 site. Drill and complete MW-02. Obtain variance to collect one soil sample for chemical analysis from the water table and use fewer samples for geotechnical analysis.
10/18	Meet at NASA office building for right-to-know safety information. Decontaminate drill rig and mobilize to MW-01 site. Bedrock encountered at 3 feet; obtain variance to auger to refusal or 10 feet and set 5 feet of screen. Obtain variance to delete permeability tests on wells which have extremely slow recharge rates. Soil samples at Ransom Road Burn Area SB-01 and SB-02 collected. Soil samples SB-03 to SB-06 collected at Snake Road Rubbish Area.
10/19	Soil borings collected at Waste Area 1 SB-13 to SB-18. Two deep soil borings collected as per variance issued by COE representative to sample soil above the water table.
10/20	Soil boring SB-19 collected. Soil borings at Waste Area 2 located. pH meter calibrated. Collect surface water samples SW-01 through SW-04. Ship soil samples.
10/21	Develop and purge monitoring wells MW-01, MW-05, and MW-06. MW-01, MW-05, and MW-06 bail dry with less than 2 gallons of water removed. These wells do not recover. Ship surface water samples.
10/22	Develop MW-02; purge MW-02. Collect soil samples from Waste Area 2 SB-07 through SB-12. SB-08 is deleted by agreement with COE in favor of a deep soil sample from Waste Area 1 soil boring rinsate sample collected.
10/23	Monitor wells MW-01, MW-05, and MW-06 have recovered to predevelopment levels. Permeability test on MW-02. Collect groundwater samples. Ship soil samples and rinsate samples.
10/24	Package groundwater samples. Secure site. Demobilize from Plum Brook site. Ship groundwater samples.

---

### **3.2 MONITORING WELL INSTALLATION AND DEVELOPMENT**

Four groundwater monitoring wells were installed at the Plum Brook site. Their locations are shown in Figure 3-1. Groundwater flow is presumed to be toward the north. The wells were placed to intercept groundwater influenced by the percolation from the red water retention ponds, to monitor quality of groundwater that is migrating toward the site boundary, and to provide a background control.

Monitoring well MW-01 is located near the southern boundary of the site, at the intersection of Scheid Road and Patrol Road, and monitors the quality of groundwater entering the site. Monitoring well MW-06 is located near the north perimeter of the site and monitors groundwater quality exiting the site. Monitoring wells MW-05 and MW-02 were located close to and downgradient of Waste Disposal Areas 1 and 2, respectively.

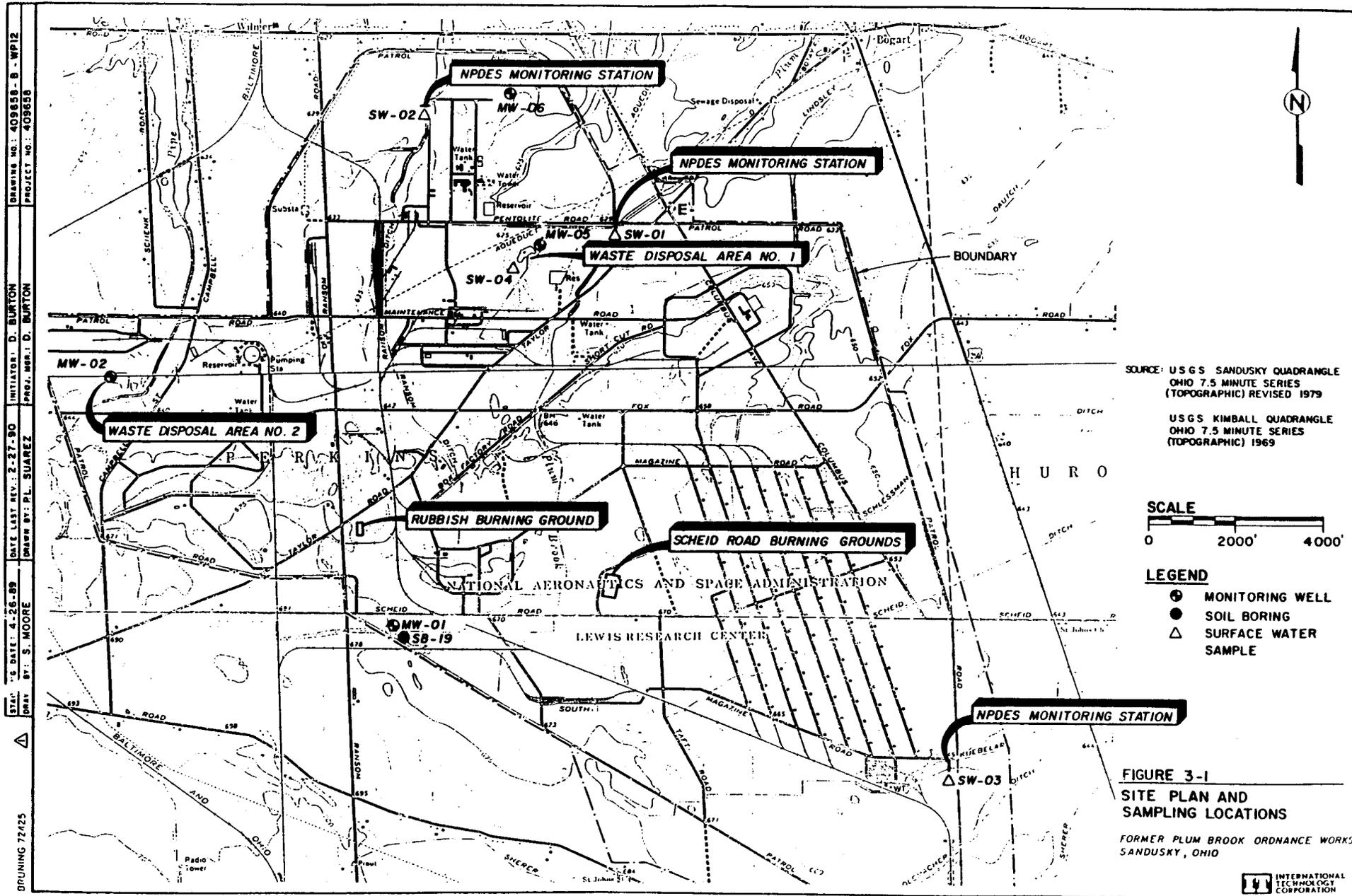
Two monitoring wells, used for monitoring the groundwater quality at two burning grounds, were deleted from the site investigation at the request of the COE representatives. Monitoring wells MW-03 and MW-04 originally were to be located at the burning ground at Taylor and Ransom roads and the Scheid Road Burning Grounds, respectively.

#### **Monitoring Well Construction**

Borehole drilling and well construction services were provided by Mateco Drilling Services of Grand Rapids, Michigan. Boreholes were drilled using an eight-inch outside diameter hollow stem augers, advanced by a truck-mounted CME 75 drill rig.

Boreholes were terminated either approximately 10 feet below the first occurrence of saturated material or at auger refusal, whichever was sooner. A variance was agreed upon to allow the termination of the wells at the bedrock to avoid opening a potential conduit for contamination of the bedrock aquifer. MW-01 was drilled to a total depth of 9 feet, MW-02 to 18.3 feet, MW-05 to 21 feet, and MW-06 to 15.5 feet. Subsurface soils were sampled continuously for the first 10 feet and every 5 feet thereafter. Sampling procedures were in accordance with American Society for Testing and Materials Method D 1586 (ASTM-D-1586-87). All samples were examined by an IT geologist and the data obtained, in accordance with ASTM-D-2488, were recorded on a standard subsurface materials log form (Appendix B). All samples were placed in sterile polyethylene bags, labeled, and securely sealed.

Six samples from boreholes at locations MW-05 and MW-06 were selected for geotechnical testing to determine Atterberg limits, grain size distribution, and moisture content. Because of the limited samples available from MW-01, only one sample was submitted for geotechnical analysis from this location. At MW-02, the COE representatives requested that a soil sample from above the water table be taken for chemical analysis, leaving only enough material for three geotechnical analyses from this location. One



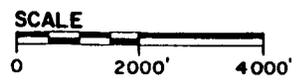
DRAWING NO.: 409658-B-WP12  
 PROJECT NO.: 409658

INITIATOR: D. BURTON  
 PROJ. MGR.: D. BURTON

DATE LAST REV.: 2-27-90  
 DRAWN BY: P.L. SUAREZ

DATE: 4-28-89  
 JOB BY: S. MOORE

SOURCE: USGS SANDUSKY QUADRANGLE  
 OHIO 7.5 MINUTE SERIES  
 (TOPOGRAPHIC) REVISED 1979  
 USGS KIMBALL QUADRANGLE  
 OHIO 7.5 MINUTE SERIES  
 (TOPOGRAPHIC) 1969



- LEGEND**
- ⊕ MONITORING WELL
  - SOIL BORING
  - △ SURFACE WATER SAMPLE

**FIGURE 3-1**  
**SITE PLAN AND SAMPLING LOCATIONS**  
 FORMER PLUM BROOK ORDNANCE WORKS  
 SANDUSKY, OHIO

additional sample from the screened interval of one well (MW-02) was chosen for sieve analysis for comparison to the sieve analysis of the filter pack material.

Monitoring wells were constructed in accordance with the U.S. Environmental Protection Agency (EPA) Manual of Water Well Construction Practices (EPA, 1983).

The general well construction specifications are shown in Figure 3-2.

Monitoring wells were constructed of 2-inch threaded, flush-jointed Schedule 40 polyvinyl chloride (PVC) well casing and 2-inch threaded factory slotted 0.010 slot PVC screen. Each well (except for MW-01) had a 2-foot sand sump constructed of 2-inch flush-threaded Schedule 80 PVC placed on the bottom of a 10-foot section of well screen. The wells were set through the auger string, placing a minimum of 0.5 foot of filter sand below the screen base. Centralizers were not required because the wells were set through the auger stems and the wells could be aligned to be plumb because of their short length. Filter sand (40/60 mesh washed silica sand) was tremied into the borehole through the auger string, raising the string continuously just above the sand pack to prevent bridging in the auger. Approximately three and a half bags of filter sand, one bucket of bentonite pellets, one bag of portland cement, and three pounds of bentonite gel were required to complete each well.

Because saturated materials or bedrock were encountered very close to the ground surface, the height of the filter pack above the screen and bentonite seal thickness could not always be maintained at two feet each and still provide a minimum of two feet of grouting. At the direction of COE, preference was given to a minimum of two feet of grouting and the remaining interval was divided as closely as possible between the filter pack above the top of the screen and the bentonite seal. However, in any case, the bentonite seal and filter pack above the top of the screen were one and a half feet or greater in thickness. The bentonite seal was hydrated using distilled water. After the seal was allowed to hydrate for a minimum of 15 minutes, the annular space was grouted to the surface using a 5 percent bentonite neat cement mixture, grout, and a locking protective casing was installed. After the grout had set, guard posts, concrete pads or aprons, and survey markers were installed. Details of individual well construction are shown on the boring logs, Appendix B.

### Well Development

A variance allowing well development to proceed 24 hours after the wells were grouted was approved by COE. The wells at the former Plum Brook site were developed by surging and bailing.

-MW06  
DRAWING NO.: 40  
PROJECT NO.: 409658  
INITIATOR: D. BURTON  
ATE LAST REV.: 2-27-90  
DRAWN BY: PL. SUAREZ  
STARTING DATE: 5-3-81  
DRAWN BY: D. HIGGS

(3)-2"x5' STEEL POSTS  
EQUALLY SPACED,  
PAINTED WITH PERMANENT,  
HIGH VISIBILITY PAINT

SURVEY MARKER 2 - 3 FT.  
GROUND SURFACE  
(SLOPED)

PERMANENT WELL IDENTIFIER

STEEL PROTECTIVE CASING  
W/HINGED CAP AND LOCK,  
PAINTED

VENTED CAP

2" I.D. PVC PIPE, W/FLUSH  
THREADED JOINTS AS REQUIRED

3' x 3' x 4' SLOPED  
CONCRETE PAD

CEMENT GROUT

FLUSH THREADED JOINT

VARIABLE

2 FT. MIN.

BENTONITE SEAL

2 FT.

FLUSH THREADED JOINT

APPROX. WATER TABLE ELEV.

15 FT. ±

2" I.D. PVC  
PRESLOTTED WELL SCREEN

10 FT.

GRAVEL PACK

FIGURE 3-2

WELL

CONSTRUCTION  
SPECIFICATIONS

FLUSH THREADED JOINT

2.5'

2" I.D. PVC  
SAND-SUMP

.5'

FLUSH THREADED PLUG

6.5 IN. MIN.



NOT TO SCALE

... Creating a Safer Tomorrow

After the wells were installed, they were surveyed to establish coordinates and elevations for each well and for two control monuments. A plat of the monitoring well and monument locations is included in Appendix B. Groundwater elevations and coordinates of well and monument locations are presented in Table 3-2.

Monitoring wells were developed by surging the water column with a four-foot PVC bailer and bailing, to remove the fines from the filter pack and to provide a transition from the formation to the filter pack thus improving the efficiency of the well. Wells were surged for approximately 15 minutes with the surge block and then were bailed. The wells are relatively low yield wells and, except for MW-02, could be bailed dry after removing 1.5 to 2.0 gallons of water from each well. After recharge of the wells for 18 hours, water levels ranged from 64 (MW-06) to 94 (MW-01) percent of their original water level. Well development time for the wells, including the time required for recharge, ranged from 24 hours for MW-01, MW-05, and MW-06 to 3 hours for MW-02. Fine sand present in the filter pack was removed during the surging and bailing and the wells appeared to produce clear water.

#### Field Hydraulic Conductivity Tests

A rising head "slug" test was performed at monitoring well MW-02 on October 23. Because of the very slow recharge observed in the wells, a variance was sought and approved to eliminate hydraulic conductivity tests on wells showing extremely low recharge. Equipment used in these tests included:

- A 0- to 15-pound-per-square-inch (psi) pressure transducer equipped with an atmospheric pressure compensation tube
- ENVIRO-LABS model DL-120-MCP data logger.

The test at MW-02 was set up by lowering the pressure transducer below the static water level and initiating the data recording sequence on the data logger. The data logger is equipped with a segmented interval logging (SILOG) feature allowing water level recording at 1- to 60-second intervals. The test was considered finished when the water column above the pressure transducer had returned to 90 percent of the original level. Evaluation of the field hydraulic conductivity tests are included in Appendix C.

### 3.3 VARIANCES TO THE WORK PLAN

Field procedures varied slightly from the procedures set forth in the original work plan. Seven changes were implemented to adjust procedures for conditions encountered in the field. Variances were noted in the Field Activity Daily Logs and recorded on Variance Log Forms included in Appendix D. These changes are discussed as follows:

Table 3-2. Well and Monument Locations

Identification	Description	Coordinate*		Elevation Top of Well* (feet MSL)	Elevation Top of Survey Marker (feet MSL)	Approximate Depth to Groundwater* (feet)	Approximate Elevation to Groundwater (feet MSL)
		North	East				
IT-MW-01	Monitoring well	616864.39	1946988.24	678.24	674.52	5.03	673.21
IT-MW-02	Monitoring well	622474.41	1941725.48	639.54	636.53	10.72	628.82
IT-MW-05	Monitoring well	625309.03	1950936.35	635.53	632.38	15.78	619.75
IT-MW-06	Monitoring well	628604.10	1950228.42	632.97	628.90	13.46	619.51
CM-01	Control monument	623737.32	1946373.89	N/A	637.04	N/A	N/A
CM-02	Control monument	616939.68	1946582.42	N/A	678.80	N/A	N/A

\*Magnetic North.

\*Top of ring of 2-inch PVC casing.

\*Measured from top of PVC casing.

N/A - Not applicable.

- Decontamination wastewaters were not collected and stored on site; rather, wastewater was allowed to run off from the decontamination area and enter a sewer system. This procedure was approved in advance by the COE and NASA project contacts.
- Because the bedrock was encountered at a high level in MW-01, only one sample was submitted for geotechnical analysis.
- Bedrock was encountered in MW-01 and MW-06 and, to avoid creating a potential conduit into a lower aquifer, boreholes were terminated even if saturated sandy materials were not encountered 10 feet above the borehole base.
- Hydraulic conductivity tests would not be run where recharge rates were significantly low such that recovery to 90 percent would not occur within 24 hours or there would be insufficient water column to remove two bails from the well.
- The burn areas were very highly vegetated and exhibited no evidence of surface contamination. In contrast, Waste Disposal Area 1 exhibited extensive contamination at the surface. In response to these observations, COE representatives authorized the following modifications to the sampling plans:
  - The monitoring wells planned for the burn areas were to be deleted and replaced with deep soil borings at Waste Disposal Area 1. In the deep soil borings, the sample was to be taken from above the first significant clay layer.
  - Where surface contamination was evident, soil samples were to be collected from 0- to 2-feet below ground surface.
- At Waste Disposal Area 2, a COE representative requested that a soil sample from MW-02 taken above the water table be submitted for chemical analysis. This reduced the amount of material recovered from borehole MW-02 and only three soil samples could be submitted for geotechnical analysis. The sample submitted for chemical analysis from MW-02 was substituted for SB-08.

### 3.4 SAMPLING PROGRAM

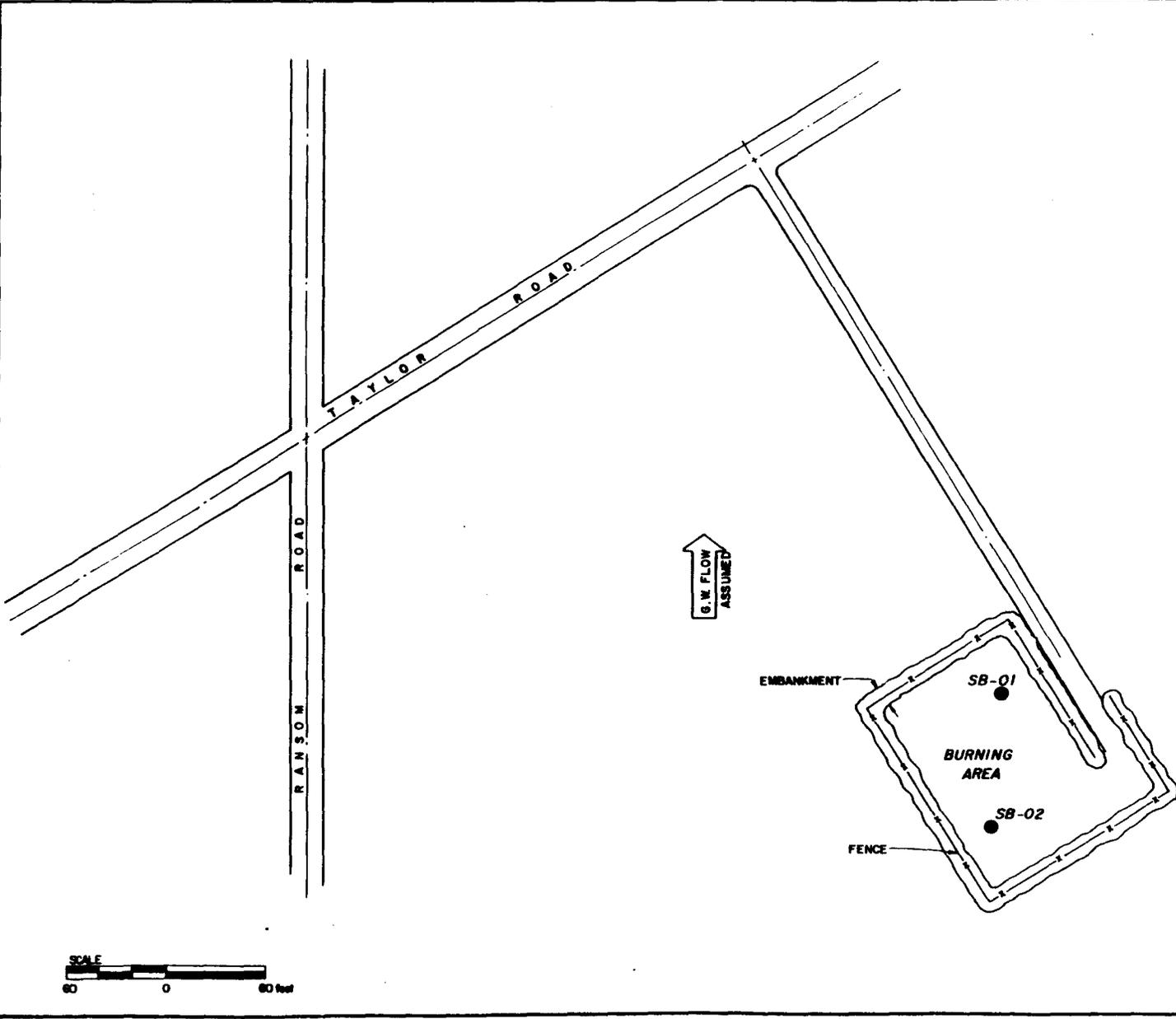
Soil, surface water, and groundwater sampling locations are shown on Figures 3-1, 3-3, 3-4, 3-5, and 3-6.

#### Soil Samples for Geotechnical Testing

Soil samples for geotechnical testing were collected from each monitoring well borehole during well construction. Individual subsurface samples from each well were taken continuously for the first 10 feet and on 5-foot intervals thereafter where capable. From the intervals sampled, two geotechnical samples were selected for grain-size distribution testing, two geotechnical samples were selected for Atterberg limits, and two geotechnical samples were selected for moisture content determination. Sampling was accomplished using a split-spoon sampler (ASTM-D-1586-87). Drilling and sampling equipment was decontaminated between each sampling event in accordance with procedures presented in Section 3.5. Soils were classified and logged in the field according to the Unified Soils Classification System (USCS) nomenclature and the Munsell Color Chart (Borings Logs, Appendix B). Classification was

2-29-90  
BRUNING 72425

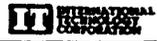
STARTING DATE: 4-28-89 DRAWN BY: S. MOORE	DATE LAST REV.: 11-28-90 DRAWN BY: S. TOKAY	INITIATOR: J. SHIREMAN PROJ. MAN.: D. BURTON	DRAWING NO.: 409459-B - MW02 PROJECT NO.: 409459
--	--	---	---



LEGEND  
● SOIL BORING

FIGURE 3-3  
RUBBISH BURNING GROUND AT  
TAYLOR AND RANSOM ROADS  
SAMPLING LOCATIONS

FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO



2-27-90

BURNING 72425

STARTING DATE: 4-26-89  
DRAWN BY: S. MOORE

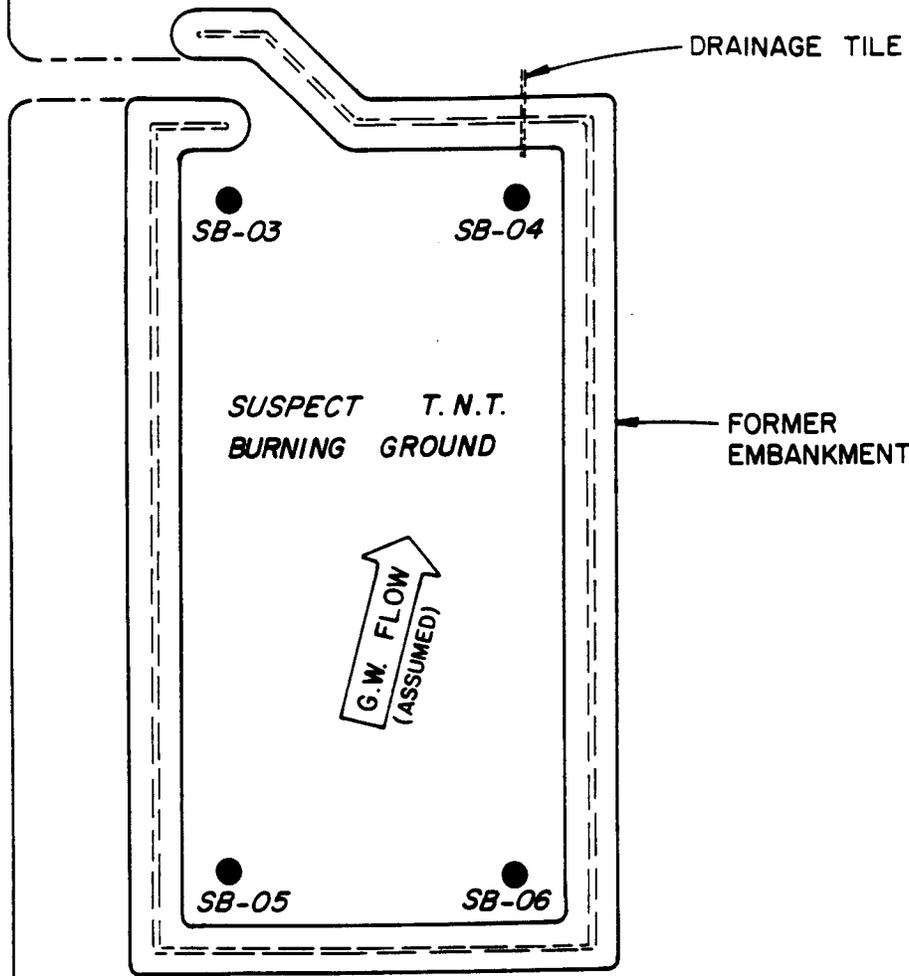
DATE LAST REV.: 11-26-90  
DRAWN BY: S. TOKAY

INITIATOR: J. SHIREMAN  
PROJ. MGR. D. BURTON

DRAWING NO.: 409658-A - MW03  
PROJECT NO.: 409658

APPROX. 800 FEET  
TO SCHEID ROAD

EXISTING SLATE ROAD



**LEGEND**

● SOIL BORING

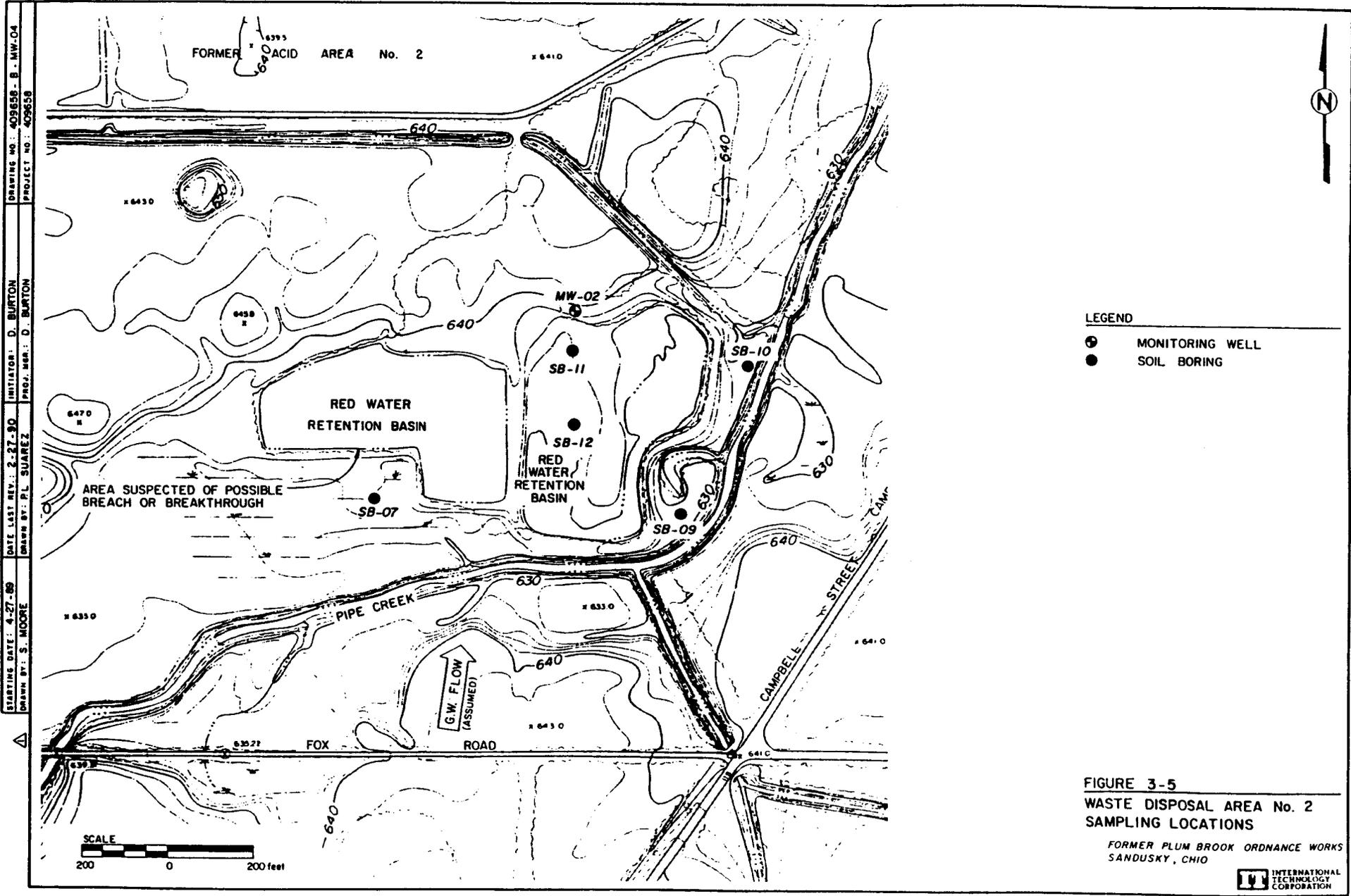


**FIGURE 3-4**

**SCHEID ROAD BURNING GROUNDS  
SAMPLING LOCATIONS**

FORMER PLUM BROOK ORDNANCE WORKS  
SANDUSKY, OHIO



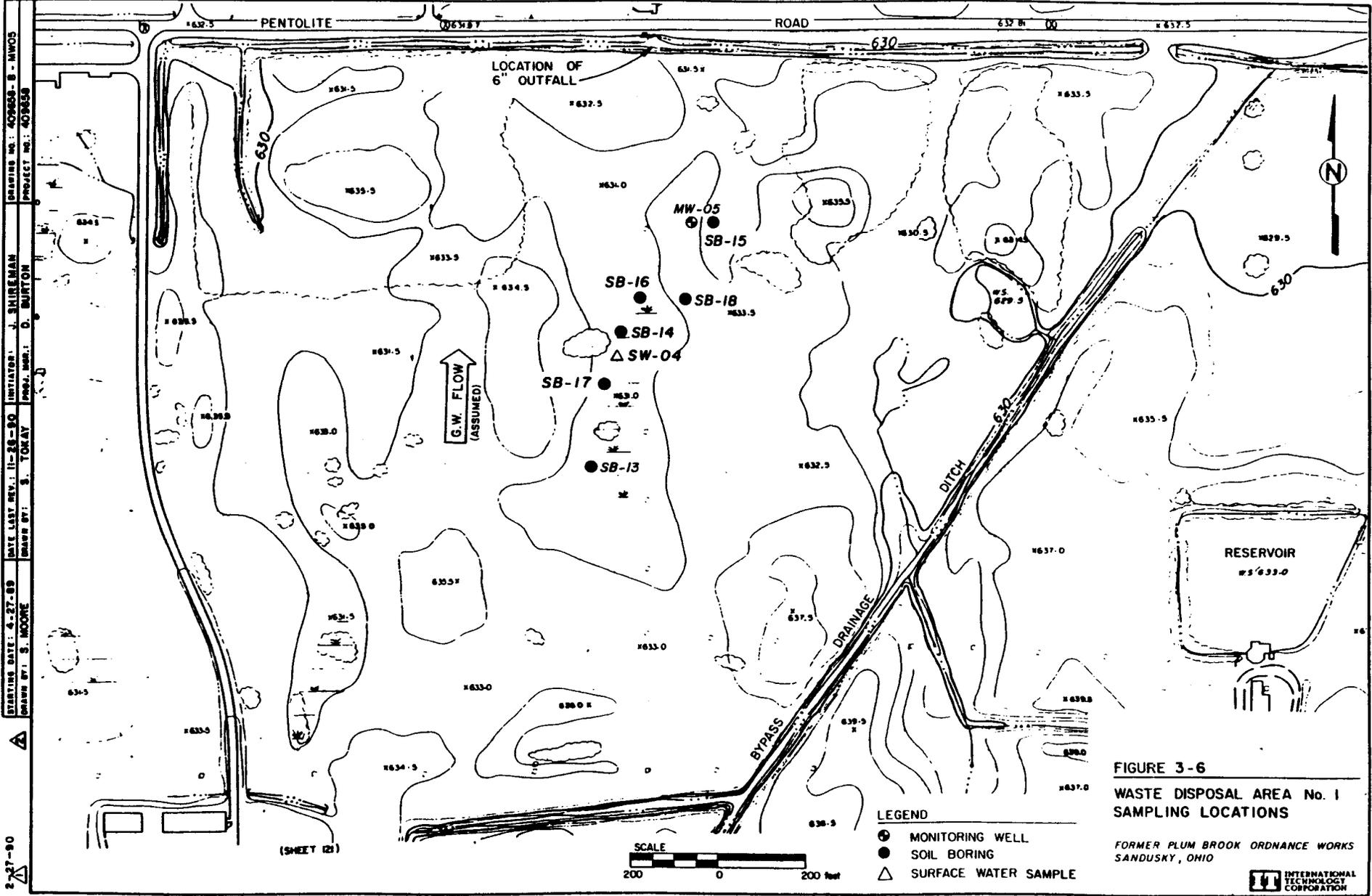


STARTING DATE: 4-27-89  
DRAWN BY: S. MOORE

DATE LAST REV.: 2-27-90  
DRAWN BY: P. SUAREZ

INITIATOR: D. BURTON  
PROJ. MGR.: D. BURTON

DRAWING NO.: 409658 - E - MW.04  
PROJECT NO.: 409658



verified by laboratory analyses consisting of grain-size distribution, Atterberg limits, and moisture content. The geotechnical analyses are presented in Appendix E.

### Shallow Soil Samples for Chemical Analysis

Soil borings were advanced and soil samples were collected to determine the presence of contamination at shallow levels at the site. Samples were examined by the IT geologist and information was recorded on standard soil boring log forms (Appendix B). All samples collected for chemical analysis were placed into appropriate sample containers and sealed. Soil borings SB-01 and SB-02 were collected at the rubbish burning ground near the intersection of Taylor and Ransom roads. Soil borings SB-03 through SB-06 were collected at the former Scheid Road burning grounds. Soil borings SB-07 and SB-09 through SB-12 were collected around Waste Disposal Area No. 2. Soil borings SB-13 through SB-18 were collected in the vicinity of Waste Disposal Area No. 1. Soil boring SB-19 serves as the background soil boring and is located near the intersection of Scheid and Patrol roads. Soil samples from soil borings SB-01 through SB-06 and from SB-13 through SB-19 were collected using a 2-foot-long, 2-inch outside diameter split spoon sampler in accordance with ASTM-D-1586-87. Soil borings SB-07 through SB-12 were collected using a hand auger. During soil boring activities, an HNu was used to monitor the levels of VOCs in the borehole and associated with the soil sample.

Soils collected during the soil boring were submitted for chemical analysis to ITAS laboratory in Knoxville, Tennessee. Duplicate samples were taken from the background sample location (SB-19) and from SB-04 for submission to the COE designated QA laboratory (COE Missouri River District Laboratory, Omaha, Nebraska). SB-04 was also split with COE. The analysis program included VOCs, semivolatile organic compounds (base/neutral and acid extractables or BNAs), total metals, total sulphates, nitrates, pH, and nitro-aromatic explosive compounds. Samples submitted for analysis of VOCs were taken from the base of the split spoon (grab samples). All other samples submitted for analysis were composites of the sampling interval. In addition to the soil samples, equipment rinsate samples were collected and split for analysis by IT and the COE QA laboratory.

Soil samples from 19 soil borings were collected from sample intervals of 0 to 6 feet. For eight soil borings (SB-01 to SB-06, SB-14, and SB-15) that showed no visible evidence of surface contamination, the upper two feet of soil was discarded and the soil interval was collected from four to six feet for chemical analysis. At soil boring locations (SB-07, SB-09 through SB-13, and SB-16 through SB-19) with visible potential surface contamination (e.g., standing red water or crystalline solids at the surface), the 0- to 2-foot soil interval was collected for chemical analysis. At Waste Disposal Area No. 1, a clay layer at 6 feet forming a perched saturated zone, was discovered during the drilling and installation of monitoring well MW-05. Two additional soil samples were collected immediately above the clay layer

at Waste Disposal Area No. 1 and analyzed for chemical analysis (SB-15 and SB-16). Six soil samples were collected from borings at Waste Disposal Area No. 2 using a hand auger because they were inaccessible by the drilling rig (SB-07, SB-09 through SB-12, and SB-19). At SB-19 (background), bedrock was encountered at 3 feet; therefore, the 0- to 2-foot interval was collected there.

### Surface Water Sampling

Surface water samples (SW-01 through SW-04, Figure 3-1) were taken on October 20 at three NPDES monitoring points and from standing water at Waste Disposal Area 1. Samples were collected using a Pyrex™ dipper and stainless steel retention bowl. The retention bowl was filled using the Pyrex dipper and sample bottles were filled directly from the retention bowl. Analytical parameters were the same as for the soil sampling program. All sampling equipment was decontaminated before the first sample and between samplings. An equipment rinsate was collected after sampling SW-01. Duplicate samples were collected from SW-01 for IT QA procedures and for the COE designated QA laboratory.

Samples collected for VOCs, nitrates, and metals were required to be preserved by acidification to pH less than two. Samples taken for VOC analysis were preserved with hydrochloric acid (HCl), for nitrate analysis were preserved with sulphuric acid (H<sub>2</sub>SO<sub>4</sub>), and for total metals analysis were preserved with nitric acid (HNO<sub>3</sub>). In all cases, acids were added to sample bottles before sampling.

### Groundwater Sampling

All monitoring wells were sampled on October 23. Samples were obtained in accordance with EPA Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities (EPA, n.d.). Because of the long time period required for recharge, monitoring wells MW-01, MW-05, and MW-06 were not purged after development before sampling. However, sampling took place less than 48 hours after development. Groundwater samples were taken using a decontaminated Teflon™ bailer. An equipment rinsate was taken after sampling at MW-02. Duplicate samples were taken from MW-02 for IT QA procedures and for the COE designated QA laboratory.

Analytical parameters and preservative methods were the same as for soil sampling and surface water sampling, respectively, as delineated above.

### 3.5 DECONTAMINATION PROCEDURES

Before entering and leaving the site and between borings, the drill rig, downhole tools, and equipment were decontaminated using a steam rinse, steam wash using a nonphosphatic detergent, and a final steam rinse.

All soil sampling equipment that came into contact with the soil (i.e., split-spoon sampler, mixing bowls, sampling spoons) were washed with a nonphosphatic detergent, rinsed with distilled water, rinsed with isopropyl alcohol, then allowed to air dry.

All well screens and riser pipes used in monitor well construction were decontaminated by steam cleaning before placement in the well borehole.

