Work Plans
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works (PBOW)
Sandusky, Ohio

Volume Two

Site-Specific Attachments I through V

Submitted To:

U.S. Army Corps of Engineers
Nashville District
Post Office Box 1070
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Revision 1

IT Project Number 766952

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September 1996

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Attachment I

Site-Specific Sampling and Analysis Plan, Reservoir No. 2 Burning Ground

Attachment I

Site-Specific Sampling and Analysis Plan
Site Investigation at Reservoir No. 2
Burning Ground (2BG)
Former Plum Brook Ordnance Works
Sandusky, Ohio

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(This SSAP must be used in conjunction with the PBOW SAP)

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List of Acronyms

2BG	Reservoir No. 2 Burning Ground
AR/COC	Analysis Request/Chain of Custody
DERP	Defense Environmental Restoration Program
EM	electromagnetic
E-W	east to west
GPR	ground-penetrating radar
IDW	investigation-derived waste
IT	IT Corporation
MHz	megahertz
NASA	National Aeronautics and Space Administration
N-W	north to west
PA	preliminary assessment
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
SAIC	Science Application International Corporation
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SI	site investigation
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
SVOC	semivolatile organic compound
USACE	U.S.Army Corps of Engineers
VOC	volatile organic compound

I.1.0 Project Description

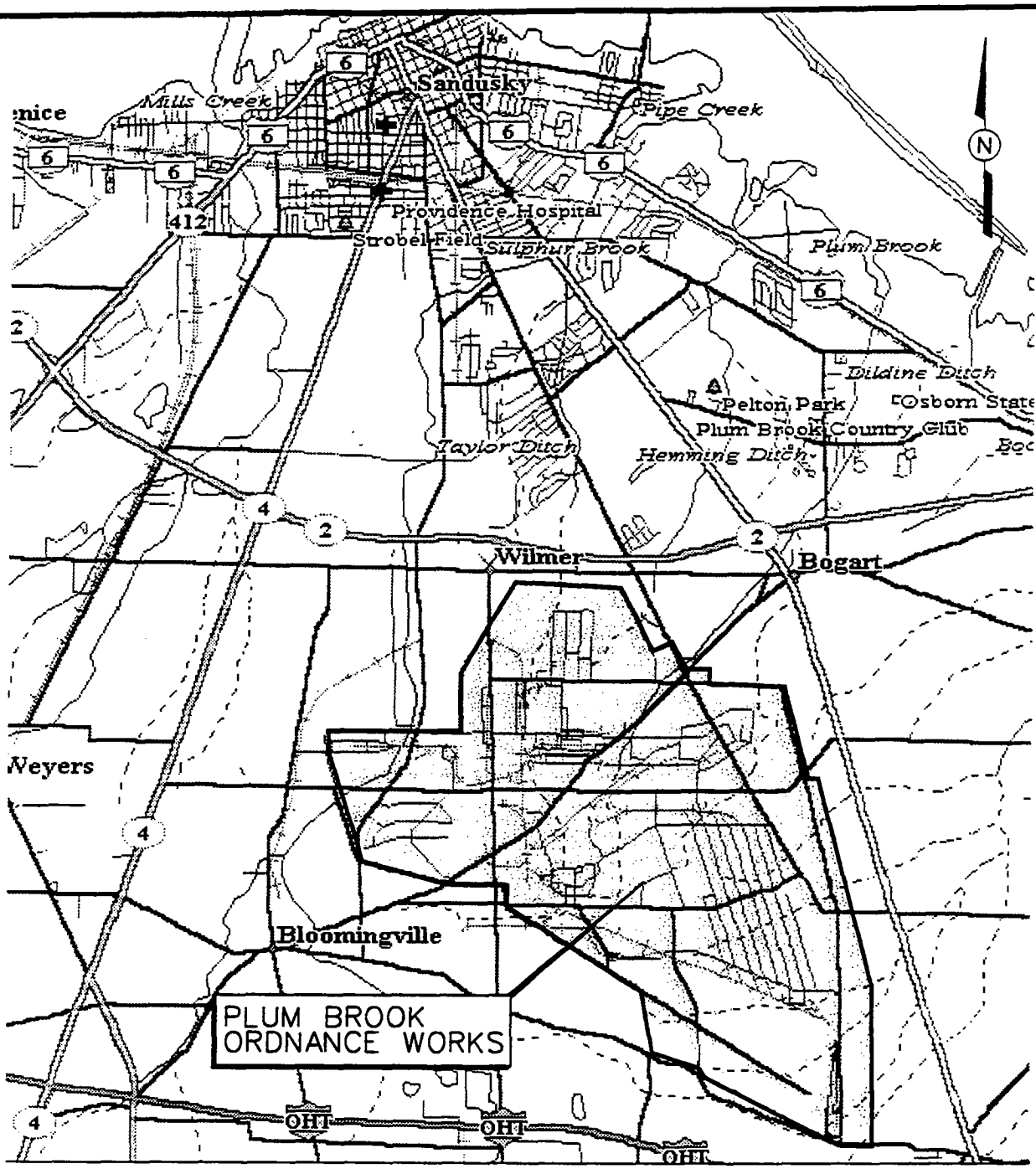
The U.S. Army is conducting studies of environmental impacts of suspected hazardous waste sites at previously owned U.S. Department of Defense properties. This work is being conducted by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW), located in Sandusky, Ohio, is a formerly used defense site under DERP currently being managed and technically overseen by the USACE District Office in Nashville, Tennessee. IT Corporation (IT) is contracted to provide engineering services to conduct a site investigation (SI) at the Reservoir No. 2 Burning Ground (2BG) at PBOW (Figure I-1).

As an attachment to the PBOW sitewide sampling and analysis plan (SAP), (IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the 2BG SI at PBOW. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP)(IT, 1996b) to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this SI that must be used in conjunction with the sitewide safety and health plan (SHP)(IT, 1996c).

I.1.1 Site History

The preliminary assessment (PA) conducted by Science Application International Corporation (SAIC) at PBOW (SAIC, 1991) identified the presence of a burn ground west of Reservoir No. 2, but the location was approximate and the dimensions were unknown. The Dames & Moore records review (Dames & Moore, 1995) states that SAIC's project files included a 1963 letter (written by Braig) to the demolition and decontamination subcontractor (Ravenna Arsenal) describing proposed work at the site that directed Ravenna Arsenal to "clear the TNT burning ground near Reservoir No. 2 of all debris and decontaminate ground, restore ground to proper grade."

During the records review, Dames & Moore representatives spoke with a former PBOW employee, who reported a former burn ground located south of Reservoir No. 2, in an area formerly used as a Plum Brook Station (PBS) ball field (Dames & Moore, 1995). A subsequent review of aerial photographs taken in 1950, 1958, and 1968 of the identified area indicated the presence of a disturbed area with a rectangular berm (1950), a pronounced burn



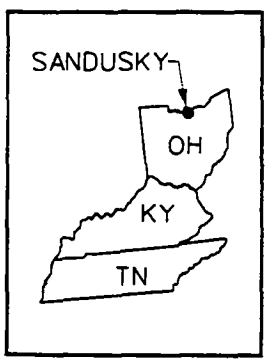


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FIGURE I -1

VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

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INITIATOR: G. YU	PROJ. MGR.: D. BURTON
DRAFT. CHCK. BY: CET	ENGR. CHCK. BY: G. YU
DATE LAST REV.:	DRAWN BY:
STARTING DATE: 6-11-96	DRAWN BY: R. KNIGHT

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ground (1958), and a large cleared area (1968), as shown in Figure I-2, attributed to the clearing of a fire break around the burn ground. Dames & Moore estimated the size of the burn ground as 125 feet wide by 175 feet long, based on the 1950 aerial photographs.

A field reconnaissance was conducted at the 2BG by the USACE and Dames & Moore in March 1995. The area was described as consisting of "open fields with stands of young hardwood trees and brush," with no stressed vegetation or burned areas being reported (Dames & Moore, 1995).

The record review indicates that 2BG is located south of Reservoir No. 2, and may have been previously referred to as the "Fox Road Burning Area." The site is estimated to have been used from at least 1950 through 1962 (Dames & Moore 1995).

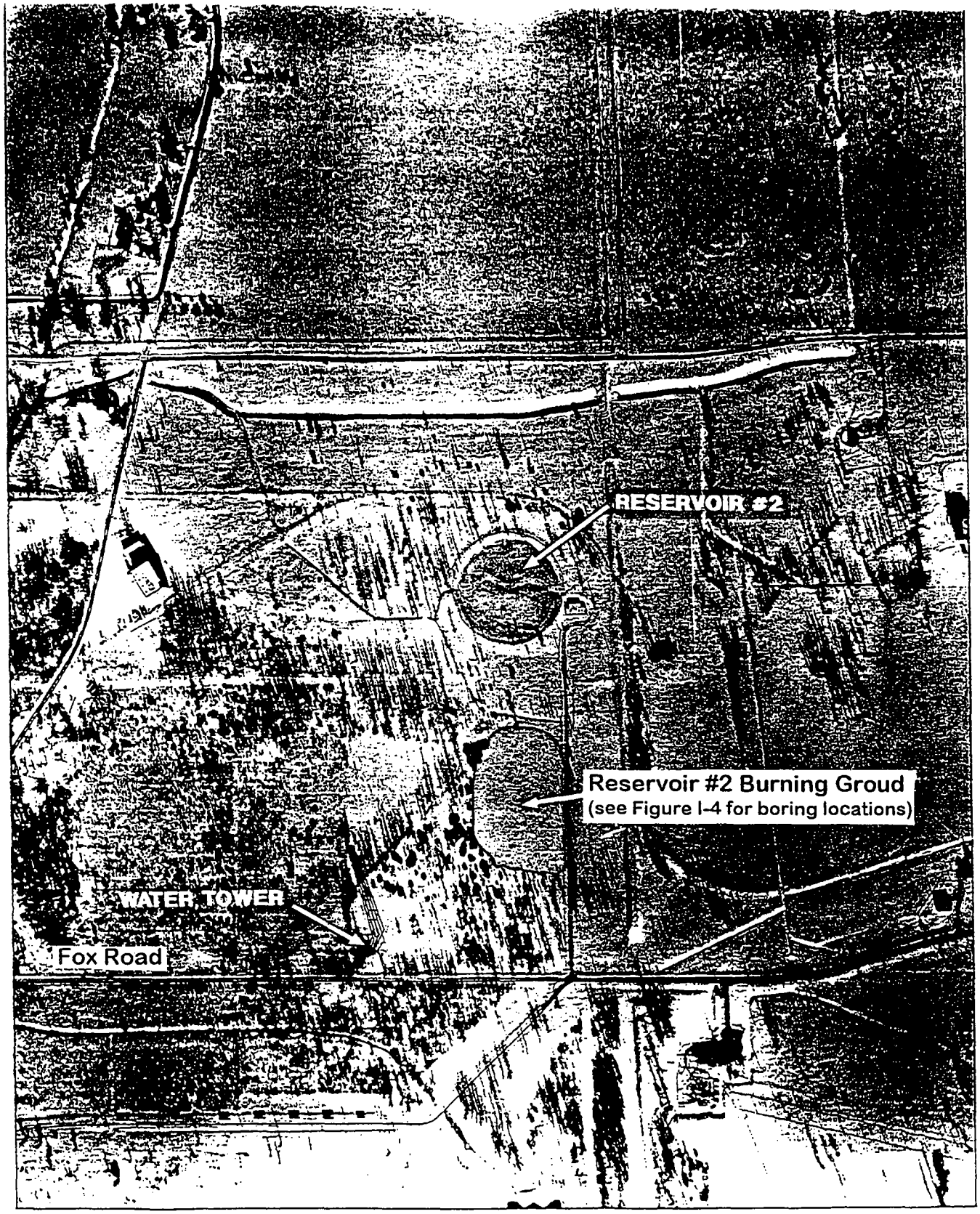
I.1.2 Summary of Existing Site Data

The area identified by Dames & Moore as 2BG has not previously been investigated. An SI conducted by Morrison Knudsen Corporation investigated an area thought to be 2BG, referred to as the "Reservoir Burn Ground," through the collection of two soil samples in an area of tall grass on the northeast side of Power Station No. 3. However, the Dames & Moore records review suggests that the area investigated was actually a former coal storage area associated with the power station. Analytical results from the soil samples are consistent with coal tar debris (Dames & Moore, 1995).

The site is located approximately south of Reservoir No. 2 at the former PBS ball field between Ransom Road and Campbell Street, and may possibly be bounded by a fire break. The railroad track and the distance between Reservoir No. 2 and Fox Road will be used to determine the approximate location of the burning ground.

I.2.0 Project Organization and Responsibility

The project organization for the 2BG SI consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.



600 300 0 600 1200 FEET

(APPROX.)

FIGURE I-2

RESERVOIR #2 BURNING GROUND AS SHOWN IN 1968 AERIAL PHOTOGRAPH

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

(Modified from Figure 5-4, Records review report by Dames & Moore, 1995)

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I.3.0 Scopes and Objectives

I.3.1 Scopes

As specified in the statement of work (USACE, 1996), the scope for the site investigation at 2BG at PBOW consists of preparation of site-specific work plans; completion of field activities including geophysical survey; collection of surface and subsurface soil samples from eight boring locations for chemical analysis; evaluation of analytical results; and preparation of the investigation report of activities, conclusions, and recommendations for future actions at the site.

I.3.2 Objectives

The general purpose of the PBOW SIs has been stated in Section 3.2 of the SAP (IT, 1996a). Specific objectives of the 2BG SI are summarized as follows:

- Delineate the location of the burning ground.
- Determine the existence and nature of contamination in shallow soils.
- Determine if soil contamination poses a threat to human health or the environment and if further investigation or cleanup of the site will be required.

I.3.3 Site-Specific Data Quality Objectives

Overview. The data quality objectives (DQO) process is followed to evaluate data requirements and to support the decision making process associated with the action selection for 2BG This section incorporates the components of the DQO process described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund*; the DQO process as applied to PBOW sites is described in more detail in Section 3.3 of the Site-wide SAP. The factors used to determine the sampling quantity and procedures necessary to meet the objectives of the SIs and to establish a basis for future action at the sites and a general decision-making process diagram are presented in Table 3-1 and in Figure 3-2 of the site-wide SAP, respectively. .

Data Users and Available Data. The intended data users and available data related to the SI at 2BG presented in Table 3-1 of the site-wide SAP have been used to formulate a site-specific conceptual model to support the development of this SSAP necessary to meet the objectives of the SI and to establish a basis for future action at the site. The data users for

information generated during this SI are primarily the EPA, USACE, Ohio Environmental Protection Agency (OEPA), PBS, and the USACE's supporting contractors. This SSSAP, along with the necessary companion documents, has been designed to provide the regulatory agencies with sufficient detail to reach a determination as to the adequacy of the SSSAP. The program has also been designed to provide the USACE with the level of defensible information required to confirm or deny the existence and nature of residual chemical contamination in site media.

Conceptual Site Model. Four factors have been considered in defining the conceptual model for 2BG:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Contaminants of concern.

Potential sources of contamination at 2BG include the use of the site for burning residual TNT product or soil contaminated with explosives. The migration pathways include groundwater infiltration, airborne (dust) distribution, and surface water runoff to the creek. The most likely receptors at 2BG are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants is unlikely at 2BG since the site is a portion of a secure NASA research station. However, potential receptors near the facility may include off-site water users. Potential contaminants of concern based on past use of the site may include VOCs, SVOCs, metals, pesticides/PCBs, total cyanide, and nitroaromatics.