All sampling equipment for surface water and groundwater collection and retention materials were decontaminated using field decontamination techniques as outlined for soil sampling.

Surge blocks, slugs, and bailers were decontaminated between wells. They were washed with a nonphosphatic detergent, rinsed with distilled water, then rinsed with isopropyl alcohol.

## 4.0 ANALYTICAL RESULTS

### 4.1 INTRODUCTION

This section discusses the results of data obtained from laboratory analyses of samples collected between October 16 and October 25, 1989. The collection of soil, groundwater, and surface water samples are described in Section 3.0. The Certificates of Analysis are presented in Appendix E.

Analytical services were provided by the ITAS Technology Development Laboratory (TDL) in Knoxville, Tennessee and by ITAS, also in Knoxville. Samples collected for geotechnical testing were analyzed in the ITAS TDL. All other samples for chemical analysis were analyzed by the ITAS laboratory, located on Middlebrook Pike in Knoxville. QA samples were analyzed by the Department of Army, Missouri River Division, and COE Laboratory in Omaha, Nebraska. All samples and duplicates were shipped by Federal Express on the day of collection or the next day.

The analyses of field samples were reviewed and compiled to complete generation of the HRS form. The scoring and other applicable data regarding the HRS form are included in Appendix F.

### 4.2 ANALYTICAL RESULTS/METHODOLOGY

All data from chemical analysis of samples, except for the CLP data, were blank corrected (i.e., if any compound was found in the corresponding blank, it was subtracted from the analytical results before it was reported). EPA Contract Laboratory Program (CLP) data, VOCs, and BNAs were not blank corrected, and CLP soil results were reported on a dry weight basis.

The samples were analyzed for VOCs by gas chromatography/mass spectroscopy (GC/MS) in accordance with EPA CLP Statement of Work, dated February 1988.

### 4.3 SOIL ANALYTICAL RESULTS

Twenty-one samples were collected from 18 soil borings, and one monitoring well location was analyzed for the parameters listed in Table 4-1. Of the 19 originally planned soil borings, one (SB-08) was not installed. Instead, a soil sample was collected from monitoring well MW-02 and analyzed. Duplicate samples were collected from SB-04 and SB-19. SB-04 was also split with COE. The analyses of SB-04 split sample have not been received by IT.

Table 4-2 summarizes VOCs and semivolatile organic compounds detected in soil samples collected at the site. Acetone was detected in 11 of the 20 samples collected and in some cases (SB-05, -06, -07 and -19) exceeded 2,000 parts per billion (ppb). Acetone was detected in SB-19 (the background soil

boring) and also in the soil rinsate sample. Acetone is a common contaminant of isopropyl alcohol which was used as the final rinse during decontamination of soil sampling equipment. Acetone detected in soil samples collected at this site may be the result of field decontamination procedures.

Methylene chloride was detected from 6 ppb to 10 ppb in 12 of the samples collected as well as the duplicate sample collected from SB-04. Methylene chloride was also detected in other samples at concentrations below the calibrated detection limit for methylene chloride and is most likely attributable to laboratory contamination.

Toluene was detected at 9 ppb in SB-19 in the 0- to 2-foot depth interval and probably represents restricted minor soil contamination.

Bis(2-ethylhexyl)phthalate was detected in six of the soil samples collected. However, it was also detected in the method blanks at concentrations below its calibrated detection limit. The compound is a plasticizer that is present in surgical gloves and other materials; therefore, it may be attributed to field or laboratory contamination.

Significant concentrations (greater than or equal to 740 ppb) of 2,6-dinitrotoluene and 2,4-dinitrotoluene were detected in samples collected from soil borings installed in the vicinity of Waste Disposal Area 1. These concentrations represent residual contamination from disposal practices associated with explosives manufacturing at the pre-existing facility. However, soil contamination does not appear to be impacting groundwater conditions in the vicinity of Waste Disposal Area 1, as no semivolatile compounds were detected in the groundwater sample collected from the monitoring well installed in this area (MW-05).

Table 4-3 summarizes nitro-aromatic nitroexplosive compounds detected in soil samples collected at the site. Nitro-aromatic explosive compounds were detected in samples collected from soil borings installed near the Scheid Road Burning Ground, Waste Disposal Area 1 and Waste Disposal Area 2. Only a minor concentration (0.093 ppm) of 1,3,5-trinitrobenzene was detected in one soil boring (SB-03) at the TNT Burning Ground area. It appears that soil contamination is minor in this area. Soil contamination in the two waste disposal areas is more significant, widespread, and diverse in composition.

Table 4-4 summarizes the results of metals analysis of soil samples collected at the site. Manganese was detected in soil sample MW-02B at a concentration significantly higher than in the background sample and may be attributable to contamination resulting from activities associated with Waste Disposal Area 2. The measured manganese concentration in MW-02B was 2,600 parts per million (ppm), which

Table 4-3. Plum Brook Ordnance Works Soil Samples -  
Nitro-Aromatic Explosive Compounds  
Results in mg/kg (ppm)

Compound	SB-01	SB-02	SB-03	SB-04	SB-04 Field Duplicate	SB-05	SB-06	MW02B 6-8'	Method Blank BL0134	SB-07	SB-09	SB-10
1,3,5-Trinitrobenzene	0.050U	0.050U	0.093	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.41	0.050U	0.050U
1,3-Dinitrobenzene	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U	0.50U	0.050U	0.050U
Nitrobenzene	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.068U	0.048U	0.48U	0.048U	0.048U
2,4,6-Trinitrotoluene	0.074U	0.074U	0.074U	0.074U	0.074U	0.074U	0.074U	0.074U	0.074U	0.74U	0.074U	0.074U
2,6-Dinitrotoluene	0.053U	0.053U	0.053U	0.053U	0.053U	0.053U	0.053U	0.053U	0.053U	0.053U	0.053U	0.053U
2,4-Dinitrotoluene	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U	0.23	0.11U	0.11U
Nitrotoluene	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U

U - Compound was analyzed for but not detected; value listed is the detection limit for the sample.

Table 4-3 (Continued)  
 Plum Brook Ordnance Works Soil Samples -  
 Nitro-Aromatic Explosive Compounds  
 Results in mg/kg (ppm)

Compound	SB-11	SB-12	SB-13 0-2'	SB-14 0-2'	SB-15 2-4'	SB-15 4-6'	SB-16 0-2'	SB-16 4-6'	SB-17 0-2'	SB-18 0-2'	Background	
											SB-19 0-2'	SB-19 Field Duplicate
1,3,5-Trinitrobenzene	0.050U	3.4	0.73	14	0.050U	0.050U	1.2	15	0.67	10	0.050U	0.050U
1,3-Dinitrobenzene	0.050U	0.59	0.62	3.7	0.50U	0.050U	0.55	6.4	0.25U	5.0	0.050U	0.050U
Nitrobenzene	0.048U	U	0.24U	2.5U	0.048U	0.048U	0.48	2.4U	0.24U	2.4U	0.048U	0.048U
2,4,6-Trinitrotoluene	0.074U	0.68	0.37U	3.7U	0.074U	0.074U	0.74	3.7U	0.37U	3.7U	0.074U	0.074U
2,6-Dinitrotoluene	0.053U	U	0.26U	2.6U	0.053U	0.053U	0.53	2.7U	0.27U	2.7	0.053U	0.053U
2,4-Dinitrotoluene	0.11U	0.91	2.2	20	0.11U	0.11U	3.2	16	1.1	19	0.11U	0.11U
Nitrotoluene	0.048U	U	0.24U	2.4U	0.048U	0.48U	0.48	2.4U	0.24U	2.4U	0.048U	0.048U

U - Compound was analyzed for but not detected; value listed is the detection limit for the sample.

Table 4-4. Plum Brook Ordnance Works  
Soil Samples - Metal Analysis  
Results in mg/kg (ppm)

Compound	Borehole Number												
	Method Blank PBSC0836	SB-01	SB-02	SB-03	SB-04	SB-04 Field Duplicate	SB-05	SB-06	MW02B C/6-8	Method Blank PSC4079	SB-07	SB-09	SB-10
<b>METALS</b>													
Arsenic	0.2U	7.0	2.8	3.7U	1.4U	1.3	2.0	5.5U	2.9U	0.2	3U	3U	3U
Barium	0.2U	51.0	51.3	31.6	41.0	29.8	21.1	58.9	214	0.2U	77.8	66.7	63.3
Cadmium	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.6
Chromium	1U	7.0	11	10	7	4	4	6	20	1U	17	14	14
Iron	1U	10,200	15,400	15,600	11,000	4,090	4,940	6,420	24,000	4	23,200	16,300	17,800
Lead	3U	10	10	50	16	10	9	16	20	3U	20	21	27
Maganese	0.2U	300	180	71.3	14.5	9.8	35.0	129	2,600	0.2U	530	104	271
Mercury	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
Selenium	0.2U	0.3U	0.4U	0.4U	0.6U	0.8U	0.8U	1.0U	1.2U	0.2U	1.5U	1.5U	0.4U
Silver	0.5U	0.5U	0.5U	0.5U	0.5	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Sodium	20U	65	110	76	45	34	32	80	578	20U	1,360	205	174

U - Compound was analyzed for but not detected; value listed is detection limit for that sample.

Method Blank PSC0836 applies to samples SB-13 0/2, SB-14 0/2, SB-15 2/4, SB-15 4/6, SB-16 0/2, SB-16 4/6, SB-17 0/2, SB-18 0/2, SB-19 0/2 replicate.

Table 4-4 (Continued)  
 Plum Brook Ordnance Works  
 Soil Samples - Metal Analysis  
 Results in mg/kg (ppm)

Compound	Borehole Number												-----Background-----
	SB-11	SB-12	Method Blank PBSC0897	SB-13 0-2	SB-14 0-2	SB-15 2-4	SB-15 4-6	SB-16 0-2	SB-16 4-6	SB-17 0-2	SB-18 0-2	SB-19 0-2	SB-19 0-2 Field Dup.
<b>METALS</b>													
Arsenic	2.3	3U	0.2	2.7U	1.8	4.6	3.2U	2.8	4.9	0.8	1.3	9.4	3U
Barium	48.4	52.2	0.2U	56.7	51.6	14.1	31.1	16.5	27.1	21.9	20.2	35.2	45.4
Cadmium	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Chromium	11	10	1U	13	10	8	10	8	6	6	5	10	8
Iron	12,800	18,000	44	15,500	12,000	10,900	13,100	5,910	7,700	8,370	6,890	23,800	9,800
Lead	14	14	3U	9	11	11	12	5	7	8	11	25	18
Maganese	211	262	0.2U	263	146	181	244	78.2	435	141	97.6	18.0	15.5
Mercury	0.5U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U
Selenium	2.5U	0.5U	0.2U	1.0U	0.9U	0.5U	1.7U	0.7U	1.0U	0.4U	2.0U	0.2	1.0U
Silver	0.5U	U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U
Sodium	539	1,660	20U	2,590	3,420	96.9	125	1,040	2,820	1,240	1,980	40.1	40

U - Compound was analyzed for but not detected; value listed is detection limit for that sample.

Method Blank PSC0836 applies to samples SB-13 0/2, SB-14 0/2, SB-15 2/4, SB-15 4/6, SB-16 0/2, SB-16 4/6, SB-17 0/2, SB-18 0/2, SB-19 0/2 replicate.

is significantly higher than any value measured in other soil samples at the site and may represent minor, restricted soil contamination.

All other metals except sodium were detected at concentrations similar to the concentrations detected in the background soil sample or are within the concentration range for elements in soils typical of the area.

Sodium concentrations in SB-07, SB-12, SB-13, SB-14, SB-16 (0 to 2 feet), SB-16 (4 to 6 feet), SB-17 (0 to 2 feet), and SB-18 (0 to 2 feet) were significantly above measured background levels. Sodium concentrations measured in these soil samples ranged from 1,040 ppm to 2,820 ppm, whereas the concentration in the background sample was 40.1 ppm. Elevated sodium concentrations were detected in soil samples collected from soil borings installed near the waste disposal areas and probably represent contamination associated with past disposal activities in these areas.

Results of analysis of sulfate, nitrate, and pH of soils collected at the site are presented in Table 4-5. Elevated sulfate concentrations (1,800 ppm and 2,500 ppm) were detected in samples SB-16 (4 to 6 feet) and SB-18 (0 to 2 feet), respectively. Elevated nitrate concentrations (2,000; 120; and 190 ppm) were detected in samples SB-12, SB-16 (4 to 6 feet), and SB-18 (0 to 2 feet), respectively. These concentrations probably represent residual breakdown products from waste materials disposed of in the waste disposal areas at the site.

#### 4.4 GROUNDWATER ANALYTICAL RESULTS

Groundwater from four shallow monitoring wells and three control samples were analyzed for parameters listed in Table 4-1.

Table 4-6 summarizes the results of analyses of VOC and semivolatile organic compounds detected in groundwater samples. Acetone was the only VOC detected above its calibration detection limit. Acetone was detected at 82 and 12 ppb in wells MW-01 and MW-02, respectively. Because acetone was not detected in the groundwater rinsate sample, concentrations in MW-01 and MW-02 probably represent minor groundwater contamination.

Significant concentrations of 2,6-dinitrotoluene and 2,4-dinitrotoluene were detected in the groundwater sample collected from MW-02 and its associated duplicate sample. Although the results of analyses of soil samples collected from soil borings installed near Waste Disposal Area 2 do not indicate the presence of detectable semivolatile compounds, it appears that groundwater has been impacted by activities associated with the area.

Table 4-5. Plum Brook Ordnance Works  
Soil Samples - Sulfate, Nitrate, and pH  
Results in ppm, Unless Otherwise Noted

Sample No.	Sulfate	Nitrate as N	pH (Standard Units)
Method Blank P0617/P0619	400U	2U	NR
SB-01	2000U	2	6.03
SB-02	2000U	2U	5.03
SB-03	2000U	2U	7.75
SB-04	2000U	2U	5.06
SB-04 Field Duplicate	2000U	2U	5.00
SB-05	2000U	2	5.10
SB-06	2000U	2U	5.32
MW-02B-C/6-8	2000U	2U	7.86
SB-07	2000U	2U	8.37
SB-09	2000U	12	4.52
SB-10	2000U	2U	6.25
SB-11	2000U	5	8.15
SB-12	2,000	7	8.02
Method Blank P0634	400U	2U	NR
SB-13 0-2'	1000U	16	7.62
SB-14 0-2'	2000U	15	7.69
SB-15 2-4'	400U	2U	7.94
SB-15 4-6'	1000U	2U	8.48
SB-16 0-2'	1000U	9	9.11
SB-16 4-6'	1,800	120	8.43
SB-17 0-2'	1000U	10	8.23
SB-18 0-2'	2,500	190	8.57
SB-19 (Background)	1000U	2U	5.00
SB-19 Field Duplicate	2000U	2U	5.50

U - Compound was analyzed for but not detected; value listed is the detection limit.  
NR - Not required.

Table 4-6. Plum Brook Ordnance Works Groundwater Samples -  
Volatile and Semivolatile Organic Compounds  
Results in ug/liter (ppb)

Compound	Method Blank 1 CB1102	Method Blank BL4994	Back- ground MW-01	Method Blank 2 BLA0044	MW-02	MW-02 Field Duplicate	Trip Blank JJ8057	Method Blank#2 CB1103	MW-05	MW-06	GW Rinsate
<b><u>Volatile Organics</u></b>											
Acetone	10U	NA	82	NA	12	10U	10U	10U	7J	10U	10U
Methylene chloride	2J	NA	5U	NA	5U	5U	2J	3J	5U	5U	5U
Carbon disulfide	5U	NA	2J	NA	5U	5U	5U	5U	4J	9	5U
Toluene	5U	NA	2J	NA	5U	5U	5U	5U	5U	5U	5U
Chloroform	5U	NA	5U	NA	5U	5U	5U	5U	5U	5U	1J
<b><u>Semivolatile Organics</u></b>											
2-nitroaniline	NA	50U	52U	50U	2J	2J	NA	NA	50U	50U	50U
2,6-dinitrotoluene	NA	10U	10U	10U	27	25	NA	NA	10U	10U	10U
3-nitroaniline	NA	50U	52U	50U	13J	12J	NA	NA	50U	50U	50U
2,4-dinitrotoluene	NA	10U	10U	10U	160	140	NA	NA	10U	10U	10U
bis(2-ethylhexyl) phthalate	NA	10U	10U	10U	2J	10U	NA	NA	2J	10U	10U
4-nitrophenol	NA	50U	52U	50U	3J	10U	NA	NA	50U	50U	50U
butylbenzylphthalate	NA	10U	10U	10U	10U	10U	NA	NA	10U	10U	3J

U - Compound was analyzed for but not detected; value listed is the detection limit for that sample.

J - Indicates a value less than the detection limit.

NA - Not analyzed.

Table 4-7 summarizes the results of analyses of nitro-aromatic explosive compounds. This table indicates that no detectable concentrations of nitroexplosive compounds were present in groundwater samples collected at the site.

Table 4-8 presents the results of metals analyses of groundwater samples. Concentrations of chromium were detected above the maximum concentration limit (MCL) and proposed maximum concentration limit (PMCL) in groundwater samples collected from MW-02 (field duplicate) and MW-06. All other metals except iron, manganese, and sodium were present below analytical detection limits or the MCL for that particular element.

Iron and manganese were detected at concentrations above their secondary maximum contaminant levels (SMCLs) in samples collected from wells MW-01, -02, -02 (split), -05, and -06. Although these concentrations may indicate that some degradation of groundwater quality has occurred resulting from past site activities, no enforceable concentration limits exist for these metals.

There is no MCL or SMCL for sodium.

Table 4-9 presents the results of sulfate, nitrate, and pH analyses of groundwater samples. Nitrate concentrations did not exceed the MCL in any of the analyzed samples. Concentrations of sulfate in samples MW-02 and MW-02 (split) exceeded the SMCL for sulfate. The elevated sulfate concentration in MW-02 appears to represent an impact from past activities at Waste Disposal Area 2 on local groundwater conditions.

#### **4.5 SURFACE WATER ANALYTICAL RESULTS**

Surface water from three NPDES monitoring points and from standing water at Waste Disposal Area 1 plus one control sample were analyzed for parameters listed in Table 4-1.

Table 4-10 indicates that only one VOC or semivolatile organic compound was detected above analytical detection limits in surface water samples collected at the site. Butyl benzyl phthalate was detected at 19 ppb in SW-04 (field duplicate). The compound was not detected in SW-04 and probably represents laboratory contamination of SW-04 (field duplicate).

Table 4-11 indicates that no nitro-aromatic explosive compounds were detected above analytical detection limits in surface water samples collected at the site.

Table 4-7. Plum Brook Ordnance Works  
Groundwater Samples - Nitro-Aromatic Explosive Compounds  
Results in mg/liter (ppm)

Compound	Method Blank #1 BL0137	Back- ground MW-01	MW-02*	MS-02* Field Duplicate	MW-05	Method Blank #2 BL0138	MW-06	GW Rinsate
1,3,5-trinitrobenzene	0.050U	U	0.25U	0.25U	U	U	U	U
1,3-dinitrobenzene	0.050U	U	0.25U	0.25U	U	U	U	U
Nitrobenzene	0.048U	U	0.24U	0.24U	U	U	U	U
2,4,6-trinitrotoluene	0.074U	U	0.37U	0.37U	U	U	U	U
2-6-dinitrotoluene	0.053U	U	0.26U	0.26U	U	U	U	U
2,4-dinitrotoluene	0.11U	U	0.55U	0.55U	U	U	U	U
Nitrotoluene	0.048U	U	0.24U	0.24U	U	U	U	U

U = Compound was analyzed for but not detected. Detection limits are as for method blank unless otherwise listed.  
\*Detection limits for these samples are elevated due to matrix interferences.

Table 4-8. Plum Brook Ordnance Works  
Groundwater Samples - Metals  
Results in mg/liter (ppm)

Compound	MCL	SMCL	PMCL	Method Blank PBWC0866	Background MW-01	MW-02	MW-02 Field Duplicate	MW-05	MW-06	GW Rinsate
Arsenic	0.050		0.030	0.005U	0.005U	0.01U	0.004U	0.007U	0.005	0.002U
Barium	1.000		5.000	0.002U	0.051	0.068	0.068	0.21	0.11	0.002U
Cadmium	0.010		0.005	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Chromium	0.050		0.100	0.01U	0.01U	0.01U	0.12	0.01U	0.12	0.01U
Iron		0.300		0.01U	2.8	2.7	1.5	0.8	0.76	0.01U
Lead	0.050		0.020	0.03U	0.03U	0.03U	0.03U	0.03U	0.03U	0.03U
Manganese		0.050		0.002U	0.31	2.8	3.0	0.053	0.093	0.002U
Mercury	0.002		0.002	NR	0.001U	0.001U	0.001U	0.001U	0.001U	0.001U
Selenium	0.010		0.050	0.002U	0.003U	0.015U	0.015U	0.003U	0.003U	0.002U
Silver	0.050			0.005U	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Sodium	NA			0.2U	18.4	401	441	17	15.3	0.2U

- U - Compound was analyzed for but not detected; listed values are the detection limits for that sample.
- NR - Not required.
- MCL - Maximum contaminant level.
- SMCL - Secondary maximum contaminant level.
- PMCL - Proposed maximum contaminant level.

Regulatory limits are from the Safe Drinking Water Act.

**Table 4-9. Plum Brook Ordnance Works  
Groundwater Samples - Sulfate, Nitrate, and pH  
Results in ppm, Unless Otherwise Noted**

	Sulfate	Nitrate as N	pH (Standard Units)
Method Blank	10U	0.05U	NR
MW-01 (Background)	130	0.07	6.38
MW-02	950	0.25U	6.95
MW-02 Field Duplicate	950	0.25U	6.92
MW-05	10U	0.05U	7.68
MW-06	60	0.12	7.56
GW Rinsate	10U	0.05U	7.37

NR - Not required.

U - Compound was analyzed for but not detected.

**Table 4-10. Plum Brook Ordnance Works Surface Water Samples -  
Volatile and Semivolatile Organic Compounds  
Results in mg/liter (ppb)**

	Method Blank EB1030	Method Blank BL4982	SW-01	SW-02	SW-03	SW-04	SW-04 Field Duplicate	Trip Blank JJ7938
<b><u>Volatile Organics</u></b>								
Acetone	10U	NA	10U	10U	10U	3J	10U	10U
Methylene chloride	3J	NA	5U	5U	5U	5U	5U	3J
4-methyl-2-pentanone	1J	NA	10U	10U	10U	10U	10U	10U
<b><u>Semivolatile Organics</u></b>								
bis(2-ethylhexyl)phthalate	NA	2J	10U	10U	10U	10U	10U	NR
butylbenzylphthalate	NA	10U	10U	10U	10U	10U	19	NR

U - Compound was analyzed for but not detected; value listed is the detection limit for that sample.

J - Indicates a value less than the detection limit; values listed are estimated.

NR - Not required.

NA - Not analyzed.

**Table 4-11. Plum Brook Ordnance Works  
Surface Water Samples - Nitro-Aromatic Explosive Compounds  
Results in mg/liter (ppm)**

Compound	Method Blank BL0141	SW-01	SW-02	SW-03	SW-04	SW-04 Field Duplicate
1,3,5-trinitrobenzene	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
1,3-dinitrobenzene	0.050U	0.050U	0.050U	0.050U	0.050U	0.050U
Nitrobenzene	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U
2,4,6-trinitrotoluene	0.074U	0.074U	0.074U	0.074U	0.074U	0.074U
2-6-dinitrotoluene	0.053U	0.053U	0.054U	0.054U	0.054U	0.054U
2,4-dinitrotoluene	0.11U	0.11U	0.11U	0.11U	0.11U	0.11U
Nitrotoluene	0.048U	0.048U	0.048U	0.048U	0.048U	0.048U

U = Compound was analyzed for but not detected.

**Table 4-12. Plum Brook Ordnance Works  
Surface Water Samples - Metals  
Results in mg/liter (ppm)**

Compound	Water Quality Criteria	SMCL	PMCL	Method Blank	SW-01	SW-02	SW-03	SW-04	SW-04 Field Duplicate
Arsenic	0		0.03	0.002U	0.003	0.002U	0.003U	0.002U	0.003U
Barium	N/L		5	0.002U	0.058	0.029	0.047	0.079	0.19
Cadmium	10		0.005	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Chromium	N/L		0.1	0.05U	0.01U	0.01U	0.01U	0.01	0.04
Iron	N/L	0.3		0.01U	0.89	0.36	1.1	9.6	40.6
Lead	50		0.02	0.03U	0.03U	0.03U	0.03U	0.03U	0.03U
Manganese	N/L	0.05		U	0.030	0.021	0.039	0.37	0.94
Mercury	10		0.002	NR	0.001U	0.001U	0.001U	0.001U	0.001U
Selenium	10		0.05	0.002U	0.004U	0.004U	0.003U	0.003U	0.004U
Silver	50		0.05	0.005U	0.005U	0.005U	0.005U	0.005U	0.005U
Sodium	N/L			U	0.2U	6.7	7.1	92.7	102

- U - Compound was analyzed for but not detected; value listed is the detection limit for the sample.
- NR - Not required.
- MCL - Maximum contaminant level.
- SMCL - Secondary contaminant level.
- PMCL - Proposed contaminant level.
- N/L - Not listed.

All regulatory limits given are derived from the Safe Drinking Water Act and the Clean Water Act.

**Table 4-13. Plum Brook Ordnance Works  
Surface Water Samples - Sulfate, Nitrate, and pH  
Results in ppm, Unless Otherwise Noted**

	Sulfate	Nitrate as N	pH (Standard Units)
Method Blank	10U	0.05U	NR
SW-01	100	15	7.60
SW-02	110	0.09	7.45
SW-03	110	1.3	7.23
SW-04	180	2.9	7.69
SW-04 Field Duplicate	180	4.4	7.67

NR - Not required.

U - Compound analyzed for but not detected; value listed is the detection limit.

Table 4-12 summarizes the analytical findings for metals in surface waters. Of those metals detected that could have a adverse effect on human health, none exceeded the MCL or PMCL. Iron was detected above its SMCL in all surface water samples collected at the site. Manganese was detected above its SMCL in SW-04 and its associated split. The SMCLs are not enforceable limits, and the actual concentrations are not viewed as an indication of a significant threat to surface water conditions.

There is no MCL or SMCL for sodium.

Table 4-13 indicates that sulfate was not detected above its SMCL in any surface water sample collected at the site. Nitrate was detected above its MCL (10 ppm) in SW-01, perhaps indicating a minor impact to surface water conditions from Waste Disposal Area 1.

#### 4.6 GEOTECHNICAL ANALYTICAL RESULTS

Six soil samples were collected during installation of monitoring wells to be analyzed for geotechnical parameters. An additional sample (MW-02, 13.5 to 15.5 feet) was collected of material considered representative of screened aquifer material for grain-size distribution determination. The results of these analyses are presented in Table 4-14 and Appendix E.

#### 4.7 RESULTS OF HYDRAULIC CONDUCTIVITY FIELD TESTS

The hydraulic conductivity test data were analyzed by using the Hvorslev Method (1951).

The results of the hydraulic conductivity field test (0.25 feet/day or  $8.8 \times 10^{-5}$  cm/s) indicate that the soil hydraulic conductivity is low. This is consistent with USCS classifications noted in Table 4-14.

#### 4.8 HAZARD RANKING SCORING

The results of the HRS, presented in Appendix F, indicate a ranking of 0.0.

Table 4-14. Plumb Brook Ordnance Works Soil Samples Geotechnical Results

Sample Location	Sample Depth (ft)	Water Content (%)	Atterberg Limits		Plasticity Index	USCS Classification
			Liquid Limit	Plastic Limit		
MW-05	0-2	--	--	--	--	--
MW-05	2-4	26.0	--	--	--	--
MW-05	4-6	--	26.6	19.2	7.4	CL-ML
MW-05	6-8	--	--	--	--	--
MW-05	8-10	--	26.9	18.3	8.6	CL
MW-05	19-21	14.0	--	--	--	--
MW-01	0-2	26.3	46.0	28.2	17.8	ML + OL
MW-02	2-4	--	--	--	--	--
MW-02	8-10	--	34.2	21.9	12.3	CL
MW-02	13.5-15.5	14.9	--	--	--	CL-ML*
MW-06	0-2	14.9	--	--	--	--
MW-06	2-4	--	--	--	--	--
MW-06	4-6	--	--	--	--	--
MW-06	6-8	--	28.3	18.5	9.8	CL
MW-06	8-10	22.5	--	--	--	--
MW-06	13.5-15.6	--	26.9	17.7	9.2	CL

\*from grain size analysis.

Table 4-1. Analyses and Approved Methods for Samples

Analysis	Analytical Methods		
	Soil Samples	Groundwater Samples	Surface Water Samples
Purgeables (volatile organics)	CLP <sup>a</sup>	CLP	CLP
Base/neutral and acid extractables	CLP	CLP	CLP
Total recoverable metals <sup>b</sup> (Ag, Ba, Cd, Cr, Pb Fe, Mn, Na)	EPA 3050/6010	EPA 3005/6010	EPA 200.7
As	EPA 3020/7060	EPA 7060	EPA 206.2
Se	EPA 3020/7740	EPA 7740	EPA 270.2
Hg	EPA 7471	EPA 7470	EPA 245.1/ 245.2
Total sulfates	EPA 9035	EPA 9035	EPA 375.3
pH	EPA 9045	EPA 9040	EPA 150.1
Nitrates	EPA 9200	EPA 9200	EPA 353.3
Nitro-aromatic explosive compounds <sup>c</sup>	THAMA <sup>d</sup> 8H	THAMA 8G	THAMA 8G

<sup>a</sup>Contract Laboratory Program.

<sup>b</sup>Fe, Mn, and Na analyzed for groundwater and surface water samples only.

<sup>c</sup>Mono-, di-, tri-nitro benzenes and toluenes.

<sup>d</sup>U.S. Army Toxic and Hazardous Materials Agency.

Table 4-2. Plum Brook Ordnance Works Soil Samples -  
 Volatile and Semivolatile Organic Compounds  
 Results in ug/kg (ppb)

Compound	Method Blank VB1030	Method Blank BL4976	SB-01	SB-02	SB-03	SB-04	SB-04 Field Duplicate	SB-05	SB-06	MW028 6-8'	Method Blank CB1101	Method Blank BL4986	SB-07	SB-09	SB-10	SB-11	SB-12
<b><u>VOLATILE ORGANIC</u></b>																	
Acetone	10U	NR	12U	12U	990	65	12U	4,300	2,300	12J	10U	NR	2,300E	5J	3J	3J	56
Toluene	5U	NR	4J	3J	6U	4J	4J	U	6U	6U	5U	NR	6U	6U	7U	4J	6U
Methylene chloride	2J	NR	10	48J	10	8	9	5J	5J	6J	2J	NR	5J	8	6J	10	8
Carbon Tetrachloride	5U	NR	3J	3J	6U	3J	4J	6U	6U	1J	5U	NR	6U	6U	6U	6U	6U
2-hexanone	10U	NR	2J	2J	3J	11U	12U	12U	11U	12U	10J	NR	6U	6U	6U	6U	6U
<b><u>SEMIVOLATILE ORGANIC</u></b>																	
2,6-Dinitrotoluene	NR	330U	380U	380U	370U	370U	380U	370U	380U	NR	NR	330U	770U	1,700U	900U	790U	770U
2,4-Dinitrotoluene	NR	330U	380U	380U	370U	370U	380U	370U	380U	NR	NR	330U	170J	1,700U	900U	790U	620J
Bis(2-ethylhexyl) phthalate	NR	300J	400	370J	380	1,200	350J	420	470	NR	NR	130J	180J	230J	280J	170J	340J

- U - Compound was analyzed for but not detected; value listed is the detection limit for that sample.  
 J - Indicates a value less than the detection limit.  
 NR - Not reported.  
 E - Compound exceeded CLP calibration range but was within instrument linear range.

Table 4-2 (Continued).  
 Plum Brook Ordnance Works Soil Samples -  
 Volatile and Semivolatile Organic Compounds  
 Results in ug/kg (ppb)

Compound	Method Blank VB1101	Method Blank 4983	SB-13 0-2'	SB-14 0-2'	SB-15 2-4'	SB-15 4-6'	SB-16 0-2'	SB-16 4-6'	SB-17 0-2'	SB-18 0-2'	SB-19 0-2'	Background		Soil Rinsate 1	Soil Rinsate 2
												SB-19 Field Duplicate			
<b><u>VOLATILE ORGANIC</u></b>															
Acetone	10U	NA	170	80	12U	12U	160	54	150	12U	3,000E	11,000		10U	80
Toluene	5U	NA	6U	6U	1J	6U	6U	6U	25J	1J	9	7U		5U	5U
Methylene chloride	2J	NA	6	9	7	7	5J	8	5J	6U	7	6J		5U	5U
<b><u>SEMIVOLATILE ORGANIC</u></b>															
2,6-Dinitrotoluene	NA	330U	180J	1,700	390U	390U	320J	1,500	82J	1,000	440U	860U		NA	NA
2,4-Dinitrotoluene	NA	330U	1,600	11,000	390U	390U	1,900	7,300	740	5,900	440U	860U		NA	NA
Bis(2-ethylhexyl) phthalate	NA	79J	230J	180J	320J	450	340J	500J	280J	250J	410J	270J		NA	NA

U - Compound was analyzed for but not detected; value listed is the detection limit for that sample.  
 J - Indicates a value less than the detection limit; value listed is estimated.  
 E - Compound exceeded CLP calibration range.  
 NA - Not analyzed.

## 5.0 REFERENCES

Hvorslev, M. J., 1951, Time Lag and Soil Permeability in Ground Water Observation, U.S. Army Corps of Engineers, Bulletin No. 36, 50 pp.

IT Corporation, 1989, "Work Plan for Contamination Evaluation at the Former Plum Brook Ordnance Works, Sandusky, Ohio," submitted to the Nashville (Tennessee) District, U.S. Corps of Engineers by D. Burton, IT Corporation, Knoxville, Tennessee, September 1, 1989.

Munsell, 1988, Munsell Soil Color Charts, Macbeth Division of Kollmorgen Instruments Corporation, Baltimore, Maryland.

U.S. Department of Agriculture, February 1971, Soil Conservation Service, Soil Survey Erie County, Ohio.

U.S. Environmental Protection Agency, 1983, Manual of Water Well Construction Practices, EPA 570/9-75-001.

U.S. Environmental Protection Agency, n.d., Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities, EPA 530/SW-611.

U.S. Environmental Protection Agency, 1984, Uncontrolled Hazardous Waste Site Ranking System, A Users Manual (MW-10).

U.S. Geological Survey, 7.5-Minute Quadrangle Map, Kimball Quadrangle, Ohio.

U.S. Geological Survey, 7.5-Minute Quadrangle Map, Sandusky Quadrangle, Ohio.

**APPENDIX A**  
**PROPERTY ACCESS AGREEMENTS**

**CEE2980APPS**  
**04/18/90 F1 NPNE**

National Aeronautics and  
Space Administration



**Lewis Research Center**  
Plum Brook Station  
6100 Columbus Avenue  
Sandusky, Ohio 44870

Reply to Attn of

**2870**

October 4, 1989

**International Technology Corporation**  
Attn: Mr. Don C. Burton  
Project Manager  
312 Directors Drive  
Knoxville, TN 37923

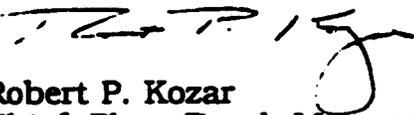
**Subject: Personnel Access to Plum Brook Station to Conduct Field  
Investigation Activities; IT Project Number 409658  
(A1T015)**

**Temporary access to Plum Brook Station to conduct field investigation activities as described in your request of September 21, 1989 is granted. Mr. Harry McCune, Plum Brook Facilities Engineer, will be your point of contact on this project. Listed below are some additional access conditions.**

**Normal working hours at Plum Brook Station are 8:00 a.m. to 4:30 p.m. Monday through Friday. Activities beyond these hours must be approved by Harry McCune. A list of all IT personnel and subcontractor personnel who will be working at Plum Brook shall be submitted prior to their arrival. The personnel on this list will be badged upon entering the Station and shall review a contractor safety video prior to commencing work.**

**A digging permit shall be obtained from Harry McCune prior to any drilling or excavation activities. Work areas, including access roads and field entrances, shall be returned to their original condition after work is completed.**

**Plum Brook Management Office offers its support to complete this field investigation.**

  
**Robert P. Kozar**  
Chief, Plum Brook Management Office



September 21, 1989

Mr. Robert Kozar  
General Manager  
NASA Lewis Research Center  
Plum Brook Station  
6100 Columbus Avenue  
Sandusky, Ohio 44870

Dear Mr. Kozar:

Subject: Permission Request for Temporary Property Access and  
Field Investigation Activities at the Former Plum Brook  
Ordnance Works; IT Project Number 409658 (A1T015)

IT Corporation has been contracted by the U.S. Army Corps of Engineers, Nashville District, to provide engineering services for the contamination evaluation at the former Plum Brook Ordnance Works. The objective of this project is a preliminary determination of the presence or absence of chemical contamination caused by Department of Defense (DOD) related activities.

IT Corporation requests permission for IT personnel and/or its subcontractors to have temporary access to the subject property to perform field investigation activities. IT will install 6 shallow ground water monitoring wells at an average depth of 25 feet per well, not to exceed 50 feet in each well. Approximately nineteen (19) shallow soil boring will be installed for sample collection for chemical analysis at various locations on the site. Representative soil, ground water, and surface water samples will be collected from site specific sampling locations as shown in Figures 1 through 5 (see attachments). Other engineering measurements and samples may be taken for this investigation. IT will confine activities on the property strictly to those necessary to complete field investigation activities.

IT plans to subcontract surveying, well drilling and construction, and split spoon sampling activities associated with this evaluation. A truck mounted rig and other incidental equipment may be brought on the property.

IT warrants its activities and will comply with all laws and ordinances applicable to perform the above work. IT will respect all property rights, including closing gates, etc., when on said property.

Regional Office

312 Directors Drive • Knoxville, Tennessee 37923 • 615-690-3211

A letter granting IT and/or our subcontractors temporary access to the property to perform field investigation activities is requested. The field investigation activities are tentatively scheduled to begin October 16, 1989, and are expected to completed within six weeks after the work has started.

Your prompt response in granting this request is appreciated. Should you have any questions, please call me at (615) 690-3211.

Sincerely,

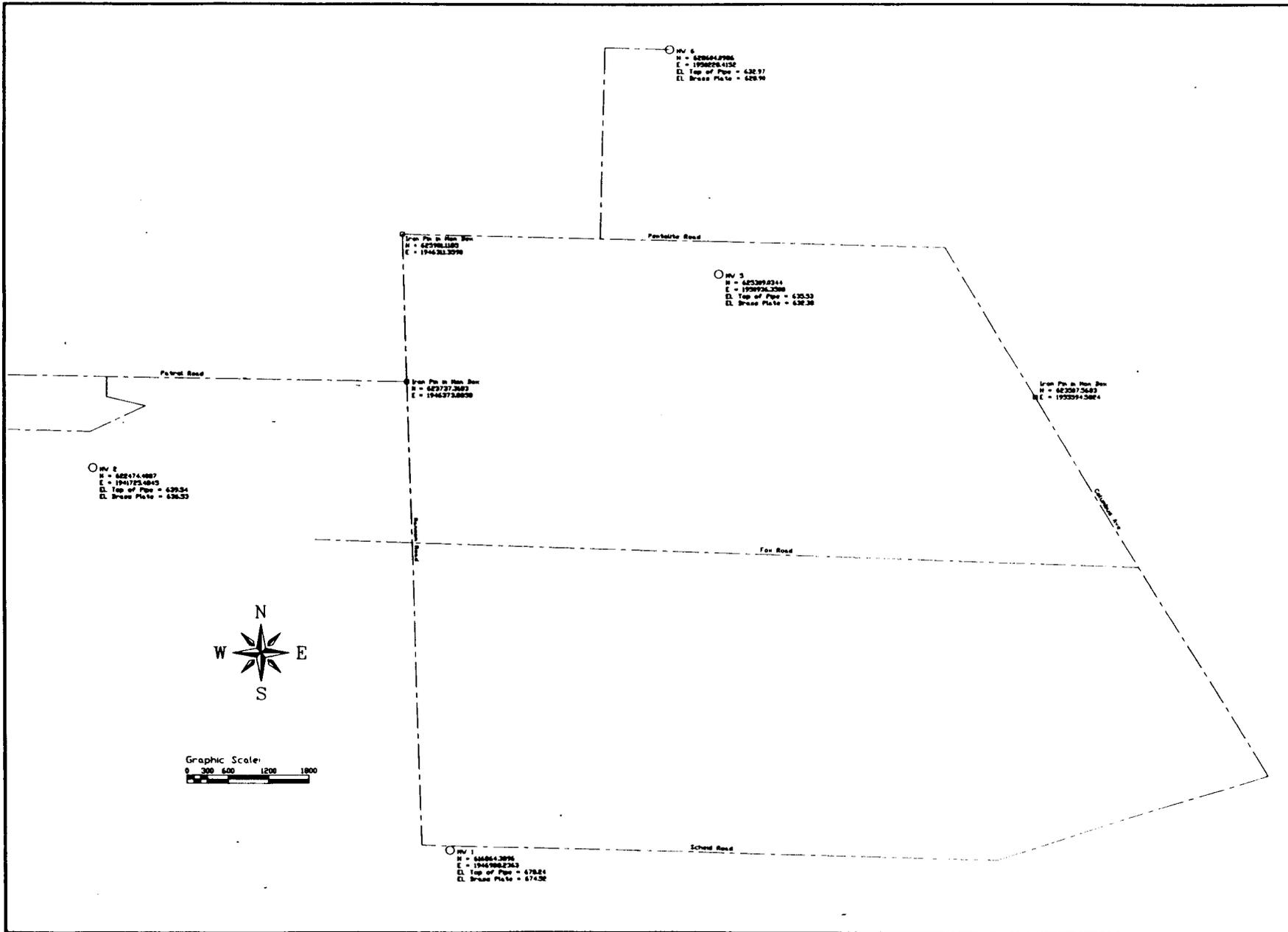


Don C. Burton  
Project Manager

attachments

cc: J. Hall - U.S. Army Corps of Engineers, Nashville  
C. Flatt- U.S. Army Corps of Engineers, Nashville  
H. McCune - NASA Plum Brook Station  
Project Files

APPENDIX B  
SOIL AND MONITORING WELL BORING LOGS



Feick Surveyors  
 224 East Water Street  
 Sandusky, Ohio 44870  
 (419) 625-2554

Monitoring Well Locations  
 for International Technology Corporation  
 NASA Plum Brook Station  
 Perkins Township, Erie County, Ohio

Date: 4/21/90

Drawn by: CMH

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-01	COORDINATES: Sandusky, OHIO	DATE: 10/19/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/19/89
DRILLING METHODS: Split Spoon Sampling		PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	Mnu ppm/time (c)	REMARKS
0							
1		DISCARD					
2							
3	com- posite	PUSH	100	SAND, fine grained, dry, reddish yellow (7.5 yr 6/8), loose. Wet to saturated at 3.8'.	sp		
4	voa			Refusal @ 3.8' T.D. = 3.8'			Shale bedrock.
5							
6							

NOTES:

Time sample taken: 1441  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Mnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658		PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-02		COORDINATES: Sandusky, OHIO	DATE: 10/18/89
ELEVATION: NA (a)		GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/18/89
GEOLOGIST: J. Shireman		Depth NA Date/Time NA	DATE COMPLETED: 10/18/89
DRILLING METHODS: Split Spoon Sampling			PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
1		DISCARD					
2							
3	com- posite	PUSH	91	SAND, very fine grained, brownish yellow (10 yr 6/6), loose. Sand grain size increases to medium in lower 0.25' of spoon.	sp		Dry Moist.
4	voa						Saturated.
				T.D. = 4.0'			
5							
6							

NOTES:

Time sample taken: 1512  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDANCE WORKS	
BORING NUMBER: SB-03	COORDINATES: Sandusky, OHIO	DATE: 10/18/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/18/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/18/89
DRILLING METHODS: Split Spoon Sampling		PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
1		DISCARD					
2				SAND, fine grained, brownish yellow, loose, dry.	sp		
3	com- posite	PUSH	95	Clayey, sandy SILT, plastic, dry.	ml		
4	voa			SAND, medium grained, light brown (7.5 yr 6/4), poorly graded, loose, moist	sm		
				T.D. = 4.0'			
5							
6							

NOTES:

Time sample taken: 1534  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-04	COORDINATES: Sandusky, OHIO	DATE: 10/18/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/18/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/18/89
DRILLING METHODS: Split Spoon Sampling		PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
1		DISCARD					
2				Silty SAND, black, very fine grained, moist.			
3	com- posite	PUSH	90	Color changes to reddish gray, dry.	sm		
4	voa						
				T.D. = 4.25'			
5							
6							

NOTES:

Time sample taken: 1603  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658		PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-05		COORDINATES: Sandusky, OHIO	DATE: 10/18/89
ELEVATION: NA (a)		GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/18/89
GEOLOGIST: J. Shireman		Depth NA Date/Time NA	DATE COMPLETED: 10/18/89
DRILLING METHODS: Split Spoon Sampling			PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
1		DISCARD					
2							
3	com- posite	PUSH	95	SAND, white with yellow mottles, medium to fine grained, medium dense to loose, dry, grain size decreases towards bottom of spoon.	SW		
4	voa						
				T.D. = 4.0'			
5							
6							

NOTES:

Time sample taken: 1551  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-06	COORDINATES: Sandusky, OHIO	DATE: 10/18/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/18/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/18/89
DRILLING METHODS: Split Spoon Sampling		PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
1		DISCARD					
2							
3	com- posite	PUSH	91	Silty SAND, fine grained, black, medium dense, approximately 30% silt, dry.	sm		
4	voa						
				T.D. = 4.0'			
5							
6							

NOTES:

- Time sample taken: 1536
- All times military
- a - Well elevation not taken on soil boring.
- b - NA - Not Available.
- c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658		PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-07		COORDINATES: Sandusky, OHIO	DATE: 10/22/89
ELEVATION: NA (a)		GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/22/89
GEOLOGIST: J. Shireman		Depth NA Date/Time NA	DATE COMPLETED: 10/22/89
DRILLING METHODS: Split Spoon Sampling			PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0	com- posite	PUSH	90	Sandy SILT, some clay, brownish yellow, very soft, slight plasticity.	ml		
1							
2	voe			T.D. = 2.0'			
3							
4							
5							
6							

NOTES:

Time sample taken: 1756  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

V I S U A L C L A S S I F I C A T I O N O F S O I L S

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS		
BORING NUMBER: SB-09	COORDINATES: Sandusky, OHIO	DATE: 10/22/89	
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/22/89	
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/22/89	
DRILLING METHODS: Hand Auger			PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
- 0 -	com- posite	NA	92	Clayey SILT, deep brown, very plastic, saturated.	ol		
- 1 -	voa			Sandy SILT/silty SAND, sand is very fine grained, brownish yellow, slight plasticity, moist.	ml		
- 2 -				T.D. = 2.0'			
- 3 -							
- 4 -							
- 5 -							
- 6 -							

NOTES:

Time sample taken: 1737  
All times military

a - Well elevation not taken on soil boring.  
b - NA - Not Available.  
c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-10	COORDINATES: Sandusky, OHIO	DATE: 10/22/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/22/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/22/89
DRILLING METHODS: Hand Auger		PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0	com- posite	NA	100	Sandy SILT, some clay, brownish yellow, very soft, high plasticity, saturated at surface, dryer at 1.0'.	ml		
1	voa						
2				T.D. = 1.75'			
3							
4							
5							
6							

NOTES:

Time sample taken: 1646  
All times military

a - Well elevation not taken on soil boring.  
b - NA - Not Available.  
c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-11	COORDINATES: Sandusky, OHIO	DATE: 10/22/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/22/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/22/89
DRILLING METHODS: Split Spoon Sampling		PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0	com- posite	NA	100	Clayey SILT, no plasticity, dark brown.	ol		
1				Sandy SILT, dark brown to reddish yellow.	ml		
2	voa			T.D. = 2.0'			
3							
4							
5							
6							

NOTES:

Time sample taken: 1414  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS		
BORING NUMBER: SB-12	COORDINATES: Sandusky, OHIO	DATE: 10/22/89	
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/22/89	
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/22/89	
DRILLING METHODS: Hand Auger			PAGE 1 OF 1

DEPTH ( ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
- 0 -							
- 1 -	com- posite	NA	100	Clayey, sandy SILT, brownish yellow, high plasticity.	ml		
- 2 -	voa			Clayey, silty SAND, brownish yellow, no plasticity.	sm		
				T.D. = 2.0'			
- 3 -							
- 4 -							
- 5 -							
- 6 -							

NOTES:

Time sample taken:  
All times military

a - Well elevation not taken on soil boring.  
b - NA - Not Available.  
c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-13	COORDINATES: Sandusky, OHIO	DATE: 10/19/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/19/89
DRILLING METHODS: Split Spoon Sampling		PAGE 1 OF 1

DEPTH ( ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0				Clayey silt.	ml		
1	com- posite	PUSH	90	Silty SAND, black, medium grained, medium dense, some fine sand.	sm		
2	vos			Silty CLAY, high plasticity, brownish yellow (7.5 yr 6/6).	cl		
				T.D. = 2.0'			
3							
4							
5							
6							

NOTES:  
 Time sample taken: 1242  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

T CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658		PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-14		COORDINATES: Sandusky, OHIO	DATE: 10/19/89
ELEVATION: NA (a)		GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89
GEOLOGIST: D. Kessler		Depth NA Date/Time NA	DATE COMPLETED: 10/19/89
DRILLING METHODS: Split Spoon Sampling			PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
1							
2	com- posite	PUSH	100	Sandy SILT, dark gray (5 yr 3/1), moist.	ml		
3							
4	voa			Sandy, clayey SILT, brown (7 yr 3/4), wet.  T.D. = 4.0'	ml		
5							
6							

NOTES:

Time sample taken: 1355  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-15	COORDINATES: Sandusky, OHIO	DATE: 10/19/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/19/89
DRILLING METHODS: Split Spoon Sampling		PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	Hnu ppm/time (c)	REMARKS
0							
				DISCARD			
1							
2							
3	com- posite	PUSH	80	SAND, dark brown (7.5 yr 3/2), fine to very fine, loose, well rounded, dry.	sp		
4	voa			Sand, reddish yellow (7.5 yr 6/8), poorly graded, fine to very fine, loose, well rounded, moist.			
5	com- posite	PUSH	95	Silty CLAY, approximately 15% silt, some very fine sand, low plasticity, moist.	cl		
6	voa			Clayey sandy SILT, reddish yellow (7.5 yr 6/6). Grading to silty CLAY, slight plasticity, medium stiff, moist to wet.	ml cl		
				T.D. = 6.0'			

NOTES:

Time sample taken: 1631  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-16	COORDINATES: Sandusky, OHIO	DATE: 10/19/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/19/89

DRILLING METHODS: Split Spoon Sampling PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
0	com- posite	NA	100	Silty SAND, medium to fine grained, loose to medium dense, moist to wet.	sm		
1							
1	voa			Sandy, silty CLAY/SILT, black.	cl/ml		
2							
3							
4	com- posite	NA	92	Silty SAND.	sm		
5	voa			Silty CLAY/clayey SILT.	cl		
6				T.D. = 6.0'			

NOTES:

- Time sample taken: 1411
- All times military
- a - Well elevation not taken on soil boring.
- b - NA - Not Available.
- c - Due to weather conditions, Hnu not used.

V I S U A L C L A S S I F I C A T I O N O F S O I L S

PROJECT NUMBER: 409658		PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-17		COORDINATES: Sandusky, OHIO	DATE: 10/19/89
ELEVATION: NA (a)		GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89
GEOLOGIST: J. Shireman		Depth NA Date/Time NA	DATE COMPLETED: 10/19/89
DRILLING METHODS: Split Spoon Sampling			PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0							
1	com- posite	NA	90	Very fine SAND, very dark gray, loose, moist.	sp		
2	voe			Silty SAND/sandy SILT, reddish brown (5yr 4/3), saturated.	sm/ml		
3							
4							
5							
6							

NOTES:  
 Time sample taken: 1318  
 All times military

a - Well elevation not taken on soil boring.  
 b - NA - Not Available.  
 c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS		
BORING NUMBER: SB-18	COORDINATES: Sandusky, OHIO	DATE: 10/19/89	
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89	
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/19/89	
DRILLING METHODS: Split Spoon Sampling			PAGE 1 OF 1

DEPTH (ft.)	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	Hnu ppm/time (c)	REMARKS
0					ml		
1	com- posite	PUSH	90		sp		
2	voa			T.D. = 2.0'			
3							
4							
5							
6							

NOTES:

Time sample taken: 1600  
All times military

- a - Well elevation not taken on soil boring.
- b - NA - Not Available.
- c - Due to weather conditions, Hnu not used.

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 409658	PROJECT NAME: FORMER PLUM BROOK ORDNANCE WORKS	
BORING NUMBER: SB-19	COORDINATES: Sandusky, OHIO	DATE: 10/19/89
ELEVATION: NA (a)	GWL:DEPTH NA (b) Date/Time NA	DATE STARTED: 10/19/89
GEOLOGIST: J. Shireman	Depth NA Date/Time NA	DATE COMPLETED: 10/19/89
DRILLING METHODS: Hand Auger		PAGE 1 OF 1

DEPTH ( ft. )	SAMPLE DEPTH & TIME	BLOWS ON SAMPLER PER 6" 6"	RECOVERY ( % )	DESCRIPTION	USCS SYMBOL	Hnu ppm/ time (c)	REMARKS
0				Grass, roots.			
1	com- posite	NA	100	Silty CLAY. reddish gray (10 yr 6/6), dry. Clay, hard, no plasticity, dry.	cl		
2	voa			T.D. = 2.0'			
3							
4							
5							
6							

NOTES:

Time sample taken:  
All times military

a - Well elevation not taken on soil boring.  
b - NA - Not Available.  
c - Due to weather conditions, Hnu not used.

# BORING NO. MW01

COORDINATES N \_\_\_\_\_  
E \_\_\_\_\_

FIELD ENGINEER J. SHIREMAN DATE BEGAN 10/18/89  
 EDITED BY D. BURTON DATE FINISHED 10/18/89  
 CHECKED BY \_\_\_\_\_ GROUND SURFACE EL. \_\_\_\_\_

## DESCRIPTION

DEPTH IN FEET	LABORATORY TEST DATA				WELL SUMMARY/ BACKFILL	PENETRATION RESISTANCE (BLOWS/FT) --SAMPLE--	USCS	PROFILE	DESCRIPTION	
	SAMPLE NO.	SAMPLE DEPTH	ATTERBERG LIMITS							MOISTURE CONTENT (%)
			LIQUID LIMIT (%)	PLASTICITY INDEX (%)						
0	GG1879	0-2	46	17.8	26.3				SILTY CLAY, REDDISH GREY (10 yr 6/6), UPPER 2 FEET CONTAINS GRASS	
	GG1879 MW01	0-2 2-3 1/2	(GRAIN SIZE)							
5									SAMPLING DEPTH 3.5 FEET  SHALE, WEATHERED BEDROCK, PARTINGS ARE .05 TO .15 INCHES APART  SHALE BECOMES HARD	
10									TOTAL BORING DEPTH 9.5 FEET AUGER REFUSAL AT 9.5 FEET	
15										
20										
25										
30									NOTE:  Screen: Johnson schedule 40, 2 inch threaded PVC, 0.01 inch from 4 to 9 feet. Riser: Johnson schedule 40, 2 inch threaded PVC, approximately 7.2 feet (including stick up.) Bentonite: 1/4 inch bentonite pellets from 1 to 2 feet in depth. Filter Sand: 40/60 mesh silica sand, tremied through augers from 2 to 9.5 feet. Grout: Portland cement with 3% bentonite from 0 to 1 feet. Well Protection: Locking steel well protector and concrete apron with (3) 3 foot guard posts. Static Water Level: 5.03 feet from top of riser, 10/21/89	
35									673.21	

PROJECT NO. 409658  
 CLIENT: PLUM BROOK

ACAD\GENERAL\409658-1



...Creating a Safer Tomorrow

# BORING NO. MW02

COORDINATES N \_\_\_\_\_  
E \_\_\_\_\_

FIELD ENGINEER J. SHIREMAN DATE BEGAN 10/17/89  
 EDITED BY D. BURTON DATE FINISHED 10/17/89  
 CHECKED BY \_\_\_\_\_ GROUND SURFACE EL. \_\_\_\_\_

DEPTH IN FEET	LABORATORY TEST DATA				WELL SUMMARY/ BACKFILL	PENETRATION RESISTANCE (BLOWS/FT) SAMPLE	USCS	PROFILE	DESCRIPTION
	SAMPLE NO.	SAMPLE DEPTH	ATTERBERG LIMITS						
			LIQUID LIMIT (%)	PLASTICITY INDEX (%)					
		MOISTURE CONTENT (%)							
0	MW02	0-2							CLAYEY SANDY SILT, DARK BROWN (7.5 yr 3/2), DRY, 20% FINE SAND
	GG1880	2-4	(GRAIN SIZE)						GRADES TO VERY FINE SAND, PINKISH YELLOW (7.5 yr 6/6) LOOSE
	MW02	4-6							SILTY CLAY, VERY STIFF, OLIVE BROWN (2.5 yr 3/4)
	MW02	6-8							SILTY CLAYEY SAND, SATURATED, GRADES DOWN TO VERY FINE GRAINED SANDY SILT
	GG1881	8-10	34.2	12.3					DARK BROWN (7.5 yr 3/2), CHANGES TO REDDISH GREY (10 r 0/1)
	GG1882	13.5-15.5	(GRAIN SIZE) 14.9						SANDY SILT TO SILTY CLAY, MOTTLED REDDISH YELLOW, DRY TO SLIGHTLY MOIST, SLIGHTLY PLASTIC
	MW02	16.5-18.5							SILTY CLAY, REDDISH GREY, MOIST MED. STIFF SLIGHTLY PLASTIC
	MW02	16.5-18.5							SILTY CLAY, REDDISH GREY (10 r 0/1), MOIST
TOTAL DEPTH 18.3 FEET SAMPLING DEPTH 18.5 FEET									
									LIMESTONE, GREY CONTAINING PYRITIZED BRACOPODS
NOTE:									
Screen: Johnson schedule 40, 2 inch threaded PVC, 0.01 inch slotted from 6 to 16 feet. Sand Pump: Johnson Schedule 80 2 inch threaded PVC from 16 to 18 feet. Riser: Johnson schedule 40, 2 inch threaded PVC, approximately 9 feet, (including stick up.) Bentonite: 1/4 inch bentonite pellets from 2 to 3.8 feet in depth. Filter Sand: 40/60 mesh silica sand, tremied through augers from 3.8 to 18.3 feet in depth. Grout: Portland cement with 3% bentonite from 0 to 2 feet. Well Protection: Lacking steel well protector and concrete apron with (3) 3 foot guard posts. Static Water Level: 10.72 feet from top of riser, 10/21/89									
628.82									

PROJECT NO. 409658  
 CLIENT: PLUM BROOK

ACAD\GENERAL\BORELOG\409658-2



...Creating a Safer Tomorrow

# BORING NO. MW05

COORDINATES N \_\_\_\_\_  
E \_\_\_\_\_

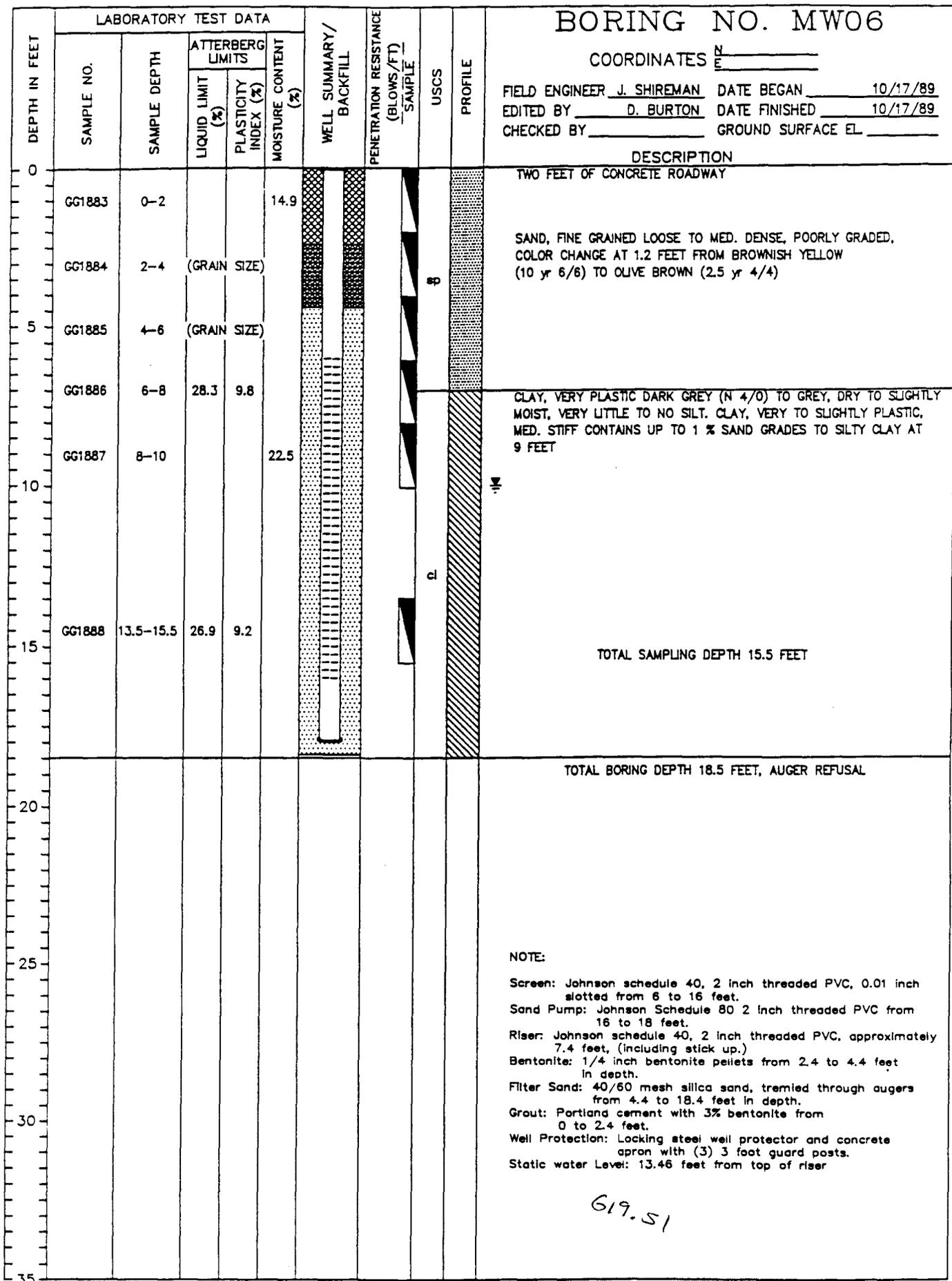
FIELD ENGINEER J. SHIREMAN DATE BEGAN 10/16/89  
 EDITED BY D. BURTON DATE FINISHED 10/17/89  
 CHECKED BY \_\_\_\_\_ GROUND SURFACE EL. \_\_\_\_\_

## DESCRIPTION

DEPTH IN FEET	LABORATORY TEST DATA				WELL SUMMARY / BACKFILL	PENETRATION RESISTANCE (BLOWS/FT) SAMPLE	USCS	PROFILE	DESCRIPTION	
	SAMPLE NO.	SAMPLE DEPTH	ATTERBERG LIMITS							MOISTURE CONTENT (%)
			LIQUID LIMIT (%)	PLASTICITY INDEX (%)						
0	GG-1873	0-2	(GRAIN SIZE)				sp	SAND VERY FINE GRAINED, DRY, LOOSE, WELL ROUNDED, POORLY GRADED, REDDISH YELLOW (7.5 yr 6/8)		
								MOIST AT 2 1/2 FT.		
	GG-1874	2-4			26.0		cl	CLAY/ SILTY CLAY STIFF CONTAINS UP TO 15% SILT		
5	GG-1875	4-6	26.6	7.4			cl/ml	CLAYEY SANDY SILT		
							sm	CLAY, SLIGHTLY PLASTIC, MOIST TO WET SILTY SAND, VERY FINE GRAINED, LOOSE TO MED. DENSE, DRY		
	GG-1876	6-8	(GRAIN SIZE)				cl	CLAY, VERY PLASTIC, WET MED. STIFF TO STIFF, GREY (N 5/0)		
	GG-1877	8-10	26.9	8.6						
10								CLAY, REDDISH GREY, MED. STIFF WET		
15	MW-05	14-16					cl	CLAY, VERY PLASTIC, SATURATED TO VERY WET, REDDISH GREY		
20	GG1878	19-21			14.0		cl	CLAY WITH ABOUT 20% COARSE SAND TO SMALL GRAVEL GRAVEL IS VERY ANGULAR		
								TOTAL BORING DEPTH 21 FEET TOTAL SAMPLE DEPTH 21 FEET		
25								NOTE: Screen: Johnson schedule 40, 2 Inch threaded PVC, 0.01 inch from 8.5 to 18.5 feet. Sand Pump: Johnson Schedule 80 2 Inch threaded PVC from 18.5 to 20.5 feet. Riser: Johnson schedule 40, 2 Inch threaded PVC, approximately 11.6 feet, (including stick up.) Bentonite: 1/4 Inch bentonite pellets from 4.5 to 6.5 feet in depth. Filter Sand: 40/60 mesh silica sand, tremied through augers from 6.5 to 21 feet in depth. Grout: Portland cement with 3% bentonite from 0 to 4.5 feet. Well Protection: Lacking steel well protector and concrete apron with (3) 3 foot guard posts. Static Water Level: 15.78 feet from top of riser, 10/21/89		
30										
35										

619.75





# BORING NO. MW06

COORDINATES N \_\_\_\_\_ E \_\_\_\_\_

FIELD ENGINEER J. SHIREMAN DATE BEGAN 10/17/89  
 EDITED BY D. BURTON DATE FINISHED 10/17/89  
 CHECKED BY \_\_\_\_\_ GROUND SURFACE EL. \_\_\_\_\_

### DESCRIPTION

TWO FEET OF CONCRETE ROADWAY

SAND, FINE GRAINED LOOSE TO MED. DENSE, POORLY GRADED, COLOR CHANGE AT 1.2 FEET FROM BROWNISH YELLOW (10 yr 6/6) TO OLIVE BROWN (2.5 yr 4/4)

CLAY, VERY PLASTIC DARK GREY (N 4/0) TO GREY, DRY TO SLIGHTLY MOIST, VERY LITTLE TO NO SILT. CLAY, VERY TO SLIGHTLY PLASTIC, MED. STIFF CONTAINS UP TO 1 % SAND GRADES TO SILTY CLAY AT 9 FEET

TOTAL SAMPLING DEPTH 15.5 FEET

TOTAL BORING DEPTH 18.5 FEET, AUGER REFUSAL

NOTE:

Screen: Johnson schedule 40, 2 inch threaded PVC, 0.01 inch slotted from 6 to 16 feet.

Sand Pump: Johnson Schedule 80 2 inch threaded PVC from 16 to 18 feet.

Riser: Johnson schedule 40, 2 inch threaded PVC, approximately 7.4 feet, (including stick up.)

Bentonite: 1/4 inch bentonite pellets from 2.4 to 4.4 feet in depth.

Filter Sand: 40/60 mesh silica sand, tremied through augers from 4.4 to 18.4 feet in depth.

Grout: Portland cement with 3% bentonite from 0 to 2.4 feet.

Well Protection: Locking steel well protector and concrete apron with (3) 3 foot guard posts.

Static water Level: 13.46 feet from top of riser

619.51



APPENDIX C  
FIELD HYDRAULIC CONDUCTIVITY TEST DATA



## SLUG TEST ANALYSIS DESCRIPTION

The method for analysis was taken from Hvorslev, 1951, Time Lag and Soil Permeability in Ground Water Observation, U.S. Army Corps of Engineers, Bulletin No. 36, 50 pp.

The data for depth to water vs. time for each slug test was converted to a head ratio vs. time where the head ratio can be calculated by the following formula:

$$\frac{H_t - H_g}{H_i - H_g}$$

Where  $H_t$  is depth to water at a certain time,  $t$ ;  $H_i$  is the lowest water level obtained for the test; and  $H_g$  is static water level before the test started. The head ratio was plotted on a logarithmic scale vs. time on a straight arithmetic scale.

From the plots, two points were selected and read to obtain the corresponding head ratio values. The head ratio value was converted back into an actual head level (depth to water value) for each time,  $t$ , and  $t_2$ . These values were used in the equation:

$$K = \frac{r^2}{2(L_1 - L_2)(t_2 - t_1)} \times \ln \frac{L_1 - L_2}{R} \times \ln \frac{(H_1 - H_g)}{(H_2 - H_g)}$$

where:

- $r$  = radius of the well
- $L_1 - L_2$  = screen length
- $H_g$  = static water level
- $r$  = effective well radius

to obtain  $K$ .

This was done for each well test. The geometric mean was calculated from the K values obtained from each well. It has been especially shown that the geometric mean is a more statistically reliable average than the normal average for K.

Time	Elapsed Time	HEAD	Head Ratio	Head Ratio	Line
13:00:00	2.68	7.96	0.060975	-1.21484	
12:55:00	2.59	7.96	0.060975	-1.21484	
12:50:00	2.51	7.96	0.060975	-1.21484	
12:45:00	2.43	7.96	0.060975	-1.21484	
12:40:00	2.34	7.96	0.060975	-1.21484	
12:35:00	2.26	7.96	0.060975	-1.21484	
12:30:00	2.18	7.95	0.065040	-1.18681	
12:25:00	2.09	7.95	0.065040	-1.18681	
12:20:00	2.01	7.94	0.069105	-1.16048	
12:15:00	1.93	7.94	0.069105	-1.16048	
12:10:00	1.84	7.94	0.069105	-1.16048	
12:05:00	1.76	7.93	0.073170	-1.13566	
12:00:00	1.68	7.93	0.073170	-1.13566	
11:55:00	1.59	7.92	0.077235	-1.11218	
11:50:00	1.51	7.92	0.077235	-1.11218	
11:45:00	1.43	7.91	0.081300	-1.08990	
11:40:00	1.34	7.91	0.081300	-1.08990	
11:35:00	1.26	7.9	0.085365	-1.06871	
11:30:00	1.18	7.89	0.089430	-1.04851	
11:25:00	1.09	7.88	0.093495	-1.02920	
11:20:00	1.01	7.87	0.097560	-1.01072	
11:15:00	0.93	7.86	0.101626	-0.99299	
11:10:00	0.84	7.85	0.105691	-0.97596	
11:05:00	0.76	7.83	0.113821	-0.94377	
11:00:00	0.68	7.81	0.121951	-0.91381	
10:55:00	0.59	7.79	0.130081	-0.88578	
10:50:00	0.51	7.77	0.138211	-0.85945	
10:47:26	0.47	7.75	0.146341	-0.83463	
10:46:26	0.45	7.74	0.150406	-0.82273	
10:45:26	0.43	7.74	0.150406	-0.82273	
10:44:26	0.42	7.73	0.154471	-0.81115	
10:43:26	0.40	7.72	0.158536	-0.79987	
10:42:26	0.38	7.72	0.158536	-0.79987	
10:41:26	0.37	7.71	0.162601	-0.78887	
10:40:26	0.35	7.7	0.166666	-0.77815	
10:39:26	0.33	7.69	0.170731	-0.76768	
10:38:26	0.32	7.68	0.174796	-0.75746	
10:37:26	0.30	7.67	0.178861	-0.74748	
10:36:26	0.28	7.66	0.182926	-0.73772	
10:35:26	0.27	7.65	0.186991	-0.72817	
10:34:26	0.25	7.64	0.191056	-0.71883	
10:33:26	0.23	7.63	0.195121	-0.70969	
10:32:26	0.22	7.62	0.199186	-0.70073	
10:31:26	0.20	7.6	0.207317	-0.68336	
10:30:26	0.18	7.59	0.211382	-0.67493	
10:29:26	0.17	7.57	0.219512	-0.65854	
10:28:26	0.15	7.55	0.227642	-0.64274	
10:27:26	0.13	7.53	0.235772	-0.62750	
10:26:26	0.12	7.51	0.243902	-0.61278	
10:25:26	0.10	7.47	0.260162	-0.58475	
10:24:26	0.08	7.43	0.276422	-0.55842	
10:23:26	0.07	7.37	0.300813	-0.52170	
10:22:26	0.05	7.27	0.341463	-0.46665	
10:21:56	0.04	7.2	0.369918	-0.43189	
10:21:26	0.03	7.07	0.422764	-0.37390	
10:20:56	0.03	6.88	0.5	-0.30102	
10:20:26	0.02	6.59	0.617886	-0.20909	
10:19:56	0.01	6.2	0.776422	-0.10990	
10:19:51	0.01	6.13	0.804878	-0.09426	

L = 8.000

MW-02

Regression Output:

Constant -0.595783  
Std Err of Y Est 0.0153099  
R Squared 0.9728488  
No. of Observations 26  
Degrees of Freedom 24

X Coefficient(s) -0.48564  
Std Err of Coef. 0.016561

To = 0.8891172

K = 0.2494469 ft/day  
8.800E-05 cm/sec

V = 0.0178176 ft/day

10:19:46	0.01	6.05	0.837398	-0.07706
10:19:41	0.00	5.97	0.869918	-0.06052
19:36	0.00	5.88	0.906504	-0.04263
7:31	0.00	5.77	0.951219	-0.02171
.19:26	0.00	5.65	1	0



APPENDIX D  
VARIANCES AND NONCONFORMANCES





### VARIANCE LOG

PROJECT NO. 409658

PAGE 1 OF 1

PROJECT NAME Plum Brook

DATE: 10/16/85

VARIANCE (INCLUDE JUSTIFICATION)

Section No. 5.0  
Revision No. 1  
Date: July 1, 1987  
Page 34 of 45

Decontamination waters will be allowed to run onto  
an asphalt covered drive and will collect in a  
drive way drain. There is no location which water  
is available and can be bermed for water collection.  
Contaminant levels are expected to be negligible.  
Approval of this has been given verbally by the  
NASA project contact

APPLICABLE DOCUMENT:

Work plan For Contaminant Evaluation  
at the Former Plum Brook Ordnance works

CC:

REQUESTED BY: Janatha Shiremas Date: 10/16/85

Approved By: Ann S. Banta Date: 10/16/85  
Project Manager

\_\_\_\_\_  
Quality Assurance Officer Date: \_\_\_\_\_

Date: \_\_\_\_\_



# VARIANCE LOG

PROJECT NO. 409658

PAGE 1 OF 1

PROJECT NAME Plumb Brook

DATE: 10/16/89

## VARIANCE (INCLUDE JUSTIFICATION)

Section No. 5.0  
Revision No. 1  
Date: July 1, 1987  
Page 34 of 45

where Auger refusal on bedrock is encountered before bore hole has been advanced to 10 feet below the first occurrence of saturated material the bore hole will be terminated. This will prevent potential spread of contaminated ground water into an other aquifers

APPLICABLE DOCUMENT: Plumb Brook site investigation work plan

CC:

REQUESTED BY: Jonathan Shirama Date: 10/16/89

Approved By: Dominic C. Burt Date: 10/16/89  
Project Manager

\_\_\_\_\_  
Quality Assurance Officer Date: \_\_\_\_\_

Date:



### VARIANCE LOG

PROJECT NO. 409658

PAGE 1 OF     

PROJECT NAME Plum brook

DATE: 10/18/89

VARIANCE (INCLUDE JUSTIFICATION)

Section No. 5.0  
Revision No. 1  
Date: July 1, 1987  
Page 34 of 45

*In MW01*  
Bedrock was encountered at 3 feet. Bedrock at this location is a deeply weathered fissel shale. The shale would act with the overlying till as a single aquifer unit. Well will be augered to refusal or until the water table is encountered, a 5 foot screen with no sand pump will be set.

Because of the recovery of only 2 feet (one sample) of soil materials from MW01, this sample will be submitted for all three geotechnical analytical tests

APPLICABLE DOCUMENT: *Plum brook site investigation work plan*

CC:

REQUESTED BY: Jonathan Shideman Date: 10/18/89

Approved By: Donald C. Burton Date: 10/18/89  
Project Manager

\_\_\_\_\_  
Quality Assurance Officer Date: \_\_\_\_\_

\_\_\_\_\_  
Date: \_\_\_\_\_



### VARIANCE LOG

PROJECT NO. 419652

PAGE 1 OF     

PROJECT NAME Plumbank

DATE: 10/18/89

VARIANCE (INCLUDE JUSTIFICATION)

Section No. 5.0  
Revision No. 1  
Date: July 1, 1987  
Page 34 of 45

OF The four wells installed three are making very little water. These wells exhibit very low permeability and a single rising head test would require over 24 hours to reach 95% recovery.

Only those wells which recharge to 90% within the limit of development time will be tested for hydraulic conductivity.