Decision-Making Process, Data Uses, and Needs. The decision-making process consists of a seven-step process which is presented in detail in Section 3.3.3 of the site-wide SAP and will be followed during the SI at 2BG. Data uses and needs are summarized in Table 3-1 of the site-wide SAP.

Risk Evaluation. Confirmation of contamination at 2BG will be based upon a comparison of detected site contaminants to the most current guidance criteria. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in site media. Definitive data will be adequate for confirming the presence of site contamination and for supporting a feasibility study and risk assessment.

Data Quality, Types, and Quality. Soil will be sampled and analyzed in order to meet the objectives of the SI at 2BG. QA/QC samples will be collected for all sample types as described in Section I.4.2.2 of this SSSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the SI, data analyzed at this level of quality are appropriate for all phases of site characterization and risk assessment.

Precision. Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this SI are provided in Section 3.3.4.4.3 of the site-wide SAP.

I.4.0 Field Activities

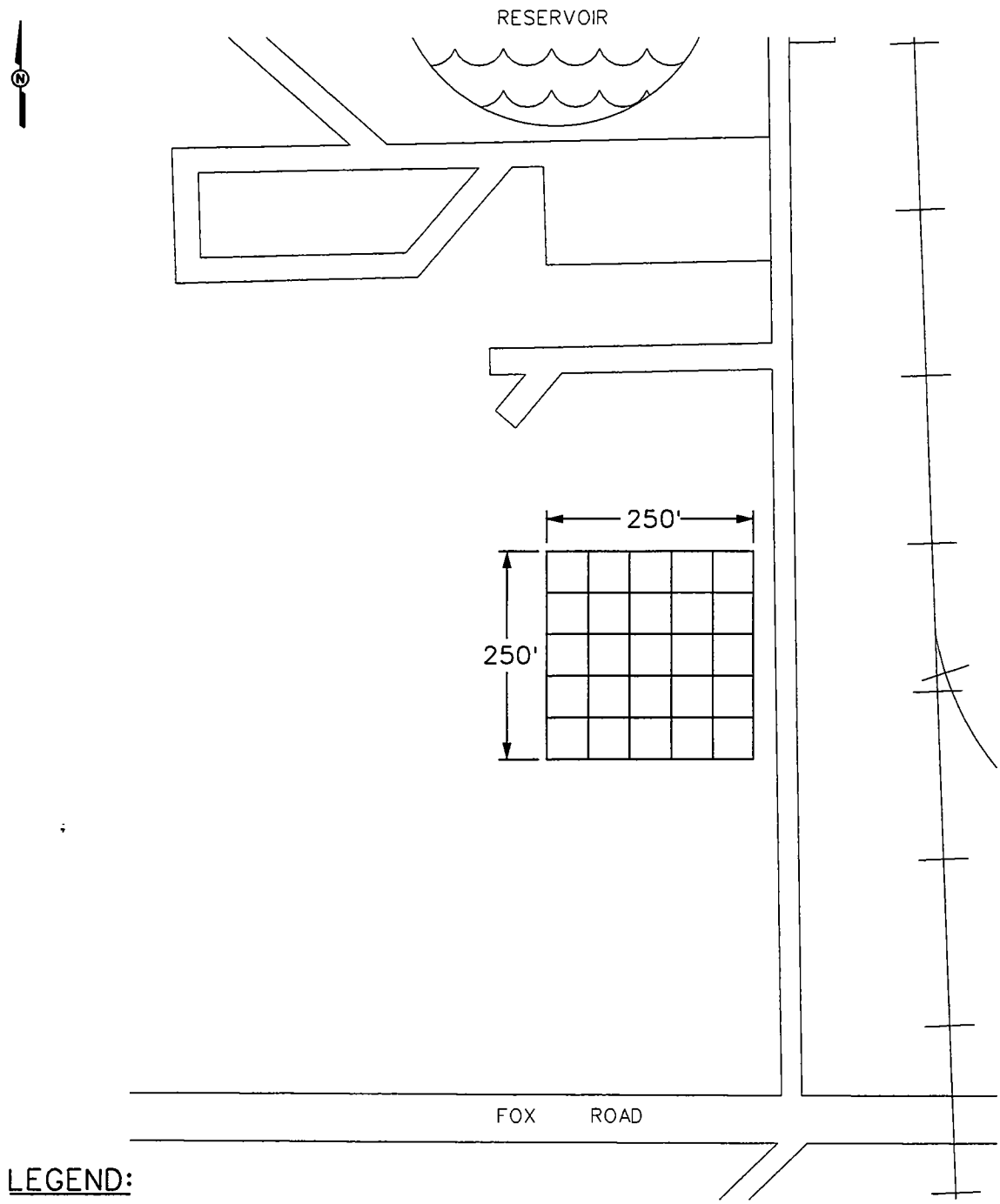
Field activities during the site investigation at 2BG include a geophysical survey, collection of surface and subsurface soil samples for chemical analysis, land survey, and management of investigation-derived waste (IDW).

I.4.1 Geophysics

A geophysical survey will be conducted at 2BG to delineate the suspected area of the burning ground and to locate any buried metallic debris left from decontamination and burning of pipe material. The survey will be conducted by an IT project geophysicist assisted by a geophysical technician (for field work), and will include use of magnetometry, electromagnetic (EM) induction, and ground-penetrating radar (GPR) techniques.

The site is located approximately south of Reservoir No. 2 at the former PBS ball field between Ransom Road and Campbell Street, and may possibly be bounded by a fire break. The railroad track and the distance between Reservoir No. 2 and Fox Road will be used to determine the approximate location of the burning ground.

The survey will be conducted from the center of the suspected burning ground and proceed outward in all directions. The survey will encompass adequate background soil conditions such that the burning ground area can be clearly distinguished. It is estimated the survey will include an area of approximately 250 by 250 feet (approximately 1.4 acres) as shown in Figure I-3. The results of the investigation will be used to accurately locate soil boring locations at the site.



LEGEND:

RAILROAD

SURFACE POND

PROPOSED PRIMARY GEOPHYSICAL SURVEY GRID

SCALE

0 200 400 FEET

FIGURE 1-3
GEOPHYSICAL SURVEY GRID MAP
SITE INVESTIGATION AT
RESERVOIR NO. 2 BURNING GROUND

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

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I.4.1.1 Methodology

Magnetic surveys will be conducted using a Geometrics G-858G magnetic gradiometer (G-858G) for field data acquisition and an EDA OmniPlus magnetometer, or equivalent, to be used as a magnetic base station. EM equipment will consist of a Geonics EM-31 terrain conductivity meter (EM-31) coupled to an Omnidata DL720 digital data logger. GPR equipment will consist of a Geophysical Survey Systems Inc. System-10, or equivalent, coupled to either 300- or 500-megahertz (MHz) antennas, depending on site conditions and signal attenuation. Subsurface utilities , if suspected in the survey area, will be verified using a Schoenstedt MAC-51B magnetic/utility locator (MAC-51B), or equivalent.

Geophysical survey field procedures, including review of existing data, survey control, equipment calibration, data validation, data processing and interpretation, and data file tracking, will be conducted in accordance with the methods and procedures outlined in Section 4.1 of the SAP (IT, 1996a).

Following review of existing site data (e.g., aerial photographs, utility maps, boring logs, etc.) and visual inspection of the site, geophysical reconnaissance scans will be conducted with the EM-31 and magnetic gradiometer to determine the precise boundary of the survey area. The geophysical survey base grid will be staked at all corners and significant turn points. A licensed land surveyor will later survey the corner stakes of the site, which will be referenced to the State Plane Coordinate System. Using the base grid as a reference, the geophysical crew will mark control points on 10-foot centers throughout the site using surveyor's paint and/or pinflags. To the extent possible, the grid will be oriented in the north to south (N-S) direction. Vegetation will be cleared as necessary through the heavy foliage portions of the site, and surface metallic debris will be removed prior to geophysical data acquisition. Figure I-3 presents a tentative primary grid based on available information about site conditions.

The geophysics crew will generate a site map in the field showing the geophysical survey area and obvious surface cultural features that could potentially affect the data (e.g., structures, fences, surface metallic objects, or overhead utilities).

Field instrument and magnetic base stations will be established off site at fixed locations clear of cultural interference (e.g., surface or subsurface metallic debris, fences, utilities or pipelines). The magnetic base station (EDA OmniPlus) will be time-synchronized with the magnetic gradiometer (G-858G) and programmed to measure the intensity of the earth's

magnetic field at 10-second intervals during the magnetic survey. These data will later be used to de-drift G-858G survey data for variations in the earth's magnetic field.

The field instrument base station will be established as a calibration point for the EM-31 and to verify the EM-31 and G-858G were operating properly during the surveys. Prior to collecting magnetic gradiometer data, approximately 60 total magnetic field readings will be recorded at the field instrument base station to provide a quantitative record of instrument variation or drift during the survey period. Magnetic gradiometer data will then be collected at 0.1-second intervals (approximate 0.5- to 1.0-foot intervals) along N-S oriented survey lines spaced 5 feet apart. The data will be stored in the internal memory of the G-858G, along with corresponding line and station numbers and the time of acquisition. Following each survey period, the field instrument base station will be reoccupied and an additional 60 magnetic gradiometer measurements will be recorded and compared with the opening magnetic gradiometer base station data set to verify proper instrument operation. Magnetic base station and field survey data will be evaluated and data files recorded using the data acceptance criteria and documentation procedures outlined in Section 4.1.3.1 of the SAP (IT, 1996a).

Prior to collecting EM data, the EM-31 will be calibrated, the in-phase component will be zeroed, and approximately 20 conductivity and in-phase component readings will be recorded at the field instrument base station and stored in the digital data logger. These data will provide a quantitative record of instrument variation or drift during the survey period. EM-31 data will then be collected at 5-foot intervals along N-S and east to west (E-W) oriented survey lines spaced 10 feet apart. The EM-31 data will be stored in the digital data logger, along with corresponding line and station numbers. Following each survey period, the field instrument base station will be reoccupied and an additional 20 conductivity and in-phase component measurements will be recorded and compared with the opening EM-31 base station data set to verify proper instrument operation. EM-31 base station and field survey data will be evaluated and data files recorded using the data acceptance criteria and documentation procedures outlined in Section 4.1.4.1 of the SAP (IT, 1996a).

Color-enhanced contour maps of magnetic gradiometer and EM-31 data will be generated in the field using the GEOSOFT® geophysical mapping system. Anomalies observed in the EM-31 and magnetic data will be field-checked immediately following the survey to differentiate between anomalies caused by surface and subsurface sources. The contour maps will be used to illustrate the 2BG survey area and the locations of geophysical anomalies caused by

any buried metallic debris and/or areas of anomalous soil conductivity potentially representing the burning ground. Anomalies verified as being caused by subsurface objects thought to represent the target burning ground will be recorded on the field interpretation map and marked in the field for further characterization with GPR.

GPR profile data will be collected to determine the lateral extent and approximate depth below ground surface (bgs) of source materials responsible for observed EM-31 and magnetic anomalies. GPR instrument calibration, site-specific field parameter selection, data acquisition, and data processing procedures will be conducted in accordance with the procedures outlined in Section 4.1.5.1 of the SAP (IT, 1996a).

Prior to collecting survey data, the GPR will be field-checked at a GPR/utility locator base station. The base station will be established where subsurface utilities are known to exist. GPR profiles will then be acquired with the 300- and 500-MHz antennas to determine the electromagnetic signal velocity for site conditions that will aid in interpreting depth to source materials at the site.

Approximately 500 linear feet of digital GPR data will be collected along perpendicular survey lines centered on the anomalies with the 300- and/or 500-MHz antennas, depending on site conditions and signal attenuation. GPR data will reviewed on a color monitor in the field and processed, as necessary, using GRADIX® processing and interpretation software by Interpex. Processing will be conducted to enhance features of interest and maximize the signal-to-noise (S/N) ratio. The interpreted locations of source materials will be recorded on the field interpretation map and marked in the field, as required.

At locations where linear EM-31 and magnetic anomalies are observed in the contoured data, the presence or absence of utility lines will be verified using a utility locator. Verification is necessary because the anomalous response caused by subsurface utilities may sometimes be mistaken for a trench containing metallic debris. Base station instrument checks and utility verification procedures will be conducted in accordance with the procedures outlined in Section 4.1.6.1 of the SAP (IT, 1996a).

I.4.1.2 Geophysics Report

A geophysics report will be included as an appendix to the draft investigation report for 2BG. The report will include a detailed discussion of the technical methods and field procedures used to conduct the surveys (instrument calibration, survey control procedures, data quality

assurance [QA]), data processing, and the interpreted results of the investigation. The report will contain select color-enhanced contour maps of EM-31 and magnetic data, select GPR profiles, and a geophysical interpretation map of the 2BG site. The geophysical maps presented in the reports will be referenced to the State Plane Coordinate System and indicate geographical information (e.g., roads, buildings, power lines, etc.).

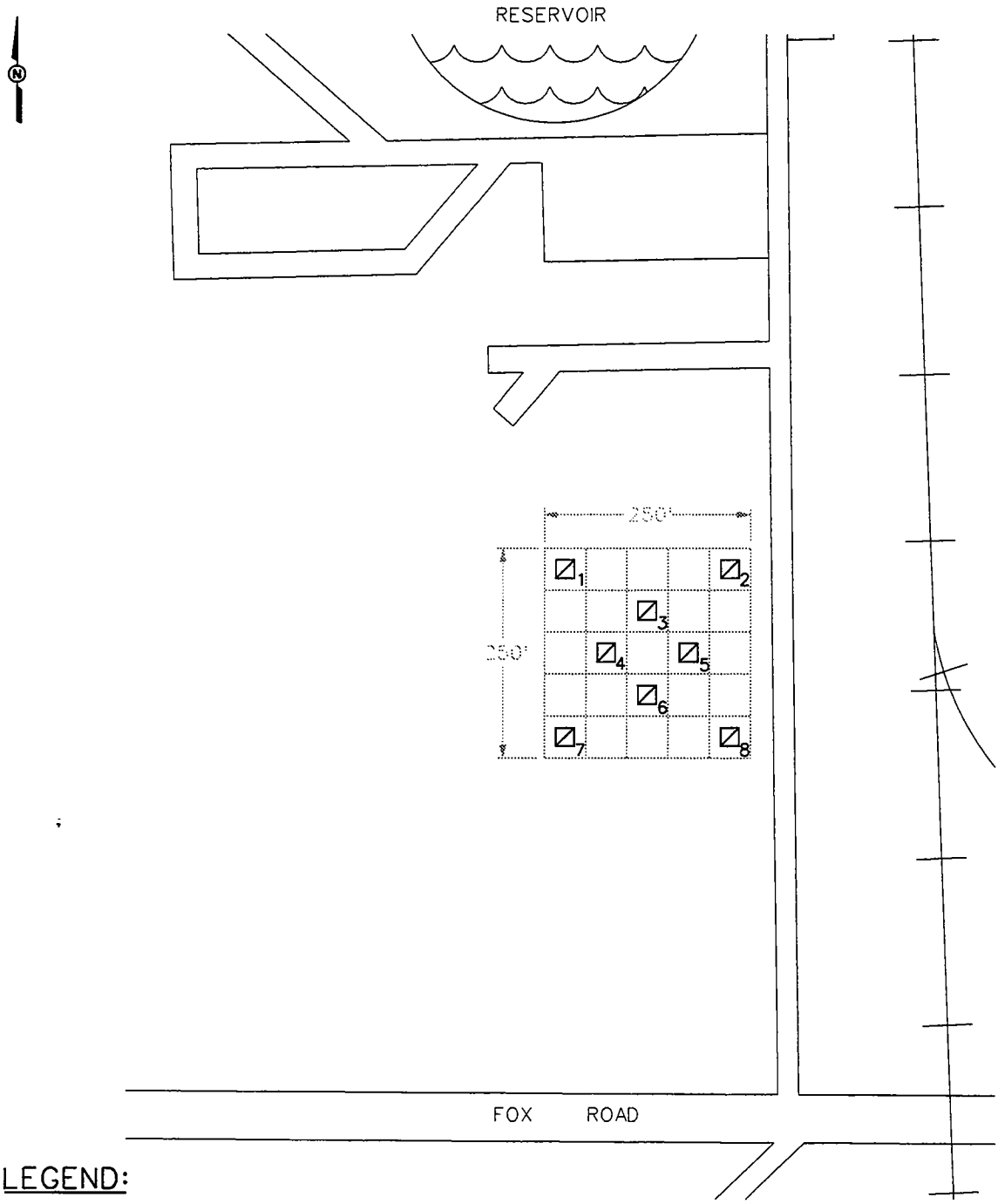
I.4.2 Surface and Subsurface Soil

I.4.2.1 Boring Locations

A total of eight soil borings will be installed within the burning ground as delineated by geophysical survey. These soil boring locations are generally selected based on a systematic grid sampling strategy in order to provide complete site coverage and to minimize sampling bias. The borings will be placed according to the established geophysical survey grid with regular intervals. Figure I-4 shows the tentative boring locations that are subject to change if geophysical survey results and/or site conditions warrant.