OR If removal of two barrels of water would expose the pressure transducer the hydraulic conductivity test will not be run

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: [Signature] Date: 10/18/89

Approved By: [Signature] Date: 10/18/89  
Project Manager

\_\_\_\_\_  
Quality Assurance Officer

\_\_\_\_\_  
Date: \_\_\_\_\_



### VARIANCE LOG

PROJECT NO. 709658

PAGE 1 OF     

PROJECT NAME Plumbrook

DATE: 10/18/85

VARIANCE (INCLUDE JUSTIFICATION)

Section No. 5.0  
Revision No. 1  
Date: July 1, 1987  
Page 34 of 45

Monitoring well at the Burning Grounds (mw-03 & mw-04) will be deleted and replaced by deep soil borings at waste disposal Area No. 1. These borings will be taken at the first significant clay layer, at about 6 feet.

Documentation of the contamination due to waste disposal at the waste disposal Area No 1 is needed to corroborate visual evidence. Also it is suspected that the majority of contamination has percolated to the water table in these areas

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: Jeanette Shremas Date: 10/18/85

Approved By: Donna C. Bente Date: 10/18/89  
Project Manager

\_\_\_\_\_  
Quality Assurance Officer Date: \_\_\_\_\_

Date:

## VARIANCE LOG

PROJECT NO. 409658

PAGE 1 OF     

PROJECT NAME Plumbrook

DATE: 10/18/87

VARIANCE (INCLUDE JUSTIFICATION)

Section No. 5.0  
Revision No. 1  
Date: July 1, 1987  
Page 34 of 45

To document the levels of VOC contamination a soil sample was taken at the water table from the Bore hole MW-02. This sample will replace soil boring SB-08 and reduce the number of samples sent for geotechnical analysis from this Bore hole. Only three sample will be sent for the geotechnical parameters analysis.

APPLICABLE DOCUMENT:

CC:

REQUESTED BY: Joseph DiRemo Date: 10/18/87

Approved By: Donna C. Banta Date: 10/18/87  
Project Manager

Quality Assurance Officer

Date: \_\_\_\_\_

Date: \_\_\_\_\_

APPENDIX E  
GEOTECHNICAL TEST RESULTS, CERTIFICATES OF ANALYSIS



GEOCHEMICAL TEST RESULTS

CEE2892GTR  
04/25/90 F1



**CERTIFICATE OF ANALYSIS**

---

---

Don Burton  
IT Corporation  
312 Directors Drive  
Knoxville, TN 37923

November 15, 1989

---

**PROJECT NUMBER: 482307**

**JOB NUMBER: 409658**

**This is the Certificate of Analysis for the following samples:**

**Client Project ID:** 409658 (COE-Plum Brook)  
**Date Received by Lab:** 10/27/89  
**Number of Samples:** 16  
**Sample Type:** Soil

---

**I. Introduction**

Sixteen (16) soil samples were received at ITAS-TDL Knoxville from an IT Knoxville engineering group (Appendix B, Chain of Custody). Six (6) samples were analyzed for water content, 6 samples for Atterberg Limits, and 7 samples for grain size distribution.

**II. Analytical Results/Methodology**

REFERENCE: Annual Book of ASTM Standards. 1989. Soil and Rock; Building Stones; Geotextiles. Vol. 4.08.

Soil Preparation (not used in water content analysis)	ASTM D421-85
Water Content	ASTM D2216-80
Atterberg Limits (liquid limit, plasticity index, classification)	ASTM D4318-84
Grain Size (hydrometer <0.075 mm and sieve analysis ≥0.075 mm)	ASTM D422-63

Reviewed and Approved:



Michael A. Krstich  
Geotechnical Services

mak\MAK013

Page 2 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

II. Analytical Results/Methodology (Continued)

Results are contained in Appendix A.

III. Quality Control

In accordance with QA/QC guidelines, duplicate samples were randomly selected and analyzed for each test procedure. In all cases precision was within acceptable limits.

Page 3 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

CROSS-REFERENCE LIST

TDL SAMPLE NO.	CLIENT SAMPLE NO.	SAMPLE DEPTH	MATRIX
GG1873	MW05-G	0-2	SOIL
GG1874	MW05-G	2-4	SOIL
GG1875	MW05-G	4-6	SOIL
GG1876	MW05-G	6-8	SOIL
GG1877	MW05-G	8-10	SOIL
GG1878	MW05-G	19-21	SOIL
GG1879	MW01-G	0-2	SOIL
GG1880	MW02-G	2-4	SOIL
GG1881	MW02-G	8-10	SOIL
GG1882	MW02-G	13.5-15.5	SOIL
GG1883	MW06-G	0-2	SOIL
GG1884	MW06-G	2-4	SOIL
GG1885	MW06-G	4-6	SOIL
GG1886	MW06-G	6-8	SOIL
GG1887	MW06-G	8-10	SOIL
GG1888	MW06-G	13.5-15.6	SOIL

APPENDIX A

Page 4 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: WATER CONTENT  
BORING NUMBER: MW05-G  
SAMPLE NUMBER: GG1874  
DEPTH (FEET): 2-4  
RESULTS (%): 26.0

mak/MAK013

Page 5 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: WATER CONTENT  
BORING NUMBER: MW05-G  
SAMPLE NUMBER: GG1878  
DEPTH (FEET): 19-21  
RESULTS (%): 14.0

mak/MAK013

Page 6 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: WATER CONTENT  
BORING NUMBER: MW01-G  
SAMPLE NUMBER: GG1879  
DEPTH (FEET): 0-2  
RESULTS (%): 26.3

mak/MAK013

Page 7 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: WATER CONTENT  
BORING NUMBER: MW02-G  
SAMPLE NUMBER: GG1882  
DEPTH (FEET): 13.5-15.5  
RESULTS (%): 14.9

mak/MAK013

Page 8 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211  
Job Number: 409658

---

ANALYSIS: WATER CONTENT  
BORING NUMBER: MW06-G  
SAMPLE NUMBER: GG1883  
DEPTH (FEET): 0-2  
RESULTS (%): 14.9

mak/MAK013

Page 9 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211  
Job Number: 409658

---

ANALYSIS: WATER CONTENT  
BORING NUMBER: MW06-G  
SAMPLE NUMBER: GG1887  
DEPTH (FEET): 8-10  
RESULTS (%): 22.5

mak/MAK013

Page 10 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: ATTERBERG LIMITS

BORING NUMBER: MW05-G

SAMPLE NUMBER: GG1875

DEPTH (FEET): 4-6

RESULTS:

LIQUID LIMIT: 26.6

PLASTIC LIMIT 19.2

PLASTICITY INDEX: 7.4

USCS: CL-ML

mak\MAK013

Page 11 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: ATTERBERG LIMITS

BORING NUMBER: MW05-G

SAMPLE NUMBER: GG1877

DEPTH (FEET): 8-10

RESULTS:

LIQUID LIMIT: 26.9

PLASTIC LIMIT 18.3

PLASTICITY INDEX: 8.6

USCS: CL

mak\MAK013

Page 12 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: ATTERBERG LIMITS

BORING NUMBER: MW01-G

SAMPLE NUMBER: GG1879

DEPTH (FEET): 0-2

RESULTS:

LIQUID LIMIT:	46.0
PLASTIC LIMIT	28.2
PLASTICITY INDEX:	17.8
USCS:	ML & OL

mak\MAK013

Page 13 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: ATTERBERG LIMITS

BORING NUMBER: MW02-G

SAMPLE NUMBER: GG1881

DEPTH (FEET): 8-10

RESULTS:

LIQUID LIMIT: 34.2

PLASTIC LIMIT 21.9

PLASTICITY INDEX: 12.3

USCS: CL

mak\MAK013

Page 14 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: ATTERBERG LIMITS

BORING NUMBER: MW06-G

SAMPLE NUMBER: GG1886

DEPTH (FEET): 6-8

RESULTS:

LIQUID LIMIT: 28.3

PLASTIC LIMIT 18.5

PLASTICITY INDEX: 9.8

USCS: CL

mak\MAK013

Page 15 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

---

ANALYSIS: ATTERBERG LIMITS

BORING NUMBER: MW06-G

SAMPLE NUMBER: GG1888

DEPTH (FEET): 13.5-15.6

RESULTS:

LIQUID LIMIT: 26.9

PLASTIC LIMIT 17.7

PLASTICITY INDEX: 9.2

USCS: CL

mak\MAK013

Page 16 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

ANALYSIS: GRAIN SIZE

BORING NUMBER: MW05-G

SAMPLE NUMBER: GG1873

DEPTH (FEET): 0-2

RESULTS:

---

SIEVE SIZE/TIME	DIAMETER (mm)	PERCENT FINER
-----------------	---------------	---------------

---

SIEVE ANALYSIS:

3.000 in.	75.000	100.0
1.500 in.	37.500	100.0
0.750 in.	19.000	100.0
0.375 in.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	99.6
NO. 20	0.850	99.1
NO. 40	0.425	97.5
NO. 60	0.250	94.6
NO. 140	0.106	46.3
NO. 200	0.075	26.8

HYDROMETER ANALYSIS

1 min	0.052	20.9
2 min	0.037	18.0
5 min	0.024	16.5
15 min	0.014	13.5
30 min	0.010	12.0
60 min	0.007	10.5
250 min	0.003	9.0
1440 min	0.001	6.0

---

mak/MAK013

Page 17 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

ANALYSIS: GRAIN SIZE

BORING NUMBER: MW05-G

SAMPLE NUMBER: GG1876

DEPTH (FEET): 6-8

RESULTS:

SIEVE SIZE/TIME	DIAMETER (mm)	PERCENT FINER
SIEVE ANALYSIS:		
3.000 in.	75.000	100.0
1.500 in.	37.500	100.0
0.750 in.	19.000	100.0
0.375 in.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	100.0
NO. 20	0.850	99.9
NO. 40	0.425	99.4
NO. 60	0.250	98.8
NO. 140	0.106	93.4
NO. 200	0.075	86.5
HYDROMETER ANALYSIS		
1 min	0.042	78.1
2 min	0.030	73.7
5 min	0.020	63.4
15 min	0.012	54.5
30 min	0.009	48.6
60 min	0.006	42.7
250 min	0.003	32.4
1440 min	0.001	23.6

mak/MAK013

Page 18 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

ANALYSIS: GRAIN SIZE

BORING NUMBER: MW01-G

SAMPLE NUMBER: GG1879

DEPTH (FEET): 0-2

RESULTS:

---

SIEVE SIZE/TIME	DIAMETER (mm)	PERCENT FINER
-----------------	---------------	---------------

---

SIEVE ANALYSIS:

3.000 in.	75.000	100.0
1.500 in.	37.500	100.0
0.750 in.	19.000	100.0
0.375 in.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	98.9
NO. 20	0.850	95.8
NO. 40	0.425	92.9
NO. 60	0.250	87.7
NO. 140	0.106	70.9
NO. 200	0.075	69.5

HYDROMETER ANALYSIS

1 min	0.044	69.0
2 min	0.032	67.2
5 min	0.020	65.9
15 min	0.012	62.5
30 min	0.009	59.1
60 min	0.006	54.0
250 min	0.003	45.6
1440 min	0.001	35.5

---

mak/MAK013

Page 19 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

ANALYSIS: GRAIN SIZE

BORING NUMBER: MW02-G

SAMPLE NUMBER: GG1880

DEPTH (FEET): 2-4

RESULTS:

---

SIEVE SIZE/TIME	DIAMETER (mm)	PERCENT FINER
-----------------	---------------	---------------

---

SIEVE ANALYSIS:

3.000 in.	75.000	100.0
1.500 in.	37.500	100.0
0.750 in.	19.000	100.0
0.375 in.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	96.4
NO. 20	0.850	93.3
NO. 40	0.425	90.7
NO. 60	0.250	87.7
NO. 140	0.106	54.7
NO. 200	0.075	49.4

HYDROMETER ANALYSIS

1 min	0.047	49.0
2 min	0.034	48.5
5 min	0.021	48.1
15 min	0.013	43.3
30 min	0.009	40.1
60 min	0.006	36.9
250 min	0.003	28.8
1440 min	0.001	19.2

---

mak/MAK013

Page 20 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

ANALYSIS: GRAIN SIZE

BORING NUMBER: MW02-G

SAMPLE NUMBER: GG1882

DEPTH (FEET): 13.5-15.5

RESULTS:

---

SIEVE SIZE/TIME	DIAMETER (mm)	PERCENT FINER
-----------------	---------------	---------------

---

SIEVE ANALYSIS:

3.000 in.	75.000	100.0
1.500 in.	37.500	100.0
0.750 in.	19.000	100.0
0.375 in.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	90.4
NO. 20	0.850	83.6
NO. 40	0.425	79.7
NO. 60	0.250	76.0
NO. 140	0.106	66.4
NO. 200	0.075	63.9

HYDROMETER ANALYSIS

1 min	0.046	55.7
2 min	0.033	52.8
5 min	0.021	48.6
15 min	0.012	42.8
30 min	0.009	37.1
60 min	0.006	31.4
250 min	0.003	24.3
1440 min	0.001	17.1

---

mak/MAk013

Page 21 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

ANALYSIS: GRAIN SIZE

BORING NUMBER: MW06-G

SAMPLE NUMBER: GG1884

DEPTH (FEET): 2-4

RESULTS:

---

SIEVE SIZE/TIME	DIAMETER (mm)	PERCENT FINER
-----------------	---------------	---------------

---

SIEVE ANALYSIS:

3.000 in.	75.000	100.0
1.500 in.	37.500	100.0
0.750 in.	19.000	100.0
0.375 in.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	97.4
NO. 20	0.850	96.3
NO. 40	0.425	95.7
NO. 60	0.250	94.7
NO. 140	0.106	30.9
NO. 200	0.075	25.5

HYDROMETER ANALYSIS

1 min	0.052	19.7
2 min	0.037	18.2
5 min	0.023	18.2
15 min	0.014	16.7
30 min	0.010	15.2
60 min	0.007	15.2
250 min	0.003	13.7
1440 min	0.001	12.1

---

mak/MAK013

Page 22 of 22  
Don Burton  
Plum Brook  
Date: 11/15/89  
Client Project ID: 409658

IT ANALYTICAL SERVICES  
304 DIRECTORS DRIVE  
KNOXVILLE, TN  
(615) 690-3211

Job Number: 409658

ANALYSIS: GRAIN SIZE

BORING NUMBER: MW06-G

SAMPLE NUMBER: GG1885

DEPTH (FEET): 4-6

RESULTS:

---

SIEVE SIZE/TIME	DIAMETER (mm)	PERCENT FINER
-----------------	---------------	---------------

---

SIEVE ANALYSIS:

3.000 in.	75.000	100.0
1.500 in.	37.500	100.0
0.750 in.	19.000	100.0
0.375 in.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	97.0
NO. 20	0.850	95.1
NO. 40	0.425	93.8
NO. 60	0.250	92.3
NO. 140	0.106	67.2
NO. 200	0.075	58.8

HYDROMETER ANALYSIS

1 min	0.046	55.6
2 min	0.033	52.7
5 min	0.021	48.3
15 min	0.013	41.0
30 min	0.009	35.1
60 min	0.006	30.8
250 min	0.003	24.9
1440 min	0.001	20.5

---

mak/MAK013

CERTIFICATES OF ANALYSES

**CERTIFICATE OF ANALYSIS**

IT Corporation  
312 Directors Drive  
Knoxville, TN 37923  
ATTN: Don Burton

January 18, 1990

Job Number: ITEK 44410 (addendum)

P.O. Number: 409658

This is the Certificate of Analysis for the following samples:

Client Project ID: COE-Plum Brook Ordnance Works  
Date Received by Lab: 10/23/89  
Number of Samples: Five (5)  
Sample Type: Water

**METALS ANALYSIS**

Results in mg/liter (ppm)

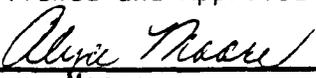
<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Barium</u>	<u>Cadmium</u>	<u>Chromium</u>	<u>Lead</u>	<u>Silver</u>
SW01	JJ7949	0.058	0.005 U	0.01 U	0.03 U	0.005 U
SW02	JJ7950	0.029	0.005 U	0.01 U	0.03 U	0.005 U
SW03	JJ7951	0.047	0.005 U	0.01 U	0.03 U	0.005 U
SW04	JJ7952	0.079	0.005 U	0.01	0.03 U	0.005 U
Split	JJ7953	0.19	0.005 U	0.04	0.03 U	0.005 U
Method Blank	PBWC0866/C0871	0.002 U	0.005 U	0.01 U	0.03 U	0.005 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

Date Digested: 10/30/89

Date Analyzed: 10/31/89

Reviewed and Approved:

  
Alyce Moore  
Laboratory Manager

American Council of Independent Laboratories  
International Association of Environmental Testing Laboratories  
American Association for Laboratory Accreditation



**CERTIFICATE OF ANALYSIS**

IT Corporation  
312 Directors Drive  
Knoxville, TN 37923  
ATTN: Don Burton

January 18, 1990

Job Number: ITEK 44421 (addendum)

P.O. Number: 409658

This is the Certificate of Analysis for the following samples:

Client Project ID: COE-Plum Brook Ordnance Works  
Date Received by Lab: 10/25/89  
Number of Samples: Six (6)  
Sample Type: Water-four (4), Duplicate-one (1), Rinsate-one (1)

**METALS ANALYSIS**

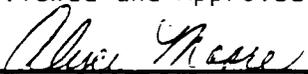
Results in mg/liter (ppm)

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Barium</u>	<u>Cadmium</u>	<u>Chromium</u>	<u>Lead</u>	<u>Silver</u>
Method Blank	PBWC0866	0.002 U	0.005 U	0.01 U	0.03 U	0.005 U
MW-01	JJ8072	0.051	0.005 U	0.01 U	0.03 U	0.005 U
MW-02	JJ8073	0.068	0.005 U	0.01 U	0.03 U	0.005 U
MW-02 Dup	JJ8074	0.068	0.005 U	0.12	0.03 U	0.005 U
MW-05	JJ8075	0.21	0.005 U	0.01 U	0.03 U	0.005 U
MW-06	JJ8076	0.11	0.005 U	0.12	0.03 U	0.005 U
GW-Rinsate	JJ8077	0.002 U	0.005 U	0.01 U	0.03 U	0.005 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

Date Digested: 10/30/89  
Date Analyzed: 10/31/89

Reviewed and Approved:

  
Alyce Moore  
Laboratory Manager

American Council of Independent Laboratornes  
International Association of Environmental Testing Laboratornes  
American Association for Laboratory Accreditation

**CERTIFICATE OF ANALYSIS**

---

IT Corporation  
312 Directors Drive  
Knoxville, TN 37923  
ATTN: Don Burton

November 28, 1989

---

Job Number: ITEK 44421

P.O. Number: 409658

This is the Certificate of Analysis for the following samples:

Client Project ID: COE-Plum Brook Ordnance Works  
Date Received by Lab: 10/25/89  
Number of Samples: Eleven (11)  
Sample Type: Water-seven (7), Rinsate-one (1), Trip Blank-three (3)

---

**I. Introduction**

On 10/25/89, seven (7) water samples, one (1) rinsate and three (3) trip blanks arrived at the ITAS-Knoxville, Tennessee laboratory from the COE-Plum Brook Ordnance Works site in Sandusky, Ohio. The list of analytical tests performed, as well as date of receipt and analysis, can be found in the attached report.

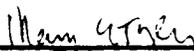
**II. Analytical Results/Methodology**

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information and the analytical results. Please note that all but CLP data are blank corrected, i.e., if any compound is found in the corresponding laboratory blank, it is subtracted from the analytical result before it is reported. CLP data are not blank corrected.

The samples were analyzed for Target Compound List (TCL) volatile and semivolatile organic compounds by gas chromatography/mass spectroscopy (GC/MS) in accordance with the EPA CLP 2/88 Statement of Work.

The samples were analyzed for the requested nitroexplosives by high performance liquid chromatography (HPLC) based on USATHAMA method 8G.

Reviewed and Approved:

  
\_\_\_\_\_  
Mary Tyler  
Laboratory Project Manager

## II. Analytical Results/Methodology (continued)

The samples were analyzed for the requested total metals by inductively coupled plasma spectroscopy (ICP), graphite furnace atomic absorption spectroscopy (GFAA) and cold vapor atomic absorption spectroscopy (CVAA) based on EPA SW-846 methods 3010, 6010, 3020, 7060, 7740 and 7470.

The samples were analyzed for sulfate and nitrate by colorimetric determination based on EPA SW-846 methods 9035 and 9200, respectively.

The pH of the samples was measured by an electrometric procedure based on EPA SW-846 method 9040.

## III. Quality Control

Routine laboratory level I QC was performed for all parameters but CLP parameters. CLP analyses followed project specific QC tracking.

The volatiles analyses were performed on 11/02, 11/03 and 11/06/89 by purge and trap with J&W DB-624 Megabore column on a Finnigan OWA GC/MS/DS. The semivolatiles analyses were performed on 11/09/89 by direct injection of sample extract on a J&W DB-5 capillary column on a VG TRIO-2 GC/MS/DS.

The volatiles runs went well. The 11/03/89 daily standard was marginally outside (by about 4%) criteria for vinyl chloride and chloroform, in terms of matching the initial calibration average. A new calibration was done on 11/04, and the standard met CLP criteria against it. This indicated the standard was good, and representative of current system conditions, and its use was allowed. MS/MSD analyses, on sample MW-01, gave generally good results except that benzene and toluene showed marginally low recoveries at 74-77%. These were not significant outliers, and may have been caused by a matrix effect.

The semivolatiles runs also went well; MS/MSD analysis (sample MW-01) results met all criteria except for one 2,4-dinitrotoluene recovery, which, at 100%, was technically "high". Again, no significant outliers were seen. There were no other problems seen in final review of the data.

The samples were analyzed for the requested nitroexplosives on 10/30 and 10/31/89. No problems were encountered.

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

---

### III. Quality Control (continued)

The samples were digested on 10/30/89 for ICP and GFAA. The samples for mercury analysis were prepared just prior to analysis. The CVAA analysis for mercury was performed on 10/31/89; the GFAA analyses for arsenic and selenium were performed on 11/01 and 10/31/89, respectively; the remaining metals were analyzed by ICP on 10/31/89. All run QC was acceptable. No problems were encountered.

The samples were analyzed for nitrate and sulfate on 11/10 and 11/13, respectively. Elevated detection limits were reported for samples MW-02 and MW-02 dup for the nitrate determination due to the turbidity of the sample. No other problems were encountered.

The pH determination was performed on 10/25/89. No problems were encountered.

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 1  
Lab Sample ID: CB1102

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/02/89  
Dilution Factor: 1

This method blank applies to the following samples: MW-01, MW-02, Trip Blank.

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44421

Client Project ID: COE-Plum Brook Ordnance Works

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-01  
Lab Sample ID: JJ8049

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	82	benzene	5 U
carbon disulfide	2 J	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	2 J
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/02/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-02  
Lab Sample ID: JJ8050

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	12	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/02/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

Client Project ID: COE-Plum Brook Ordnance Works

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Job Number: ITEK 44421

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Trip Blank  
Lab Sample ID: JJ8057

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 BJ	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/02/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 2  
Lab Sample ID: CB1103

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	3 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/03/89  
Dilution Factor: 1

This method blank applies to the following samples: GW Rinsate, MW-02 Dup, MW-05, MW-06.

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: MW-02 Dup  
Lab Sample ID: JJ8051

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/03/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

Client Project ID: COE-Plum Brook Ordnance Works

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Job Number: ITEK 44421

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-05  
Lab Sample ID: JJ8052

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	7 J	benzene	5 U
carbon disulfide	4 J	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/03/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: MW-06  
Lab Sample ID: JJ8053

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	9	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/03/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: GW Rinsate  
Lab Sample ID: JJ8056

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	1 J	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/03/89  
Dilution Factor: 1

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in µg/liter (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 3  
Lab Sample ID: CB1106

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/06/89  
Dilution Factor: 1

This method blank applies to the following samples: GWMS-1, GWMS-2.

WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Results in  $\mu\text{g/liter}$  (ppb)

Client Sample ID: GWMS-1, GWMS-2 (MW-02)  
Lab Sample ID: JJ8050

	<u>Conc. Spike Added</u>	<u>Sample Conc.</u>	<u>MS Conc.</u>	<u>MS % Rec.</u>
1,1-dichloroethene	50	5 U	52.3	105
trichloroethene	50	5 U	53.5	107
benzene	50	5 U	37.0	74 *
toluene	50	5 U	38.4	77
chlorobenzene	50	5 U	52.3	105

	<u>Conc. Spike Added</u>	<u>MSD Conc.</u>	<u>MSD % Rec.</u>	<u>RPD</u>
1,1-dichloroethene	50	49.0	98	7
trichloroethene	50	52.8	106	1
benzene	50	37.4	75 *	-1
toluene	50	37.5	75 *	3
chlorobenzene	50	51.6	103	2

RPD = Relative Percent Difference

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

\*Asterisked values are outside USEPA advisory QC limits.

WATER SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	VOLATILE		
	<u>Toluene-D8</u> (88-110%)*	<u>BFB</u> (86-115%)*	<u>1,2 Dichloroethane-D4</u> (76-114%)*
GW Rinsate	97	96	78
MW-01	96	99	91
MW-02	99	103	91
MW-02 Dup	102	96	86
MW-05	104	99	94
MW-06	108	101	91
Trip Blank	90	95	80
GWMS-1	94	97	83
GWMS-2	95	102	81
Method Blank 1	106	108	94
Method Blank 2	101	97	96
Method Blank 3	97	101	82

\*Values in parenthesis represent USEPA contract required QC limits.

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 1  
Lab Sample ID: BL4994

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

This method blank applies to the following samples: GW Rinsate, MW-01, MW-02 Dup, MW-05, MW-06.

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 1  
Lab Sample ID: BL4994

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-01  
Lab Sample ID: JJ8078

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	52 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	52 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	52 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-01  
Lab Sample ID: JJ8078

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	52 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	52 U	fluoranthene	10 U
4-nitrophenol	52 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	21 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	52 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	52 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	52 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: MW-02 Dup  
Lab Sample ID: JJ8080

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	2 J
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	25
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: MW-02 Dup  
Lab Sample ID: JJ8080

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	12 J	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	140	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: MW-05  
Lab Sample ID: JJ8081

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-05  
Lab Sample ID: JJ8081

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	2 J
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-06  
Lab Sample ID: JJ8082

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-06  
Lab Sample ID: JJ8082

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: GW Rinsate  
Lab Sample ID: JJ8085

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: GW Rinsate  
Lab Sample ID: JJ8085

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	3 J
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/26/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 2  
Lab Sample ID: BLA0044

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 11/06/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

This method blank applies to the following samples: MW-02, GWMS-1, GWMS-2.

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 2  
Lab Sample ID: BLA0044

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	his(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 11/06/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-02  
Lab Sample ID: JJ8079

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	2 J
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	27
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 11/06/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: MW-02  
Lab Sample ID: JJ8079

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	13 J	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	3 J	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	160	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	2 J
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 11/06/89  
Date Analyzed: 11/09/89  
Dilution Factor: 1

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Results in ug/liter (ppb)

Client Sample ID: GWMS-1, GWMS-2 (MW-02)  
Lab Sample ID: JJ8079

	<u>Conc. Spike Added</u>	<u>Sample Conc.</u>	<u>MS Conc.</u>	<u>MS % Rec.</u>
phenol	400	10 U	176	44
2-chlorophenol	400	10 U	240	60
1,4-dichlorobenzene	200	10 U	144	72
n-nitroso-di-n-propylamine	200	10 U	164	82
1,2,4-trichlorobenzene	200	10 U	144	72
4-chloro-3-methylphenol	400	10 U	296	74
acenaphthene	200	10 U	166	83
4-nitrophenol	400	2.58 J	278	69
2,4-dinitrotoluene	200	156	328	86
pentachlorophenol	400	50 U	187	47
pyrene	200	10 U	160	8
	<u>Conc. Spike Added</u>	<u>MSD Conc.</u>	<u>MSD % Rec.</u>	<u>RPD</u>
phenol	400	198	50	-13
2-chlorophenol	400	276	69	-14
1,4-dichlorobenzene	200	157	79	-9
n-nitroso-di-n-propylamine	200	183	92	-11
1,2,4-trichlorobenzene	200	157	79	-9
4-chloro-3-methylphenol	400	300	75	-1
acenaphthene	200	177	89	-7
4-nitrophenol	400	256	63	9
2,4-dinitrotoluene	200	356	100 *	-15
pentachlorophenol	400	148	37	24
pyrene	200	170	85	-6

RPD = Relative Percent Difference

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

\*Asterisked values are outside USEPA advisory QC limits.

WATER SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	SEMI-VOLATILE					
	Nitro-Benzene-D5 (35-114%)*	2-Fluoro-Biphenyl (43-116%)*	Terphenyl-D14 (33-141%)*	Phenol-D5 (10-94%)*	2-Fluoro-Phenol (21-100%)*	2,4,6 Tribromo-Phenol (10-123%)*
GW Rinsate	83	70	79	34	47	76
MW-01	82	73	82	32	44	84
MW-02	91	77	76	28	40	70
MW-02 Dup	82	71	69	29	37	80
MW-05	76	67	86	31	43	73
MW-06	78	69	78	37	50	82
GWMS-1	87	73	70	41	50	76
GWMS-2	93	78	72	45	57	76
Method Blank 1	86	69	80	35	50	80
Method Blank 2	89	75	88	33	50	81

\*Values in parenthesis represent USEPA contract required QC limits.

NITROEXPLOSIVES ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	Method Blank 1 <u>BL0137</u>	MW-01 <u>JJ8086</u>	MW-02 <u>JJ8087</u>
1,3,5-trinitrobenzene	0.050 U	0.050 U	0.25 U*
1,3-dinitrobenzene	0.050 U	0.050 U	0.25 U*
nitrobenzene	0.048 U	0.048 U	0.24 U*
2,4,6-trinitrotoluene	0.074 U	0.074 U	0.37 U*
2,6-dinitrotoluene	0.053 U	0.053 U	0.26 U*
2,4-dinitrotoluene	0.11 U	0.11 U	0.55 U*
nitrotoluene	0.048 U	0.048 U	0.24 U*
Date Analyzed:	10/30/89	10/30/89	10/30/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit is higher than normal due to sample matrix interferences.

NITROEXPLOSIVES ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	MW-02 Dup <u>JJ8088</u>	MW-05 <u>JJ8089</u>
1,3,5-trinitrobenzene	0.25 U*	0.050 U
1,3-dinitrobenzene	0.25 U*	0.050 U
nitrobenzene	0.24 U*	0.048 U
2,4,6-trinitrotoluene	0.37 U*	0.074 U
2,6-dinitrotoluene	0.26 U*	0.053 U
2,4-dinitrotoluene	0.55 U*	0.11 U
nitrotoluene	0.24 U*	0.048 U
Date Analyzed:	10/30/89	10/30/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit is higher than normal due to sample matrix interferences.

NITROEXPLOSIVES ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	<u>Method Blank 2</u> <u>BL0138</u>	<u>MW-06</u> <u>JJ8090</u>	<u>GW Rinsate</u> <u>JJ8091</u>
1,3,5-trinitrobenzene	0.050 U	0.050 U	0.050 U
1,3-dinitrobenzene	0.050 U	0.050 U	0.050 U
nitrobenzene	0.048 U	0.048 U	0.048 U
2,4,6-trinitrotoluene	0.074 U	0.074 U	0.074 U
2,6-dinitrotoluene	0.053 U	0.053 U	0.053 U
2,4-dinitrotoluene	0.11 U	0.11 U	0.11 U
nitrotoluene	0.048 U	0.048 U	0.048 U
Date Analyzed:	10/31/89	10/31/89	10/31/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

METALS ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	<u>MW-01</u> <u>JJ8072</u>	<u>MW-02</u> <u>JJ8073</u>	<u>MW-02 Dup</u> <u>JJ8074</u>	<u>MW-05</u> <u>JJ8075</u>
arsenic	0.005 U*	0.01 U*	0.004 U*	0.007 U*
iron	2.8	2.7	1.5	0.8
manganese	0.31	2.8	3.0	0.053
selenium	0.003 U*	0.015 U*	0.015 U*	0.003 U*
sodium	18.4	401	441	17.0
mercury	0.001 U	0.001 U	0.001 U	0.001 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

Date Digested: 10/30/89  
Date Analyzed: 10/31/89 (ICP)  
10/31 and 11/01/89 (GFAA)  
10/31/89 (CVAA)

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44421

Client Project ID: COE-Plum Brook Ordnance Works

METALS ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID:	MW-06	GW Rinsate	Method Blank
Lab Sample ID:	<u>JJ8076</u>	<u>JJ8077</u>	<u>PBWC0866/C0871</u>
arsenic	0.005	0.002 U	0.002 U
iron	0.76	0.01 U	0.01 U
manganese	0.093	0.002 U	0.002 U
selenium	0.003 U*	0.002 U	0.002 U
sodium	15.3	0.2 U	0.2 U
mercury	0.001 U	0.001 U	NR

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

NR - Not required.

Date Digested: 10/30/89  
Date Analyzed: 10/31/89 (ICP)  
10/31 and 11/01/89 (GFAA)  
10/31/89 (CVAA)

IT Corporation  
November 28, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook Ordnance Works

Job Number: ITEK 44421

WASTEWATER ANALYSIS

Results in mg/liter (ppm) unless otherwise stated

Sample Matrix: Water

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>pH (standard units)</u>	<u>Sulfate</u>
Method Blank	P0614	*	10 U
MW-01	JJ8066	6.38	130
MW-02	JJ8067	6.95	.950
MW-02 Dup	JJ8068	6.92	950
MW-05	JJ8069	7.68	10 U
MW-06	JJ8070	7.56	60
GW Rinsate	JJ8071	7.37	10 U
Date Analyzed		10/25/89	11/10/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - A method blank is not applicable for pH analysis.

IT Corporation  
November 28, 1989

Client Project ID: COE-Plum Brook Ordnance Works

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44421

WASTEWATER ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Nitrate, as N</u>
Method Blank	P0617	0.05 U
MW-01	JJ8060	0.07
MW-02	JJ8061	0.25 U*
MW-02 Dup	JJ8062	0.25 U*
MW-05	JJ8063	0.05 U
MW-06	JJ8064	0.12
GW Rinsate	JJ8065	0.05 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Elevated detection limit due to dilution factor. Dilution was required because of turbidity of the sample.

Date Analyzed: 11/13/89

**CERTIFICATE OF ANALYSIS**

---

IT Corporation  
312 Directors Drive  
Knoxville, TN 37923  
ATTN: Don Burton

November 30, 1989

---

Job Number: ITEK 44394

P.O. Number: 409658

This is the Certificate of Analysis for the following samples:

Client Project ID: COE-Plum Brook  
Date Received by Lab: 10/20/89  
Number of Samples: Nine (9)  
Sample Type: Soil-eight (8), Trip Blank-one (1)

---

**I. Introduction**

On 10/20/89, eight (8) soil samples and one (1) trip blank arrived at the ITAS-Knoxville, Tennessee laboratory from the COE-Plum Brook Ordnance Works site in Sandusky, Ohio. The list of analytical tests performed, as well as date of receipt and analysis, can be found in the attached report.

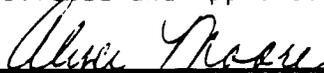
**II. Analytical Results/Methodology**

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information and the analytical results. Please note that all but CLP data are blank corrected, i.e., if any compound is found in the corresponding laboratory blank, it is subtracted from the analytical result before it is reported. CLP data are not blank corrected and CLP soil results are reported on a dry weight basis.

The samples were analyzed for Target Compound List (TCL) volatile and semivolatile organic compounds by gas chromatography/mass spectroscopy (GC/MS) in accordance with the EPA CLP 2/88 Statement of Work.

The samples were analyzed for the requested nitroexplosives by high performance liquid chromatography (HPLC) based on USATHAMA method 8H.

Reviewed and Approved:

  
Alyce Moore  
Laboratory Manager

## II. Analytical Results/Methodology (continued)

The samples were analyzed for the requested metals by inductively coupled plasma spectroscopy (ICP), graphite furnace atomic absorption spectroscopy (GFAA) and cold vapor atomic absorption spectroscopy (CVAA) based on EPA SW-846 methods 3050, 6010, 3020, 7060, 7740 and 7471.

The samples were analyzed for sulfate and nitrate by colorimetric determination based on EPA SW-846 methods 9035 and 9200, respectively.

The pH of the samples was measured by an electrometric procedure based on EPA SW-846 method 9045.

## III. Quality Control

Routine laboratory level I QC was performed for all parameters but CLP parameters. CLP analyses followed project specific QC tracking.

The volatiles analyses were performed on 10/30 and 10/31/89 by purge and trap with J&W DB-624 Megabore column on a Finnigan OWA GC/MS/DS. The semivolatiles analyses were performed on 10/25 and 10/26/89 by direct injection of sample extract on a J&W DB-5 capillary column on a VG TRIO-2 GC/MS/DS. The volatiles runs generally went well, with some varying acetone levels seen. Samples SB05 and SB06 showed high acetone levels and were rerun at medium level, with both initial and rerun data submitted. The samples had the consistency of a hard dry paste, and it was difficult to mix without losing volatiles; the indication was that acetone was more concentrated near the surface of the sample. The semivolatiles runs went well. There were no other problems seen in final review of the data for either fraction. Associated QC samples were analyzed with ITAS project ITEK 44414, sample SB-10.

The samples were extracted on 10/30/89 and analyzed on 10/31/89 for the requested nitroexplosives. Sample MW02B-C/6-8 showed an elevated detection limit for nitrobenzene due to matrix interferences and is noted as such on the report form. No other problems were encountered. All run QC was acceptable.

The samples were digested on 10/25/89 for ICP and GFAA. The samples for mercury analysis were prepared just prior to analysis. The CVAA analysis for mercury was performed on 10/26/89; the GFAA analyses for arsenic and selenium were performed on 10/29 and 10/31/89; the remaining metals were analyzed by ICP on 10/28/89. All run QC was acceptable. No problems were encountered.

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

---

### III. Quality Control (continued)

The samples were analyzed for nitrate and sulfate on 11/13/89 and 11/14/89, respectively. Elevated detection limits were reported for all samples due to extreme sample turbidity. The samples were filtered and centrifuged, but this did not eliminate the turbidity effects. No other problems were encountered.

The pH of the samples was measured on 11/09/89. No problems were encountered.

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank  
Lab Sample ID: VB1030

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Trip Blank  
Lab Sample ID: JJ7766

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 BJ	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

---

WATER SURROGATE PERCENT RECOVERY SUMMARY

<u>Sample No.</u>	<u>VOLATILE</u>		
	<u>Toluene-D8 (88-110%)*</u>	<u>BFB (86-115%)*</u>	<u>1,2 Dichloroethane-D4 (76-114%)*</u>
Trip Blank	97	98	98
Method Blank	91	92	93

\*Values in parenthesis represent USEPA contract required QC limits.

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: VB1030

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

This method blank applies to the following samples: MW02B-C/6-8, SB01, SB02, SB03, SB03 DL, SB04, SB04 Split, SB05, SB06, SB06 DL.