I.4.2.2 Sampling Procedures

A total of 24 soil samples will be collected from eight borings. Samples will be collected from the surface (0 to 6 inches), from a depth of 2 to 3 feet, and from a depth of 6 to 7 feet. In the event that the bedrock/soil interface is encountered above the proposed total depth of 7 feet, then the deep sample from the boring will be collected at the bedrock/soil interface. The proposed location for the eight borings as shown in Figure I-4 will be adjusted based on the geophysical survey results. Either a hand auger, a portable gas powered drill rig, or truck-mounted drill rig will be used to drill borings to a specific depth. Soil samples for laboratory analysis will be collected using stainless-steel split spoons or hand augers; undisturbed samples will be collected for volatile organic compounds (VOC) analysis using a drive sampler. If a drive sampler cannot be used effectively due to the proximity of bedrock or weathered bedrock, then care will be used to collect a disturbed sample and place it in the appropriate container. If the quantity of soil in the spoon is not sufficient, then an additional boring will be advanced immediately adjacent to the original boring, and samples will be collected at the same interval as the original sample. Upon completion of sampling, soil borings will be backfilled with soil cuttings removed from the borehole during drilling. Each borehole will be staked, labeled, and surveyed. A summary of soil sample designation and QA/quality control (QC) sample quantity is provided in Table I-1.



LEGEND:

RAILROAD

SURFACE POND

PROPOSED PRIMARY GEOPHYSICAL SURVEY GRID

1 PROPOSED SOIL BORING (2BGSO-01)

SCALE

0 200 400 FEET

FIGURE 1-4
PROPOSED SOIL BORING LOCATION
SITE INVESTIGATION AT
RESERVOIR NO. 2 BURNING GROUND

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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Table I-1
Summary of Soil Sample Designation and QA/QC Sample Quantity
Site Investigation at Reservoir No. 2 Burning Ground
Former Plum Brook Ordnance Works
Sandusky, Ohio

Soil Sample Designation	Soil Boring Designation	Sampling Depth Interval[a] (feet, bgs)	QA/QC Sample Quantity			
			FD/FS	MS/MD	FB	ER
PBOW-96-SO-2BG-SO01-1010-(0-0.5)	2BGSO01	0-0.5				
PBOW-96-SO-2BG-SO01-1020-(2-3.0)		2-3.0				
PBOW-96-SO-2BG-SO01-1030-(6-7.0)		6-7.0				
PBOW-96-SO-2BG-SO02-1040-(0-0.5)	2BGSO02	0-0.5	X			
PBOW-96-SO-2BG-SO02-1050-(2-3.0)		2-3.0				
PBOW-96-SO-2BG-SO02-1060-(6-7.0)		6-7.0				
PBOW-96-SO-2BG-SO02-1070-(0-0.5)	2BGSO03	0-0.5				
PBOW-96-SO-2BG-SO03-1080-(2-3.0)		2-3.0			X	X
PBOW-96-SO-2BG-SO03-1090-(6-7.0)		6-7.0				
PBOW-96-SO-2BG-SO04-1100-(0-0.5)	2BGSO04	0-0.5				
PBOW-96-SO-2BG-SO04-1110-(2-3.0)		2-3.0				
PBOW-96-SO-2BG-SO04-1120-(6-7.0)		6-7.0				
PBOW-96-SO-2BG-SO05-1130-(0-0.5)	2BGSO05	0-0.5				
PBOW-96-SO-2BG-SO05-1140-(2-3.0)		2-3.0	X	X		X
PBOW-96-SO-2BG-SO05-1150-(6-7.0)		6-7.0				
PBOW-96-SO-2BG-SO06-1160-(0-0.5)	2BGSO06	0-0.5				
PBOW-96-SO-2BG-SO06-1170-(2-3.0)		2-3.0				
PBOW-96-SO-2BG-SO06-1180-(6-7.0)		6-7.0				
PBOW-96-SO-2BG-SO07-1190-(0-0.5)	2BGSO07	0-0.5				
PBOW-96-SO-2BG-SO07-1200-(2-3.0)		2-3.0				
PBOW-96-SO-2BG-SO07-1210-(6-7.0)		6-7.0	X		X	X
PBOW-96-SO-2BG-SO08-1220-(0-0.5)	2BGSO08	0-0.5				
PBOW-96-SO-2BG-SO08-1230-(2-3.0)		2-3.0				
PBOW-96-SO-2BG-SO08-1240-(6-7.0)		6-7.0				

a If bedrock is encountered at a depth less than 6 feet below ground surface, soil sample will be collected at soil/bedrock interface.

FD/FS - field duplicate/field split sample
MS/MD - Matrix spike/matrix spike duplicate
FB - Field blank sample
ER - Equipment rinsate sample

All soil samples collected by IT field personnel will be documented through the use of the Analysis Request/Chain of Custody Record form (AR/COC, Figure 6-2 of the SAP) following field custody procedures specified in Section 5.1 of the QAPP (IT, 1996b).

I.5.0 Sample Analysis and Decontamination Needs

I.5.1 Sample Numbering System

The sample numbering system to be used during this investigation will conform to USACE Nashville District's numbering convention and will be used in each of the site-specific investigations. Specifically, each sample will be assigned a unique sample identification number that describes where the sample is collected. Each number consists of a group of letters and numbers, separated by hyphens. The sample media and numbering system used for the 2BG SI is described as follows:

Project Code	Year	Sample Type and Number	Site Identification	Site Location	Sample Number	Depth
PBOW	96	XXXX	2BG	XXXX	XXXX	(XXXX)

Sample types:

SO - Soil sample
FS - Field split sample
FD - Field duplicate sample
MS - Matrix spike sample
MD - Matrix spike duplicate sample
ER - Equipment rinsate sample
FB - Field blank sample

"PBOW-96-SO-2BG-SO02-1040-(0-0.5)" signifies that this soil sample is collected at a depth between 0 and 0.5 foot bgs from soil boring 02 at 2BG with a laboratory number of 1040. The sample identification number will be recorded by the IT field geologist in the Field Activity Daily Log, Boring Log, and Sample Collection Log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

I.5.2 Analytical Program

All soil samples designated for chemical analysis will be collected as described in Section I.4.2. Soil samples collected from borings will be placed in appropriate sample containers,

sealed, labeled, and shipped. These samples will be analyzed for chemical parameters including VOCs, semivolatile organic compounds (SVOC), pesticides/PCBs, metals, total cyanide, and nitroaromatic compounds as listed in Table I-2, along with analytical methods. All soil samples will be sent to Quanterra Environmental Services, located in Knoxville, Tennessee, for analysis, using approved analytical methods listed in Table I-2. Laboratory QA/QC protocol and data reporting requirements will follow procedures specified in Chapter 9.0 of the QAPP (IT, 1996b). Data validation will be performed by an independent subcontractor as stated in Chapter 8.0 of the QAPP.

I.5.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SAP (IT, 1996a) and will be followed during the 2BG SI. The IT field coordinator will need to contact PBS for access to potable water source for decontamination use. The following summarizes decontamination procedures for sampling equipment before site entry, between borings, and before site departure:

Equipment used not in contact with analytical samples:

- Steam-rinse with potable water, or wash and scrub using a brush with non-phosphate detergent and then rinse with potable water.

Equipment used to collect analytical samples:

- Wash and scrub using a brush with nonphosphate detergent.
- Rinse with potable water.
- Rinse with deionized water (American Society for Testing and Materials Type II water).
- Rinse with methanol.
- Final rinse with deionized water. The volume of water used will be at least five times greater than the volume of methanol used.
- Air dry.
- Wrap in aluminum foil.

I.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned containers from I-CHEM, made of materials recommended by the U.S. Environmental Protection Agency in Title 40 Code of Federal Regulations Part 136 and SW-846 (3rd Edition). Sample containers and preservative/preservation methods are summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that the sample is received by the laboratory.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimized the possibility of container breakage by using vermiculite or styrofoam peanuts to fill void space in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4 degrees Celsius and maintained at that temperature by means of blue ice or packaged ice from the time the shipping container is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of shipment. If this is not possible, the laboratory will be notified the following morning. Field split samples will be sent to the USACE-designated QA/QC laboratory following the same procedures as for other primary laboratory samples.

Completed AR/COC records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or

USACE QA Laboratory
Mr. John Adams (CEORD-PE-GL)
USACE Ohio River Division Laboratory

11275 Sebring Drive
Cincinnati, Ohio 45240-2714
Telephone: (513)-589-3604

I.7.0 Investigation-Derived Waste Management Plan

Anticipated IDW during the investigation includes excess soil samples, decontamination fluid, and disposable personal protective equipment. Detailed procedures of IDW management are provided in Chapter 8.0 of the SAP (IT, 1996a). The following is a brief summary of the procedures for handling IDW during the 2BG SI at PBOW.

I.7.1 Surface Soil

Residual surface soil will be used as backfill or spread out on the surface at the point of origin.

I.7.2 Drill Cuttings from Borings

Soil cuttings from soil borings and excess soil samples will be returned immediately after sample collection to the point of origin (backfill).

I.7.3 Decontamination Fluids

Decontamination water will be collected and stored in 55-gallon drums and transported to the designated on-site disposal area located in the Pentolite Road Red Water Pond, south of Pentolite Road, for disposal. Decontamination chemicals (methanol) will be kept in a stainless-steel pan and will be allowed to evaporate. Residues will be disposed of in the on-site disposal area.

I.7.4 Personal Protective Equipment

Disposable personal protective equipment will be double-bagged and disposed of in the on-site dumpster.

I.8.0 Project Schedule

The project schedule will be provided in the submittal of the final SAP.

Attachment I

Site-Specific Safety and Health Plan
Site Investigation of
Reservoir No. 2 Burning Ground (2BG)
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

September 1996

(This SSHP must be used in conjunction with the PBOW SHP)

Reviews and Approvals

Program Manager
IT Corporation

Dennis C Burton 12/12/96
Date

Health and Safety Manager
IT Corporation

Melissa G Smith 12/12/96
Date

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List of Acronyms

dBA	A-weighted decibels
DERP	Defense Environmental Restoration Program
IT	IT Corporation
mg/m^3	milligram per cubic meter
PBOW	Plum Brook Ordnance Works
PPE	personal protective equipment
ppm	parts per million
2BG	Reservoir No. 2 Burning Grounds
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SI	site investigation
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers

I.1.0 Site Work Plan Summary

The U.S Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S. Department of Defense properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW), located in Sandusky, Ohio, is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering services to conduct a site investigation (SI) at the former Reservoir No. 2 Burning Ground (2BG) at PBOW (Figure II-1).

As an attachment to the PBOW sitewide safety and health plan (SHP), this site-specific safety and health plan (SSHP) has been prepared for the work to be carried out in support of the 2BG SI at PBOW. This SSHP must be used in conjunction with the SHP and the quality assurance project plan to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific sampling and analysis plan (SSAP) has also been prepared separately for this SI that must be used in conjunction with the sitewide sampling and analysis plan (SAP).

Project Objective. The specific objectives for the 2BG SI include:

- Delineate the location of the burning ground.
- Determine the existence and nature of contamination in shallow soils.
- Determine if soil contamination poses a threat to human health or the environment and if further investigation or cleanup of the site will be required.

Project Tasks

- Geophysical survey
- Surface and subsurface soil sampling from eight soil boring locations.

Personnel Requirements. Up to 15 employees will be needed. All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the PBOW SHP.

I.2.0 Site Characterization and Analysis

I.2.1 Anticipated Hazards

Chemical and Physical Hazards. The job hazard analysis in Chapter I.4.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The job hazard analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

Employee Protection for Initial Site Entry. Level D protection is required, with chemical-resistant gloves as specified in Chapter 5.0 and emergency equipment as specified in Chapter 11.0 of the SHP.

I.2.2 General Site Information

Location and Approximate Size of Site. The 2BG was reportedly located approximately 500 feet south of Reservoir No. 2, also the location of a former Plum Brook Station (PBS) ball field. Review of aerial photographs taken in the 1950s and 1960s indicate the 2BG was approximately 125 by 175 feet long, not including additional areas that may have been cleared as firebreaks along the margin of the site. The site location map is presented in the SAP.

Duration of Planned Employee Activity. Planned employee activity is estimated at 2 to 6 months.

Site Topography. The site vicinity is open fields with stands of young hardwood trees and brush.

Site Accessibility (By Road). Unpaved access roads traverse the area, which is accessed by Fox Road.

Pathways for Hazardous Substance Dispersion. Possible pathways for hazardous substances in the area are groundwater, surface water, soils, and sediments.

I.3.0 Site Monitoring

The environmental contaminants of concern include organic compounds, cyanide, metals, and nitroaromatics. Nitroaromatic contamination resulted from industrial sewer lines, process and refining facilities, materials, wastes, or intermittent compounds associated with production of 2,4,6-trinitrotoluene (TNT). Petroleum hydrocarbons were used in processes at the former TNT Manufacturing Area. The potential for exposure to these contaminants is unlikely; however, monitoring will be conducted as follows:

Chemical or Physical Agent	Permissible Exposure Limit	Action Level	Monitoring Equipment	Sampling and Analytical Method	Frequency of Analytical Method
Particulates	0.5 milligrams per cubic meter (mg/m^3) (TNT) 1.0 mg/m^3 (dinitrotoluene)	1 mg/m^3	Dust Monitor	Direct Reading	During Activities When Airborne Dust is Generated.
Petroleum Hydrocarbons	100 parts per million (ppm) (Toluene) 100 ppm (Xylene)	20 ppm	photoionization detector or organic vapor analyzer	Direct Reading	During Ground-intrusive Activities
Noise	90 A-weighted decibels (dBA)	85 dBA	Sound Level Meter	Direct Reading	Not Necessary

If noticeable odors are present in the workplace but direct-reading instruments do not detect any volatile contaminants or if levels exceed the action level specified in the table, evacuate area and allow contaminant to dissipate. Don Level C PPE as described in the PBOW SHP, and retest. If odors or levels continue, either postpone work until conditions return to background levels or contact the health and safety manager coordinator for assistance. In the case of noise, noise levels during similar operations have been characterized. Hearing protection will be required by all employees working near heavy equipment or drill rig in operation.

Attachment II

Site-Specific Safety and Health Plan
Site Investigation of
Additional Burn Ground (ABG)
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

September 1996

(This SSHP must be used in conjunction with the PBOW SHP)

Reviews and Approvals

Program Manager
IT Corporation

_____ 12/12/96
Date

Health and Safety Manager
IT Corporation

Melissa G Smith 12/12/96
Date

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List of Acronyms

ABG	Additional Burn Ground
DERP	Defense Environmental Restoration Program
IT	IT Corporation
PBOW	Plum Brook Ordnance Works
PPE	personal protective equipment
ppm	parts per million
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SI	site investigation
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers

II.1.0 Site Work Plan Summary

The U.S Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S. Department of Defense properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW), located in Sandusky, Ohio, is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering services to conduct a site investigation (SI) at the Additional Burn Ground (ABG) at PBOW.

As an attachment to the PBOW sitewide safety and health plan (SHP), this site-specific safety and health plan (SSHP) has been prepared for the work to be carried out in support of the ABG SI at PBOW. This SSHP must be used in conjunction with the SAP and the quality assurance project plan to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific sampling and analysis plan (SSAP) has also been prepared separately for this SI that must be used in conjunction with the sitewide sampling and analysis plan (SAP).

Project Objective. The specific objectives for the ABG SI include:

- Delineate the location of the burning ground.
- Determine the existence and nature of contamination in shallow soils.
- Determine if soil contamination poses a threat to human health or the environment and if further investigation or cleanup of the site will be required.

Project Tasks

- Geophysical survey
- Surface and subsurface soil sampling from 12 soil boring locations.

Personnel Requirements. Up to 15 employees will be needed. All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the PBOW SHP.

II.2.0 Site Characterization and Analysis

II.2.1 Anticipated Hazards

Chemical and Physical Hazards. The job hazard analysis in Section II.4.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The job hazard analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

Employee Protection for Initial Site Entry. Level D protection is required, with chemical resistant gloves as specified in Chapter 5.0 and emergency equipment as specified in Chapter 11.0 of the SHP.

II.2.2 General Site Information

Location and Approximate Size of Site. The ABG site is believed to be located near the intersection of Fox Road and Snake Road in the vicinity of the waste tower. The actual size of the ABG is not known. The site location map is presented in the SAP.

Duration of Planned Employee Activity. Planned employee activity is estimated at 2 to 6 months.

Site Topography. The site vicinity is open fields with stands of young hardwood trees and brush.

Site Accessibility (By Road). Unpaved access roads traverse the area, which is accessed by Fox Road.

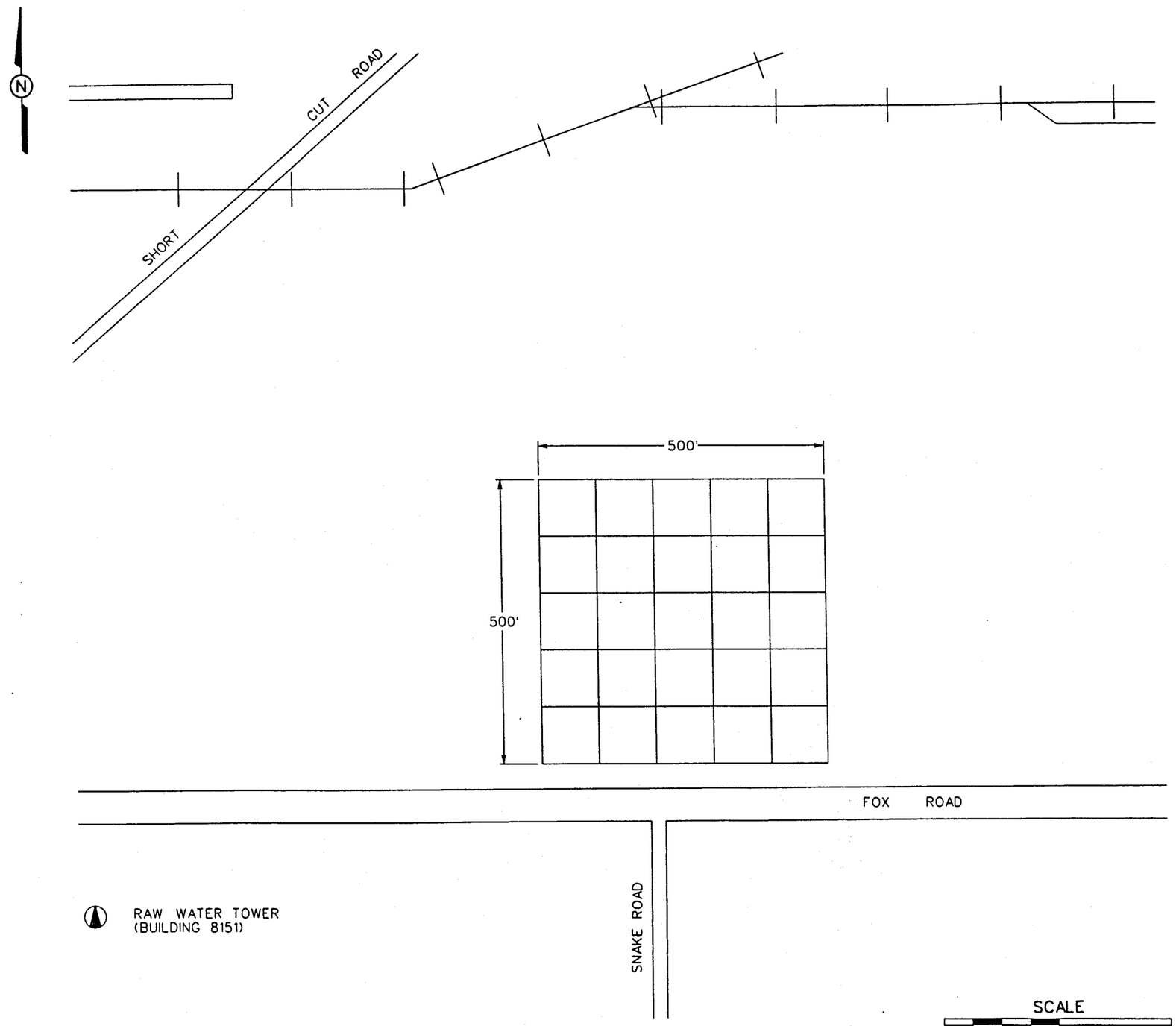
Pathways for Hazardous Substance Dispersion. Possible pathways for hazardous substances in the area are groundwater, surface water, soils, and sediments.

II.3.0 Site Monitoring

The environmental contaminants of concern include organic compounds, cyanide, metals, and nitroaromatics. Nitroaromatic contamination resulted from industrial sewer lines, process and refining facilities, materials, wastes or intermittent compounds associated with production of 2,4,6-trinitrotoluene (TNT). Petroleum hydrocarbons were used in processes at the former TNT Manufacturing Area. The potential for exposure to these contaminants is unlikely, however, monitoring will be conducted as follows:

Chemical or Physical Agent	Permissible Exposure Limit	Action Level	Monitoring Equipment	Sampling and Analytical Method	Frequency of Analytical Method
Particulates	0.5 milligrams per cubic meter (TNT) 1.0 mg/m^3 (dinitrotoluene)	1 mg/m^3	Dust Monitor	Direct Reading	During Activities When Airborne Dust is Generated
Petroleum Hydrocarbons	100 parts per million (ppm) (Toluene) 100 ppm (Xylene)	20 ppm	Photoionization detector or organic vapor analyzer	Direct Reading	During Ground-intrusive Activities
Noise	90 A-weighted decibels (dBA)	85 dBA	Sound Level Meter	Direct Reading	Not Necessary

If noticeable odors are present in the workplace but direct-reading instruments do not detect any volatile contaminants or if levels exceed the action level specified in the table, evacuate area and allow contaminant to dissipate. Don Level C PPE as described in the PBOW SHP, and retest. If odors or levels continue, either postpone work until conditions return to background levels or contact the health and safety manager for assistance. In the case of noise, noise levels during similar operations have been characterized. Hearing protection will be required by all employees working near heavy equipment or drill rig in operation.



LEGEND:

RAILROAD

PROPOSED GEOPHYSICAL SURVEY GRID

WATER TOWER

FIGURE II-2
SITE LOCATION MAP AND PROPOSED GEOPHYSICAL SURVEY GRID
SITE INVESTIGATION, ADDITIONAL BURN GROUND

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 7/7/96	DATE LAST REV:	DRAFT. CHCK. BY: CET	INITIATOR: G. YU
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON
DWG. NO.: .2ES.008			
PROJ. NO.: 766952			

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most likely receptors at ABG are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants is unlikely at ABG since the site is a portion of a secure NASA research station. However, potential receptors near the facility may include off-site water users. Potential contaminants of concern based on past use of the site may include VOCs, SVOCs, metals, pesticides/PCBs, total cyanide, and nitroaromatics.

Decision-Making Process, Data Uses, and Needs. The decision-making process consists of a seven-step process which is presented in detail in Section 3.3.3 of the site-wide SAP and will be followed during the SI at ABG. Data uses and needs are summarized in Table 3-1 of the site-wide SAP.

Risk Evaluation. Confirmation of contamination at ABG will be based upon a comparison of detected site contaminants to the most current guidance criteria. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in site media. Definitive data will be adequate for confirming the presence of site contamination and for supporting a feasibility study and risk assessment.

Data Quality, Types, and Quality. Soil will be sampled and analyzed in order to meet the objectives of the SI at ABG. QA/QC samples will be collected for all sample types as described in Section II.4.2.2 of this SSSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the SI, data analyzed at this level of quality are appropriate for all phases of site characterization and risk assessment.

Precision. Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this SI are provided in Section 3.3.4.4.3 of the site-wide SAP.

II.4.0 Field Activities

Field activities during the SI at ABG include a geophysical survey, collection of surface and subsurface soil samples for chemical analysis, land survey, and management of investigation-derived waste (IDW).

II.4.1 Geophysics

A geophysical survey will be conducted at ABG to delineate the suspected area of the burning ground and to locate any buried metallic debris left from decontamination and burning of pipe materials. The survey will be conducted by an IT project geophysicist assisted by a geophysical technician (for field work), and will include use of magnetometry, electromagnetic (EM) induction, and ground-penetrating radar (GPR) techniques.

The survey will be conducted from the intersection of Fox Road and Snake Road and proceed outward in all directions. The survey will encompass adequate background soil conditions such that the burning ground area can be clearly distinguished. It is estimated the survey will include an area of approximately 500 by 500 feet (approximately 5.7 acres) as shown in Figure II-2. The results of the investigation will be used to accurately locate soil boring locations at the site.

II.4.1.1 Methodology

Magnetic surveys will be conducted using a Geometrics G-858G magnetic gradiometer (G-858G) for field data acquisition and an EDA OmniPlus magnetometer, or equivalent, to be used as a magnetic base station. EM equipment will consist of a Geonics EM-31 terrain conductivity meter (EM-31) coupled to an Omnidata DL720 digital data logger. GPR equipment will consist of a Geophysical Survey Systems Inc. (GSSI) System-10, or equivalent, coupled to either 300- or 500-megahertz (MHz) antennas, depending on site conditions and signal attenuation. Subsurface utilities , if suspected in the survey area, will be verified using a Schoenstedt MAC-51B magnetic/utility locator (MAC-51B), or equivalent.

Geophysical survey field procedures, including review of existing data, survey control, equipment calibration, data validation, data processing and interpretation, and data file tracking, will be conducted in accordance with the methods and procedures outlined in Section 4.4.1 of the SAP (IT, 1996a).

Following review of existing site data (e.g., aerial photographs, utility maps, boring logs, etc.) and visual inspection of the site, geophysical reconnaissance scans will be conducted with the EM-31 and magnetic gradiometer to determine the precise boundary of the survey area. The geophysical survey base grid will be staked at all corners and significant turn points. A licensed land surveyor will later survey the corner stakes of the site, which will be referenced to the State Plane Coordinate System. Using the base grid as a reference, the geophysical crew will mark control points on 10-foot centers throughout the site using surveyor's paint

and/or pinflags. To the extent possible, the grid will be oriented in the north to south (N-S) direction. Vegetation will be cleared as necessary through the heavy foliage portions of the site, and surface metallic debris will be removed prior to geophysical data acquisition. Figure II-2 presents a tentative primary grid based on available information about site conditions.

The geophysics crew will generate a site map in the field showing the geophysical survey area and obvious surface cultural features that could potentially affect the data (e.g., structures, fences, surface metallic objects, or overhead utilities).

Field instrument and magnetic base stations will be established off site at fixed locations clear of cultural interference (e.g., surface or subsurface metallic debris, fences, utilities or pipelines). The magnetic base station (EDA OmniPlus) will be time-synchronized with the magnetic gradiometer (G-858G) and programmed to measure the intensity of the earth's magnetic field at 10-second intervals during the magnetic survey. These data will later be used to de-drift G-858G survey data for variations in the earth's magnetic field.

The field instrument base station will be established as a calibration point for the EM-31 and to verify the EM-31 and G-858G were operating properly during the surveys. Prior to collecting magnetic gradiometer data, approximately 60 total magnetic field readings will be recorded at the field instrument base station to provide a quantitative record of instrument variation or drift during the survey period. Magnetic gradiometer data will then be collected at 0.1-second intervals (approximate 0.5- to 1.0-foot intervals) along N-S oriented survey lines spaced 5 feet apart. The data will be stored in the internal memory of the G-858G, along with corresponding line and station numbers and the time of acquisition. Following each survey period, the field instrument base station will be reoccupied and an additional 60 magnetic gradiometer measurements will be recorded and compared with the opening magnetic gradiometer base station data set to verify proper instrument operation. Magnetic base station and field survey data will be evaluated and data files recorded using the data acceptance criteria and documentation procedures outlined in Section 4.1.3.1 of the SAP (IT, 1996a).

Prior to collecting EM data, the EM-31 will be calibrated, the in-phase component will be zeroed, and approximately 20 conductivity and in-phase component readings will be recorded at the field instrument base station and stored in the digital data logger. These data will provide a quantitative record of instrument variation or drift during the survey period. EM-31 data will then be collected at 5-foot intervals along N-S and east to west (E-W) oriented

survey lines spaced 10 feet apart. The EM-31 data will be stored in the digital data logger, along with corresponding line and station numbers. Following each survey period, the field instrument base station will be reoccupied and an additional 20 conductivity and in-phase component measurements will be recorded and compared with the opening EM-31 base station data set to verify proper instrument operation. EM-31 base station and field survey data will be evaluated and data files recorded using the data acceptance criteria and documentation procedures outlined in Section 4.1.4.1 of the SAP (IT, 1996a).

Color-enhanced contour maps of magnetic gradiometer and EM-31 data will be generated in the field using the GEOSOFT® geophysical mapping system. Anomalies observed in the EM-31 and magnetic data will be field-checked immediately following the survey to differentiate between anomalies caused by surface and subsurface sources. The contour maps will be used to illustrate the ABG survey area and the locations of geophysical anomalies caused by any buried metallic debris and/or areas of anomalous soil conductivity potentially representing the burning ground. Anomalies verified as being caused by subsurface objects thought to represent the target burning ground will be recorded on the field interpretation map and marked in the field for further characterization with GPR.