DL - Dilution

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: VB1031

<u>Compound</u>		<u>Compound</u>	
chloromethane	1,200 U	1,2-dichloropropane	620 U
bromomethane	1,200 U	cis-1,3-dichloropropene	620 U
vinyl chloride	1,200 U	trichloroethene	620 U
chloroethane	1,200 U	dibromochloromethane	620 U
methylene chloride	260 J	1,1,2-trichloroethane	620 U
acetone	1,200 U	benzene	620 U
carbon disulfide	620 U	trans-1,3-dichloropropene	620 U
1,1-dichloroethene	620 U	bromoform	620 U
1,1-dichloroethane	620 U	4-methyl-2-pentanone	1,200 U
1,2-dichloroethene (total)	620 U	2-hexanone	1,200 U
chloroform	620 U	tetrachloroethene	620 U
1,2-dichloroethane	620 U	1,1,2,2-tetrachloroethane	620 U
2-butanone	1,200 U	toluene	620 U
1,1,1-trichloroethane	620 U	chlorobenzene	620 U
carbon tetrachloride	620 U	ethylbenzene	620 U
vinyl acetate	1,200 U	styrene	620 U
bromodichloromethane	620 U	total xylenes	620 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/31/89  
Dilution Factor: 1

This method blank applies to the following sample: SB05 DL.

DL - Dilution

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB01  
Lab Sample ID: JJ7767

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	10 B	1,1,2-trichloroethane	6 U
acetone	12 U	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	4 J
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	4 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	3 J	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	2 J

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 10/30/89  
Dilution Factor: 1  
% Moisture: 17

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB02  
Lab Sample ID: JJ7770

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	4 BJ	1,1,2-trichloroethane	6 U
acetone	12 U	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	5 J
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	3 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	3 J	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	2 J

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 10/30/89  
Dilution Factor: 1  
% Moisture: 15

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB03  
Lab Sample ID: JJ7771

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	10 B	1,1,2-trichloroethane	6 U
acetone	990 D	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	3 J
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

D - Compound analyzed at a secondary dilution factor.

Date Analyzed: 10/30/89  
Dilution Factor: 1  
% Moisture: 18

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB04  
Lab Sample ID: JJ7772

<u>Compound</u>		<u>Compound</u>	
chloromethane	11 U	1,2-dichloropropane	6 U
bromomethane	11 U	cis-1,3-dichloropropene	6 U
vinyl chloride	11 U	trichloroethene	6 U
chloroethane	11 U	dibromochloromethane	6 U
methylene chloride	8 B	1,1,2-trichloroethane	6 U
acetone	65	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	11 U
1,2-dichloroethene (total)	6 U	2-hexanone	11 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	11 U	toluene	4 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	3 J	ethylbenzene	6 U
vinyl acetate	11 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	2 J

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 10/30/89  
Dilution Factor: 1  
% Moisture: 12

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB04 Split  
Lab Sample ID: JJ7773

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	9 B	1,1,2-trichloroethane	6 U
acetone	12 U	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	4 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	4 J	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 10/30/89  
Dilution Factor: 1  
% Moisture: 14

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB05  
Lab Sample ID: JJ7774

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	5 BJ	1,1,2-trichloroethane	6 U
acetone	4,300 D	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

D - Compound analyzed at a secondary dilution factor.

Date Analyzed: 10/30/89  
Dilution Factor: 1  
% Moisture: 17

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB06  
Lab Sample ID: JJ7775

<u>Compound</u>		<u>Compound</u>	
chloromethane	11 U	1,2-dichloropropane	6 U
bromomethane	11 U	cis-1,3-dichloropropene	6 U
vinyl chloride	11 U	trichloroethene	6 U
chloroethane	11 U	dibromochloromethane	6 U
methylene chloride	5 BJ	1,1,2-trichloroethane	6 U
acetone	2,300 D	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	11 U
1,2-dichloroethene (total)	6 U	2-hexanone	11 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	11 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	11 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

D - Compound analyzed at a secondary dilution factor.

Date Analyzed: 10/30/89  
Dilution Factor: 1  
% Moisture: 11

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: MW02B-C/6-8

Lab Sample ID: JJ7776

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	6 BJ	1,1,2-trichloroethane	6 U
acetone	12 U	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	1 J	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 10/30/89

Dilution Factor: 1

% Moisture: 19

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	VOLATILE		
	Toluene-D8 (81-117%)*	BFB (74-121%)*	1,2 Dichloroethane-D4 (70-121%)*
MW02B-C/6-8	94	96	96
SB01	100	102	97
SB02	98	93	93
SB03	95	96	98
SB03 DL	94	97	96
SB04	93	92	94
SB04 Split	99	94	100
SB05	92	93	93
SB06	92	95	95
Method Blank	91	92	93
SB05 DL	103	105	102
SB06 DL	93	97	102
Method Blank	108	112	107

\*Values in parenthesis represent USEPA contract required QC limits.

DL - Dilution

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: BL4976

<u>Compound</u>		<u>Compound</u>	
phenol	330 U	bis(2-chloroethoxy)methane	330 U
bis(2-chloroethyl)ether	330 U	2,4-dichlorophenol	330 U
2-chlorophenol	330 U	1,2,4-trichlorobenzene	330 U
1,3-dichlorobenzene	330 U	naphthalene	330 U
1,4-dichlorobenzene	330 U	4-chloroaniline	330 U
benzyl alcohol	330 U	hexachlorobutadiene	330 U
2-dichlorobenzene	330 U	4-chloro-3-methylphenol	330 U
2-methylphenol	330 U	2-methylnaphthalene	330 U
bis(2-chloroisopropyl)ether	330 U	hexachlorocyclopentadiene	330 U
4-methylphenol	330 U	2,4,6-trichlorophenol	330 U
n-nitroso-di-n-propylamine	330 U	2,4,5-trichlorophenol	1,600 U
hexachloroethane	330 U	2-chloronaphthalene	330 U
nitrobenzene	330 U	2-nitroaniline	1,600 U
isophorone	330 U	dimethyl phthalate	330 U
2-nitrophenol	330 U	acenaphthylene	330 U
2,4-dimethylphenol	330 U	2,6-dinitrotoluene	330 U
benzoic acid	1,600 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: BL4976

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,600 U	anthracene	330 U
acenaphthene	330 U	di-n-butylphthalate	330 U
2,4-dinitrophenol	1,600 U	fluoranthene	330 U
4-nitrophenol	1,600 U	pyrene	330 U
dibenzofuran	330 U	butylbenzylphthalate	330 U
2,4-dinitrotoluene	330 U	3,3'-dichlorobenzidine	660 U
diethylphthalate	330 U	benzo(a)anthracene	330 U
4-chlorophenyl-phenylether	330 U	chrysene	330 U
fluorene	330 U	bis(2-ethylhexyl)phthalate	300 J
4-nitroaniline	1,600 U	di-n-octylphthalate	330 U
4,6-dinitro-2-methylphenol	1,600 U	benzo(b)fluoranthene	330 U
n-nitrosodiphenylamine <sup>1</sup>	330 U	benzo(k)fluoranthene	330 U
4-bromophenyl-phenylether	330 U	benzo(a)pyrene	330 U
hexachlorobenzene	330 U	indeno(1,2,3-cd)pyrene	330 U
pentachlorophenol	1,600 U	dibenzo(a,h)anthracene	330 U
phenanthrene	330 U	benzo(g,h,i)perylene	330 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB01  
Lab Sample ID: JJ7777

<u>Compound</u>		<u>Compound</u>	
phenol	380 U	bis(2-chloroethoxy)methane	380 U
bis(2-chloroethyl)ether	380 U	2,4-dichlorophenol	380 U
2-chlorophenol	380 U	1,2,4-trichlorobenzene	380 U
1,3-dichlorobenzene	380 U	naphthalene	380 U
1,4-dichlorobenzene	380 U	4-chloroaniline	380 U
benzyl alcohol	380 U	hexachlorobutadiene	380 U
1,2-dichlorobenzene	380 U	4-chloro-3-methylphenol	380 U
2-methylphenol	380 U	2-methylnaphthalene	380 U
bis(2-chloroisopropyl)ether	380 U	hexachlorocyclopentadiene	380 U
4-methylphenol	380 U	2,4,6-trichlorophenol	380 U
n-nitroso-di-n-propylamine	380 U	2,4,5-trichlorophenol	1,900 U
hexachloroethane	380 U	2-chloronaphthalene	380 U
nitrobenzene	380 U	2-nitroaniline	1,900 U
isophorone	380 U	dimethyl phthalate	380 U
2-nitrophenol	380 U	acenaphthylene	380 U
2,4-dimethylphenol	380 U	2,6-dinitrotoluene	380 U
benzoic acid	1,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1  
% Moisture: 14

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB01  
Lab Sample ID: JJ7777

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,900 U	anthracene	380 U
acenaphthene	380 U	di-n-butylphthalate	380 U
2,4-dinitrophenol	1,900 U	fluoranthene	380 U
4-nitrophenol	1,900 U	pyrene	380 U
dibenzofuran	380 U	butylbenzylphthalate	380 U
2,4-dinitrotoluene	380 U	3,3'-dichlorobenzidine	770 U
ethylphthalate	380 U	benzo(a)anthracene	380 U
1-chlorophenyl-phenylether	380 U	chrysene	380 U
fluorene	380 U	bis(2-ethylhexyl)phthalate	400 B
4-nitroaniline	1,900 U	di-n-octylphthalate	380 U
4,6-dinitro-2-methylphenol	1,900 U	benzo(b)fluoranthene	380 U
n-nitrosodiphenylamine <sup>1</sup>	380 U	benzo(k)fluoranthene	380 U
4-bromophenyl-phenylether	380 U	benzo(a)pyrene	380 U
hexachlorobenzene	380 U	indeno(1,2,3-cd)pyrene	380 U
pentachlorophenol	1,900 U	dibenzo(a,h)anthracene	380 U
phenanthrene	380 U	benzo(g,h,i)perylene	380 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1  
% Moisture: 14

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB02  
Lab Sample ID: JJ7780

<u>Compound</u>		<u>Compound</u>	
phenol	380 U	bis(2-chloroethoxy)methane	380 U
bis(2-chloroethyl)ether	380 U	2,4-dichlorophenol	380 U
2-chlorophenol	380 U	1,2,4-trichlorobenzene	380 U
1,3-dichlorobenzene	380 U	naphthalene	380 U
1,4-dichlorobenzene	380 U	4-chloroaniline	380 U
benzyl alcohol	380 U	hexachlorobutadiene	380 U
1,2-dichlorobenzene	380 U	4-chloro-3-methylphenol	380 U
2-methylphenol	380 U	2-methylnaphthalene	380 U
bis(2-chloroisopropyl)ether	380 U	hexachlorocyclopentadiene	380 U
4-methylphenol	380 U	2,4,6-trichlorophenol	380 U
n-nitroso-di-n-propylamine	380 U	2,4,5-trichlorophenol	1,800 U
hexachloroethane	380 U	2-chloronaphthalene	380 U
nitrobenzene	380 U	2-nitroaniline	1,800 U
isophorone	380 U	dimethyl phthalate	380 U
2-nitrophenol	380 U	acenaphthylene	380 U
2,4-dimethylphenol	380 U	2,6-dinitrotoluene	380 U
benzoic acid	1,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1  
% Moisture: 14

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: BL4986

<u>Compound</u>		<u>Compound</u>	
phenol	330 U	bis(2-chloroethoxy)methane	330 U
bis(2-chloroethyl)ether	330 U	2,4-dichlorophenol	330 U
2-chlorophenol	330 U	1,2,4-trichlorobenzene	330 U
1,3-dichlorobenzene	330 U	naphthalene	330 U
1,4-dichlorobenzene	330 U	4-chloroaniline	330 U
benzyl alcohol	330 U	hexachlorobutadiene	330 U
1,2-dichlorobenzene	330 U	4-chloro-3-methylphenol	330 U
2-methylphenol	330 U	2-methylnaphthalene	330 U
bis(2-chloroisopropyl)ether	330 U	hexachlorocyclopentadiene	330 U
4-methylphenol	330 U	2,4,6-trichlorophenol	330 U
n-nitroso-di-n-propylamine	330 U	2,4,5-trichlorophenol	1,600 U
hexachloroethane	330 U	2-chloronaphthalene	330 U
nitrobenzene	330 U	2-nitroaniline	1,600 U
isophorone	330 U	dimethyl phthalate	330 U
2-nitrophenol	330 U	acenaphthylene	330 U
2,4-dimethylphenol	330 U	2,6-dinitrotoluene	330 U
benzoic acid	1,600 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

Client Project ID: COE-Plum Brook

Job Number: ITEK 444\*

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: BL4986

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,600 U	anthracene	330 U
acenaphthene	330 U	di-n-butylphthalate	330 U
2,4-dinitrophenol	1,600 U	fluoranthene	330 U
4-nitrophenol	1,600 U	pyrene	330 U
dibenzofuran	330 U	butylbenzylphthalate	330 U
2,4-dinitrotoluene	330 U	3,3'-dichlorobenzidine	660 U
diethylphthalate	330 U	benzo(a)anthracene	330 U
4-chlorophenyl-phenylether	330 U	chrysene	330 U
fluorene	330 U	bis(2-ethylhexyl)phthalate	130 J
4-nitroaniline	1,600 U	di-n-octylphthalate	330 U
4,6-dinitro-2-methylphenol	1,600 U	benzo(b)fluoranthene	330 U
n-nitrosodiphenylamine <sup>1</sup>	46 J	benzo(k)fluoranthene	330 U
4-bromophenyl-phenylether	330 U	benzo(a)pyrene	330 U
hexachlorobenzene	330 U	indeno(1,2,3-cd)pyrene	330 U
pentachlorophenol	1,600 U	dibenzo(a,h)anthracene	330 U
phenanthrene	330 U	benzo(g,h,i)perylene	330 U

U - Compound was analyzed for but not detected. The number is the detection limit for this sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-07  
Lab Sample ID: JJ8001

<u>Compound</u>		<u>Compound</u>	
phenol	770 U	bis(2-chloroethoxy)methane	770 U
bis(2-chloroethyl)ether	770 U	2,4-dichlorophenol	770 U
2-chlorophenol	770 U	1,2,4-trichlorobenzene	770 U
1,3-dichlorobenzene	770 U	naphthalene	770 U
1,4-dichlorobenzene	770 U	4-chloroaniline	770 U
benzyl alcohol	770 U	hexachlorobutadiene	770 U
1,2-dichlorobenzene	770 U	4-chloro-3-methylphenol	770 U
2-methylphenol	770 U	2-methylnaphthalene	770 U
bis(2-chloroisopropyl)ether	770 U	hexachlorocyclopentadiene	770 U
4-methylphenol	770 U	2,4,6-trichlorophenol	770 U
n-nitroso-di-n-propylamine	770 U	2,4,5-trichlorophenol	3,800 U
hexachloroethane	770 U	2-chloronaphthalene	770 U
nitrobenzene	770 U	2-nitroaniline	3,800 U
isophorone	770 U	dimethyl phthalate	770 U
2-nitrophenol	770 U	acenaphthylene	770 U
2,4-dimethylphenol	770 U	2,6-dinitrotoluene	770 U
benzoic acid	3,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 2  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-07  
Lab Sample ID: JJ8001

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	3,800 U	anthracene	770 U
acenaphthene	770 U	di-n-butylphthalate	770 U
2,4-dinitrophenol	3,800 U	fluoranthene	770 U
4-nitrophenol	3,800 U	pyrene	770 U
dibenzofuran	770 U	butylbenzylphthalate	770 U
2,4-dinitrotoluene	170 J	3,3'-dichlorobenzidine	1,500 U
diethylphthalate	770 U	benzo(a)anthracene	770 U
4-chlorophenyl-phenylether	770 U	chrysene	770
fluorene	770 U	bis(2-ethylhexyl)phthalate	180 U
4-nitroaniline	3,800 U	di-n-octylphthalate	770 U
4,6-dinitro-2-methylphenol	3,800 U	benzo(b)fluoranthene	770 U
n-nitrosodiphenylamine <sup>1</sup>	99 B <sub>1</sub>	benzo(k)fluoranthene	770 U
4-bromophenyl-phenylether	770 U	benzo(a)pyrene	770 U
hexachlorobenzene	770 U	indeno(1,2,3-cd)pyrene	770 U
pentachlorophenol	3,800 U	dibenzo(a,h)anthracene	770 U
phenanthrene	770 U	benzo(g,h,i)perylene	770 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89

Date Analyzed: 10/30/89

Dilution Factor: 2

% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-09  
Lab Sample ID: JJ8002

<u>Compound</u>		<u>Compound</u>	
phenol	1,700 U	bis(2-chloroethoxy)methane	1,700 U
bis(2-chloroethyl)ether	1,700 U	2,4-dichlorophenol	1,700 U
2-chlorophenol	1,700 U	1,2,4-trichlorobenzene	1,700 U
1,3-dichlorobenzene	1,700 U	naphthalene	1,700 U
1,4-dichlorobenzene	1,700 U	4-chloroaniline	1,700 U
benzyl alcohol	1,700 U	hexachlorobutadiene	1,700 U
1,2-dichlorobenzene	1,700 U	4-chloro-3-methylphenol	1,700 U
2-methylphenol	1,700 U	2-methylnaphthalene	1,700 U
bis(2-chloroisopropyl)ether	1,700 U	hexachlorocyclopentadiene	1,700 U
4-methylphenol	1,700 U	2,4,6-trichlorophenol	1,700 U
n-nitroso-di-n-propylamine	1,700 U	2,4,5-trichlorophenol	8,000 U
hexachloroethane	1,700 U	2-chloronaphthalene	1,700 U
nitrobenzene	1,700 U	2-nitroaniline	8,000 U
isophorone	1,700 U	dimethyl phthalate	1,700 U
2-nitrophenol	1,700 U	acenaphthylene	1,700 U
2,4-dimethylphenol	1,700 U	2,6-dinitrotoluene	1,700 U
benzoic acid	180 J		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 11/07/89  
Dilution Factor: 4  
% Moisture: 21

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441<sup>A</sup>

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in µg/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-09  
Lab Sample ID: JJ8002

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	8,000 U	anthracene	1,700 U
acenaphthene	1,700 U	di-n-butylphthalate	1,700 U
2,4-dinitrophenol	8,000 U	fluoranthene	1,700 U
4-nitrophenol	8,000 U	pyrene	1,700 U
dibenzofuran	1,700 U	butylbenzylphthalate	1,700 U
2,4-dinitrotoluene	1,700 U	3,3'-dichlorobenzidine	3,300 U
diethylphthalate	1,700 U	benzo(a)anthracene	1,700 U
4-chlorophenyl-phenylether	1,700 U	chrysene	1,700 U
fluorene	1,700 U	bis(2-ethylhexyl)phthalate	230 U
4-nitroaniline	8,000 U	di-n-octylphthalate	1,700 U
4,6-dinitro-2-methylphenol	8,000 U	benzo(b)fluoranthene	1,700 U
n-nitrosodiphenylamine <sup>1</sup>	330 BJ	benzo(k)fluoranthene	1,700 U
4-bromophenyl-phenylether	1,700 U	benzo(a)pyrene	1,700 U
hexachlorobenzene	1,700 U	indeno(1,2,3-cd)pyrene	1,700 U
pentachlorophenol	8,000 U	dibenzo(a,h)anthracene	1,700 U
phenanthrene	1,700 U	benzo(g,h,i)perylene	1,700 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 11/07/89  
Dilution Factor: 4  
% Moisture: 21

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-10  
Lab Sample ID: JJ8003

<u>Compound</u>		<u>Compound</u>	
phenol	900 U	bis(2-chloroethoxy)methane	900 U
bis(2-chloroethyl)ether	900 U	2,4-dichlorophenol	900 U
2-chlorophenol	900 U	1,2,4-trichlorobenzene	900 U
1,3-dichlorobenzene	900 U	naphthalene	900 U
1,4-dichlorobenzene	900 U	4-chloroaniline	900 U
benzyl alcohol	900 U	hexachlorobutadiene	900 U
1,2-dichlorobenzene	900 U	4-chloro-3-methylphenol	900 U
2-methylphenol	900 U	2-methylnaphthalene	900 U
bis(2-chloroisopropyl)ether	900 U	hexachlorocyclopentadiene	900 U
4-methylphenol	900 U	2,4,6-trichlorophenol	900 U
n-nitroso-di-n-propylamine	900 U	2,4,5-trichlorophenol	4,400 U
hexachloroethane	900 U	2-chloronaphthalene	900 U
nitrobenzene	900 U	2-nitroaniline	4,400 U
isophorone	900 U	dimethyl phthalate	900 U
2-nitrophenol	900 U	acenaphthylene	900 U
2,4-dimethylphenol	900 U	2,6-dinitrotoluene	900 U
benzoic acid	4,400 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 11/07/89  
Dilution Factor: 2  
% Moisture: 27

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-10  
Lab Sample ID: JJ8003

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	4,400 U	anthracene	900 U
acenaphthene	900 U	di-n-butylphthalate	900 U
2,4-dinitrophenol	4,400 U	fluoranthene	900 U
4-nitrophenol	4,400 U	pyrene	900 U
dibenzofuran	900 U	butylbenzylphthalate	110 J
2,4-dinitrotoluene	900 U	3,3'-dichlorobenzidine	1,800 U
diethylphthalate	900 U	benzo(a)anthracene	900 U
4-chlorophenyl-phenylether	900 U	chrysene	900 U
fluorene	900 U	bis(2-ethylhexyl)phthalate	280 U
4-nitroaniline	4,400 U	di-n-octylphthalate	900 U
4,6-dinitro-2-methylphenol	4,400 U	benzo(b)fluoranthene	900 U
n-nitrosodiphenylamine <sup>1</sup>	140 BJ	benzo(k)fluoranthene	900 U
4-bromophenyl-phenylether	900 U	benzo(a)pyrene	900 U
hexachlorobenzene	900 U	indeno(1,2,3-cd)pyrene	900 U
pentachlorophenol	4,400 U	dibenzo(a,h)anthracene	900 U
phenanthrene	900 U	benzo(g,h,i)perylene	900 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 11/07/89  
Dilution Factor: 2  
% Moisture: 27

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-11  
Lab Sample ID: JJ8006

<u>Compound</u>		<u>Compound</u>	
phenol	790 U	bis(2-chloroethoxy)methane	790 U
bis(2-chloroethyl)ether	790 U	2,4-dichlorophenol	790 U
2-chlorophenol	790 U	1,2,4-trichlorobenzene	790 U
1,3-dichlorobenzene	790 U	naphthalene	790 U
1,4-dichlorobenzene	790 U	4-chloroaniline	790 U
benzyl alcohol	790 U	hexachlorobutadiene	790 U
1,2-dichlorobenzene	790 U	4-chloro-3-methylphenol	790 U
2-methylphenol	790 U	2-methylnaphthalene	790 U
bis(2-chloroisopropyl)ether	790 U	hexachlorocyclopentadiene	790 U
4-methylphenol	790 U	2,4,6-trichlorophenol	790 U
n-nitroso-di-n-propylamine	790 U	2,4,5-trichlorophenol	3,800 U
hexachloroethane	790 U	2-chloronaphthalene	790 U
nitrobenzene	790 U	2-nitroaniline	3,800 U
isophorone	790 U	dimethyl phthalate	790 U
2-nitrophenol	790 U	acenaphthylene	790 U
2,4-dimethylphenol	790 U	2,6-dinitrotoluene	790 U
benzoic acid	3,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 2  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-11  
Lab Sample ID: JJ8006

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	3,800 U	anthracene	790 U
acenaphthene	790 U	di-n-butylphthalate	790 U
2,4-dinitrophenol	3,800 U	fluoranthene	790 U
4-nitrophenol	3,800 U	pyrene	790 U
dibenzofuran	790 U	butylbenzylphthalate	790 U
2,4-dinitrotoluene	790 U	3,3'-dichlorobenzidine	1,600 U
diethylphthalate	790 U	benzo(a)anthracene	790 U
4-chlorophenyl-phenylether	790 U	chrysene	790 U
fluorene	790 U	bis(2-ethylhexyl)phthalate	170 U
4-nitroaniline	3,800 U	di-n-octylphthalate	790 U
4,6-dinitro-2-methylphenol	3,800 U	benzo(b)fluoranthene	790 U
n-nitrosodiphenylamine <sup>1</sup>	150 BJ	benzo(k)fluoranthene	790 U
4-bromophenyl-phenylether	790 U	benzo(a)pyrene	790 U
hexachlorobenzene	790 U	indeno(1,2,3-cd)pyrene	790 U
pentachlorophenol	3,800 U	dibenzo(a,h)anthracene	790 U
phenanthrene	790 U	benzo(g,h,i)perylene	790 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 2  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-12  
Lab Sample ID: JJ8007

<u>Compound</u>		<u>Compound</u>	
phenol	770 U	bis(2-chloroethoxy)methane	770 U
bis(2-chloroethyl)ether	770 U	2,4-dichlorophenol	770 U
2-chlorophenol	770 U	1,2,4-trichlorobenzene	770 U
1,3-dichlorobenzene	770 U	naphthalene	770 U
1,4-dichlorobenzene	770 U	4-chloroaniline	770 U
benzyl alcohol	770 U	hexachlorobutadiene	770 U
1,2-dichlorobenzene	770 U	4-chloro-3-methylphenol	770 U
2-methylphenol	770 U	2-methylnaphthalene	770 U
bis(2-chloroisopropyl)ether	770 U	hexachlorocyclopentadiene	770 U
4-methylphenol	770 U	2,4,6-trichlorophenol	770 U
n-nitroso-di-n-propylamine	770 U	2,4,5-trichlorophenol	3,800 U
hexachloroethane	770 U	2-chloronaphthalene	770 U
nitrobenzene	770 U	2-nitroaniline	3,800 U
isophorone	770 U	dimethyl phthalate	770 U
2-nitrophenol	770 U	acenaphthylene	770 U
2,4-dimethylphenol	770 U	2,6-dinitrotoluene	770 U
benzoic acid	3,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 2  
% Moisture: 16

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441/

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-12  
Lab Sample ID: JJ8007

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	3,800 U	anthracene	770 U
acenaphthene	770 U	di-n-butylphthalate	770 U
2,4-dinitrophenol	3,800 U	fluoranthene	770 U
4-nitrophenol	3,800 U	pyrene	770 U
dibenzofuran	770 U	butylbenzylphthalate	770 U
2,4-dinitrotoluene	620 J	3,3'-dichlorobenzidine	1,500 U
diethylphthalate	770 U	benzo(a)anthracene	770 U
4-chlorophenyl-phenylether	770 U	chrysene	770 U
fluorene	770 U	bis(2-ethylhexyl)phthalate	340 BJ
4-nitroaniline	3,800 U	di-n-octylphthalate	770 U
4,6-dinitro-2-methylphenol	3,800 U	benzo(b)fluoranthene	770 U
n-nitrosodiphenylamine <sup>1</sup>	89 BJ	benzo(k)fluoranthene	770 U
4-bromophenyl-phenylether	770 U	benzo(a)pyrene	770 U
hexachlorobenzene	770 U	indeno(1,2,3-cd)pyrene	770 U
pentachlorophenol	3,800 U	dibenzo(a,h)anthracene	770 U
phenanthrene	770 U	benzo(g,h,i)perylene	770 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 2  
% Moisture: 16

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-19  
Lab Sample ID: JJ8008

<u>Compound</u>		<u>Compound</u>	
phenol	860 U	bis(2-chloroethoxy)methane	860 U
bis(2-chloroethyl)ether	860 U	2,4-dichlorophenol	860 U
2-chlorophenol	860 U	1,2,4-trichlorobenzene	860 U
1,3-dichlorobenzene	860 U	naphthalene	860 U
1,4-dichlorobenzene	860 U	4-chloroaniline	860 U
benzyl alcohol	860 U	hexachlorobutadiene	860 U
1,2-dichlorobenzene	860 U	4-chloro-3-methylphenol	860 U
2-methylphenol	860 U	2-methylnaphthalene	860 U
bis(2-chloroisopropyl)ether	860 U	hexachlorocyclopentadiene	860 U
4-methylphenol	860 U	2,4,6-trichlorophenol	860 U
n-nitroso-di-n-propylamine	860 U	2,4,5-trichlorophenol	4,200 U
hexachloroethane	860 U	2-chloronaphthalene	860 U
nitrobenzene	360 U	2-nitroaniline	4,200 U
isophorone	860 U	dimethyl phthalate	860 U
2-nitrophenol	860 U	acenaphthylene	860 U
2,4-dimethylphenol	860 U	2,6-dinitrotoluene	860 U
benzoic acid	110 J		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 2  
% Moisture: 24

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-19  
Lab Sample ID: JJ8008

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	4,200 U	anthracene	860 U
acenaphthene	860 U	di-n-butylphthalate	860 U
2,4-dinitrophenol	4,200 U	fluoranthene	120 J
4-nitrophenol	4,200 U	pyrene	860 U
dibenzofuran	860 U	butylbenzylphthalate	860 U
2,4-dinitrotoluene	860 U	3,3'-dichlorobenzidine	1,700 U
diethylphthalate	860 U	benzo(a)anthracene	860 U
4-chlorophenyl-phenylether	860 U	chrysene	860 U
fluorene	860 U	bis(2-ethylhexyl)phthalate	270 BJ
4-nitroaniline	4,200 U	di-n-octylphthalate	860 U
4,6-dinitro-2-methylphenol	4,200 U	benzo(b)fluoranthene	860 U
n-nitrosodiphenylamine <sup>1</sup>	150 BJ	benzo(k)fluoranthene	360 U
4-bromophenyl-phenylether	860 U	benzo(a)pyrene	860 U
hexachlorobenzene	860 U	indeno(1,2,3-cd)pyrene	860 U
pentachlorophenol	4,200 U	dibenzo(a,h)anthracene	860 U
phenanthrene	860 U	benzo(g,h,i)perylene	860 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 2  
% Moisture: 24

SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Results in  $\mu\text{g}/\text{kg}$  (ppb) in dry weight

Client Sample ID: SB-10  
Lab Sample ID: JJ8003

	<u>Conc. Spike Added</u>	<u>Sample Conc.</u>	<u>MS Conc.</u>	<u>MS % Rec.</u>
phenol	9,140	90 U	8,240	90
2-chlorophenol	9,140	90 U	8,350	91
1,4-dichlorobenzene	4,570	90 U	3,770	82
n-nitroso-di-n-propylamine	4,570	90 U	4,190	92
1,2,4-trichlorobenzene	4,570	90 U	3,990	87
4-chloro-3-methylphenol	9,140	90 U	7,890	86
acenaphthene	4,570	90 U	4,020	88
4-nitrophenol	9,140	440 U	9,050	99
2,4-dinitrotoluene	4,570	90 U	3,740	82
pentachlorophenol	9,140	440 U	8,910	97
pyrene	4,570	90 U	4,030	88

	<u>Conc. Spike Added</u>	<u>MSD Conc.</u>	<u>MSD % Rec.</u>	<u>RPD</u>
phenol	9,140	7,960	87	3
2-chlorophenol	9,140	8,120	89	2
1,4-dichlorobenzene	4,570	3,690	81	1
n-nitroso-di-n-propylamine	4,570	4,390	96	-4
1,2,4-trichlorobenzene	4,570	3,940	86	1
4-chloro-3-methylphenol	9,140	8,520	93	-8
acenaphthene	4,570	4,010	88	0
4-nitrophenol	9,140	9,870	108	-9
2,4-dinitrotoluene	4,570	3,770	82	0
pentachlorophenol	9,140	9,100	100	-3
pyrene	4,570	4,740	104	-17

RPD = Relative Percent Difference

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	SEMI-VOLATILE					
	Nitro-Benzene-D5 (23-120%)*	2-Fluoro-Biphenyl (30-116%)*	Terphenyl-D14 (18-137%)*	Phenol-D5 (24-113%)*	2-Fluoro-Phenol (26-121%)*	2,4,6 Tribromo-Phenol (18-122%)*
SB-07	96	82	100	79	83	102
SB-09	94	86	114	74	87	99
SB-10	88	79	103	78	83	88
SB-11	75	66	75	59	64	82
SB-12	82	70	94	69	72	95
SB-19	77	73	80	57	67	9
SB-10 MS	90	81	88	85	90	89
SB-10 MSD	89	78	100	82	86	93
Method Blank	69	64	82	61	62	83

\*Values in parenthesis represent USEPA contract required QC limits.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

NITROEXPLOSIVES ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	<u>Rinsate</u> <u>JJ8013</u>	<u>Method Blank</u> <u>BL0141</u>
1,3,5-Trinitrobenzene	0.050 U	0.050 U
1,3-Dinitrobenzene	0.050 U	0.050 U
Nitrobenzene	0.048 U	0.048 U
2,4,6-Trinitrotoluene	0.074 U	0.074 U
2,6-Dinitrotoluene	0.053 U	0.053 U
2,4-Dinitrotoluene	0.11 U	0.11 U
Nitrotoluene	0.048 U	0.048 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

Date Analyzed: 10/27/89

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

NITROEXPLOSIVES ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID:	SB-07	SB-09	SB-10
Lab Sample ID:	<u>JJ8001</u>	<u>JJ8002</u>	<u>JJ8003</u>
1,3,5-Trinitrobenzene	0.41	0.050 U	0.050 U
1,3-Dinitrobenzene	0.050 U	0.050 U	0.050 U
Nitrobenzene	0.048 U	0.048 U	0.048 U
2,4,6-Trinitrotoluene	0.074 U	0.074 U	0.074 U
2,6-Dinitrotoluene	0.053 U	0.053 U	0.053 U
2,4-Dinitrotoluene	0.23	0.11 U	0.11 U
Nitrotoluene	0.048 U	0.048 U	0.048 U
Date Extracted:	10/30/89	10/30/89	10/30/89
Date Analyzed:	11/02/89	11/07/89	11/06/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

NITROEXPLOSIVES ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID:	SB-11	SB-12	SB-19
Lab Sample ID:	<u>JJ8006</u>	<u>JJ8007</u>	<u>JJ8008</u>
1,3,5-Trinitrobenzene	0.050 U	3.4	0.050 U
1,3-Dinitrobenzene	0.050 U	0.59	0.050 U
Nitrobenzene	0.048 U	0.24 U*	0.048 U
2,4,6-Trinitrotoluene	0.074 U	0.68	0.074 U
2,6-Dinitrotoluene	0.053 U	0.27 U*	0.053 U
2,4-Dinitrotoluene	0.11 U	0.91	0.11 U
Nitrotoluene	0.048 U	0.24 U*	0.048 U
Date Extracted:	10/30/89	10/30/89	10/30/89
Date Analyzed:	11/06/89	11/06/89	11/06/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

---

NITROEXPLOSIVES ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	Method Blank <u>BL0134</u>
1,3,5-Trinitrobenzene	0.050 U
1,3-Dinitrobenzene	0.050 U
Nitrobenzene	0.048 U
2,4,6-Trinitrotoluene	0.074 U
2,6-Dinitrotoluene	0.053 U
2,4-Dinitrotoluene	0.11 U
Nitrotoluene	0.048 U
Date Extracted:	10/30/89
Date Analyzed:	11/01/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

METALS ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	Rinsate <u>JJ8012</u>	Method Blank <u>PBWC0871/C0866</u>
arsenic	0.003 U*	0.002 U
barium	0.004	0.002 U
cadmium	0.005 U	0.005 U
chromium	0.01 U	0.01 U
iron	0.44	0.01 U
lead	0.03 U	0.03 U
manganese	0.010	0.002 U
selenium	0.002 U	0.002 U
silver	0.005 U	0.005 U
sodium	0.6	0.2 U
mercury	0.001 U	NR

U - Compound was analyzed for but not detected. The number is the detection limit for sample.

\* - Detection limit higher than normal due to sample matrix interferences.

NR - Not required.

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID:	SB-07	SB-09	SB-10	SB-11
Lab Sample ID:	<u>JJ7995</u>	<u>JJ7996</u>	<u>JJ7997</u>	<u>JJ7998</u>
arsenic	3 U <sup>1</sup>	3 U <sup>1</sup>	3 U <sup>1</sup>	2.3
barium	77.8	66.7	63.3	48.4
cadmium	0.5 U	0.5 U	0.6	0.5 U
chromium	17	14	14	11
iron	23,200	16,300	17,800	12,800
lead	20	21	27	14
manganese	530	104	217	211
selenium	1.5 U*	1.5 U*	0.4 U*	2.5 U*
silver	0.5 U	0.5 U	0.5 U	0.5 U
sodium	1,360	205	174	539
mercury	0.1 U	0.1 U	0.1 U	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

<sup>1</sup> - ICP value reported.

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	<u>SB-12</u> <u>JJ7999</u>	<u>SB-19</u> <u>JJ8000</u>	<u>Method Blank</u> <u>PBSC4079/C0896/C0897</u>
arsenic	3 U <sup>1</sup>	3 U <sup>1</sup>	0.2
barium	52.2	45.4	0.2 U
cadmium	0.5 U	0.5 U	0.5 U
chromium	10	8	1 U
iron	18,000	9,800	4
lead	14	18	3 U
manganese	262	15.5	0.2 U
selenium	1.0 U*	1.0 U*	0.2 U
silver	0.5 U	0.5 U	0.5 U
sodium	1,660	40	20 U
mercury	0.1 U	0.1 U	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

<sup>1</sup> - ICP value reported.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

WASTEWATER ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	<u>Method Blank</u> <u>P0614/P0602</u>	<u>Rinsate</u> <u>JJ8010/JJ8011</u>	<u>Analysis</u> <u>Date</u>
Sulfate	10 U	10 U	11/10/89
Nitrate, as N	0.05 U	0.10	11/08/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

---

WASTEWATER ANALYSIS

Results in mg/kg (ppm) unless otherwise stated

Sample Matrix: Soil

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>pH</u> <u>(standard units)</u>	<u>Nitrate,</u> <u>as N</u>	<u>Sulfate</u>
Method Blank	P0617/P0619	*	2 U	400 U
SB-07	JJ7995	8.37	2 U	2,000 U
SB-09	JJ7996	4.52	12	2,000 U
SB-10	JJ7997	6.25	2 U	2,000 U
SB-11	JJ7998	8.15	5	2,000 U
SB-12	JJ7999	8.02	7	2,000
SB-19	JJ8000	5.50	2 U	2,000 U
Analysis Date:		11/10/89	11/13/89	11/14/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - A method blank is not applicable to pH analysis.