GPR profile data will be collected to determine the lateral extent and approximate depth below ground surface (bgs) of source materials responsible for observed EM-31 and magnetic anomalies. GPR instrument calibration, site-specific field parameter selection, data acquisition, and data processing procedures will be conducted in accordance with the procedures outlined in Section 4.1.5.1 of the SAP (IT, 1996a).

Prior to collecting survey data, the GPR will be field-checked at a GPR/utility locator base station. The base station will be established where subsurface utilities are known to exist. GPR profiles will then be acquired with the 300- and 500-MHz antennas to determine the electromagnetic signal velocity for site conditions that will aid in interpreting depth to source materials at the Site.

Approximately 1,000 linear feet of digital GPR data will be collected along perpendicular survey lines centered on the anomalies with the 300- and/or 500-MHz antennas, depending on site conditions and signal attenuation. GPR data will reviewed on a color monitor in the field and processed, as necessary, using GRADIX® processing and interpretation software by Interpex. Processing will be conducted to enhance features of interest and maximize the

signal to noise (S/N) ratio. The interpreted locations of source materials will be recorded on the field interpretation map and marked in the field, as required.

At locations where linear EM-31 and magnetic anomalies are observed in the contoured data, the presence or absence of utility lines will be verified using a utility locator. Verification is necessary because the anomalous response caused by subsurface utilities may sometimes be mistaken for a trench containing metallic debris. Base station instrument checks and utility verification procedures will be conducted in accordance with the procedures outlined in Section 4.1.6.1 of the SAP (IT, 1996a).

II.4.1.2 Geophysics Report

A geophysics report will be included as an Appendix to the draft investigation report for the ABG. The report will include a detailed discussion of the technical methods and field procedures used to conduct the surveys (instrument calibration, survey control procedures, data quality assurance [QA]), data processing, and the interpreted results of the investigation. The report will contain select color-enhanced contour maps of EM-31 and magnetic data, select GPR profiles, and a geophysical interpretation map of the ABG site. The geophysical maps presented in the reports will be referenced to the State Plane Coordinate System and indicate geographical information (e.g., roads, buildings, power lines, etc.).

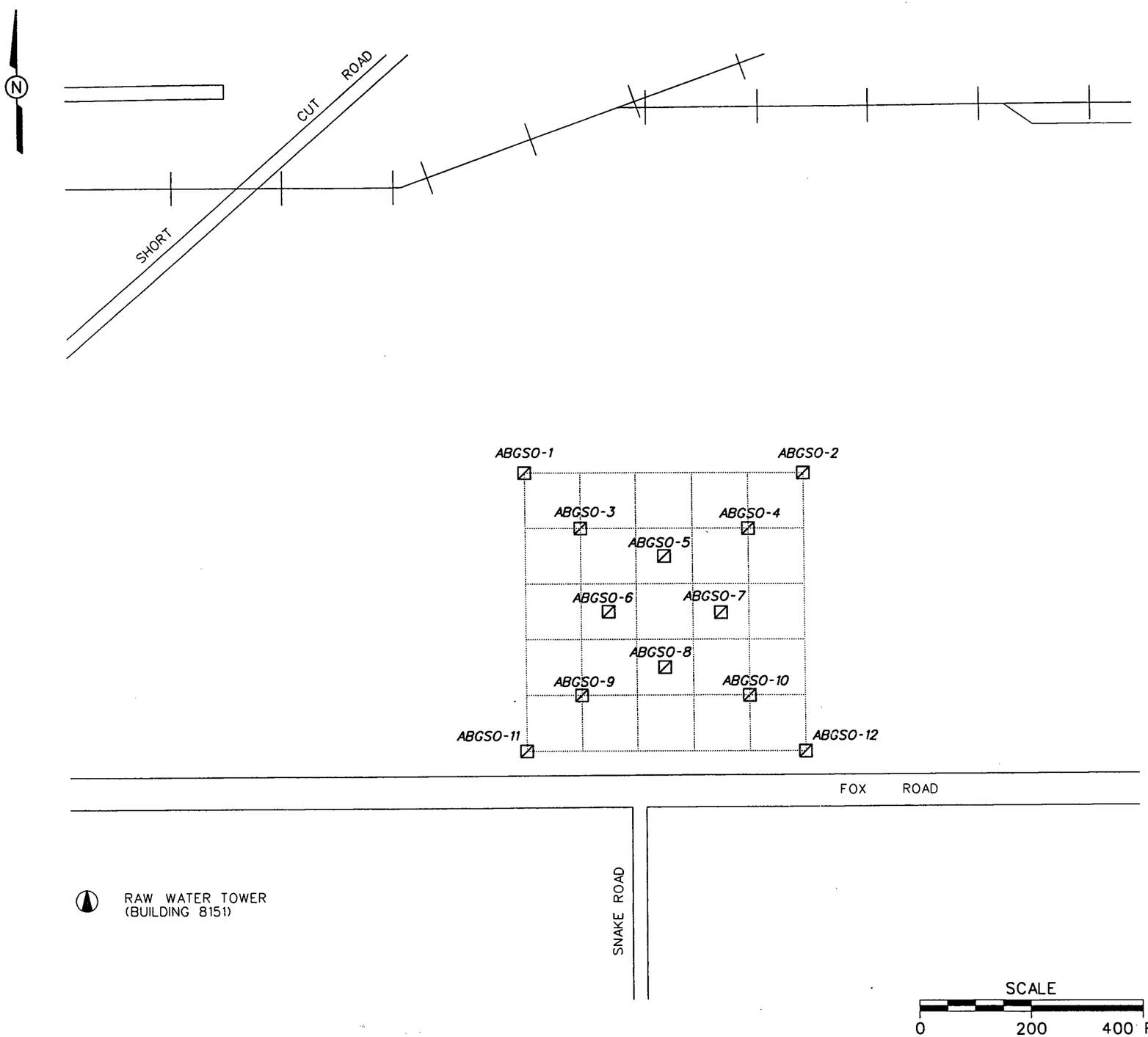
II.4.2 Surface and Subsurface Soil

II.4.2.1 Boring Locations

A total of 12 soil borings will be installed within the ABG as delineated by geophysical survey. These soil boring locations are generally selected based on the systematic grid sampling strategy in order to provide complete site coverage and to minimize sampling bias. The borings will be placed according to the established geophysical survey grid with regular intervals. Figure II-3 shows the tentative boring locations that are subject to change if geophysical survey results and/or site conditions warrant.

II.4.2.2 Sampling Procedures

A total of 24 soil samples will be collected from 12 borings. Samples will be collected from the surface (0 to 6 inches) and from a depth of 2 to 3 feet. If that the bedrock/soil interface is encountered above the proposed total depth of 3 feet, then the deep sample from the boring will be collected at the bedrock/soil interface. The final determination of the eight borings will be determined from the results of the geophysical survey. Either a hand auger, a portable



LEGEND:

RAILROAD

PROPOSED GEOPHYSICAL SURVEY GRID

WATER TOWER

PROPOSED SOIL BORING
(SUBJECT TO CHANGE ACCORDING TO GEOPHYSICAL SURVEY RESULTS)

FIGURE II-3
SITE LOCATION MAP AND PROPOSED SOIL BORING LOCATION
SITE INVESTIGATION, ADDITIONAL BURN GROUND

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 7/7/96	DATE LAST R	DRAFT. CHCK. BY: CET	INITIATOR: G. YU	DWG. NO.:7E .S.010
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.:D. BURTON	PROJ. NO.:766952

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gas-powered drill rig, or truck-mounted drill rig will be used to drill borings to a specific depth. Soil samples for laboratory analysis will be collected using stainless-steel split spoons or hand augers; undisturbed samples will be collected for VOC analysis using a drive sampler. If a drive sampler could not be used effectively due to the proximity of bedrock or weathered bedrock, then care will be used to collect a disturbed sample and place it in the appropriate container. If the quantity of soil in the spoon is not sufficient, then an additional boring will be advanced immediately adjacent to the original boring, and samples will be collected at the same interval as the original sample. Upon completion of sampling, soil borings will be backfilled with soil cuttings removed from the borehole during drilling. Each borehole will be staked, labeled, and surveyed. A summary of soil sample identifications and QA\quality control (QC) samples to be collected is provided in Table II-1.

All soil samples collected by IT field personnel will be documented through the use of Analysis Request/Chain of Custody Record forms (AR/COC, Figure 6-2 of the SAP (IT, 1996a)) following filed custody procedures specified in Section 5.1 of the QAPP (IT 1996b).

II.5.0 Sample Analysis and Decontamination Needs

II.5.1 Sample Numbering System

Sample numbering system to be used during this investigation will conform to USACE Nashville District's numbering convention and be used in each of the site-specific investigations. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number consists of a group of letters and numbers, separated by hyphens. The sample media and numbering system to be used for the ABG SI are described as follows:

Project Code	Year	Sample Type and Number	Site Location	Site Location	Sample Number	Depth
PBOW	96	XXXX	ABG	XXXX	XXXX	(XXXX)

Sample types:

SO - Soil sample
FS - Field split sample
SS - Field screening sample
FD - Field duplicate sample
MS - Matrix spike sample

Table II-1
Summary of Soil Sample Designation and QA/QC Sample Quantity
Site Investigation at Additional Burn Ground
Former Plum Brook Ordnance Works
Sandusky, Ohio

Soil Sample Designation	Soil Boring Designation	Sampling Depth Interval (feet, bgs)	QA/QC Sample Quantity			
			FD/FS	MS/MD	FB	ER
PBOW-96-SO-ABG-SO01-2010-(0-0.5)	ABGSO01	0 - 0.5				
PBOW-96-SO-ABG-SO01-2020-(2-3.0)		2 - 3	X			X
PBOW-96-SO-ABG-SO02-2030-(0-0.5)	ABGSO02	0 - 0.5				
PBOW-96-SO-ABG-SO02-2040-(2-3.0)		2 - 3		X	X	
PBOW-96-SO-ABG-SO03-2050-(0-0.5)	ABGSO03	0 - 0.5				
PBOW-96-SO-ABG-SO03-2060-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO04-2070-(0-0.5)	ABGSO04	0 - 0.5				
PBOW-96-SO-ABG-SO04-2080-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO05-2090-(0-0.5)	ABGSO05	0 - 0.5				
PBOW-96-SO-ABG-SO05-2100-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO06-2110-(0-0.5)	ABGSO06	0 - 0.5				
PBOW-96-SO-ABG-SO06-2120-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO07-2130-(0-0.5)	ABGSO07	0 - 0.5				
PBOW-96-SO-ABG-SO07-2140-(2-3.0)		2 - 3			X	X
PBOW-96-SO-ABG-SO08-2150-(0-0.5)	ABGSO08	0 - 0.5				
PBOW-96-SO-ABG-SO08-2160-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO09-2170-(0-0.5)	ABGSO09	0 - 0.5				
PBOW-96-SO-ABG-SO09-2180-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO10-2190-(0-0.5)	ABGSO10	0 - 0.5				
PBOW-96-SO-ABG-SO10-2200-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO11-2210-(0-0.5)	ABGSO11	0 - 0.5	X			X
PBOW-96-SO-ABG-SO11-2220-(2-3.0)		2 - 3				
PBOW-96-SO-ABG-SO12-2230-(0-0.5)	ABGSO12	0 - 0.5				
PBOW-96-SO-ABG-SO12-2240-(2-3.0)		2 - 3				

FD/FS - Field duplicate/field split sample
MS/MD - Matrix spike/matrix spike duplicate
FB - Field blank sample
ER - Equipment rinsate sample

MD - Matrix spike duplicate sample
FB - Field blank
ER - Equipment rinsate.

"PBOW-96-SO-ABG-SO02-2030-(0-0.5)" signifies that this soil sample is collected at a depth between 0 and 0.5 foot bgs from soil boring 02 at the ABG with a laboratory number of 2030. The sample identification number will be recorded by the IT field geologist in the Field Activity Daily Log, Boring Log, and Sample Collection Log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

II.5.2 Analytical Program

All soil samples designated for chemical analysis will be collected as described in Section II.4.2. Soil samples collected from borings will be placed in appropriate sample containers, sealed, labeled, and shipped. These samples will be analyzed for chemical parameters including VOCs, SVOCs, metals, pesticides/PCBS, total cyanide, and nitroaromatic compounds as listed in Table II-2, along with analytical methods. All soil samples will be sent to the primary laboratory Quanterra Environmental Services, located in Knoxville, Tennessee for analysis, using approved analytical methods listed in Table II-2. Laboratory QA/QC protocol and data reporting requirements will follow procedures specified in Chapter 9.0 of the QAPP (IT, 1996b). Data validation will be performed by an independent subcontractor as stated in Chapter 8.0 of the QAPP (IT, 1996b).

II.5.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SAP (IT, 1996a) and will be followed during the ABG SI. The IT field coordinator will need to contact Plum Brook Station for access to potable water source for decontamination use. The following summarizes decontamination procedures for sampling equipment before site entry, between borings, and before site departure:

Equipment used not in contact with analytical samples:

- Steam-rinse with potable water, or wash and scrub using a brush with non-phosphate detergent and then rinse with potable water.

Equipment used to collect analytical samples:

- Wash and scrub using a brush with nonphosphate detergent.

- Rinse with potable water.
- Rinse with deionized water (American Society for Testing and Material Type II water).
- Rinse with methanol.
- Final rinse with deionized water. The volume of water used will be at least five times greater than the volume of methanol used.
- Air dry.
- Wrap in aluminum foil.

II.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned containers from I-CHEM, made of materials recommended by the U.S. Environmental Protection Agency in Title 40 Code of Federal Regulations Part 136 and SW-846 (3rd Edition). Sample containers and preservative/preservation methods are summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that the sample is received by the laboratory.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimized the possibility of container breakage by using vermiculite or styrofoam peanuts to fill void space in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4 degrees Celsius and maintained at that temperature by means of blue ice or packaged ice from the time the shipping container is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of shipment. If this in not possible, the laboratory will be notified the following morning. Field split samples will be sent to the USACE-designated QA/QC laboratory following the same procedures as for other primary laboratory samples.

Completed AR/COC records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or

USACE QA Laboratory
Mr. John Adams (CEORD-PE-GL)
USACE Ohio River Division Laboratory
11275 Sebring Drive
Cincinnati, Ohio 45240-2714
Telephone: (513)-589-3604

II.7.0 Investigation-Derived Waste Management Plan

Anticipated IDW during the investigation includes excess soil samples, decontamination fluid, and disposable personal protective equipment. Detailed procedures of IDW management are provided in Chapter 8.0 of the SAP (IT, 1996a). The following is a brief summary of the procedures for handling IDW.

II.7.1 Surface Soil

Residual surface soil will be used as backfill or spread out on the surface at the point of origin.

II.7.2 Drill Cuttings from Borings

Soil cuttings from soil borings and excess soil samples will be returned immediately after sample collection to the point of origin (backfill).

II.7.3 Decontamination Fluids

Decontamination water will be collected and stored in 55-gallon drums and transported to the designated on-site disposal area located in the Pentolite Road Red Water Pond, south of Pentolite Road, for disposal. Decontamination chemicals (methanol) will be kept in a stainless-steel pan and will be allowed to evaporate. Residues will be disposed of in the on-site disposal area.

Attachment III

Site-Specific Sampling and Analysis Plan, Wastewater Disposal Plan No. 2

Attachment III

Site-Specific Sampling and Analysis Plan
Site Investigation at
Waste Water Disposal Plant No. 2 (WP2)
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

Commander
U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

September 1996

(This SSAP must be used in conjunction with the PBOW SAP)

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List of Acronyms

AR/COC	Analysis Request/Chain of Custody
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
g	gram
IDW	investigation-derived waste
IT	IT Corporation
mL	milliliter
nm	nanometer
PBOW	Plum Brook Ordnance Works
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
SVOC	semivolatile organic compound
TNT	trinitrotoluene
USACE	U.S.Army Corps of Engineers
VOC	volatile organic compound
WP2	Waste Water Disposal Plant No. 2

III.1.0 Project Description

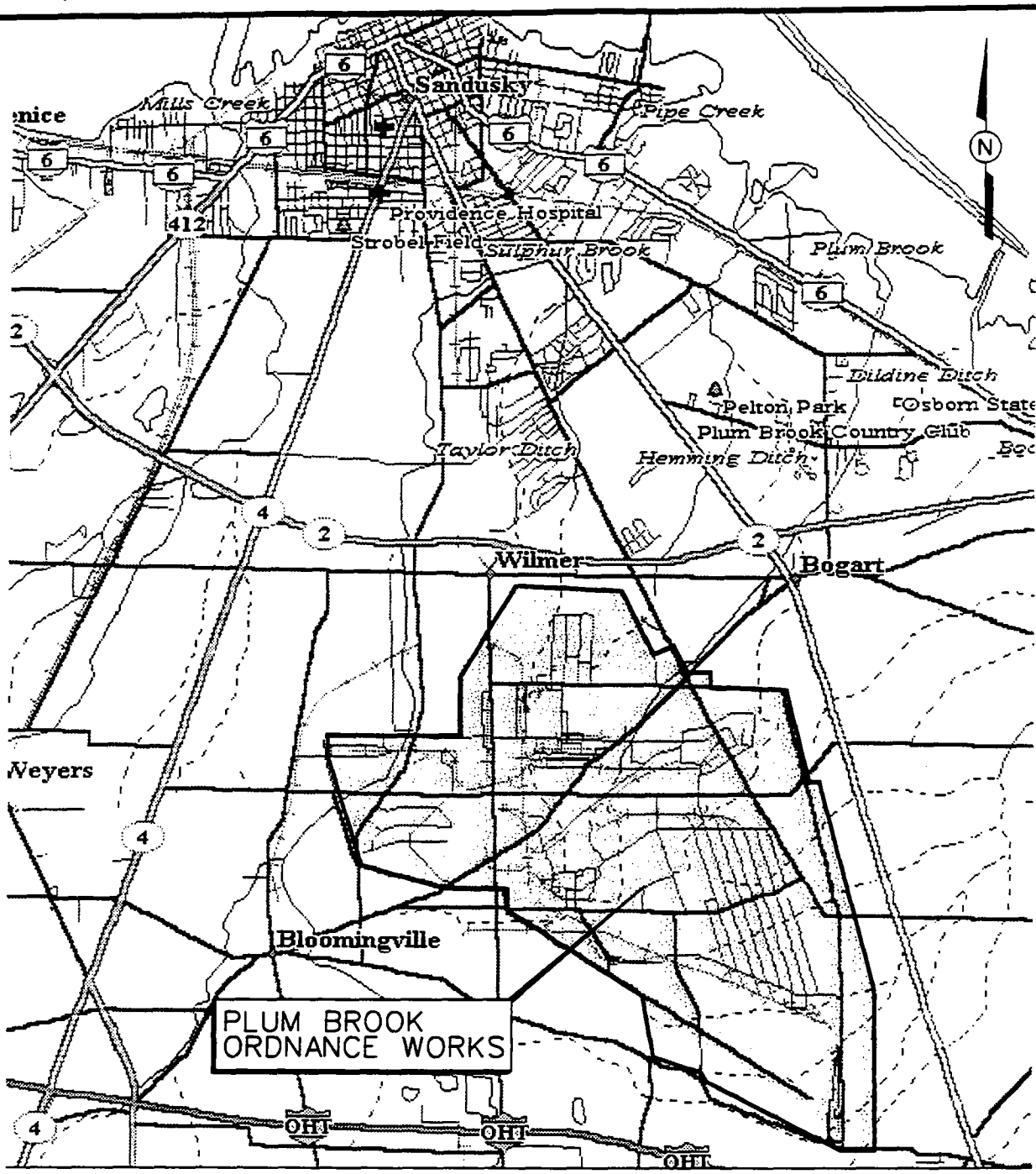
The U.S.Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S.Department of Defense properties. This work is being pursued by the U.S.Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance works (PBOW) site, located in Sandusky, Ohio, is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District office. Work contracted to IT Corporation (IT) includes providing engineering services to site investigations (SI) at the former Waste Water Disposal Plant No. 2 (WP2) at PBOW (Figure III-1).

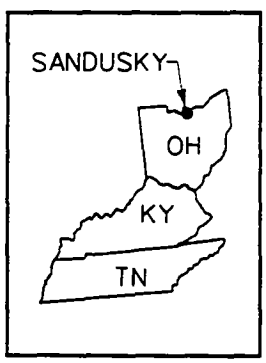
As an attachment to the PBOW sitewide sampling and analysis plan (SAP)(IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the SI at the former WP2. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP)(IT, 1996b) to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this SI which must be used in conjunction with the sitewide safety and health plan (SHP)(IT, 1996c).

III.1.1 Site History

PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to Ordnance Department, then to the War Assets Administration after it was certified by the U.S.Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration. The National Aeronautics and Space Administration acquired the PBOW in 1963 and is presently utilizing the site.

The former WP2 was located due west of the Power Station No. 2 ash pit on the opposite side of Pipe Creek as shown in Figure III-2. Historical data shows that this area might have received waste water discharged from the wastewater settling basins at TNT Area C during PBOW operation. According to the records review report (Dames & Moore, 1995), WP2





NOT TO SCALE

FIGURE III -1

VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 6-11-96	DATE LAST REV.:	DRAFT. CHCK. BY: CEI	INITIATOR: G. YU	DWG. NO.: 766952ES.005
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON	PROJ. NO.: 766952

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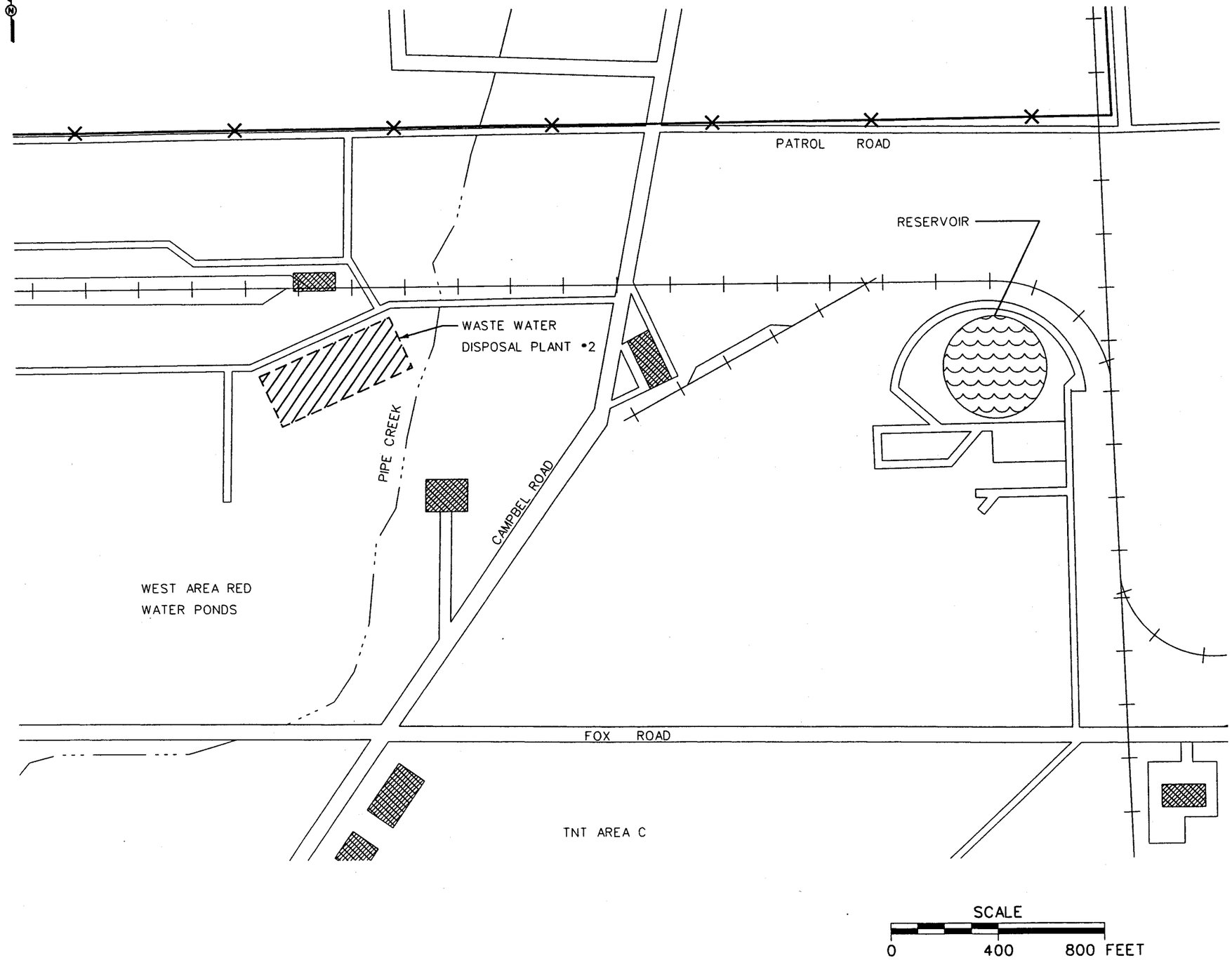

LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- APPROXIMATE INVESTIGATION AREA BOUNDARY

FIGURE III-2
SITE LOCATION MAP
WASTE WATER DISPOSAL
PLANT NO. 2

FORMER PLUM BROOK ORDNANCE
WORKS
SANDUSKY, OHIO

INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 7/7/96	DATE LAST R.	DRAFT. CHCK. BY: CET	INITIATOR: G. YU
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON
			DWG. NO.: 7(.S.011
			PROJ. NO.: 766952

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consisted of an evaporator and incinerator, and the wastewater was discharged from the plant into open ditches. This disposal plant is reported to be dismantled prior to 1963.

III.1.2 Summary of Existing Site Data

No site-specific records of previous environmental investigations in WP2 were available. Therefore, no site-specific contaminations are known to exist. However, this area is in close proximity of the West Area Waste Water Ponds where site contaminations of volatile organic compounds (VOC) and nitroaromatic compounds were detected during previous investigations. During the recent site visit, the area was found to be heavily wooded. Other possible contaminants may include semivolatile organic compounds (SVOC), cyanide, and metals.

III.2.0 Project Organization and Responsibility

The project organization for this site investigation consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.

III.3.0 Scopes and Objectives

III.3.1 Scope

As specified in the statement of work (USACE, 1996), the scope for the site investigation at WP2 at PBOW consists of preparation of site-specific work plans; completion of field activities including collection of surface and subsurface soil samples from ten boring locations for field screening and laboratory chemical analysis; evaluation of analytical results; and preparation of the investigation report of activities, conclusions, and recommendations for future actions.

III.3.2 Objectives

General purpose of the PBOW site investigations has been stated in Section 3.2 of the SAP (IT, 1996a). Specific objectives of the WP2 SI are summarized as follows:

- Determine the existence and nature of contamination in site soils.
- Determine if soil contamination poses a threat to human health or the environment.

III.3.3 Site-Specific Data Quality Objectives

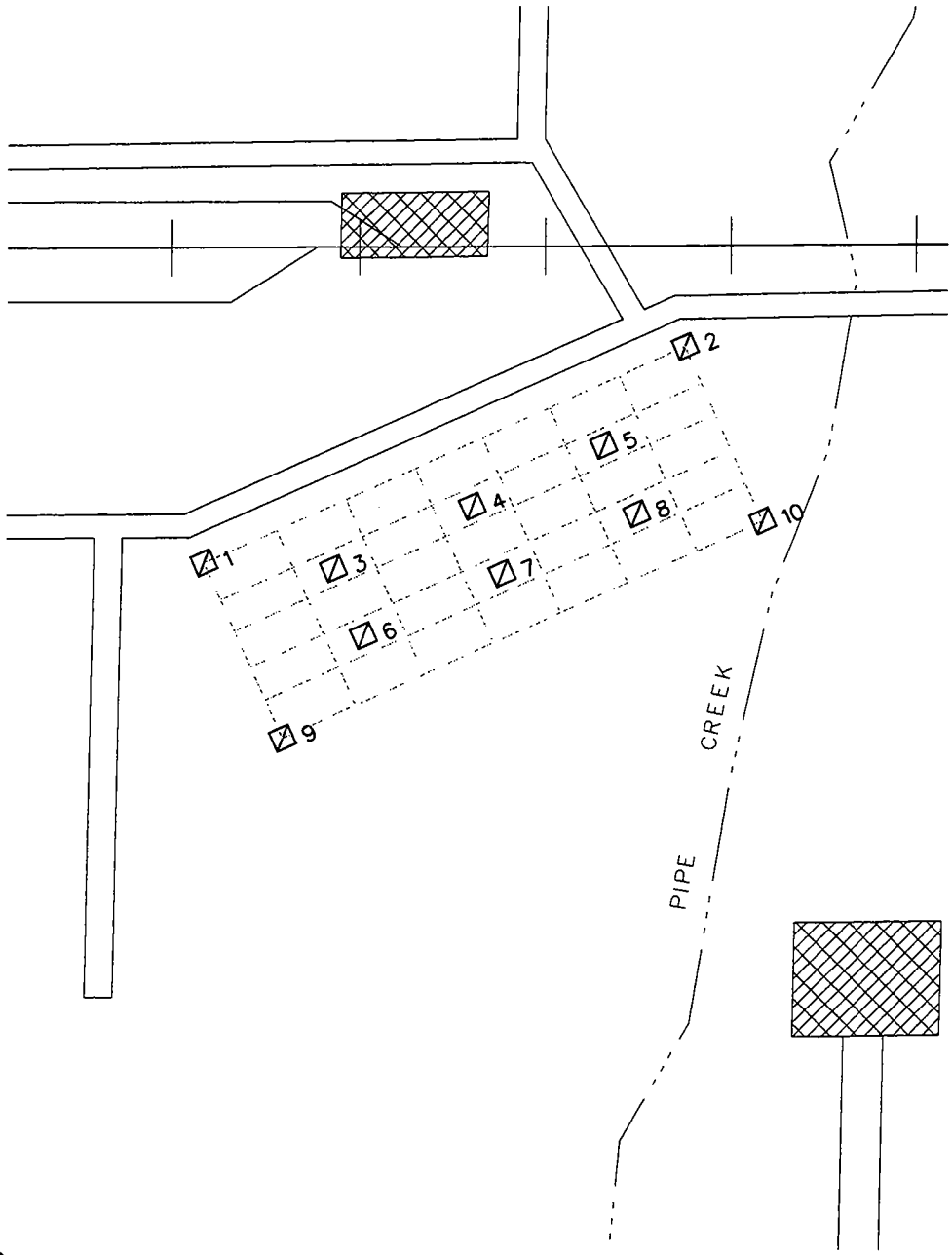
Overview. The data quality objectives (DQO) process is followed to evaluate data requirements and to support the decision making process associated with the action selection for WP2 This section incorporates the components of the DQO process described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund*; the DQO process as applied to PBOW sites is described in more detail in Section 3.3 of the Site-wide SAP. The factors used to determine the sampling quantity and procedures necessary to meet the objectives of the SIs and to establish a basis for future action at the sites and a general decision-making process diagram are presented in Table 3-1 and in Figure 3-2 of the site-wide SAP, respectively.