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB02  
Lab Sample ID: JJ7780

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,800 U	anthracene	380 U
acenaphthene	380 U	di-n-butylphthalate	380 U
2,4-dinitrophenol	1,800 U	fluoranthene	380 U
4-nitrophenol	1,800 U	pyrene	380 U
dibenzofuran	380 U	butylbenzylphthalate	380 U
2,4-dinitrotoluene	380 U	3,3'-dichlorobenzidine	760 U
diethylphthalate	380 U	benzo(a)anthracene	380 U
1,2-dichlorophenyl-phenylether	380 U	chrysene	380 U
fluorene	380 U	bis(2-ethylhexyl)phthalate	370 BJ
4-nitroaniline	1,800 U	di-n-octylphthalate	380 U
4,6-dinitro-2-methylphenol	1,800 U	benzo(b)fluoranthene	380 U
n-nitrosodiphenylamine <sup>1</sup>	380 U	benzo(k)fluoranthene	380 U
4-bromophenyl-phenylether	380 U	benzo(a)pyrene	380 U
hexachlorobenzene	380 U	indeno(1,2,3-cd)pyrene	380 U
pentachlorophenol	1,800 U	dibenzo(a,h)anthracene	380 U
phenanthrene	380 U	benzo(g,h,i)perylene	380 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1  
% Moisture: 14

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB03  
Lab Sample ID: JJ7781

<u>Compound</u>		<u>Compound</u>	
phenol	370 U	bis(2-chloroethoxy)methane	370 U
bis(2-chloroethyl)ether	370 U	2,4-dichlorophenol	370 U
2-chlorophenol	370 U	1,2,4-trichlorobenzene	370 U
1,3-dichlorobenzene	370 U	naphthalene	370 U
1,4-dichlorobenzene	370 U	4-chloroaniline	370 U
benzyl alcohol	370 U	hexachlorobutadiene	370 U
1,2-dichlorobenzene	370 U	4-chloro-3-methylphenol	370 U
o-methylphenol	370 U	2-methylnaphthalene	370 U
bis(2-chloroisopropyl)ether	370 U	hexachlorocyclopentadiene	370 U
4-methylphenol	370 U	2,4,6-trichlorophenol	370 U
n-nitroso-di-n-propylamine	370 U	2,4,5-trichlorophenol	1,800 U
hexachloroethane	370 U	2-chloronaphthalene	370 U
nitrobenzene	370 U	2-nitroaniline	1,800 U
isophorone	370 U	dimethyl phthalate	370 U
2-nitrophenol	370 U	acenaphthylene	370 U
2,4-dimethylphenol	370 U	2,6-dinitrotoluene	370 U
benzoic acid	1,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1  
% Moisture: 11

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB03  
Lab Sample ID: JJ7781

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,800 U	anthracene	370 U
acenaphthene	370 U	di-n-butylphthalate	370 U
2,4-dinitrophenol	1,800 U	fluoranthene	370 U
4-nitrophenol	1,800 U	pyrene	370 U
dibenzofuran	370 U	butylbenzylphthalate	370 U
2,4-dinitrotoluene	370 U	3,3'-dichlorobenzidine	740 U
diethylphthalate	370 U	benzo(a)anthracene	370 U
4-chlorophenyl-phenylether	370 U	chrysene	370 U
fluorene	370 U	bis(2-ethylhexyl)phthalate	380 B
4-nitroaniline	1,800 U	di-n-octylphthalate	370 U
4,6-dinitro-2-methylphenol	1,800 U	benzo(b)fluoranthene	370 U
n-nitrosodiphenylamine <sup>1</sup>	370 U	benzo(k)fluoranthene	370 U
4-bromophenyl-phenylether	370 U	benzo(a)pyrene	370 U
hexachlorobenzene	370 U	indeno(1,2,3-cd)pyrene	370 U
pentachlorophenol	1,800 U	dibenzo(a,h)anthracene	370 U
phenanthrene	370 U	benzo(g,h,i)perylene	370 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1  
% Moisture: 11

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB04  
Lab Sample ID: JJ7782

<u>Compound</u>		<u>Compound</u>	
phenol	370 U	bis(2-chloroethoxy)methane	370 U
bis(2-chloroethyl)ether	370 U	2,4-dichlorophenol	370 U
2-chlorophenol	370 U	1,2,4-trichlorobenzene	370 U
1,3-dichlorobenzene	370 U	naphthalene	370 U
1,4-dichlorobenzene	370 U	4-chloroaniline	370 U
benzyl alcohol	370 U	hexachlorobutadiene	370 U
1,2-dichlorobenzene	370 U	4-chloro-3-methylphenol	370 U
2-methylphenol	370 U	2-methylnaphthalene	370 U
bis(2-chloroisopropyl)ether	370 U	hexachlorocyclopentadiene	370 U
4-methylphenol	370 U	2,4,6-trichlorophenol	370 U
n-nitroso-di-n-propylamine	370 U	2,4,5-trichlorophenol	1,800 U
hexachloroethane	370 U	2-chloronaphthalene	370 U
nitrobenzene	370 U	2-nitroaniline	1,800 U
isophorone	370 U	dimethyl phthalate	370 U
2-nitrophenol	370 U	acenaphthylene	370 U
2,4-dimethylphenol	370 U	2,6-dinitrotoluene	370 U
benzoic acid	1,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1  
% Moisture: 12

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB04  
Lab Sample ID: JJ7782

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,800 U	anthracene	370 U
acenaphthene	370 U	di-n-butylphthalate	370 U
2,4-dinitrophenol	1,800 U	fluoranthene	370 U
4-nitrophenol	1,800 U	pyrene	370 U
dibenzofuran	370 U	butylbenzylphthalate	370 U
2,4-dinitrotoluene	370 U	3,3'-dichlorobenzidine	740 U
liethylphthalate	370 U	benzo(a)anthracene	370 U
4-chlorophenyl-phenylether	370 U	chrysene	370 U
fluorene	370 U	bis(2-ethylhexyl)phthalate	1,200 B
4-nitroaniline	1,800 U	di-n-octylphthalate	370 U
4,6-dinitro-2-methylphenol	1,800 U	benzo(b)fluoranthene	370 U
n-nitrosodiphenylamine <sup>1</sup>	370 U	benzo(k)fluoranthene	370 U
4-bromophenyl-phenylether	370 U	benzo(a)pyrene	370 U
hexachlorobenzene	370 U	indeno(1,2,3-cd)pyrene	370 U
pentachlorophenol	1,800 U	dibenzo(a,h)anthracene	370 U
phenanthrene	370 U	benzo(g,h,i)perylene	370 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1  
% Moisture: 12

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: S804 Split  
Lab Sample ID: JJ7783

<u>Compound</u>		<u>Compound</u>	
phenol	380 U	bis(2-chloroethoxy)methane	380 U
bis(2-chloroethyl)ether	380 U	2,4-dichlorophenol	380 U
2-chlorophenol	380 U	1,2,4-trichlorobenzene	380 U
1,3-dichlorobenzene	380 U	naphthalene	380 U
1,4-dichlorobenzene	380 U	4-chloroaniline	380 U
benzyl alcohol	380 U	hexachlorobutadiene	380 U
1,2-dichlorobenzene	380 U	4-chloro-3-methylphenol	380 U
o-methylphenol	380 U	2-methylnaphthalene	380 U
bis(2-chloroisopropyl)ether	380 U	hexachlorocyclopentadiene	380 U
4-methylphenol	380 U	2,4,6-trichlorophenol	380 U
n-nitroso-di-n-propylamine	380 U	2,4,5-trichlorophenol	1,800 U
hexachloroethane	380 U	2-chloronaphthalene	380 U
nitrobenzene	380 U	2-nitroaniline	1,800 U
isophorone	380 U	dimethyl phthalate	380 U
2-nitrophenol	380 U	acenaphthylene	380 U
2,4-dimethylphenol	380 U	2,6-dinitrotoluene	380 U
benzoic acid	1,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1  
% Moisture: 13

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB04 Split  
Lab Sample ID: JJ7783

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,800 U	anthracene	380 U
acenaphthene	380 U	di-n-butylphthalate	380 U
2,4-dinitrophenol	1,800 U	fluoranthene	380 U
4-nitrophenol	1,800 U	pyrene	380 U
dibenzofuran	380 U	butylbenzylphthalate	380 U
2,4-dinitrotoluene	380 U	3,3'-dichlorobenzidine	750 U
diethylphthalate	380 U	benzo(a)anthracene	380 U
4-chlorophenyl-phenylether	380 U	chrysene	380 U
fluorene	380 U	bis(2-ethylhexyl)phthalate	350 BJ
4-nitroaniline	1,800 U	di-n-octylphthalate	380 U
4,6-dinitro-2-methylphenol	1,800 U	benzo(b)fluoranthene	380 U
n-nitrosodiphenylamine <sup>1</sup>	380 U	benzo(k)fluoranthene	380 U
4-bromophenyl-phenylether	380 U	benzo(a)pyrene	380 U
hexachlorobenzene	380 U	indeno(1,2,3-cd)pyrene	380 U
pentachlorophenol	1,800 U	dibenzo(a,h)anthracene	380 U
phenanthrene	380 U	benzo(g,h,i)perylene	380 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89

Date Analyzed: 10/26/89

Dilution Factor: 1

% Moisture: 13

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB05  
Lab Sample ID: JJ7784

<u>Compound</u>		<u>Compound</u>	
phenol	370 U	bis(2-chloroethoxy)methane	370 U
bis(2-chloroethyl)ether	370 U	2,4-dichlorophenol	370 U
2-chlorophenol	370 U	1,2,4-trichlorobenzene	370 U
1,3-dichlorobenzene	370 U	naphthalene	370 U
1,4-dichlorobenzene	370 U	4-chloroaniline	370 U
benzyl alcohol	370 U	hexachlorobutadiene	370 U
1,2-dichlorobenzene	370 U	4-chloro-3-methylphenol	370 U
2-methylphenol	370 U	2-methylnaphthalene	370 U
bis(2-chloroisopropyl)ether	370 U	hexachlorocyclopentadiene	370 U
4-methylphenol	370 U	2,4,6-trichlorophenol	370 U
n-nitroso-di-n-propylamine	370 U	2,4,5-trichlorophenol	1,800 U
hexachloroethane	370 U	2-chloronaphthalene	370 U
nitrobenzene	370 U	2-nitroaniline	1,800 U
isophorone	370 U	dimethyl phthalate	370 U
2-nitrophenol	370 U	acenaphthylene	370 U
2,4-dimethylphenol	370 U	2,6-dinitrotoluene	370 U
benzoic acid	1,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1  
% Moisture: 12

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in µg/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB05  
Lab Sample ID: JJ7784

<u>Compound</u>		<u>Compound</u>	
-nitroaniline	1,800 U	anthracene	370 U
acenaphthene	370 U	di-n-butylphthalate	370 U
2,4-dinitrophenol	1,800 U	fluoranthene	370 U
4-nitrophenol	1,800 U	pyrene	370 U
dibenzofuran	370 U	butylbenzylphthalate	370 U
2,4-dinitrotoluene	370 U	3,3'-dichlorobenzidine	740 U
diethylphthalate	370 U	benzo(a)anthracene	370 U
4-chlorophenyl-phenylether	370 U	chrysene	370 U
fluorene	370 U	bis(2-ethylhexyl)phthalate	420 B
4-nitroaniline	1,800 U	di-n-octylphthalate	370 U
4,6-dinitro-2-methylphenol	1,800 U	benzo(b)fluoranthene	370 U
n-nitrosodiphenylamine <sup>1</sup>	370 U	benzo(k)fluoranthene	370 U
4-bromophenyl-phenylether	370 U	benzo(a)pyrene	370 U
hexachlorobenzene	370 U	indeno(1,2,3-cd)pyrene	370 U
pentachlorophenol	1,800 U	dibenzo(a,h)anthracene	370 U
phenanthrene	370 U	benzo(g,h,i)perylene	370 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1  
% Moisture: 12

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB06  
Lab Sample ID: JJ7785

<u>Compound</u>		<u>Compound</u>	
phenol	380 U	bis(2-chloroethoxy)methane	380 U
bis(2-chloroethyl)ether	380 U	2,4-dichlorophenol	380 U
2-chlorophenol	380 U	1,2,4-trichlorobenzene	380 U
1,3-dichlorobenzene	380 U	naphthalene	380 U
1,4-dichlorobenzene	380 U	4-chloroaniline	380 U
benzyl alcohol	380 U	hexachlorobutadiene	380 U
1,2-dichlorobenzene	380 U	4-chloro-3-methylphenol	380 U
2-methylphenol	380 U	2-methylnaphthalene	380 U
bis(2-chloroisopropyl)ether	380 U	hexachlorocyclopentadiene	380 U
4-methylphenol	380 U	2,4,6-trichlorophenol	380 U
n-nitroso-di-n-propylamine	380 U	2,4,5-trichlorophenol	1,800 U
hexachloroethane	380 U	2-chloronaphthalene	380 U
nitrobenzene	380 U	2-nitroaniline	1,800 U
isophorone	380 U	dimethyl phthalate	380 U
2-nitrophenol	380 U	acenaphthylene	380 U
2,4-dimethylphenol	380 U	2,6-dinitrotoluene	380 U
benzoic acid	1,800 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/23/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1  
% Moisture: 13

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB06  
Lab Sample ID: JJ7785

<u>Compound</u>		<u>Compound</u>	
-nitroaniline	1,800 U	anthracene	380 U
acenaphthene	380 U	di-n-butylphthalate	380 U
2,4-dinitrophenol	1,800 U	fluoranthene	380 U
4-nitrophenol	1,800 U	pyrene	380 U
dibenzofuran	380 U	butylbenzylphthalate	380 U
2,4-dinitrotoluene	380 U	3,3'-dichlorobenzidine	760 U
diethylphthalate	380 U	benzo(a)anthracene	380 U
4-chlorophenyl-phenylether	380 U	chrysene	380 U
fluorene	380 U	bis(2-ethylhexyl)phthalate	470 B
4-nitroaniline	1,800 U	di-n-octylphthalate	380 U
4,6-dinitro-2-methylphenol	1,800 U	benzo(b)fluoranthene	380 U
n-nitrosodiphenylamine <sup>1</sup>	380 U	benzo(k)fluoranthene	380 U
4-bromophenyl-phenylether	380 U	benzo(a)pyrene	380 U
hexachlorobenzene	380 U	indeno(1,2,3-cd)pyrene	380 U
pentachlorophenol	1,800 U	dibenzo(a,h)anthracene	380 U
phenanthrene	380 U	benzo(g,h,i)perylene	380 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/23/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1  
% Moisture: 13

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	SEMI-VOLATILE					
	Nitro-Benzene-D5 (23-120%)*	2-Fluoro-Biphenyl (30-116%)*	Terphenyl-D14 (18-137%)*	Phenol-D5 (24-113%)*	2-Fluoro-Phenol (26-121%)*	2,4,6-Tribromo-Phenol (18-122%)*
SB01	91	80	87	77	72	81
SB02	75	70	71	67	61	72
SB03	80	69	80	69	65	69
SB04	73	71	73	70	64	75
SB04 Split	73	72	69	67	60	74
SB05	83	78	78	76	69	77
SB06	79	75	74	75	67	77
Method Blank	78	72	84	68	63	68

\*Values in parenthesis represent USEPA contract required QC limits.

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

NITROEXPLOSIVES

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	<u>SB02</u> <u>JJ7780</u>	<u>SB03</u> <u>JJ7781</u>	<u>SB04</u> <u>JJ7782</u>	<u>SB04 Split</u> <u>JJ7783</u>	<u>SB05</u> <u>JJ7784</u>
1,3,5-Trinitrobenzene	0.050 U	0.093	0.050 U	0.050 U	0.050 U
1,3-Dinitrobenzene	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Nitrobenzene	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U
2,4,6-Trinitrotoluene	0.074 U	0.074 U	0.074 U	0.074 U	0.074 U
2,6-Dinitrotoluene	0.053 U	0.053 U	0.053 U	0.053 U	0.053 U
3,4-Dinitrotoluene	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Nitrotoluene	0.048 U	0.048 U	0.048 U	0.048 U	0.048 U
Extraction Date:	10/30/89	10/30/89	10/30/89	10/30/89	10/30/89
Analysis Date:	10/31/89	10/31/89	10/31/89	10/31/89	10/31/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

NITROEXPLOSIVES

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	<u>SB06</u> <u>JJ7785</u>	<u>MW02B-C/6-8</u> <u>JJ7786</u>	<u>SB01</u> <u>JJ7777</u>	<u>Method Blank</u> <u>BL0134</u>
1,3,5-Trinitrobenzene	0.050 U	0.050 U	0.050 U	0.050 U
1,3-Dinitrobenzene	0.050 U	0.050 U	0.050 U	0.050 U
Nitrobenzene	0.048 U	0.068 U*	0.048 U	0.048 U
2,4,6-Trinitrotoluene	0.074 U	0.074 U	0.074 U	0.074 U
2,6-Dinitrotoluene	0.053 U	0.053 U	0.053 U	0.053 U
2,4-Dinitrotoluene	0.11 U	0.11 U	0.11 U	0.11 U
Nitrotoluene	0.048 U	0.048 U	0.048 U	0.048 U
Extraction Date:	10/30/89	10/30/89	10/30/89	10/30/89
Analysis Date:	10/31/89	10/31/89	10/31/89	10/30/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	Method Blank <u>PBSC0836/C0832/C4076</u>
arsenic	0.2 U
barium	0.2 U
cadmium	0.5 U
chromium	1 U
iron	1 U
lead	3 U
manganese	0.2 U
selenium	0.2 U
silver	0.5 U
sodium	20 U
mercury	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

Date Digested: 10/25/89  
Date Analyzed: 10/28/89 (ICP)  
10/29 and 10/31/89 (GFAA)  
10/26/89 (CVAA)

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	<u>SB01</u> <u>JJ7787</u>	<u>SB02</u> <u>JJ7788</u>	<u>SB03</u> <u>JJ7789</u>	<u>SB04</u> <u>JJ7790</u>
arsenic	7.0	2.8	3.7 U*	1.4 U*
barium	51.0	51.3	31.6	41.0
cadmium	0.5 U	0.5 U	0.5 U	0.5 U
chromium	7	11	10	7
iron	10,200	15,400	15,600	11,000
lead	10	10	50	16
manganese	300	180	71.3	14.5
selenium	0.3 U*	0.4 U*	0.4 U*	0.6 U*
silver	0.5 U	0.5 U	0.5 U	0.5
sodium	65	110	76	45
mercury	0.1 U	0.1 U	0.1 U	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

Date Digested: 10/25/89  
Date Analyzed: 10/28/89 (ICP)  
10/29 and 10/31/89 (GFAA)  
10/26/89 (CVAA)

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4439

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	<u>SB04 Split JJ7791</u>	<u>SB05 JJ7792</u>	<u>SB06 JJ7793</u>	<u>MW02B-C/6-8 JJ7794</u>
arsenic	1.3	2.0	5.5 U*	2.9 U*
barium	29.8	21.1	58.9	214
cadmium	0.5 U	0.5 U	0.5 U	0.5 U
chromium	4	4	6	20
iron	4,090	4,940	6,420	24,000
lead	10	9	16	20
manganese	9.8	35.0	129	2,600
selenium	0.8 U*	0.8 U*	1.0 U*	1.2 U*
silver	0.5 U	0.5 U	0.5 U	0.5 U
sodium	34	32	80	578
mercury	0.1 U	0.1 U	0.1 U	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

Date Digested: 10/25/89  
Date Analyzed: 10/28/89 (ICP)  
10/29 and 10/31/89 (GFAA)  
10/26/89 (CVAA)

IT Corporation  
November 30, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44394

WASTEWATER ANALYSIS

Results in mg/kg (ppm) unless otherwise stated

Sample Matrix: Soil

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Nitrate, as N</u>	<u>Sulfate</u>	<u>pH (standard units)</u>
Method Blank	P0617/P0619	2 U	400 U	*
SB01	JJ7787	2	2,000 U	6.03
SB02	JJ7788	2 U	2,000 U	5.80
SB03	JJ7789	2 U	2,000 U	7.75
SB04	JJ7790	2 U	2,000 U	5.06
SB04 Split	JJ7791	2 U	2,000 U	5.00
SB05	JJ7792	2	2,000 U	5.10
SB06	JJ7793	2 U	2,000 U	5.32
MW02B-C/6-8	JJ7794	2 U	2,000 U	7.86
Date Analyzed		11/13/89	11/14/89	11/09/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - A method blank is not applicable for pH analysis.



**CERTIFICATE OF ANALYSIS**

---

IT Corporation  
312 Directors Drive  
Knoxville, TN 37923  
ATTN: Don Burton

November 27, 1989

---

Job Number: ITEK 44410

P.O. Number: 409658

This is the Certificate of Analysis for the following samples:

Client Project ID: COE-Plum Brook  
Date Received by Lab: 10/23/89  
Number of Samples: Seventeen (17)  
Sample Type: Water-five (5), Soil-nine (9), Water duplicates-two (2)  
Trip blank-one (1)

---

**I. Introduction**

On 10/23/89, nine (9) soil samples, five (5) water samples, two (2) water duplicates and one (1) trip blank arrived at the ITAS-Knoxville, Tennessee laboratory from the COE-Plum Brook Ordnance Works site in Sandusky, Ohio. The list of analytical tests performed, as well as date of receipt and analysis, can be found in the attached report.

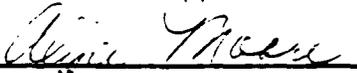
**II. Analytical Results/Methodology**

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information and the analytical results. Please note that all but CLP data are blank corrected, i.e., if any compound is found in the corresponding laboratory blank, it is subtracted from the analytical result before it is reported. CLP data are not blank corrected and CLP soil results are reported on a dry weight basis.

The samples were analyzed for Target Compound List (TCL) volatile and semivolatile organic compounds by gas chromatography/mass spectroscopy (GC/MS) in accordance with the EPA CLP 2/88 Statement of Work.

The samples were analyzed for the requested nitroexplosives by high performance liquid chromatography (HPLC) based on USATHAMA methods 8G and 8H.

Reviewed and Approved:

  
Alyce Moore  
Laboratory Manager

---

American Council of Independent Laboratories  
International Association of Environmental Testing Laboratories  
American Association for Laboratory Accreditation

## II. Analytical Results/Methodology (continued)

The samples were analyzed for the requested metals by inductively coupled plasma spectroscopy (ICP), graphite furnace atomic absorption spectroscopy (GFAA) and cold vapor atomic absorption spectroscopy (CVAA) based on EPA SW-846 methods 3050, 6010, 3020, 7060, 7740 and 7471 for soils and EPA methods 200.7, 206.2, 270.2, and 245.1 for surface waters.

The samples were analyzed for sulfate and nitrate by colorimetric determination based on EPA SW-846 methods 9035 and 9200, for soils and EPA methods 375.3 and 353.3 for surface waters.

The pH of the samples was measured by an electrometric procedure based on EPA SW-846 method 9045 for soils and EPA method 150.1 for surface waters.

## III. Quality Control

Routine laboratory level I QC was performed for all parameters but CLP parameters. CLP analyses followed project specific QC tracking.

The volatiles analyses were performed on 10/30 and 11/01/89 by purge and trap with J&W DB-624 Megabore column on two Finnigan OWA GC/MS/DS units. The semivolatiles analyses were performed on 10/25, 10/26, 11/02, 11/06, and 11/08/89 by direct injection of sample extract on a J&W DB-5 capillary column on a VG TRIO-2 GC/MS/DS. The volatiles sample runs went well, except that data review indicated acetone was present in some soil samples although it had been judged not present during analysis. The reason for originally rejecting acetone was that its relatively simple spectrum closely matched that of some non-TCL compounds. Confirmation of acetone presence, and quantification, led to a difficulty with sample SB19 0-2', where the level exceeded calibration range. As holding time had expired, the sample was not rerun, and the value found was submitted as an estimate; the peak did not exceed the range of the detector. The semivolatiles runs went well. There were no other problems seen in final data review for either fraction. Associated QC samples for soil analyses were performed with ITAS project ITEK 44414, sample SB-10, with acceptable results. Associated QC samples for water analyses were analyzed with ITAS project ITEK 44421, sample MW02, with acceptable results.

The samples were analyzed for the requested nitroexplosives on 10/27/89 through 11/02/89. No problems were encountered.

### III. Quality Control (continued)

The samples were digested on 10/30/89 and 10/31/89 for ICP and GFAA. The samples for mercury analysis were prepared just prior to analysis. The CVAA analysis for mercury was performed on 10/31/89 and 11/01/89; the GFAA analyses for arsenic and selenium were performed on 10/31 through 11/06/89; the remaining metals were analyzed by ICP on 10/31/89. All run QC was acceptable. No problems were encountered.

The samples were analyzed for pH on 10/24 and 11/10/89. No problems were encountered.

The samples were analyzed for nitrate on 11/08/89 and 11/17/89. No problems were encountered.

The samples were analyzed for sulfate on 11/02/89 and 11/17/89. Elevated detection limits were reported for all soil samples except SB-15 (2'-4') due to extreme sample turbidity. The samples were centrifuged and filtered, but this did not eliminate the turbidity.

IT Corporation  
November 27, 1989

Client Project ID: COE-Plum Brook

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank  
Lab Sample ID: EB1030

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	3 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	1 J
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW01  
Lab Sample ID: JJ7931

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: SW02  
Lab Sample ID: JJ7934

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in µg/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW03  
Lab Sample ID: JJ7935

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: SW04  
Lab Sample ID: JJ7936

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	3 J	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 444'

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in µg/liter (ppb)

Sample Matrix: Water

Client Sample ID: Split  
Lab Sample ID: JJ7937

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Trip Blank  
Lab Sample ID: JJ7938

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	3 BJ	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

WATER SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	VOLATILE		
	Toluene-D8 (88-110%)*	BFB (86-115%)*	1,2 Dichloroethane-D4 (76-114%)*
Split	99	103	101
SW01	95	101	96
SW02	94	100	93
SW03	92	98	92
SW04	95	98	94
Trip Blank	95	99	91
Method Blank	99	101	94

\*Values in parenthesis represent USEPA contract required QC limits.

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: VB1101

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/01/89  
Dilution Factor: 1

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB13 0-2'  
Lab Sample ID: JJ7904

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	6 B	1,1,2-trichloroethane	6 U
acetone	170	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB14 0-2'  
Lab Sample ID: JJ7905

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	9 B	1,1,2-trichloroethane	6 U
acetone	80	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB15 2-4'  
Lab Sample ID: JJ7906

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	7 B	1,1,2-trichloroethane	6 U
acetone	12 U	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	1 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB15 4-6'  
Lab Sample ID: JJ7907

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	7 B	1,1,2-trichloroethane	6 U
acetone	12 U	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for t sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 17

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB16 0-2'  
Lab Sample ID: JJ7908

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	5 BJ	1,1,2-trichloroethane	6 U
acetone	160	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB16 4-6'  
Lab Sample ID: JJ7909

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	8 B	1,1,2-trichloroethane	6 U
acetone	54	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	3 J	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 19

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB17 0-2'  
Lab Sample ID: JJ7910

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	5 BJ	1,1,2-trichloroethane	6 U
acetone	150	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	2 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB18 0-2'  
Lab Sample ID: JJ7911

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	6 U	1,1,2-trichloroethane	6 U
acetone	12 U	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	1 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 19

IT Corporation  
November 27, 1989

Client Project ID: COE-Plum Brook

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Job Number: ITEK 44410

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB19 0-2'  
Lab Sample ID: JJ7912

<u>Compound</u>		<u>Compound</u>	
chloromethane	13 U	1,2-dichloropropane	7 U
bromomethane	13 U	cis-1,3-dichloropropene	7 U
vinyl chloride	13 U	trichloroethene	7 U
chloroethane	13 U	dibromochloromethane	7 U
methylene chloride	7 B	1,1,2-trichloroethane	7 U
acetone	3,000 E	benzene	7 U
carbon disulfide	7 U	trans-1,3-dichloropropene	7 U
1,1-dichloroethene	7 U	bromoform	7 U
1,1-dichloroethane	7 U	4-methyl-2-pentanone	13 U
1,2-dichloroethene (total)	7 U	2-hexanone	13 U
chloroform	7 U	tetrachloroethene	7 U
1,2-dichloroethane	7 U	1,1,2,2-tetrachloroethane	7 U
2-butanone	13 U	toluene	9
1,1,1-trichloroethane	7 U	chlorobenzene	7 U
carbon tetrachloride	7 U	ethylbenzene	7 U
vinyl acetate	13 U	styrene	7 U
bromodichloromethane	7 U	total xylenes	7 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

E - Compound exceeded CLP calibration range.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 25

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	VOLATILE		
	Toluene-D8 (81-117%)*	BFB (74-121%)*	1,2 Dichloroethane-D4 (70-121%)*
SB13 0-2'	99	101	92
SB14 0-2'	96	105	90
SB15 2-4'	107	105	96
SB15 4-6'	102	102	89
SB16 0-2'	94	102	83
SB16 4-6'	100	102	90
SB17 0-2'	96	106	87
SB18 0-2'	99	110	89
SB19 0-2'	106	105	93
Method Blank	98	98	89

\*Values in parenthesis represent USEPA contract required QC limits.

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank  
Lab Sample ID: BL4982

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank  
Lab Sample ID: BL4982

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	2 J
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 10/25/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW01  
Lab Sample ID: JJ7959

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW01  
Lab Sample ID: JJ7959

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW02  
Lab Sample ID: JJ7962

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW02  
Lab Sample ID: JJ7962

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW03  
Lab Sample ID: JJ7963

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: SW03  
Lab Sample ID: JJ7963

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: SW04  
Lab Sample ID: JJ7964

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: SW04  
Lab Sample ID: JJ7964

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Split  
Lab Sample ID: JJ7965

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Split  
Lab Sample ID: JJ7965

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	19
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	10 U	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 10/26/89  
Dilution Factor: 1

WATER SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	SEMI-VOLATILE					
	Nitro-Benzene-D5 (35-114%)*	2-Fluoro-Biphenyl (43-116%)*	Terphenyl-D14 (33-141%)*	Phenol-D5 (10-94%)*	2-Fluoro-Phenol (21-100%)*	2,4,6-Tribromo-Phenol (10-123%)*
Split	64	66	82	38	48	80
SW01	94	85	78	43	58	77
SW02	92	84	92	43	57	79
SW03	97	90	94	41	55	76
SW04	75	73	86	36	47	80
Method Blank	87	76	90	40	52	

\*Values in parenthesis represent USEPA contract required QC limits.

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: BL4983

<u>Compound</u>		<u>Compound</u>	
phenol	330 U	bis(2-chloroethoxy)methane	330 U
bis(2-chloroethyl)ether	330 U	2,4-dichlorophenol	330 U
2-chlorophenol	330 U	1,2,4-trichlorobenzene	330 U
1,3-dichlorobenzene	330 U	naphthalene	330 U
1,4-dichlorobenzene	330 U	4-chloroaniline	330 U
benzyl alcohol	330 U	hexachlorobutadiene	330 U
1,2-dichlorobenzene	330 U	4-chloro-3-methylphenol	330 U
2-methylphenol	330 U	2-methylnaphthalene	330 U
bis(2-chloroisopropyl)ether	330 U	hexachlorocyclopentadiene	330 U
4-methylphenol	330 U	2,4,6-trichlorophenol	330 U
n-nitroso-di-n-propylamine	330 U	2,4,5-trichlorophenol	1,600 U
hexachloroethane	330 U	2-chloronaphthalene	330 U
nitrobenzene	330 U	2-nitroaniline	1,600 U
isophorone	330 U	dimethyl phthalate	330 U
2-nitrophenol	330 U	acenaphthylene	330 U
2,4-dimethylphenol	330 U	2,6-dinitrotoluene	330 U
benzoic acid	1,600 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank  
Lab Sample ID: BL4983

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,600 U	anthracene	330 U
acenaphthene	330 U	di-n-butylphthalate	330 U
2,4-dinitrophenol	1,600 U	fluoranthene	330 U
4-nitrophenol	1,600 U	pyrene	330 U
dibenzofuran	330 U	butylbenzylphthalate	330 U
2,4-dinitrotoluene	330 U	3,3'-dichlorobenzidine	660 U
diethylphthalate	330 U	benzo(a)anthracene	330 U
4-chlorophenyl-phenylether	330 U	chrysene	330 U
fluorene	330 U	bis(2-ethylhexyl)phthalate	79
4-nitroaniline	1,600 U	di-n-octylphthalate	330 U
4,6-dinitro-2-methylphenol	1,600 U	benzo(b)fluoranthene	330 U
n-nitrosodiphenylamine <sup>1</sup>	330 U	benzo(k)fluoranthene	330 U
4-bromophenyl-phenylether	330 U	benzo(a)pyrene	330 U
hexachlorobenzene	330 U	indeno(1,2,3-cd)pyrene	330 U
pentachlorophenol	1,600 U	dibenzo(a,h)anthracene	330 U
phenanthrene	330 U	benzo(g,h,i)perylene	330 U

U - Compound was analyzed for but not detected. The number is the detection limit for t sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 27, 1989

Client Project ID: COE-Plum Brook

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB13 0-2'  
Lab Sample ID: JJ7922

<u>Compound</u>		<u>Compound</u>	
phenol	390 U	bis(2-chloroethoxy)methane	390 U
bis(2-chloroethyl)ether	390 U	2,4-dichlorophenol	390 U
2-chlorophenol	390 U	1,2,4-trichlorobenzene	390 U
1,3-dichlorobenzene	390 U	naphthalene	390 U
1,4-dichlorobenzene	390 U	4-chloroaniline	390 U
benzyl alcohol	390 U	hexachlorobutadiene	390 U
1,2-dichlorobenzene	390 U	4-chloro-3-methylphenol	390 U
2-methylphenol	390 U	2-methylnaphthalene	390 U
bis(2-chloroisopropyl)ether	390 U	hexachlorocyclopentadiene	390 U
4-methylphenol	390 U	2,4,6-trichlorophenol	390 U
n-nitroso-di-n-propylamine	390 U	2,4,5-trichlorophenol	1,900 U
hexachloroethane	390 U	2-chloronaphthalene	390 U
nitrobenzene	390 U	2-nitroaniline	1,900 U
isophorone	390 U	dimethyl phthalate	390 U
2-nitrophenol	390 U	acenaphthylene	390 U
2,4-dimethylphenol	390 U	2,6-dinitrotoluene	180 J
benzoic acid	1,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/02/89  
Dilution Factor: 1  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB13 0-2'  
Lab Sample ID: JJ7922

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,900 U	anthracene	390 U
acenaphthene	390 U	di-n-butylphthalate	390 U
2,4-dinitrophenol	1,900 U	fluoranthene	390 U
4-nitrophenol	1,900 U	pyrene	390 U
dibenzofuran	390 U	butylbenzylphthalate	48 J
2,4-dinitrotoluene	1,600	3,3'-dichlorobenzidine	790 U
diethylphthalate	390 U	benzo(a)anthracene	390 U
4-chlorophenyl-phenylether	390 U	chrysene	390 U
fluorene	390 U	bis(2-ethylhexyl)phthalate	230 U
4-nitroaniline	1,900 U	di-n-octylphthalate	390 U
4,6-dinitro-2-methylphenol	1,900 U	benzo(b)fluoranthene	390 U
n-nitrosodiphenylamine <sup>1</sup>	390 U	benzo(k)fluoranthene	390 U
4-bromophenyl-phenylether	390 U	benzo(a)pyrene	390 U
hexachlorobenzene	390 U	indeno(1,2,3-cd)pyrene	390 U
pentachlorophenol	1,900 U	dibenzo(a,h)anthracene	390 U
phenanthrene	390 U	benzo(g,h,i)perylene	390 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/02/89  
Dilution Factor: 1  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB14 0-2'

Lab Sample ID: JJ7923

<u>Compound</u>		<u>Compound</u>	
phenol	1,200 U	bis(2-chloroethoxy)methane	1,200 U
bis(2-chloroethyl)ether	1,200 U	2,4-dichlorophenol	1,200 U
2-chlorophenol	1,200 U	1,2,4-trichlorobenzene	1,200 U
1,3-dichlorobenzene	1,200 U	naphthalene	1,200 U
1,4-dichlorobenzene	1,200 U	4-chloroaniline	1,200 U
benzyl alcohol	1,200 U	hexachlorobutadiene	1,200 U
1,2-dichlorobenzene	1,200 U	4-chloro-3-methylphenol	1,200 U
2-methylphenol	1,200 U	2-methylnaphthalene	1,200 U
bis(2-chloroisopropyl)ether	1,200 U	hexachlorocyclopentadiene	1,200 U
4-methylphenol	1,200 U	2,4,6-trichlorophenol	1,200 U
n-nitroso-di-n-propylamine	1,200 U	2,4,5-trichlorophenol	5,700 U
hexachloroethane	1,200 U	2-chloronaphthalene	1,200 U
nitrobenzene	1,200 U	2-nitroaniline	5,700 U
isophorone	1,200 U	dimethyl phthalate	1,200 U
2-nitrophenol	1,200 U	acenaphthylene	1,200 U
2,4-dimethylphenol	1,200 U	2,6-dinitrotoluene	1,700 U
benzoic acid	5,700 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89

Date Analyzed: 11/06/89

Dilution Factor: 3

% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in µg/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB14 0-2'

Lab Sample ID: JJ7923

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	5,700 U	anthracene	1,200 U
acenaphthene	1,200 U	di-n-butylphthalate	1,200 U
2,4-dinitrophenol	270 J	fluoranthene	1,200 U
4-nitrophenol	310 J	pyrene	1,200 U
dibenzofuran	1,200 U	butylbenzylphthalate	1,200 U
2,4-dinitrotoluene	11,000	3,3'-dichlorobenzidine	2,300 U
diethylphthalate	1,200 U	benzo(a)anthracene	1,200 U
4-chlorophenyl-phenylether	1,200 U	chrysene	1,200 U
fluorene	1,200 U	bis(2-ethylhexyl)phthalate	180
4-nitroaniline	5,700 U	di-n-octylphthalate	1,200 U
4,6-dinitro-2-methylphenol	390 J	benzo(b)fluoranthene	1,200 U
n-nitrosodiphenylamine <sup>1</sup>	1,200 U	benzo(k)fluoranthene	1,200 U
4-bromophenyl-phenylether	1,200 U	benzo(a)pyrene	1,200 U
hexachlorobenzene	1,200 U	indeno(1,2,3-cd)pyrene	1,200 U
pentachlorophenol	5,700 U	dibenzo(a,h)anthracene	1,200 U
phenanthrene	1,200 U	benzo(g,h,i)perylene	1,200 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 3  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB15 2-4'

Lab Sample ID: JJ7924

<u>Compound</u>		<u>Compound</u>	
phenol	390 U	bis(2-chloroethoxy)methane	390 U
bis(2-chloroethyl)ether	390 U	2,4-dichlorophenol	390 U
2-chlorophenol	390 U	1,2,4-trichlorobenzene	390 U
1,3-dichlorobenzene	390 U	naphthalene	390 U
1,4-dichlorobenzene	390 U	4-chloroaniline	390 U
benzyl alcohol	390 U	hexachlorobutadiene	390 U
1,2-dichlorobenzene	390 U	4-chloro-3-methylphenol	390 U
2-methylphenol	390 U	2-methylnaphthalene	390 U
bis(2-chloroisopropyl)ether	390 U	hexachlorocyclopentadiene	390 U
4-methylphenol	390 U	2,4,6-trichlorophenol	390 U
n-nitroso-di-n-propylamine	390 U	2,4,5-trichlorophenol	1,900 U
hexachloroethane	390 U	2-chloronaphthalene	390 U
nitrobenzene	390 U	2-nitroaniline	1,900 U
isophorone	390 U	dimethyl phthalate	390 U
2-nitrophenol	390 U	acenaphthylene	390 U
2,4-dimethylphenol	390 U	2,6-dinitrotoluene	390 U
benzoic acid	1,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB15 2-4'  
Lab Sample ID: JJ7924