Data Users and Available Data. The intended data users and available data related to the SI at WP2 presented in Table 3-1 of the site-wide SAP have been used to formulate a site-specific conceptual model to support the development of this SSAP necessary to meet the objectives of the SI and to establish a basis for future action at the site. The data users for information generated during this SI are primarily the EPA, USACE, Ohio Environmental Protection Agency (OEPA), PBS, and the USACE's supporting contractors. This SSSAP, along with the necessary companion documents, has been designed to provide the regulatory agencies with sufficient detail to reach a determination as to the adequacy of the SSSAP. The program has also been designed to provide the USACE with the level of defensible information required to confirm or deny the existence and nature of residual chemical contamination in site media.

Conceptual Site Model. Four factors have been considered in defining the conceptual model for WP2:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Contaminants of Concern.

Potential sources of contamination at WP2 include the use of the site for waste water disposal purpose during TNT manufacturing operations. The migration pathways include groundwater infiltration, soil, surface water runoff to the creek. The most likely receptors at WP2 are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants is unlikely at WP2 since the site is a portion of a secure NASA research station.



LEGEND:

BUILDINGS

RAILROAD

DITCH

1 PROPOSED SOIL BORING (WP2SO-01)(INCLUDING SOIL SCREENING SAMPLES)

SCALE

0 200 400 FEET

FIGURE III-3
PROPOSED SOIL BORING LOCATION
SITE INVESTIGATION WASTE WATER DISPOSAL PLANT NO.2

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 7/7/96	DATE LAST REV.:	DRAFT. CHCK. BY: CET	INITIATOR: G. YU	DWG. NO.:766952ES.013
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.:D. BURTON	PROJ. NO.:766952

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However, potential receptors near the facility may include off-site water users. Potential contaminants of concern based on past use of the site may include VOCs, SVOCs, metals, pesticides/PCBs, total cyanide, and nitroaromatics.

Decision-Making Process, Data Uses, and Needs. The decision-making process consists of a seven-step process which is presented in detail in Section 3.3.3 of the site-wide SAP and will be followed during the SI at WP2. Data uses and needs are summarized in Table 3-1 of the site-wide SAP.

Risk Evaluation. Confirmation of contamination at WP2 will be based upon a comparison of detected site contaminants to the most current guidance criteria. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in site media. Definitive data will be adequate for confirming the presence of site contamination and for supporting a feasibility study and risk assessment.

Data Quality, Types, and Quality. Soil will be sampled and analyzed in order to meet the objectives of the SI at WP2. QA/QC samples will be collected for all sample types as described in Section III.4.2.2 of this SSSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the SI, data analyzed at this level of quality are appropriate for all phases of site characterization and risk assessment.

Precision. Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this SI are provided in Section 3.3.4.4.3 of the site-wide SAP.

III.4.0 Field Activities

Field activities in WP2 include collection of surface and subsurface soil screening samples, collection of confirmation soil samples, land survey, and management of investigation-derived wastes (IDW).

III.4.1 Boring Locations

Ten soil boring locations will be selected within WP2 to allow collection of 20 field soil screening samples and up to 10 confirmation soil samples along with required quality assurance/quality control (QA/QC) samples. These soil boring locations are selected based on the systematic grid sampling strategy in order to provide better site coverage with limited numbers of samples and to minimize sampling bias. Because confirmation soil samples

cannot be collected from the same boring from which screening samples are collected, additional borings for confirmation samples will be installed adjacent to the screening boring location. Tentative soil boring locations are shown in Figure III-3 and are subject to change if site conditions warrant.

III.4.2 Surface and Subsurface Soil

A total of 20 field screening soil samples will be collected from ten borings from depths of 0 to 0.5 feet and 4 to 5 feet. These samples will be analyzed on site and the results will be used to select boring locations for confirmation samples. Field screening of soil samples will be performed by an IT field chemist using a field screening kit following procedures outlined in Section III.5.2.1 of this SSAP.

Up to ten confirmation samples will be collected from the ten soil borings. Samples will be collected from the surface (0 to 6 inches) and/or from a depth of 4 to 5 feet. The objective of collecting confirmation soil samples is to correlate the results of field screening, both positive and negative, with more definitive analytical methods. Therefore, confirmation samples will be collected around screening sample locations that exhibits both positive and negative field screening results. Analytical parameters and laboratory methodologies will be discussed in Section III.5.2.2 of this SSAP.

Either a hand auger, a portable gas-powered drill rig, or a truck-mounted drill rig will be used to drill borings to a specific depth. Soil samples for field screening and laboratory analysis will be collected using stainless-steel split spoons or hand augers; undisturbed samples will be collected for VOC analysis using a drive sampler. If a drive sampler cannot be used effectively due to the proximity of bedrock or weathered bedrock, then care will be used to collect a disturbed sample and place it in the appropriate container. If the quantity of soil in the spoon is not sufficient, then an additional boring will be advanced immediately adjacent to the original boring, and samples will be collected at the same interval as the original sample. Upon completion of sampling, soil borings will be backfilled with soil cuttings removed from the borehole during drilling. Each borehole will be staked, labeled, and surveyed. A summary of soil sample designation and QA/QC samples to be collected is provided in Table III-1.

All soil samples collected by IT field personnel will be documented through the use of Analysis Request/Chain of Custody Record forms (AR/COC, Figure 6-2 of the SAP) following field custody procedures specified in Section 5.1 of the QAPP (IT, 1996b).

Table III-1
Summary of Soil Sample Designation and QA/QC Sample Quantity
Site Investigation at Waste Water Disposal Plant No.2
Former Plume Brook Ordnance Works
Sandusky, Ohio

Screening Soil Sample Designation	Soil Boring Designation	Sampling Depth Interval (feet, bgs)	Confirmation Sample and QA/QC Sample Quantity				
			Confirmation Soil Sample Designation[a]	FD/FS	MS/MD	FB	ER
PBOW-96-SS-WP2-SO01-3010-(0-0.5)	WP2SO01	0-0.5	PBOW-96-SO-WP2-SO01-3210-(0-0.5)				X
PBOW-96-SS-WP2-SO01-3020-(4-5.0)		4-5.0					
PBOW-96-SS-WP2-SO02-3030-(0-0.5)	WP2SO02	0-0.5					
PBOW-96-SS-WP2-SO02-3040-(4-5.0)		4-5.0	PBOW-96-SO-WP2-SO02-3220-(4-5.0)				
PBOW-96-SS-WP2-SO03-3050-(0-0.5)	WP2SO03	0-0.5	PBOW-96-SO-WP2-SO03-3230-(0-0.5)				
PBOW-96-SS-WP2-SO03-3060-(4-5.0)		4-5.0					
PBOW-96-SS-WP2-SO04-3070-(0-0.5)	WP2SO04	0-0.5					
PBOW-96-SS-WP2-SO04-3080-(4-5.0)		4-5.0	PBOW-96-SO-WP2-SO04-3240-(4-5.0)	X		X	
PBOW-96-SS-WP2-SO05-3090-(0-0.5)	WP2SO05	0-0.5	PBOW-96-SO-WP2-SO05-3250-(0-0.5)				
PBOW-96-SS-WP2-SO05-3100-(4-5.0)		4-5.0					
PBOW-96-SS-WP2-SO06-3110-(0-0.5)	WP2SO06	0-0.5					
PBOW-96-SS-WP2-SO06-3120-(4-5.0)		4-5.0	PBOW-96-SO-WP2-SO06-3260-(4-5.0)				
PBOW-96-SS-WP2-SO07-3130-(0-0.5)	WP2SO07	0-0.5					
PBOW-96-SS-WP2-SO07-3140-(4-5.0)		4-5.0	PBOW-96-SO-WP2-SO07-3270-(4-5.0)				
PBOW-96-SS-WP2-SO08-3150-(0-0.5)	WP2SO08	0-0.5	PBOW-96-SO-WP2-SO08-3280-(0-0.5)				
PBOW-96-SS-WP2-SO08-3160-(4-5.0)		4-5.0					
PBOW-96-SS-WP2-SO09-3170-(0-0.5)	WP2SO09	0-0.5	PBOW-96-SO-WP2-SO09-3290-(0-0.5)		X	X	X
PBOW-96-SS-WP2-SO09-3180-(4-5.0)		4-5.0					
PBOW-96-SS-WP2-SO10-3190-(0-0.5)	WP2SO10	0-0.5					
PBOW-96-SS-WP2-SO10-3200-(4-5.0)		4-5.0	PBOW-96-SO-WP2-SO10-3300-(4-5.0)				

a - Tentative sampling location. Adjustment will be made in the field based on screening results.
FD/FS - Field duplicate/field split sample
MS/MD - Matrix spike/matrix spike duplicate
FB - Field blank sample
ER - Equipment rinsate sample

III.5.0 Sample Analysis and Decontamination Needs

III.5.1 Sample Numbering System

The sample numbering system to be used during this investigation will conform to USACE Nashville District's numbering convention. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number consists of a group of letters and numbers, separated by hyphens. The sample media and numbering system to be used for the WP2 SI is described as follows:

Project Code	Year	Sample Number	Site Identification	Site Location	Sample Number	Depth
PBOW	96	XXXX	WP2	XXXX	XXXX	(XX-XX)

Sample types:

SO - Soil sample
MS - Matrix spike sample
MD - Matrix spike duplicate sample
FD - Field duplicate sample
FS - Field split sample
SS - Field screening sample
FB - Field blank sample
ER - Equipment rinsate sample.

"PBOW-96-SO-WP2-SO03-3050-(0-0.5)" signifies that this soil sample is collected at a depth between 0 and 0.5 foot below ground surface from soil boring 03 at WP2 with a laboratory number of 3050. The sample identification number will be recorded by the IT field geologist in the Field Activity Daily Log, Boring Log, and Sample Collection Log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

III.5.2 Analytical Program

All soil samples designated for chemical analysis will be collected as described in Section III.4.4.2. Soil samples collected from borings will be placed in appropriate sample containers, sealed, labeled, and shipped. These samples will be analyzed for chemical parameters including VOCs, SVOCs, metals, pesticides/PCBs, total cyanide, and nitroaromatic compounds as listed in Table III-2, along with analytical methods. All soil samples will be sent to Quanterra Environmental Services, located in Knoxville, Tennessee for analysis, using approved analytical methods listed in Table III-2. Laboratory QA/QC protocol and data

reporting requirements will follow procedures specified in Chapter 9.0 of the QAPP(IT, 1996b). Data validation will be performed by an independent subcontractor.

III.5.2.1 Analysis of Field Screening Samples

Soil samples will be screened on site by an IT field chemist for the presence of 2,4,6-TNT, as per USACE's *Field Method for Determination of 2,4,6-TNT in Soil* (Jenkins, 1990). Specifically, a soil sample will be prepared for analysis by transferring a weighted 20 gram (g) aliquot of soil to a 120-milliliter (mL) clear class bottle and autopipetting 100 mL of acetone. The bottle will be capped and shaked vigorously for a minimum of 3 minutes and the contents will be allowed to settle for a minimum of 5 minutes. A 25-mL aliquot of the extract will be syringe-filtered through a 0.5-micro filter into a 25-mL glass cuvette. The absorbance of the extract at 540 nanometer (nm) will be measured on a spectrophotometer against an acetone reference. After recording the absorbance volume, approximately 0.1 to 0.5 g of sodium sulfite (Na_2SO_3), along with one pellet of potassium hydroxide (KOH), will be immediately syringe-filtered through a second 0.5-micro filter into a clean 25-mL glass cuvette. A second absorbance measurement of the reacted extract at 540 nm will be taken. The addition of sodium sulfite and potassium hydroxide will cause the formation of red color in the extract solution if TNT is present. The color intensity is directly proportional to the concentration of TNT in the solution. No attempt will be made in the field to quantify the concentrations of TNT in the solution.

During field screening, a start- and end-of-day standard and duplicate samples will be run to allow evaluation of the quality and consistency of field screening results. Field screening results will be recorded in the field log shown in Table III-3.

III.5.2.2 Analysis of Confirmation Soil Samples

All confirmation soil samples will be analyzed using the methodologies and for the parameters listed in Table III-2 by Quanterra Environmental Services in Knoxville, Tennessee.

III.5.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SAP and will be followed during the WP2 SI. The IT field coordinator will need to contact Plum Brook Station for access to potable water source for decontamination use. The following summarizes decontamination procedures for sampling equipment before site entry, between borings, and before site departure:

Equipment used not in contact with analytical samples:

- Steam-rinse with potable water, or wash and scrub using a brush with non-phosphate detergent, then rinse with potable water.

Equipment used to collect analytical samples:

- Wash and scrub using a brush with nonphosphate detergent.
- Rinse with potable water.
- Rinse with deionized water (American Society for Testing and Materials Type II water).
- Rinse with methanol.
- Final rinse with deionized water. The volume of water used will be at least five times greater than the volume of methanol used.
- Air dry.
- Wrap in aluminum foil.

III.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned containers from I-CHEM, made of materials recommended by the U.S. Environmental Protection Agency in Title 40 Code of Federal Regulations Part 136 and SW-846 (3rd Edition). Sample containers and preservative/preservation methods are summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that the sample is received by the laboratory.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimized the possibility of container breakage by using vermiculite or styrofoam peanuts to fill void space in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4 degrees Celsius and maintained at that temperature by means

of blue ice or packaged ice from the time the shipping container is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of shipment. If this is not possible, the laboratory will be notified the following morning. Field split samples will be sent to the USACE-designated QA/QC laboratory following the same procedures as for other primary laboratory samples.

Completed AR/COC records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or

USACE QA Laboratory
Mr. John Adams (CEORD-PE-GL)
USACE Ohio River Division Laboratory
11275 Sebring Drive
Cincinnati, Ohio 45240-2714
Telephone: (513)-589-3604

III.7.0 Investigation-Derived Waste Management Plan

Anticipated IDW during the investigation includes excess soil samples, decontamination fluid, and disposable personal protective equipment. Detailed procedures of IDW management is provided in Chapter 8.0 of the SAP (IT, 1996a). The following is a brief summary of the procedures for handling IDW.

III.7.1 Surface Soil

Residual surface soil will be used as backfill or spread out on the surface at the point of origin.

III.7.2 Drill Cuttings from Borings

Soil cuttings from soil borings and excess soil samples will be returned immediately after sample collection to the point of origin (backfill).

Attachment III

Site-Specific Safety and Health Plan
Site Investigation of
Waste Water Disposal Plant No. 2 (WP2)
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

September 1996

(This SSHP must be used in conjunction with the PBOW SHP)

Reviews and Approvals

Program Manager
IT Corporation

_____ 12/12/96
Date

Health and Safety Manager
IT Corporation

_____ 12/12/96
Date

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List of Acronyms

dBA	A-weighted decibels
DERP	Defense Environmental Restoration Program
IT	IT Corporation
mg/m^3	milligram per cubic meter
PBOW	Plum Brook Ordnance Works
PPE	personal protective equipment
ppm	parts per million
2BG	Reservoir No. 2 Burning Grounds
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SI	site investigation
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
WP2	Waste Water Disposal Plant No. 2

III.1.0 Site Work Plan Summary

The U.S Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S. Department of Defense properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW), located in Sandusky, Ohio, is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering services to conduct a site investigation (SI) at the Waste Water Disposal Plant No. 2 (WP2) at PBOW.