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,900 U	anthracene	390 U
acenaphthene	390 U	di-n-butylphthalate	390 U
2,4-dinitrophenol	1,900 U	fluoranthene	390 U
4-nitrophenol	1,900 U	pyrene	390 U
dibenzofuran	390 U	butylbenzylphthalate	390 U
2,4-dinitrotoluene	390 U	3,3'-dichlorobenzidine	780 U
diethylphthalate	390 U	benzo(a)anthracene	390 U
4-chlorophenyl-phenylether	390 U	chrysene	390 U
fluorene	390 U	bis(2-ethylhexyl)phthalate	320
4-nitroaniline	1,900 U	di-n-octylphthalate	390 U
4,6-dinitro-2-methylphenol	1,900 U	benzo(b)fluoranthene	390 U
n-nitrosodiphenylamine <sup>1</sup>	390 U	benzo(k)fluoranthene	390 U
4-bromophenyl-phenylether	390 U	benzo(a)pyrene	390 U
hexachlorobenzene	390 U	indeno(1,2,3-cd)pyrene	390 U
pentachlorophenol	1,900 U	dibenzo(a,h)anthracene	390 U
phenanthrene	390 U	benzo(g,h,i)perylene	390 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 16

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB15 4-6'  
Lab Sample ID: JJ7925

<u>Compound</u>		<u>Compound</u>	
phenol	390 U	bis(2-chloroethoxy)methane	390 U
bis(2-chloroethyl)ether	390 U	2,4-dichlorophenol	390 U
2-chlorophenol	390 U	1,2,4-trichlorobenzene	390 U
1,3-dichlorobenzene	390 U	naphthalene	390 U
1,4-dichlorobenzene	390 U	4-chloroaniline	390 U
benzyl alcohol	390 U	hexachlorobutadiene	390 U
1,2-dichlorobenzene	390 U	4-chloro-3-methylphenol	390 U
2-methylphenol	390 U	2-methylnaphthalene	390 U
bis(2-chloroisopropyl)ether	390 U	hexachlorocyclopentadiene	390 U
4-methylphenol	390 U	2,4,6-trichlorophenol	390 U
n-nitroso-di-n-propylamine	390 U	2,4,5-trichlorophenol	1,900 U
hexachloroethane	390 U	2-chloronaphthalene	390 U
nitrobenzene	390 U	2-nitroaniline	1,900 U
isophorone	390 U	dimethyl phthalate	390 U
2-nitrophenol	390 U	acenaphthylene	390 U
2,4-dimethylphenol	390 U	2,6-dinitrotoluene	390 U
benzoic acid	1,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 17

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: S815 4-6'  
Lab Sample ID: JJ7925

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,900 U	anthracene	390 U
acenaphthene	390 U	di-n-butylphthalate	390 U
2,4-dinitrophenol	1,900 U	fluoranthene	390 U
4-nitrophenol	1,900 U	pyrene	390 U
dibenzofuran	390 U	butylbenzylphthalate	390 U
2,4-dinitrotoluene	390 U	3,3'-dichlorobenzidine	790 U
diethylphthalate	390 U	benzo(a)anthracene	390 U
4-chlorophenyl-phenylether	390 U	chrysene	390 U
fluorene	390 U	bis(2-ethylhexyl)phthalate	450
4-nitroaniline	1,900 U	di-n-octylphthalate	390 U
4,6-dinitro-2-methylphenol	1,900 U	benzo(b)fluoranthene	390 U
n-nitrosodiphenylamine <sup>1</sup>	390 U	benzo(k)fluoranthene	390 U
4-bromophenyl-phenylether	390 U	benzo(a)pyrene	390 U
hexachlorobenzene	390 U	indeno(1,2,3-cd)pyrene	390 U
pentachlorophenol	1,900 U	dibenzo(a,h)anthracene	390 U
phenanthrene	390 U	benzo(g,h,i)perylene	390 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 17

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB16 0-2'  
Lab Sample ID: JJ7926

<u>Compound</u>		<u>Compound</u>	
phenol	390 U	bis(2-chloroethoxy)methane	390 U
bis(2-chloroethyl)ether	390 U	2,4-dichlorophenol	390 U
2-chlorophenol	390 U	1,2,4-trichlorobenzene	390 U
1,3-dichlorobenzene	390 U	naphthalene	390 U
1,4-dichlorobenzene	390 U	4-chloroaniline	390 U
benzyl alcohol	390 U	hexachlorobutadiene	390 U
1,2-dichlorobenzene	390 U	4-chloro-3-methylphenol	390 U
2-methylphenol	390 U	2-methylnaphthalene	390 U
bis(2-chloroisopropyl)ether	390 U	hexachlorocyclopentadiene	390 U
4-methylphenol	390 U	2,4,6-trichlorophenol	390 U
n-nitroso-di-n-propylamine	390 U	2,4,5-trichlorophenol	1,900 U
hexachloroethane	390 U	2-chloronaphthalene	390 U
nitrobenzene	390 U	2-nitroaniline	1,900 U
isophorone	390 U	dimethyl phthalate	390 U
2-nitrophenol	390 U	acenaphthylene	390 U
2,4-dimethylphenol	390 U	2,6-dinitrotoluene	320 J
benzoic acid	1,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in µg/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB16 0-2'

Lab Sample ID: JJ7926

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,900 U	anthracene	390 U
acenaphthene	390 U	di-n-butylphthalate	390 U
2,4-dinitrophenol	1,900 U	fluoranthene	390 U
4-nitrophenol	1,900 U	pyrene	390 U
dibenzofuran	390 U	butylbenzylphthalate	390 U
2,4-dinitrotoluene	1,900	3,3'-dichlorobenzidine	780 U
diethylphthalate	390 U	benzo(a)anthracene	390 U
4-chlorophenyl-phenylether	390 U	chrysene	390 U
fluorene	390 U	bis(2-ethylhexyl)phthalate	340
4-nitroaniline	1,900 U	di-n-octylphthalate	390 U
4,6-dinitro-2-methylphenol	1,900 U	benzo(b)fluoranthene	390 U
n-nitrosodiphenylamine <sup>1</sup>	390 U	benzo(k)fluoranthene	390 U
4-bromophenyl-phenylether	390 U	benzo(a)pyrene	390 U
hexachlorobenzene	390 U	indeno(1,2,3-cd)pyrene	390 U
pentachlorophenol	1,900 U	dibenzo(a,h)anthracene	390 U
phenanthrene	390 U	benzo(g,h,i)perylene	390 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89

Date Analyzed: 11/06/89

Dilution Factor: 1

% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB16 4-6'  
Lab Sample ID: JJ7927

<u>Compound</u>		<u>Compound</u>	
phenol	1,200 U	bis(2-chloroethoxy)methane	1,200 U
bis(2-chloroethyl)ether	1,200 U	2,4-dichlorophenol	1,200 U
2-chlorophenol	1,200 U	1,2,4-trichlorobenzene	1,200 U
1,3-dichlorobenzene	1,200 U	naphthalene	1,200 U
1,4-dichlorobenzene	1,200 U	4-chloroaniline	1,200 U
benzyl alcohol	1,200 U	hexachlorobutadiene	1,200 U
1,2-dichlorobenzene	1,200 U	4-chloro-3-methylphenol	1,200 U
2-methylphenol	1,200 U	2-methylnaphthalene	1,200 U
bis(2-chloroisopropyl)ether	1,200 U	hexachlorocyclopentadiene	1,200 U
4-methylphenol	1,200 U	2,4,6-trichlorophenol	1,200 U
n-nitroso-di-n-propylamine	1,200 U	2,4,5-trichlorophenol	5,900 U
hexachloroethane	1,200 U	2-chloronaphthalene	1,200 U
nitrobenzene	1,200 U	2-nitroaniline	5,900 U
isophorone	1,200 U	dimethyl phthalate	1,200 U
2-nitrophenol	1,200 U	acenaphthylene	1,200 U
2,4-dimethylphenol	1,200 U	2,6-dinitrotoluene	1,500
benzoic acid	5,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/08/89  
Dilution Factor: 3  
% Moisture: 19

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB16 4-6'  
Lab Sample ID: JJ7927

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	5,900 U	anthracene	1,200 U
acenaphthene	1,200 U	di-n-butylphthalate	1,200 U
2,4-dinitrophenol	1,200 J	fluoranthene	1,200 U
4-nitrophenol	5,900 U	pyrene	1,200 U
dibenzofuran	1,200 U	butylbenzylphthalate	1,200 U
2,4-dinitrotoluene	7,300	3,3'-dichlorobenzidine	2,400 U
diethylphthalate	1,200 U	benzo(a)anthracene	1,200 U
4-chlorophenyl-phenylether	1,200 U	chrysene	1,200 U
fluorene	1,200 U	bis(2-ethylhexyl)phthalate	500
4-nitroaniline	5,900 U	di-n-octylphthalate	1,200 U
4,6-dinitro-2-methylphenol	950 J	benzo(b)fluoranthene	1,200 U
n-nitrosodiphenylamine <sup>1</sup>	1,200 U	benzo(k)fluoranthene	1,200 U
4-bromophenyl-phenylether	1,200 U	benzo(a)pyrene	1,200 U
hexachlorobenzene	1,200 U	indeno(1,2,3-cd)pyrene	1,200 U
pentachlorophenol	5,900 U	dibenzo(a,h)anthracene	1,200 U
phenanthrene	1,200 U	benzo(g,h,i)perylene	1,200 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/08/89  
Dilution Factor: 3  
% Moisture: 19

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB17 0-2'

Lab Sample ID: JJ7928

<u>Compound</u>		<u>Compound</u>	
phenol	390 U	bis(2-chloroethoxy)methane	390 U
bis(2-chloroethyl)ether	390 U	2,4-dichlorophenol	390 U
2-chlorophenol	390 U	1,2,4-trichlorobenzene	390 U
1,3-dichlorobenzene	390 U	naphthalene	390 U
1,4-dichlorobenzene	390 U	4-chloroaniline	390 U
benzyl alcohol	390 U	hexachlorobutadiene	390 U
1,2-dichlorobenzene	390 U	4-chloro-3-methylphenol	390 U
2-methylphenol	390 U	2-methylnaphthalene	390 U
bis(2-chloroisopropyl)ether	390 U	hexachlorocyclopentadiene	390 U
4-methylphenol	390 U	2,4,6-trichlorophenol	390 U
n-nitroso-di-n-propylamine	390 U	2,4,5-trichlorophenol	1,900 U
hexachloroethane	390 U	2-chloronaphthalene	390 U
nitrobenzene	390 U	2-nitroaniline	1,900 U
isophorone	390 U	dimethyl phthalate	390 U
2-nitrophenol	390 U	acenaphthylene	390 U
2,4-dimethylphenol	390 U	2,6-dinitrotoluene	82 J
benzoic acid	1,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB17 0-2'  
Lab Sample ID: JJ7928

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	1,900 U	anthracene	390 U
acenaphthene	390 U	di-n-butylphthalate	390 U
2,4-dinitrophenol	1,900 U	fluoranthene	390 U
4-nitrophenol	1,900 U	pyrene	390 U
dibenzofuran	390 U	butylbenzylphthalate	390 U
2,4-dinitrotoluene	740	3,3'-dichlorobenzidine	780 U
diethylphthalate	390 U	benzo(a)anthracene	390 U
4-chlorophenyl-phenylether	390 U	chrysene	390 U
fluorene	390 U	bis(2-ethylhexyl)phthalate	280
4-nitroaniline	1,900 U	di-n-octylphthalate	390 U
4,6-dinitro-2-methylphenol	1,900 U	benzo(b)fluoranthene	390 U
n-nitrosodiphenylamine <sup>1</sup>	390 U	benzo(k)fluoranthene	390 U
4-bromophenyl-phenylether	390 U	benzo(a)pyrene	390 U
hexachlorobenzene	390 U	indeno(1,2,3-cd)pyrene	390 U
pentachlorophenol	1,900 U	dibenzo(a,h)anthracene	390 U
phenanthrene	390 U	benzo(g,h,i)perylene	390 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 16

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB18 0-2'

Lab Sample ID: JJ7929

<u>Compound</u>		<u>Compound</u>	
phenol	810 U	bis(2-chloroethoxy)methane	810 U
bis(2-chloroethyl)ether	810 U	2,4-dichlorophenol	810 U
2-chlorophenol	810 U	1,2,4-trichlorobenzene	810 U
1,3-dichlorobenzene	810 U	naphthalene	810 U
1,4-dichlorobenzene	810 U	4-chloroaniline	810 U
benzyl alcohol	810 U	hexachlorobutadiene	810 U
1,2-dichlorobenzene	810 U	4-chloro-3-methylphenol	810 U
2-methylphenol	810 U	2-methylnaphthalene	810 U
bis(2-chloroisopropyl)ether	810 U	hexachlorocyclopentadiene	810 U
4-methylphenol	810 U	2,4,6-trichlorophenol	810 U
n-nitroso-di-n-propylamine	810 U	2,4,5-trichlorophenol	3,900 U
hexachloroethane	810 U	2-chloronaphthalene	810 U
nitrobenzene	810 U	2-nitroaniline	3,900 U
isophorone	810 U	dimethyl phthalate	810 U
2-nitrophenol	810 U	acenaphthylene	810 U
2,4-dimethylphenol	810 U	2,6-dinitrotoluene	1,000
benzoic acid	3,900 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/08/89  
Dilution Factor: 2  
% Moisture: 19

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB18 0-2'  
Lab Sample ID: JJ7929

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	3,900 U	anthracene	810 U
acenaphthene	810 U	di-n-butylphthalate	810 U
2,4-dinitrophenol	960 J	fluoranthene	810 U
4-nitrophenol	150 J	pyrene	810 U
dibenzofuran	810 U	butylbenzylphthalate	810 U
2,4-dinitrotoluene	5,900	3,3'-dichlorobenzidine	1,600 U
diethylphthalate	810 U	benzo(a)anthracene	810 U
4-chlorophenyl-phenylether	810 U	chrysene	810 "
fluorene	810 U	bis(2-ethylhexyl)phthalate	250
4-nitroaniline	3,900 U	di-n-octylphthalate	810 U
4,6-dinitro-2-methylphenol	730 J	benzo(b)fluoranthene	810 U
n-nitrosodiphenylamine <sup>1</sup>	810 U	benzo(k)fluoranthene	810 U
4-bromophenyl-phenylether	810 U	benzo(a)pyrene	810 U
hexachlorobenzene	810 U	indeno(1,2,3-cd)pyrene	810 U
pentachlorophenol	3,900 U	dibenzo(a,h)anthracene	810 U
phenanthrene	810 U	benzo(g,h,i)perylene	810 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/08/89  
Dilution Factor: 2  
% Moisture: 19

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SR19 0-2'  
Lab Sample ID: JJ7930

<u>Compound</u>		<u>Compound</u>	
phenol	440 U	bis(2-chloroethoxy)methane	440 U
bis(2-chloroethyl)ether	440 U	2,4-dichlorophenol	440 U
2-chlorophenol	440 U	1,2,4-trichlorobenzene	440 U
1,3-dichlorobenzene	440 U	naphthalene	440 U
1,4-dichlorobenzene	440 U	4-chloroaniline	440 U
benzyl alcohol	440 U	hexachlorobutadiene	440 U
1,2-dichlorobenzene	440 U	4-chloro-3-methylphenol	440 U
2-methylphenol	440 U	2-methylnaphthalene	440 U
bis(2-chloroisopropyl)ether	440 U	hexachlorocyclopentadiene	440 U
4-methylphenol	440 U	2,4,6-trichlorophenol	440 U
n-nitroso-di-n-propylamine	440 U	2,4,5-trichlorophenol	2,100 U
hexachloroethane	440 U	2-chloronaphthalene	440 U
nitrobenzene	440 U	2-nitroaniline	2,100 U
isophorone	440 U	dimethyl phthalate	440 U
2-nitrophenol	440 U	acenaphthylene	440 U
2,4-dimethylphenol	440 U	2,6-dinitrotoluene	440 U
benzoic acid	2,100 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 25

IT Corporation  
November 27, 1989

Client Project ID: COE-Plum Brook

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44410

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB19 0-2'

Lab Sample ID: JJ7930

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	2,100 U	anthracene	440 U
acenaphthene	440 U	di-n-butylphthalate	440 U
2,4-dinitrophenol	2,100 U	fluoranthene	220 J
4-nitrophenol	2,100 U	pyrene	170 J
dibenzofuran	440 U	butylbenzylphthalate	440 U
2,4-dinitrotoluene	440 U	3,3'-dichlorobenzidine	880 U
diethylphthalate	440 U	benzo(a)anthracene	110 J
4-chlorophenyl-phenylether	440 U	chrysene	150 J
fluorene	440 U	bis(2-ethylhexyl)phthalate	410
4-nitroaniline	2,100 U	di-n-octylphthalate	440 J
4,6-dinitro-2-methylphenol	2,100 U	benzo(b)fluoranthene	180 J
n-nitrosodiphenylamine <sup>1</sup>	440 U	benzo(k)fluoranthene	100 J
4-bromophenyl-phenylether	440 U	benzo(a)pyrene	100 J
hexachlorobenzene	440 U	indeno(1,2,3-cd)pyrene	440 U
pentachlorophenol	2,100 U	dibenzo(a,h)anthracene	440 U
phenanthrene	99 J	benzo(g,h,i)perylene	440 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/24/89  
Date Analyzed: 11/06/89  
Dilution Factor: 1  
% Moisture: 25

Client Project ID: COE-Plum Brook

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	SEMI-VOLATILE					
	Nitro-Benzene-D5 (23-120%)*	2-Fluoro-Biphenyl (30-116%)*	Terphenyl-D14 (18-137%)*	Phenol-D5 (24-113%)*	2-Fluoro-Phenol (26-121%)*	2,4,6-Tribromo-Phenol (18-122%)
SB13 0-2'	96	82	101	72	76	84
SB14 0-2'	111	83	110	94	92	98
SB15 2-4'	106	77	80	97	85	56
SB15 4-6'	104	73	78	89	76	52
SB16 0-2'	98	66	71	81	76	53
SB16 4-6'	83	85	106	87	91	79
SB17 0-2'	120	80	80	99	96	64
SB18 0-2'	96	86	89	74	79	89
SB19 0-2'	108	71	75	95	82	63
Method Blank	98	82	95	80	76	65

\*Values in parenthesis represent USEPA contract required QC limits.

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441C

NITROEXPLOSIVES ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID: Lab Sample ID:	Method Blank <u>BL0141</u>	SW01 <u>JJ7954</u>	SW02 <u>JJ7955</u>
1,3,5-trinitrobenzene	0.050 U	0.050 U	0.050 U
1,3-dinitrobenzene	0.050 U	0.050 U	0.050 U
nitrobenzene	0.048 U	0.048 U	0.048 U
2,4,6-trinitrotoluene	0.074 U	0.074 U	0.074 U
2,6-dinitrotoluene	0.053 U	0.053 U	0.053 U
2,4-dinitrotoluene	0.11 U	0.11 U	0.11 U
nitrotoluene	0.048 U	0.048 U	0.048 U
Date Analyzed:	10/27/89	10/27/89	10/27/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

---

NITROEXPLOSIVES ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID:	SW03	SW04	Split
Lab Sample ID:	<u>JJ7956</u>	<u>JJ7957</u>	<u>JJ7958</u>
1,3,5-trinitrobenzene	0.050 U	0.050 U	0.050 U
1,3-dinitrobenzene	0.050 U	0.050 U	0.050 U
nitrobenzene	0.048 U	0.048 U	0.048 U
2,4,6-trinitrotoluene	0.074 U	0.074 U	0.074 U
2,6-dinitrotoluene	0.053 U	0.053 U	0.053 U
2,4-dinitrotoluene	0.11 U	0.11 U	0.11 U
nitrotoluene	0.048 U	0.048 U	0.048 U
Date Analyzed:	10/27/89	10/27/89	10/27/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

NITROEXPLOSIVES ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	SB13 0-2' <u>JJ7922</u>	SB14 0-2' <u>JJ7923</u>	SB15 2-4' <u>JJ7924</u>	SB15 4-6' <u>JJ7925</u>
1,3,5-trinitrobenzene	0.73	14	0.050 U	0.050 U
1,3-dinitrobenzene	0.62	3.7 *	0.050 U	0.050 U
nitrobenzene	0.24 U*	2.5 U*	0.048 U	0.048 U
2,4,6-trinitrotoluene	0.37 U*	3.7 U*	0.074 U	0.074 U
2,6-dinitrotoluene	0.26 U*	2.6 U*	0.053 U	0.053 U
2,4-dinitrotoluene	2.2	20	0.11 U	0.11 U
nitrotoluene	0.24 U*	2.4 U*	0.048 U	0.048 U
Date Extracted:	10/30/89	10/30/89	10/30/89	10/30/89
Date Analyzed:	11/01/89	11/01/89	11/01/89	11/01/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

NITROEXPLOSIVES ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID:	SB16 0-2'	SB16 4-6'	SB17 0-2'	SB18 0-2'
Lab Sample ID:	<u>JJ7926</u>	<u>JJ7927</u>	<u>JJ7928</u>	<u>JJ7929</u>
1,3,5-trinitrobenzene	1.2	15	0.67	10
1,3 dinitrobenzene	0.55	6.4	0.25 U*	5.0
nitrobenzene	0.48 *	2.4 U*	0.24 U*	2.4 U*
2,4,6-trinitrotoluene	0.74 *	3.7 U*	0.37 U*	3.7 U*
2,6-dinitrotoluene	0.53 *	2.7 U*	0.27 U*	2.7 U*
2,4-dinitrotoluene	3.2	16	1.1	19
nitrotoluene	0.48 *	2.4 U*	0.24 U*	2.4 U*
Date Extracted:	10/30/89	10/30/89	10/30/89	10/30/89
Date Analyzed:	11/02/89	11/02/89	11/02/89	11/02/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

NITROEXPLOSIVES ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	<u>SB19 0-2'</u> <u>JJ7930</u>	<u>Method Blank</u> <u>BL0134</u>
1,3,5-trinitrobenzene	0.050 U	0.050 U
1,3 dinitrobenzene	0.050 U	0.050 U
nitrobenzene	0.048 U	0.048 U
2,4,6-trinitrotoluene	0.074 U	0.074 U
2,6-dinitrotoluene	0.053 U	0.053 U
2,4-dinitrotoluene	0.11 U	0.11 U
nitrotoluene	0.048 U	0.048 U
Date Extracted:	10/30/89	10/30/89
Date Analyzed:	11/02/89	11/02/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44410

METALS ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID:	SW01	SW02	SW03
Lab Sample ID:	<u>JJ7949</u>	<u>JJ7950</u>	<u>JJ7951</u>
arsenic	0.003	0.002 U	0.002 U
iron	0.89	0.36	1.1
manganese	0.030	0.021	0.039
selenium	0.004 U*	0.004 U*	0.003 U*
sodium	0.2 U	6.7	7.1
mercury	0.001 U	0.001 U	0.001 U

U - Compound was analyzed for but not detected. The number is the detection limit for t sample.

\* - Detection limit higher than normal due to sample matrix interferences.

Date Digested: 10/30/89  
Date Analyzed: 10/31/89 (ICP)  
10/31 and 11/03/89 (GFAA)  
10/31/89 (CVAA)

IT Corporation  
November 27, 1989

Client Project ID: COE-Plum Brook

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Job Number: ITEK 4441C

METALS ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

Client Sample ID:	SW04	Split	Method Blank
Lab Sample ID:	<u>JJ7952</u>	<u>JJ7953</u>	<u>PBWC0866/C0871</u>
arsenic	0.002 U	0.003 U*	0.002 U
iron	9.6	40.6	0.01 U
manganese	0.37	0.94	0.002 U
selenium	0.003 U*	0.004 U*	0.002 U
sodium	92.7	102	0.2 U
mercury	0.001 U	0.001 U	NR

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

NR - Not required.

Date Digested: 10/30/89

Date Analyzed: 10/31/89 (ICP)

10/31 and 11/03/89 (GFAA)

10/31/89 (CVAA)

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID: Lab Sample ID:	Method Blank <u>PBSC0897/C4079/C0896</u>	SB13 0-2' <u>JJ7913</u>	SB14 0-2' <u>JJ7914</u>	SB15 2-4' <u>JJ7915</u>
arsenic	0.2 U	2.7 U*	1.8	4.6
barium	0.2 U	56.7	51.6	14.1
cadmium	0.5 U	0.5 U	0.5 U	0.5 U
chromium	1 U	13	10	8
iron	4	15,500	12,000	10,900
lead	3 U	9	11	11
manganese	0.2 U	263	146	181
selenium	0.2 U	1.0 U*	0.9 U*	0.5 U*
silver	0.5 U	0.5 U	0.5 U	0.5 U
sodium	20 U	2,590	3,420	96.9
mercury	0.1 U	0.1 U	0.1 U	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

Date Digested: 10/31/89  
Date Analyzed: 10/31/89 (ICP)  
11/04 and 11/06/89 (GFAA)  
11/01/89 (CVAA)

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID:	SB15 4-6'	SB16 0-2'	SB16 4-6'	SB17 0-2'
Lab Sample ID:	<u>JJ7916</u>	<u>JJ7917</u>	<u>JJ7918</u>	<u>JJ7919</u>
arsenic	3.2 U*	2.8	4.9	0.8
barium	31.1	16.5	27.1	21.9
cadmium	0.5 U	0.5 U	0.5 U	0.5 U
chromium	10	8	6	6
iron	13,100	5,910	7,700	8,370
lead	12	5	7	8
manganese	244	78.2	435	141
selenium	1.7 U*	0.7 U*	1.0 U*	0.4 U*
silver	0.5 U	0.5 U	0.5 U	0.5 U
sodium	125	1,040	2,820	1,240
mercury	0.1 U	0.1 U	0.1 U	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

Date Digested: 10/31/89  
Date Analyzed: 10/31/89 (ICP)  
11/04 and 11/06/89 (GFAA)  
11/01/89 (CVAA)

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44410

Client Project ID: COE-Plum Brook

METALS ANALYSIS

Results in mg/kg (ppm)

Sample Matrix: Soil

Client Sample ID:	SB18 0-2'	SB19 0-2'
Lab Sample ID:	<u>JJ7920</u>	<u>JJ7921</u>
arsenic	1.3	9.4
barium	20.2	35.2
cadmium	0.5 U	0.5 U
chromium	5	10
iron	6,890	23,800
lead	11	25
manganese	97.6	18.0
selenium	2.0 U*	0.2
silver	0.5 U	0.5 U
sodium	1,980	40.1
mercury	0.1 U	0.1 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

Date Digested: 10/31/89  
Date Analyzed: 10/31/89 (ICP)  
11/04 and 11/06/89 (GFAA)  
11/01/89 (CVAA)

IT Corporation  
November 27, 1989

Client Project ID: COE-Plum Brook

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44410

WASTEWATER ANALYSIS

Results in mg/kg (ppm) unless otherwise stated

Sample Matrix: Soil

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>pH (standard units)</u>	<u>Sulfate</u>	<u>Nitrate, as N</u>
Method Blank	P0634	**	400 U	2 U
SB13 0-2'	JJ7913	7.62	1,000 U*	16
SB14 0-2'	JJ7914	7.69	2,000 U*	15
SB15 2-4'	JJ7915	7.94	400 U	2 U
SB15 4-6'	JJ7916	8.48	1,000 U*	2 U
SB16 0-2'	JJ7917	9.11	1,000 U*	9
SB16 4-6'	JJ7918	8.43	1,800	120
SB17 0-2'	JJ7919	8.23	1,000 U*	10
SB18 0-2'	JJ7920	8.57	2,500	190
SB19 0-2'	JJ7921	5.00	1,000 U*	2 U
Date Analyzed:		11/10/89	11/17/89	11/17/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

\* - Detection limit higher than normal due to sample matrix interferences.

\*\* - A method blank is not applicable for pH analysis.

IT Corporation  
November 27, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44410

Client Project ID: COE-Plum Brook

WASTEWATER ANALYSIS

Results in mg/liter (ppm) unless otherwise stated

Sample Matrix: Water

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Sulfate</u>	<u>pH (standard units)</u>
Method Blank	P0588	10 U	*
SW01	JJ7939	100	7.60
SW02	JJ7940	110	7.45
SW03	JJ7941	110	7.23
SW04	JJ7942	180	7.69
Split	JJ7943	180	7.67
Date Analyzed:		11/02/89	10/24/89

- U - Compound was analyzed for but not detected. The number is the detection limit for the sample.  
\* - A method blank is not applicable for pH analysis.

IT Corporation  
November 27, 1989

Client Project ID: COE-Plum Brook

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN  
Job Number: ITEK 44410

---

WASTEWATER ANALYSIS

Results in mg/liter (ppm)

Sample Matrix: Water

<u>Client Sample ID</u>	<u>Lab Sample ID</u>	<u>Nitrate, as N</u>
Method Blank	P0602	0.05 U
SW01	JJ7944	15
SW02	JJ7945	0.09
SW03	JJ7946	1.3
SW04	JJ7947	2.9
Split	JJ7948	4.4
Date Analyzed:		11/08/89

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

**CERTIFICATE OF ANALYSIS**

---

IT Corporation  
312 Directors Drive  
Knoxville, TN 37923  
ATTN: Don Burton

November 17, 1989

---

Job Number: ITEK 44414

P.O. Number: 409658

This is the Certificate of Analysis for the following samples:

Client Project ID: COE-Plum Brook  
Date Received by Lab: 10/24/89  
Number of Samples: Nine (9)  
Sample Type: Soil-six (6), Soil duplicates-two (2), Rinsate-one (1)

---

**I. Introduction**

On 10/24/89, six (6) soil samples, two soil duplicates and one (1) rinsate arrived at the ITAS-Knoxville, Tennessee laboratory from the COE-Plum Brook Ordnance Works site in Sandusky, Ohio. The list of analytical tests performed, as well as date of receipt and analysis, can be found in the attached report.

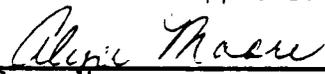
**II. Analytical Results/Methodology**

The analytical results for this report are presented by analytical test. Each set of data will include sample identification information and the analytical results. Please note that all but CLP data are blank corrected, i.e., if any compound is found in the corresponding laboratory blank, it is subtracted from the analytical result before it is reported. CLP data are not blank corrected and CLP soil results are reported on a dry weight basis.

The samples were analyzed for Target Compound List (TCL) volatile and semivolatile organic compounds by gas chromatography/mass spectroscopy (GC/MS) in accordance with the EPA CLP 2/88 Statement of Work.

The samples were analyzed for the requested nitroexplosives by high performance liquid chromatography (HPLC) based on USATHAMA methods 8G and 8H.

Reviewed and Approved:

  
\_\_\_\_\_  
Alyce Moore  
Laboratory Manager

## II. Analytical Results/Methodology (continued)

The samples were analyzed for the requested metals by inductively coupled plasma spectroscopy (ICP), graphite furnace atomic absorption spectroscopy (GFAA) and cold vapor atomic absorption spectroscopy (CVAA) based on EPA SW-846 methods 3050, 6010, 3020, 7060, 7740 and 7471.

The samples were analyzed for sulfate and nitrate by colorimetric determination based on EPA SW-846 methods 9035 and 9200, respectively.

The pH of the samples was measured by an electrometric procedure based on EPA SW-846 method 9045.

## III. Quality Control

Routine laboratory level I QC was performed for all parameters but CLP parameters. CLP analyses followed project specific QC tracking.

The volatiles analyses were performed on 11/01 and 11/07/89 by purge and trap with J&W DB-624 Megabore column on a Finnigan OWA GC/MS/DS. The semivolatiles analyses were performed on 10/30 and 11/07/89 by direct injection of sample extract on a Restek RTX-5 capillary column on a Finnigan 4500 GC/MS/DS. The volatiles runs generally went well. The rinsate run was noted, in review, to have two variant internal standard retention times and it was rerun on 11/07/89 (2 days beyond 14 day holding time), and data from both runs were reported. The initial run was considered to have the most representative results; the differing retention times did not affect the search for TCL's, and the second run (from a second vial) showed a moderate level of acetone which might have been system related (i.e. 2-propanol was seen in the runs and this compound tends to collect in the system and in turn trap acetone, causing carryover). In another case, acetone was seen at high level in sample SB-07, and also in a secondary dilution. The dilution value, while outside calibration range, was still in instrument linear range, and the data were accepted without further runs. Sample SB-19 required a 125 fold dilution, by methanol extraction, for acetone. This medium extraction dilution was run on heated purge just as the rinsate and low level soil samples, and was referenced to the same blank and standard. MS/MSD analysis was performed on sample SB-10: all parameters were within QC limits. Semivolatiles runs went well. MS/MSD analysis of SB-10 again showed all parameters within limits. There were no other problems seen in final data review for either fraction.

The samples were analyzed for the requested nitroexplosives from 11/02/89 through 11/07/89. No problems were encountered.

### III. Quality Control (continued)

The samples were digested on 10/30/89 for ICP and GFAA. The samples for mercury analysis were prepared just prior to analysis. The CVAA analysis for mercury was performed on 10/31/89; the GFAA analyses for arsenic and selenium were performed on 10/31-11/13; the remaining metals were analyzed by ICP on 10/31/89. All run QC was acceptable.

We reported ICP values for arsenic on soil samples SB-07, SB-09, SB-10, SB-12 and SB-19. All soil samples exhibited severe matrix interferences, probably due to the fact that the iron concentration was extremely high. The soil samples were analyzed by GFAA for arsenic on two separate charts on nonconsecutive days. Dilutions as high as 1:20 were performed but matrix interferences remained a problem. The Method of Standard Additions (MSA's) was also attempted, but due to the nature of the samples, no reportable values were obtained; samples were yielding false positives. No other problems were encountered.

The samples were analyzed for pH on 11/10/89. No problems were encountered.

The samples were analyzed for nitrate on 11/08/89 and 11/13/89. No problems were encountered.

The samples were analyzed for sulfate on 11/10/89 and 11/14/89. Elevated detection limits were reported for all soil samples but SB-12 due to extreme sample turbidity. The samples were centrifuged and filtered, but this did not eliminate the turbidity.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 1  
Lab Sample ID: CB1101

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/01/89  
Dilution Factor: 1

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Rinsate  
Lab Sample ID: JJ8009

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/01/89  
Dilution Factor: 1

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank 2  
Lab Sample ID: CB1107

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	1 J	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/07/89  
Dilution Factor: 1

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Rinsate R  
Lab Sample ID: JJ8009R

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	5 U	1,1,2-trichloroethane	5 U
acetone	80	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/07/89  
Dilution Factor: 1

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 444

WATER SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	VOLATILE		
	<u>Toluene-D8</u> (88-110%)*	<u>BFB</u> (86-115%)*	<u>1,2 Dichloroethane-D4</u> (76-114%)*
Rinsate	89	90	93
Rinsate R	107	97	92
Method Blank 1	90	88	89
Method Blank 2	94	97	93

\*Values in parenthesis represent USEPA contract required QC limits.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: Method Blank 1  
Lab Sample ID: CB1101

<u>Compound</u>		<u>Compound</u>	
chloromethane	10 U	1,2-dichloropropane	5 U
bromomethane	10 U	cis-1,3-dichloropropene	5 U
vinyl chloride	10 U	trichloroethene	5 U
chloroethane	10 U	dibromochloromethane	5 U
methylene chloride	2 J	1,1,2-trichloroethane	5 U
acetone	10 U	benzene	5 U
carbon disulfide	5 U	trans-1,3-dichloropropene	5 U
1,1-dichloroethene	5 U	bromoform	5 U
1,1-dichloroethane	5 U	4-methyl-2-pentanone	10 U
1,2-dichloroethene (total)	5 U	2-hexanone	10 U
chloroform	5 U	tetrachloroethene	5 U
1,2-dichloroethane	5 U	1,1,2,2-tetrachloroethane	5 U
2-butanone	10 U	toluene	5 U
1,1,1-trichloroethane	5 U	chlorobenzene	5 U
carbon tetrachloride	5 U	ethylbenzene	5 U
vinyl acetate	10 U	styrene	5 U
bromodichloromethane	5 U	total xylenes	5 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Analyzed: 11/01/89  
Dilution Factor: 1

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-07  
Lab Sample ID: JJ7987

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	5 BJ	1,1,2-trichloroethane	6 U
acetone	2,300 ED	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

D - Value taken from 1:5 dilution

E - Compound exceeded CLP calibration range, but was within instrument linear range.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-09  
Lab Sample ID: JJ7988

<u>Compound</u>		<u>Compound</u>	
chloromethane	13 U	1,2-dichloropropane	6 U
bromomethane	13 U	cis-1,3-dichloropropene	6 U
vinyl chloride	13 U	trichloroethene	6 U
chloroethane	13 U	dibromochloromethane	6 U
methylene chloride	8 B	1,1,2-trichloroethane	6 U
acetone	5 J	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	13 U
1,2-dichloroethene (total)	6 U	2-hexanone	13 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	13 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	13 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 20

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 444

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in  $\mu\text{g}/\text{kg}$  (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-10  
Lab Sample ID: JJ7989

<u>Compound</u>		<u>Compound</u>	
chloromethane	14 U	1,2-dichloropropane	7 U
bromomethane	14 U	cis-1,3-dichloropropene	7 U
vinyl chloride	14 U	trichloroethene	7 U
chloroethane	14 U	dibromochloromethane	7 U
methylene chloride	6 BJ	1,1,2-trichloroethane	7 U
acetone	3 J	benzene	7 U
carbon disulfide	7 U	trans-1,3-dichloropropene	7 U
1,1-dichloroethene	7 U	bromoform	7 U
1,1-dichloroethane	7 U	4-methyl-2-pentanone	14 U
1,2-dichloroethene (total)	7 U	2-hexanone	14 U
chloroform	7 U	tetrachloroethene	7 U
1,2-dichloroethane	7 U	1,1,2,2-tetrachloroethane	7 U
2-butanone	14 U	toluene	7 U
1,1,1-trichloroethane	7 U	chlorobenzene	7 U
carbon tetrachloride	7 U	ethylbenzene	7 U
vinyl acetate	14 U	styrene	7 U
bromodichloromethane	7 U	total xylenes	7 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 27

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-11  
Lab Sample ID: JJ7992

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	10 B	1,1,2-trichloroethane	6 U
acetone	3 J	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	4 J
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 444'

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in ug/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-12  
Lab Sample ID: JJ7993

<u>Compound</u>		<u>Compound</u>	
chloromethane	12 U	1,2-dichloropropane	6 U
bromomethane	12 U	cis-1,3-dichloropropene	6 U
vinyl chloride	12 U	trichloroethene	6 U
chloroethane	12 U	dibromochloromethane	6 U
methylene chloride	8 B	1,1,2-trichloroethane	6 U
acetone	56	benzene	6 U
carbon disulfide	6 U	trans-1,3-dichloropropene	6 U
1,1-dichloroethene	6 U	bromoform	6 U
1,1-dichloroethane	6 U	4-methyl-2-pentanone	12 U
1,2-dichloroethene (total)	6 U	2-hexanone	12 U
chloroform	6 U	tetrachloroethene	6 U
1,2-dichloroethane	6 U	1,1,2,2-tetrachloroethane	6 U
2-butanone	12 U	toluene	6 U
1,1,1-trichloroethane	6 U	chlorobenzene	6 U
carbon tetrachloride	6 U	ethylbenzene	6 U
vinyl acetate	12 U	styrene	6 U
bromodichloromethane	6 U	total xylenes	6 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 16

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

VOLATILE ORGANIC TARGET COMPOUND LIST

Results in µg/kg (ppb) dry weight

Sample Matrix: Soil

Client Sample ID: SB-19  
Lab Sample ID: JJ7994

<u>Compound</u>		<u>Compound</u>	
chloromethane	13 U	1,2-dichloropropane	7 U
bromomethane	13 U	cis-1,3-dichloropropene	7 U
vinyl chloride	13 U	trichloroethene	7 U
chloroethane	13 U	dibromochloromethane	7 U
methylene chloride	6 BJ	1,1,2-trichloroethane	7 U
acetone	11,000 D	benzene	7 U
carbon disulfide	7 U	trans-1,3-dichloropropene	7 U
1,1-dichloroethene	7 U	bromoform	7 U
1,1-dichloroethane	7 U	4-methyl-2-pentanone	13 U
1,2-dichloroethene (total)	7 U	2-hexanone	13 U
chloroform	7 U	tetrachloroethene	7 U
1,2-dichloroethane	7 U	1,1,2,2-tetrachloroethane	7 U
2-butanone	13 U	toluene	7 U
1,1,1-trichloroethane	7 U	chlorobenzene	7 U
carbon tetrachloride	7 U	ethylbenzene	7 U
vinyl acetate	13 U	styrene	7 U
bromodichloromethane	7 U	total xylenes	7 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.  
J - Indicates an estimated value less than the detection limit.  
B - Analyte was found in the blank as well as the sample.  
D - Value taken from 1:125 dilution.

Date Analyzed: 11/01/89  
Dilution Factor: 1  
% Moisture: 24

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 444'

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

Results in ug/kg (ppb) dry weight

Client Sample ID: SB-10  
Lab Sample ID: JJ7989

	<u>Conc. Spike Added</u>	<u>Sample Conc.</u>	<u>MS Conc.</u>	<u>MS % Rec.</u>
1,1-dichloroethene	68.5	7 U	57.5	84
trichloroethene	68.5	7 U	58.1	85
benzene	68.5	7 U	45.9	67
toluene	68.5	7 U	45.9	67
chlorobenzene	68.5	7 U	58.5	85

	<u>Conc. Spike Added</u>	<u>MSD Conc.</u>	<u>MSD % Rec.</u>	<u>RPD</u>
1,1-dichloroethene	68.5	63.3	92	-9
trichloroethene	68.5	61.8	90	-6
benzene	68.5	50.7	74	-10
toluene	68.5	51.6	75	-11
chlorobenzene	68.5	65.3	95	-11

RPD = Relative Percent Difference

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

SOIL SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	VOLATILE		
	Toluene-D8 (81-117%)*	BFB (74-121%)*	1,2 Dichloroethane-D4 (70-121%)*
SB-07	91	89	83
SB-07 DL	91	93	89
SB-09	94	92	85
SB-10	84	82	79
SB-11	91	91	82
SB-12	84	90	81
SB-19	91	94	86
SB-10 MS	85	84	81
SB-10 MSD	90	86	83
Method Blank 1	90	88	89
SB-19 DL	97	96	94

\*Values in parenthesis represent USEPA contract required QC limits.

DL - Dilution

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank  
Lab Sample ID: BL4984

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in  $\mu\text{g/liter}$  (ppb)

Sample Matrix: Water

Client Sample ID: Method Blank  
Lab Sample ID: BL4984

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	2 J
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	2 J	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	10 U
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	4 J	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 4441'

SEMIVOLATILE TARGET COMPOUND LIST

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Rinsate  
Lab Sample ID: JJ8014

<u>Compound</u>		<u>Compound</u>	
phenol	10 U	bis(2-chloroethoxy)methane	10 U
bis(2-chloroethyl)ether	10 U	2,4-dichlorophenol	10 U
2-chlorophenol	10 U	1,2,4-trichlorobenzene	10 U
1,3-dichlorobenzene	10 U	naphthalene	10 U
1,4-dichlorobenzene	10 U	4-chloroaniline	10 U
benzyl alcohol	10 U	hexachlorobutadiene	10 U
1,2-dichlorobenzene	10 U	4-chloro-3-methylphenol	10 U
2-methylphenol	10 U	2-methylnaphthalene	10 U
bis(2-chloroisopropyl)ether	10 U	hexachlorocyclopentadiene	10 U
4-methylphenol	10 U	2,4,6-trichlorophenol	10 U
n-nitroso-di-n-propylamine	10 U	2,4,5-trichlorophenol	50 U
hexachloroethane	10 U	2-chloronaphthalene	10 U
nitrobenzene	10 U	2-nitroaniline	50 U
isophorone	10 U	dimethyl phthalate	10 U
2-nitrophenol	10 U	acenaphthylene	10 U
2,4-dimethylphenol	10 U	2,6-dinitrotoluene	10 U
benzoic acid	50 U		

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

SEMIVOLATILE TARGET COMPOUND LIST (continued)

Results in ug/liter (ppb)

Sample Matrix: Water

Client Sample ID: Rinsate  
Lab Sample ID: JJ8014

<u>Compound</u>		<u>Compound</u>	
3-nitroaniline	50 U	anthracene	10 U
acenaphthene	10 U	di-n-butylphthalate	10 U
2,4-dinitrophenol	50 U	fluoranthene	10 U
4-nitrophenol	50 U	pyrene	10 U
dibenzofuran	10 U	butylbenzylphthalate	10 U
2,4-dinitrotoluene	10 U	3,3'-dichlorobenzidine	20 U
diethylphthalate	10 U	benzo(a)anthracene	10 U
4-chlorophenyl-phenylether	10 U	chrysene	10 U
fluorene	10 U	bis(2-ethylhexyl)phthalate	3 J
4-nitroaniline	50 U	di-n-octylphthalate	10 U
4,6-dinitro-2-methylphenol	50 U	benzo(b)fluoranthene	10 U
n-nitrosodiphenylamine <sup>1</sup>	2 BJ	benzo(k)fluoranthene	10 U
4-bromophenyl-phenylether	10 U	benzo(a)pyrene	10 U
hexachlorobenzene	10 U	indeno(1,2,3-cd)pyrene	10 U
pentachlorophenol	50 U	dibenzo(a,h)anthracene	10 U
phenanthrene	10 U	benzo(g,h,i)perylene	10 U

U - Compound was analyzed for but not detected. The number is the detection limit for the sample.

J - Indicates an estimated value less than the detection limit.

B - Analyte was found in the blank as well as the sample.

1 - Detected as diphenylamine.

Date Extracted: 10/25/89  
Date Analyzed: 10/30/89  
Dilution Factor: 1

IT Corporation  
November 17, 1989

IT ANALYTICAL SERVICES  
5815 MIDDLEBROOK PIKE  
KNOXVILLE, TN

Client Project ID: COE-Plum Brook

Job Number: ITEK 44414

WATER SURROGATE PERCENT RECOVERY SUMMARY

Sample No.	SEMI-VOLATILE					
	Nitro-Benzene-D5 (35-114%)*	2-Fluoro-Biphenyl (43-116%)*	Terphenyl-D14 (33-141%)*	Phenol-D5 (10-94%)*	2-Fluoro-Phenol (21-100%)*	2,4,6-Tribromo-Phenol (10-123%)*
Rinsate	90	79	95	28	46	86
Method Blank	85	75	91	31	50	94

\*Values in parenthesis represent USEPA contract required QC limits.

APPENDIX F  
HAZARDOUS RANKING SYSTEM (HRS) FORM

Facility name: Former Plum Brook Ordnance Works

Location: NASA Lewis Research Center, Plum Brook Station, Sandusky, Ohio

EPA Region: \_\_\_\_\_

Person(s) in charge of the facility: Robert Kozar, NASA Lewis Research Center

6100 Columbus Avenue

Sandusky, Ohio 44870

Name of Reviewer: Jonathan Shireman

Date: 1/16/90

General description of the facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Interest was focused to address possible chemical contamination at waste  
water (red water) retention ponds and at suspect burial and burn area sites.

The effort involved the investigation of the remaining DOD structures and  
the contiguous ground water, surface water, and soil for possible  
contamination by any hazardous substances associated with the operation,  
maintenance, and deactivation of the former ordnance site. The former  
Plum Brook Ordnance Works was used for the purpose of manufacturing

trinitrotoluene (TNT), dinitrotoluene (DNT), pentolite, and nitric and sulfuric  
acids in support of World War II.

Scores:  $S_H = 0$  ( $S_{GW} = 0$   $S_{SW} = 0$   $S_a = 0$  )

$S_{FE} = 0$

$S_{DC} = 0$

**FIGURE 1**  
**HRS COVER SHEET**

	S	S <sup>2</sup>
Groundwater Route Score (S <sub>gw</sub> )	0	0
Surface Water Route Score (S <sub>sw</sub> )	0	0
Air Route Score (S <sub>a</sub> )	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		0
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		0

**FIGURE 10**  
**WORKSHEET FOR COMPUTING S<sub>M</sub>**

Ground Water Route Work Sheet																				
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max Score	Ref. (Section)															
<b>1</b> Observed Release	0 <b>45</b>	1		45	3.1															
If observed release is given a score of 45, proceed to line <b>4</b> . If observed release is given a score of 0, proceed to line <b>2</b> .																				
<b>2</b> Route Characteristics					3.2															
Depth to Aquifer of Concern	0 <b>1</b> 2 3	2		6																
Net Precipitation	0 <b>1</b> 2 3	1		3																
Permeability of the Unsaturated Zone	0 1 <b>2</b> 3	1		3																
Physical State	0 1 2 <b>3</b>	1		3																
Total Route Characteristics Score				15																
<b>3</b> Containment	0 1 2 <b>3</b>	1		3	3.3															
<b>4</b> Waste Characteristics					3.4															
Toxicity/Persistence	0 3 6 9 12 <b>15</b> 18	1		18																
Hazardous Waste Quantity	0 <b>1</b> 2 3 4 5 6 7 8	1		8																
Total Waste Characteristics Score				26																
<b>5</b> Targets					3.5															
Ground Water Use	<table style="display: inline-table; border: none;"> <tr><td style="text-align: center;"><b>0</b></td><td style="text-align: center;">1</td><td style="text-align: center;">2</td><td style="text-align: center;">3</td></tr> </table>	<b>0</b>	1	2	3	3		9												
<b>0</b>	1	2	3																	
Distance to Nearest Well/Population Served	<table style="display: inline-table; border: none;"> <tr><td style="text-align: center;"><b>0</b></td><td style="text-align: center;">4</td><td style="text-align: center;">6</td><td style="text-align: center;">8</td><td style="text-align: center;">10</td></tr> <tr><td style="text-align: center;">12</td><td style="text-align: center;">16</td><td style="text-align: center;">18</td><td style="text-align: center;">20</td><td></td></tr> <tr><td style="text-align: center;">24</td><td style="text-align: center;">30</td><td style="text-align: center;">32</td><td style="text-align: center;">35</td><td style="text-align: center;">40</td></tr> </table>	<b>0</b>	4	6	8	10	12	16	18	20		24	30	32	35	40	1		40	
<b>0</b>	4	6	8	10																
12	16	18	20																	
24	30	32	35	40																
Total Targets Score				49																
<b>6</b>	If line <b>1</b> is 45, multiply <b>1</b> x <b>4</b> x <b>5</b> If line <b>1</b> is 0, multiply <b>2</b> x <b>3</b> x <b>4</b> x <b>5</b>			57.330																
<b>7</b>	Divide line <b>6</b> by 57.330 and multiply by 100			$S_{gw} =$																

**FIGURE 2**  
**GROUND WATER ROUTE WORK SHEET**

Surface Water Route Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max Score	Ref (Section)	
<b>1</b> Observed Release	0      45	1	0	45	4.1	
If observed release is given a value of 45, proceed to line <b>4</b> If observed release is given a value of 0, proceed to line <b>2</b>						
<b>2</b> Route Characteristics					4.2	
Facility Slope and Intervening Terrain	(0) 1 2 3	1		3		
1-yr 24-hr Rainfall	0 1 (2) 3	1		3		
Distance to Nearest Surface Water	0 1 2 (3)	2		6		
Physical State	0 1 2 (3)	1		3		
Total Route Characteristics Score			11	15		
<b>3</b> Containment	0 1 2 (3)	1	3	3	4.3	
<b>4</b> Waste Characteristics					4.4	
Toxicity/Persistence	0 3 6 9 12 (15) 18	1		18		
Hazardous Waste Quantity	0 (1) 2 3 4 5 6 7 8	1		8		
Total Waste Characteristics Score			16	26		
<b>5</b> Targets					4.5	
Surface Water Use	(0) 1 2 3	3		9		
Distance to a Sensitive Environment	(0) 1 2 3	2		6		
Population Served/Distance to Water Intake Downstream	(0) 4 6 8 10 12 16 18 20 24 30 32 35 40	1		40		
Total Targets Score			0	55		
<b>6</b> If line <b>1</b> is 45, multiply <b>1</b> x <b>4</b> x <b>5</b> If line <b>1</b> is 0, multiply <b>2</b> x <b>3</b> x <b>4</b> x <b>5</b>			0	64,350		
<b>7</b> Divide line <b>6</b> by 64,350 and multiply by 100			S <sub>sw</sub> = 0			

**FIGURE 7**  
**SURFACE WATER ROUTE WORK SHEET**

**DOCUMENTATION  
FOR  
HAZARD RANKING SYSTEM**

**INSTRUCTIONS:** As briefly as possible summarize the information you used to assign the score for each factor (e.g., "Waste quantity = 4,230 drums plus 800 cubic yards of sludges"). The source of information should be provided for each entry and should be a bibliographic-type reference. Include the location of the document.

**FACILITY NAME:**

Former Plum Brooks Ordnance Works

**LOCATION:**

NASA Lewis Research Center, Plum Brook Station, Sandusky, Ohio

**DATE SCORED:**

January 16, 1990

**PERSON SCORING:**

Jonathan Shireman

**PRIMARY SOURCE(S) OF INFORMATION(e.g., EPA region, state, FIT, etc.):**

Primary source of information was from the contamination evaluation performed at the site in October 1989.

**FACTORS NOT SCORED DUE TO INSUFFICIENT INFORMATION:**

Air Route.  
Fire and Explosion.

**COMMENTS OR QUALIFICATIONS:**

Limited discrete soil, ground and surface water samples have been collected at this site. Information on contaminants is based on the analytical results of the samples.

## GROUND WATER ROUTE

### 1 OBSERVED RELEASE

#### Contaminants detected (5 maximum):

	[ <sup>C</sup> GW]	Table 1
Arsenic	.005	Ref 1
2,6 Dinitro toluene	.025	Appendix F
2,4 Dinitro toluene	.140	(Certificates of Analysis)

#### Rationale for attributing the contaminants to the facility:

Each of the above contaminants found in ground water is also found in the soils of contaminates in soil

Score 45

\* \* \*

### 2 ROUTE CHARACTERISTICS

#### Depth to Aquifer of Concern

##### Name/description of aquifer(s) of concern:

The Glacial deposits form a thick sequence of clays, silts and sands and gravels. At the site these deposits are reworked clays and fine sands about 30 feet thick. However, gravel deposits at approximately 130 to 150 feet are mined for drinking water.

##### Depth(s) from the ground surface to the highest seasonal level of the saturated zone [water table(s)] of the aquifer of concern:

The sand and gravel unit which is mined for drinking water is under confined conditions. Depth to the top of the aquifer is about 130 feet.

##### Depth from the ground surface to the lowest point of waste contamination:

Soil borings at waste area number 1 showed contamination at 6 feet below surface.

Distance from contaminated soil to aquifer of concern  
130 - 6 = 124 feet                      Score = 1

**Net Precipitation**

**Mean annual or seasonal precipitation (list months for seasonal):**

Mean annual precipitation for this part of Ohio is 34 inches, Ref. 3, page 43.

**Mean annual lake or seasonal evaporation (list months for seasonal):**

The mean annual lake evaporation is 31 inches based on period 1946 to 1955, Ref. 3, plate 2, page 68.

**Net precipitation (subtract the above figures):**

Net ppt = 34-31 = 3 inches

(SCORE: 1)

**Permeability of Unsaturated Zone**

**Soil type in unsaturated zone:**

Clays and sandy silts. Locally some sandy silts are present. Hydraulic conductivity measured in the range of  $9 \times 10^{-5}$  cm/sec.

**Permeability associated with soil type:**

Measured at  $9.0 \times 10^{-5}$  cm/sec. Assigned value 2  
Ref 1

**Physical State**

**Physical state of substance at time of disposal (or at present time for generated gases):**

Waste waters were discharged to retention lagoons.

Physical state: liquids  
Assigned value 3  
Ref 1

\* \* \*

### 3 CONTAINMENT

#### Containment

**Method(s) of waste or leachate containment evaluated:**

Waste was either piled on the ground and burned or placed in unlined, clay bottomed retention ponds

Ref 1

**Method with highest score:**

Clay bottomed surface impoundment

(SCORE: 3)

### 4 WASTE CHARACTERISTICS

#### Toxicity and Persistence

**Compound(s) evaluated:**

Compound	Toxicity	Persistence	Ref
Arsenic	3	3	
2,6 dinitrotoluene	3	2	
2,4 dinitrotoluene	3	2	
Nitrate	Not rated		4,5,6
Sulphate	Not rated		

**Compounds with highest score:**

Arsenic has a total score of 18. However, its concentration in ground water is below its MCL.

The Dinitrotoluene isomers have a score of 15, and do not have a MCL established.

(SCORE: 15)

#### Hazardous Waste Quantity

**Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):**

Estimation of dinitrotoluene in water and soil must be based on these assumptions: Average concentration in soil is computed from analyses at waste areas and on assumed concentration in water at waste area number 2.

(SCORE: 2)

**Basis of estimating and/or computing waste quantity:**

See attachment for method of computing

1.81 ton DNT                      Score = 1

Ref 1

**5 TARGETS**

**Ground Water Use**

**Use(s) of Aquifer of concern within a 3-mile radius of the facility:**

The aquifer of concern is used for a drinking water supply for the City of Milan. Milan is, however, over 5 miles southwest of the facility boundary (Ref. 7). The waterbearing material is not used for any purpose.

Ref 2

(SCORE: 0)

**Distance to Nearest Well**

**Location of nearest well drawing from aquifer of concern or occupied building not served by a public water supply:**

There are no wells drawing from the aquifer of concern.

Ref 2

The yield from well placed in these materials is extremely low.

Ref 1

(SCORE: 0)

**Distance to above well or building:**

Not Applicable

Ref 2

**Population Served by Ground Water Wells Within a 3-Mile Radius**

**Identified water-supply well(s) drawing from aquifer(s) of concern within a 3-mile radius and populations served by each:**

There are no households being served

Ref 2

**Computation of land area irrigated by supply well(s) drawing from aquifer(s) of concern within a 3-mile radius, and conversion to population (1.5 people per acre):**

There are no irrigation wells into the surficial materials

Ref 2

(SCORE 0)

**Total population served by ground water within a 3-mile radius:**

There is no population served. Ref 2

Target score 0

(SCORE: 0)

## SURFACE WATER ROUTE

### 1 OBSERVED RELEASE

Contaminants detected in surface water at the facility or downhill from it (5 maximum):

There are no contaminants detected in surface waters which exceed safe water drinking act MCLs, PMCLs or can be attributed to the site.

Ref 1

Rationale for attributing the contaminants to the facility:

Not Applicable

Score 0

### 2 ROUTE CHARACTERISTICS

#### Facility Slope and Intervening Terrain

Average slope of facility in percent:

Highest point on facility 685 feet at Taylor and Patrol Road, south edge of facility

Point on north edge of facility 625 feet  
Distance between points  $1.28 \times 10^4$  feet

$$\frac{685 - 625}{1.28 \times 10^4} \times 100 = 0.47\%$$

Assigned value = 0

Name/description of nearest downslope surface water:

All streams which exit the facility drain into Sandusky Bay, Lake Erie, 3.7 miles down stream from facility boundary along Taylor Creek.  
Ref 8

Average slope of terrain between facility and above-cited surface water body in percent:

Elevation at boundary 625 feet  
Elevation at Bay 572.5 feet

$$\frac{625 - 572}{2.16 \times 10^4} \times 100 = 0.25\%$$

Distance to Bay  $2.16 \times 10^4$  feet  
Assigned value = 0

Is the facility located either totally or partially in surface water?

There are several retention ponds and three streams on the property; however, only one site contains water.

Ref 1

**Is the facility completely surrounded by areas of higher elevation?**

The slope of the terrain is gentle to the north  
Ref 8

**1-Year 24-Hour Rainfall in Inches**

From Figure 8 in Ref 6 the 1 year 24-hour rainfall is between 2 and 2.5 inches.  
Ref 6 Assigned value = 2

**Distance to Nearest Downslope Surface Water**

Lake Erie, Sandusky Bay is the nearest downslope significant water body, 3.7 miles. However, there are streams on site and surface water retention ponds.  
Ref 8 Assigned value = 3

**Physical State of Waste**

Waste water in unlined lagoons  
Ref 1 Assigned value = 3

\* \* \*

**3 CONTAINMENT**

**Containment**

**Method(s) of waste or leachate containment evaluated:**

See Section 3, Ground Water section  
Assigned value = 3

**Method with highest score:**

#### **4 WASTE CHARACTERISTICS**

##### **Toxicity and Persistence**

**Compound(s) evaluated**

See Section 4, Ground Water

**Compound with highest score:**

See Section 4, Ground Water

Score = 15

##### **Hazardous Waste Quantity**

**Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):**

See Attachment A

Score = 1

**Basis of estimating and/or computing waste quantity:**

#### **5 TARGETS**

##### **Surface Water Use**

**Use(s) of surface water within 3 miles downstream of the hazardous substance:**

Water intakes for Sandusky are located in Lake Erie NE of the water treatment plant, in 28 feet of water (Ref 9) which is approximately 4.5 miles from the facility. There are no other bodies used for drinking water in the area.

Ref 9

**Is there tidal influence?**

No tidal influence in the Great Lakes area.

**Distance to a Sensitive Environment**

**Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:**

There are no coastal wet lands within 2 miles of the site.

Ref 8

**Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less:**

There are no fresh water wetlands within one mile of the site (Ref. 8)

**Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less:**

There are no Federally designated critical habitats in Erie County. However, the Bald Eagle has a winter feeding habitat there and the summer range of the Indiana.

Ref 10

**Population Served by Surface Water**

**Location(s) of water-supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static water bodies) downstream of the hazardous substance and population served by each intake:**

The water intake for Sandusky Water Company is in Lake Erie.

Ref 9

Computation of land area irrigated by above-cited intake(s) and conversion to population (1.5 people per acre):

Total population served:

Population served 0

Name/description of nearest of above water bodies:

Distance to above-cited intakes, measured in stream miles.

There are no intakes in the vicinity of the site.

## AIR ROUTE

### 1. OBSERVED RELEASE

Contaminants detected: The air route is presumed to have a scoring of 0 because the character of the contamination makes wind erosion an unlikely transport pathway.

Date and location of detection of contaminants

Methods used to detect the contaminants:

Rationale for attributing the contaminants to the site:

\*\*\*

### 2. WASTE CHARACTERISTICS

#### Reactivity and Incompatibility

Most reactive compound:

Most incompatible pair of compounds:

## FIRE AND EXPLOSION

### 1. CONTAINMENT

Risk of fire and explosion is deemed to be zero because of the character of the materials present - slightly contaminated soil at 2-6 feet depth.

## DIRECT CONTACT

### 1 OBSERVED INCIDENT

Date, Location, and pertinent details of incident:

There have been no reported incidences of contact with contaminants at the site.

The secure nature of the site and the character of the materials precludes future incidents of direct contact.

### 2 ACCESSIBILITY

Describe type of barrier(s):

### 3 CONTAINMENT

Type of containment, if applicable:

### 4 WASTE CHARACTERISTICS

Toxicity

Compounds evaluated:

Compound with highest score:

**5 TARGETS**

Population within one-mile radius

Distance to critical habitat (of endangered species)

**Table 1**  
**Maximum TCL Concentrations in Sampled Media**

Metals (ppm) <sup>a</sup>	Soil	Groundwater	Surface Water	Release Observed
As	7.0	.005	.003	Y
Pb	50	Ub	U	N
<b>Volatile Compounds (PPb)</b>				
Acetone <sup>c</sup>	4300	82	U	N
Tolvene	U	J	U	NA
Carbon disulphide	U	9	U	NA
<b>Semi-volatiles &amp; Nitro Explosives (PPb)</b>				
Bytlbenyl-phthalate <sup>d</sup>	U	U <sup>e</sup>	19	N
1,3,5 TNB	15.0	U <sup>e</sup>	U	N
1, 3 DNB	6.4	U <sup>e</sup>	U	N
NB	.48	U <sup>e</sup>	U	N
1,4,6 TNT	.74	U <sup>e</sup>	U	N
2, 6 DNT	.53	.025	U	Y
2, 4 DNT	20.0	.140	U	Y
NT	.48	U <sup>e</sup>	U	N
Nitrate (asn)	2500	.12	4.4	Y
Sulphate	190	950	180.0	Y

<sup>a</sup> Metals listed are those which either exceed average background levels or exceed their MCL in water.

<sup>b</sup> N: not detected; J: detected by at a level less than the minimum quantifiable level.

<sup>c</sup> Acetone present in samples is attributed to use of Isoproponol during decontamination activities.

<sup>d</sup> Phthalates in samples may result from contact with latex gloves.

<sup>e</sup> Nitro explosives analyzed by USA THAMA-8G which has high detection limits.

## Attachment A

### Mass of Nitrotoulene Compounds in Soil and Water at Waste Disposal Areas

- 1) **Soil Types at Waste Disposal Areas**  
 Plum Brook Ordnance Works are underlain by Arkport-Galen Association - nearly level to moderate sloping with loamy fine sand.

Soil Symbol	Soil Type	lb./ft. <sup>3</sup> Bulk Density	Slope
<b>Waste Disposal Area 1</b>			
ArB	Arkport fine sand	109	0-2%
Bw	Borrow Pits (Marl)	NA	NA
GaA	Galen loamy fine sands	109	0-2%
Lc	Lenawee silty clay loam	97	

#### Waste Disposal Area 2

Sm	Shoals silty loam	97	
----	-------------------	----	--

Reference 7

#### Volume and Mass of Soils at Waste Areas 1 and 2

##### Waste Area 1

$1140 \text{ ft.} \times 720 \text{ ft.} = 8.21 \times 10^5 \text{ ft.}^2 = A_1$   
 Volume of contaminated soil =  $A_1 \times d_1$   
 Assume 6 ft. depth;  $8.21 \times 10^5 \times 6 = 4.92 \times 10^6 \text{ ft.}^3 = V_1$   
 Reference 1: See accompanying figure

##### Waste Area 2

$860 \text{ ft} \times 700 \text{ ft} = 6.02 \times 10^5 \text{ ft}^2$   
 Assume 6 ft. depth volume of contaminated soil  
 $= (6.02 \times 10^5 \text{ ft}^2) \times 6 \text{ ft} = 3.61 \times 10^6 \text{ ft}^3$   
 Reference 1: See accompanying figure

### **Mass of Soil In Waste Area 1**

Density x Volume = Mass

Assume bulk density of 97 lb/ft<sup>3</sup> (i.e. soil is like soil type Lc)

$$\text{Mass of soil} = (97 \text{ lb/ft}^3) \times (4.92 \times 10^6 \text{ ft}^3) = 4.77 \times 10^8 \text{ lb}$$

### **Mass of Soil in Waste Area 2**

Assume bulk density of 97 lb/ft<sup>3</sup> (i.e. soil is type Sm)

$$\text{Mass of soil} = (97 \text{ lb/ft}^3) \times (3.61 \times 10^6 \text{ ft}^3) = 3.5 \times 10^8 \text{ lb}$$

### **Mass of Dinitrotoluene in Soils at Waste Areas 1 and 2**

#### **Waste Area 1**

$$\begin{aligned} \text{Average concentration} &= (7.5 \text{ mg/kg}) \times (0.45 \text{ kg/lb}) \\ &= 3.41 \text{ mg/lb} \end{aligned}$$

$$\begin{aligned} \text{Mass (M}_1\text{)} &= (4.77 \times 10^8 \text{ lb}) \times (3.41 \text{ mg/lb}) \\ &= 1.63 \times 10^9 \text{ mg} \times (1.0 \text{ kg}/10^6 \text{ mg}) \\ &= 1626.1 \text{ kg} \end{aligned}$$

#### **Waste Area 2**

$$\begin{aligned} \text{Average concentration} &= (0.14 \text{ mg/kg}) \times (0.45 \text{ kg/lb}) \\ &= 6.4 \times 10^{-2} \text{ mg/kg} \end{aligned}$$

$$\text{Mass (M}_2\text{)} = 2.24 \times 10^7 \text{ mg} = 22.4 \text{ kg}$$

#### **Total Mass Waste Area 2**

$$\text{Total Mass (M}_1 + \text{M}_2) = 1648.5 \text{ kg dinitrotoluene in soil}$$

$$\text{Tons Mass} = (1648.5 \text{ kg}) \times (1.1 \times 10^{-3} \text{ ton/kg}) = 1.81 \text{ ton}$$

$$\text{Total Mass (tons)} = 1.81 \text{ ton DNT in soil}$$

## Mass of Dinitrotoluene in the Retention Pond at Waste Area 2

Volume of pond = A x Depth

A = 8 acres Ref. 1

d = 6 feet Ref. 1 from Figure 3-4

8 acres x 6 feet = 48 acre-feet

Volume = (48 acre-ft) x (43560 ft<sup>3</sup>/acre) x (7.48 gal/ft<sup>3</sup>)  
= 1.56 x 10<sup>7</sup> gal. x 3.78 l/gal.  
= 5.91 x 10<sup>7</sup> l = Volume of the redwater pond = V<sub>w</sub>

Assume: [C]<sub>DNT</sub> in water in Redwater pond is the same as  
the concentration in groundwater from MW-02.

M<sub>DNT</sub> = V<sub>w</sub> x [C]<sub>DNT</sub> = (5.91 x 10<sup>7</sup> l) x (0.165 mg/l)  
= 9.75 x 10<sup>6</sup> mg DNT

M<sub>DNT</sub> = (9.75 X 10<sup>6</sup> mg) x (10<sup>-3</sup> kg/mg) x (1.1 X 10<sup>-3</sup> ton/kg)  
= 1.07 x 10<sup>-2</sup> ton

Total DNT at the site is as follows:

Mass (soil) + Mass (water) = (1.81 + 1.07 x 10<sup>-2</sup>) ton  
Total Mass = 1.81 ton

---

<sup>a</sup> Comparative to Arkport loamy fine sand.

<sup>b</sup> Comparative to Shoals silty loam.

HRS DOCUMENTATION

SITE NAME Former Plum Brook Ordnance Works

LOG SHEET

CITY SanduskySTATE OH

IDENTIFICATION NUMBER \_\_\_\_\_

REFERENCE NUMBER	DESCRIPTION OF THE REFERENCE
1	Engineering Report for Contamination Evaluation at the Former Plumbrook Ordnance Works, Plumbrook Station, Sandusky, OH, IT Corporation
2	Phone log, Jonathan Shireman 1/18/90 and 1/19/90 to Wyan Jones, Ohio Geologic Survey, Division of Water Groundwater office.
3	Climatic Atlas of the United States, 1982 U.S. Department of Commerce, National Climatic Center
4	Phone log, Jonathan Shireman 1/19/90, to Mary Anne Walsh, Chemist, Corp of Engineers, Cold regions research and engineering laboratory
5	Dangerous Properties of Industrial Materials 6th Edition N.I. SAX, 1984
6	Uncontrolled Hazardous Waste Site Ranking System, A Users Manual F, R, July 16, 1982

HRS DOCUMENTATION

SITE NAME Former Plum Brook Ordnance Works

LOG SHEET

CITY SanduskySTATE OH

IDENTIFICATION NUMBER \_\_\_\_\_

REFERENCE NUMBER	DESCRIPTION OF THE REFERENCE
7	Soil Survey Erie County, Ohio, U.S. Department of
	Agriculture soil conservation service, 1971
8	Topographic maps, Kimimball, Ohio, 1969 and Sandusky
	Ohio, 1969, Revised 1979
9	Phone log, Jonathan Shireman to David Blair,
	filtration plant operator, Sandusky Water Distribution,
	1/17/90
10	Phone log, Jonathan Shireman to Ken Multener, U.S. Fish
	and Wildlife Service, Columbus, OH 1/22/90



**INTERNATIONAL  
TECHNOLOGY  
CORPORATION**

312 DIRECTORS DRIVE  
KNOXVILLE, TENNESSEE 37923  
TEL: 615/690-3211

# RECORD OF

TELECON  
 MEETING

Project Name	Number	Phase	Task	21
COE	409658			

Date 1/18/90 Time

CALL FROM  NAME:  
CALL TO  J. Shireman

Other Participants — Name/Location/Representing:

CALL FROM  NAME:  
CALL TO  Wayne Jones

Telephone Number: 614/265-6739

Company Name: Ohio Geological Survey

Address: Div. of Water, Ground Water Of

Topic  
Ground Water Usage in the Sandusky Area

City

State Zip Code

**Summary (Decisions & Specific Actions Required by Named Persons):**

Ohio Geologic Survey, Dept. of Water, Office of Ground Water keeps well records of domestic wells. Mr. Jones stated that most wells in the Sandusky area, esp. in Perkins County, are in Silurian Limestone and would be screened at approximately 150 feet to produce 100-500 gpm. Also, some wells are flowing artissian wells. Further the map appearing in the Work Plan as Figure 3-3 was generated by their office. The wells shown are representative designating TD of well formation yield/depth to bed rock

**Required Action:**

I asked Mr. Jones to review the well records so that we could determine the number of domestic wells within three miles of the site, obtain the Milan Village records to determine depth to the major aquifer.

Prepared by (Signature):

Distribution:  
Original to Project File  
Copy to Project Manager  
Copy to Preparer

Other Distribution (By Preparer)

PAGE \_\_\_ OF \_\_\_



**INTERNATIONAL  
TECHNOLOGY  
CORPORATION**

312 DIRECTORS DRIVE  
KNOXVILLE, TENNESSEE 37923  
TEL: 615/690-3211

# RECORD OF

TELECON  
 MEETING

Project Name	Number	Phase	Task	Sub
COE	409658			

Date 1/18/90 & 1/19/90 Time

CALL FROM  NAME: J. Shireman  
CALL TO

Other Participants - Name/Location/Representing:

CALL FROM  NAME: Wayne Jones  
CALL TO   
Telephone Number: 614/265-6739

Company Name: Ohio Geological Survey  
Address: Div. of Water, Ground Water

Topic Ground Water Usage in the Sandusky Area

City  
State Zip Code

**Summary (Decisions & Specific Actions Required by Named Persons):**

- Wayne returned my call of 1/18 to provide the information I requested.
1. The Lake Plain deposits at Plum Brook are 16 to 35 feet thick. Domestic wells are cased through these deposits and open in the Huron Shale, Plum Brook Limestone or the Devonian Columbus and Delaware Limestone termatius.
  2. The Milan municipal wells are located in a NE trending glacial valley and are constructed with 10 to 15 foot screens at approximately 140 to 160 feet.

**Required Action:**

I asked Wayne to forward copies of typical well logs for the domestic wells around the site and for the milar wells. Map in work plan is Ground Water Resources of Erie County 1986, Al Walker.

Prepared by (Signature):

Distribution:  
Original to Project File  
Copy to Project Manager  
Copy to Preparer

Other Distribution (By Preparer)



**INTERNATIONAL  
TECHNOLOGY  
CORPORATION**

312 DIRECTORS DRIVE  
KNOXVILLE, TENNESSEE 37923  
TEL: 615/690-3211

# RECORD OF

TELECON  
 MEETING

Project Name	Number	Phase	Task	It:
COE	409658			

Date 1/17/90

Time

CALL FROM  NAME: J. Shireman  
CALL TO

Other Participants — Name/Location/Representing:

CALL FROM  NAME: David Blair, Operator  
CALL TO   
Telephone Number: 419/627-5904  
Company Name: Sandusky Water Distribution  
Address:

Topic  
Sandusky water distribution

City  
State Zip Code

**Summary (Decisions & Specific Actions Required by Named Persons):**

Sandusky Water distributes water to the City and to several surrounding areas. Their water intake is in Lake Erie at 28 feet on a line due N45E from the filtration plant at 1st East of the Cedar Point causeway. Water lines extend to Mason Road along RT 4 and Platten Tract Road and to Fox Road south of Bogart Road. All residences north of the NASA station are served by Lake Water distributed from the Sandusky intake. NASA has two intakes, one at the Sandusky intake and one at the Huron intake.

**Required Action:**

Prepared by (Signature):

Distribution:  
Original to Project File  
Copy to Project Manager  
Copy to Preparer

Other Distribution (By Preparer)



**INTERNATIONAL  
TECHNOLOGY  
CORPORATION**

312 DIRECTORS DRIVE  
KNOXVILLE, TENNESSEE 37923  
TEL: 615/690-3211

# RECORD OF

- TELECON
- MEETING

Project Name	Number	Phase	Task	Subj
COE				

Date 1/22/90

Time

CALL FROM  NAME: J. Shireman  
CALL TO

Other Participants — Name/Location/Representing:

CALL FROM  NAME: Ken Multener  
CALL TO

Telephone Number: 614/469-6923

Company Name: U.S. Fish & Wildlife Service

Address: Dept. of Ecology

Topic  
Sensitive Environments

City: Columbus, Ohio

State: Zip Code

**Summary (Decisions & Specific Actions Required by Named Persons):**

Mr. Multener stated that there are no critical habitats in Ohio listed on the Federal Register. However, Erie County is the winter habitat and feeding habitat for the Bald Eagle. Also, Erie County includes the range of the Indiana Bat.

**Required Action:**

Prepared by (Signature):

Distribution:  
Original to Project File  
Copy to Project Manager  
Copy to Preparer

Other Distribution (By Preparer)