As an attachment to the PBOW sitewide safety and health plan (SHP), this site-specific safety and health plan (SSHP) has been prepared for the work to be carried out in support of the 2BG SI at PBOW. This SSHP must be used in conjunction with the SAP and the quality assurance project plan to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific sampling and analysis plan (SSAP) has also been prepared separately for this SI that must be used in conjunction with the sitewide sampling and analysis plan (SAP).

Project Objective. The specific objectives of the WP2 SI are summarized as follows:

- Determine the existence and nature of contamination in site soils.
- Determine if soil contamination poses a threat to human health or the environment.

Project Tasks

- Surface and subsurface soil sampling from ten soil boring locations.

Personnel Requirements. Up to 15 employees will be needed. All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the PBOW SHP.

III.2.0 Site Characterization and Analysis

III.2.1 Anticipated Hazards

Chemical and Physical Hazards. The job hazard analysis in Section III.4.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The job hazard analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

Employee Protection for Initial Site Entry. Level D protection is required with chemical-resistant gloves as specified in Chapter 5.0 and emergency equipment as specified in Chapter 11.0 of the SHP.

III.2.2 General Site Information

Location and Approximate Size of Site. The WP2 is located due west of the Power Station No. 2 ash surface impoundment, across Pipe Creek. WP2 is known to have received wastewater from a wastewater settling basins at TNT Area C. The site location map is provided in the SAP.

Duration of Planned Employee Activity. Planned employee activity is estimated at 2 to 6 months.

Site Topography. The site is disintegrating pavement being overgrown with brush and is located on relatively flat topography.

Site Accessibility (By Road). WP2 is accessed via Campbell Street.

Pathways for Hazardous Substance Dispersion. Possible pathways for hazardous substances in the area are groundwater, surface water, soils, and sediments.

III.3.0 Site Monitoring

The environmental contaminants of concern include organic compounds, cyanide, metals, and nitroaromatics. Nitroaromatic contamination resulted from industrial sewer lines, process and refining facilities, materials, wastes, or intermittent compounds associated with production of 2,4,6-trinitrotoluene (TNT). Petroleum hydrocarbons were used in processes at the former TNT Manufacturing Area. The potential for exposure to these contaminants is unlikely; however, monitoring will be conducted as follows:

Chemical or Physical Agent	Permissible Exposure Limit	Action Level	Monitoring Equipment	Sampling and Analytical Method	Frequency of Analytical Method
Particulates	0.5 milligrams per cubic meter (mg/m^3) (TNT) 1.0 mg/m^3 (dinitrotoluene)	1 mg/m^3	Dust Monitor	Direct Reading	During Activities When Airborne Dust is Generated
Petroleum Hydrocarbons	100 parts per million (ppm) (Toluene) 100 ppm (Xylene)	20 ppm	photoionization detector or organic vapor analyzer	Direct Reading	During Ground-intrusive Activities
Noise	90 A-weighted decibels (dBA)	85 dBA	Sound Level Meter	Direct Reading	Not Necessary

If noticeable odors are present in the workplace but direct-reading instruments do not detect any volatile contaminants or if levels exceed the action level specified in the table, evacuate area and allow contaminant to dissipate. Don Level C PPE as described in PBOW SHP, and retest. If odors or levels continue, either postpone work until conditions return to background levels or contact the health and safety manager for assistance. In the case of noise, noise levels during similar operations have been characterized. Hearing protection will be required by all employees working near heavy equipment or drill rig in operation.

Attachment IV

Site-Specific Sampling and Analysis Plan, Powerhouse No. 2 Ash Pit

Attachment IV

Site-Specific Sampling and Analysis Plan
Site Investigation at
Power House No. 2 Ash Pit (PH2)
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

Commander
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Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

September 1996

(This SSAP must be used in conjunction with the PBOW SAP)

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List of Acronyms

AR/COC	Analysis Request/Chain of Custody
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
IDW	investigation-derived waste
IT	IT Corporation
NAGD	North America Geodetic Datum
PBOW	Plum Brook Ordnance Works
PH2	Power House No. 2 Ash Pit
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SI	site investigation
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
SVOC	semivolatile organic compound
TNT	trinitrotoluene
USACE	U.S.Army Corps of Engineers
VOC	volatile organic compound

IV.1.0 Project Description

The U.S Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S. Department of Defense properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW) is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering services to conduct a site investigation (SI) in the Power House No. 2 Ash Pit (PH2) at the former PBOW, located in Sandusky, Ohio (Figure IV-1).

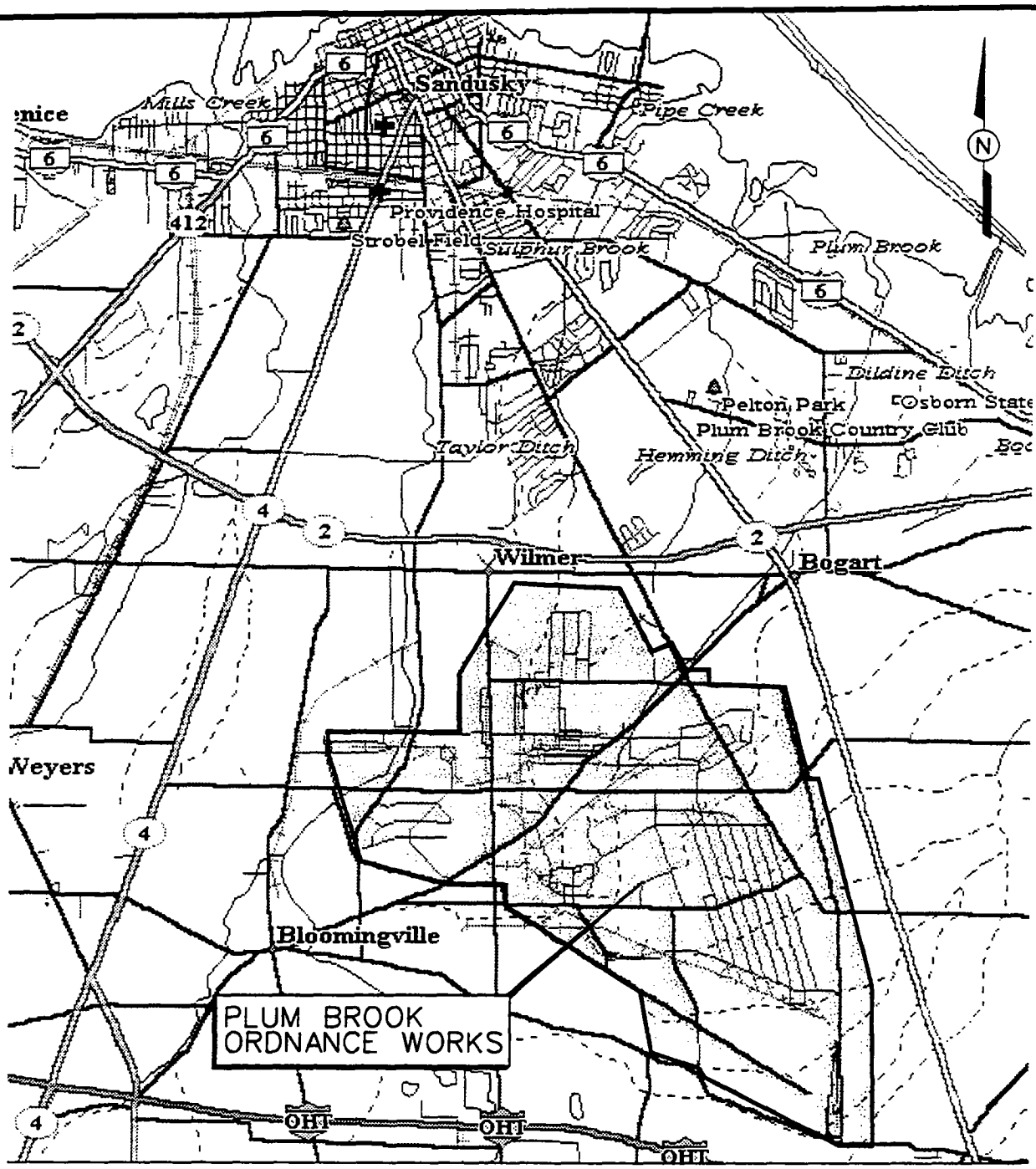
As an attachment to the PBOW sitewide sampling and analysis plan (SAP)(IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the PH2 SI at PBOW. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP)(IT, 1996b) to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this SI that must be used in conjunction with the sitewide safety and health plan (SHP)(1996c).

IV.1.1 Site History

The PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to Ordnance Department, then to the War Assets Administration after it was certified by the U.S.Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration. The National Aeronautics and Space Administration acquired the PBOW in 1963 and is presently utilizing the site.

IV.1.2 Summary of Existing Site Data

The PH2 site is located west of Campbell Road and east of Pipe Creek (Figure IV-2). According to the records review report (Dames & Moore, 1995), the ash pit was believed to be a surface impoundment rectangular in shape and measured 400 feet by 200 feet and was



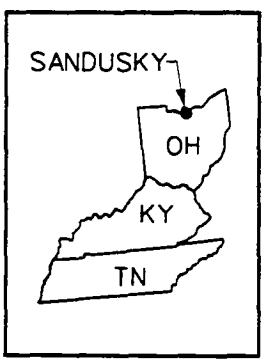


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FIGURE IV -1

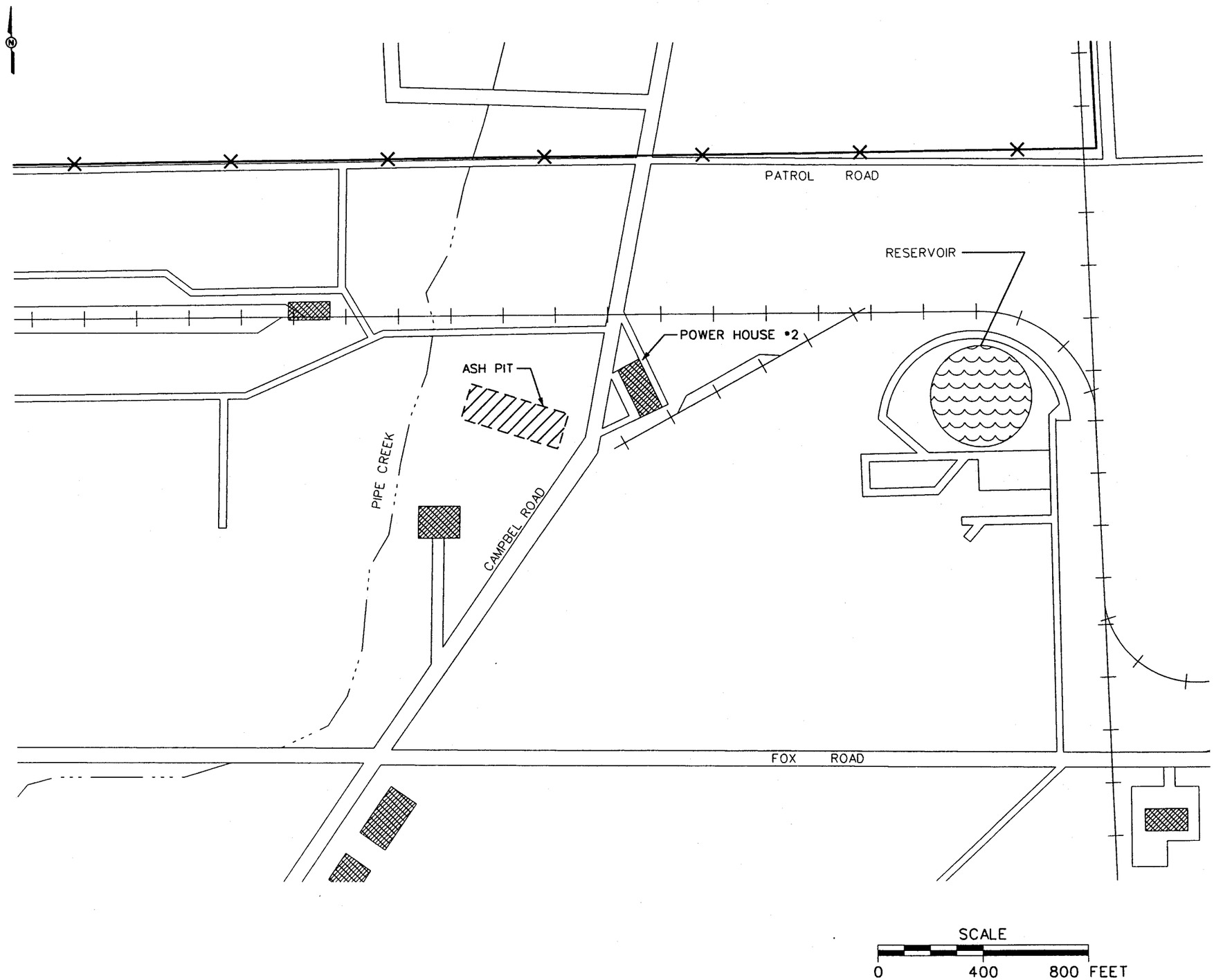
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 6-11-96	DATE LAST REV.:	DRAFT. CHCK. BY: CET	INITIATOR: G. YU	DWG. NO.: 766952ES.005
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON	PROJ. NO.: 766952

766952ES.005 14:16:12 JUL. 1, 1996 KHB



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- APPROXIMATE INVESTIGATION AREA BOUNDARY

FIGURE IV-2
SITE LOCATION MAP
POWER HOUSE NO.2 ASH PIT

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 7/7/96	DATE LAST	DRAFT. CHCK. BY: CET	INITIATOR: G. YU
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON
			DWG. NO.: ES.009
			PROJ. NO.: 766952

766952ES.009 7/16/96 10:40pm RMK

possibly surrounded by a 5-foot-wide and approximately 4-foot-high earthen embankment. Review of aerial photographs taken in 1950 and 1968 show an impoundment in the same location as that shown on the historical drawing. However, records review did not find documentation that would confirm the use of the impoundment during PBOW operation. During a site visit conducted by IT project members in May 1996, this area was found to be covered by dense undergrowth and trees so that access is not possible without clearing and grubbing.

Field reconnaissance conducted by Dames & Moore personnel and USACE in 1994 observed the bermed area and also found a considerable amount of black cinders inside the eastern two-thirds of the bermed area.

No records of previous environmental investigations were found in this area. Therefore, no site-specific contamination is known to exist. During PBOW operation, fly ash was generated on site at coal-fired power stations and in wastewater incinerator. The fly ash was mixed with water and disposed of and concentrated in the ash pit associated with the power house. Fly ash is suspected to be hazardous with respect to pH, metals, and possibly organic compounds.

IV.2.0 Project Organization and Responsibility

The project organization for the PH2 SI consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.

IV.3.0 Scope and Objectives

IV.3.1 Scopes

As specified in the statement of work (USACE, January, 1996), the scope for the SI at PH2 at PBOW consists of preparation of site-specific work plans; completion of field activities, including collection of surface and subsurface soil samples from 12 boring locations for chemical analysis; evaluation of analytical results; and preparation of the investigation report of activities, conclusions, and recommendations for future actions at the site.

IV.3.2 Objectives

The general purpose of the PBOW SI has been stated in Section 3.2 of the SAP (IT, 1996a). Specific objectives of the PH2 SI are summarized as follows:

- Determine the existence and nature of contamination in shallow soils
- Determine if soil contamination poses a threat to human health or the environment and if further investigation or cleanup of the site will be required.

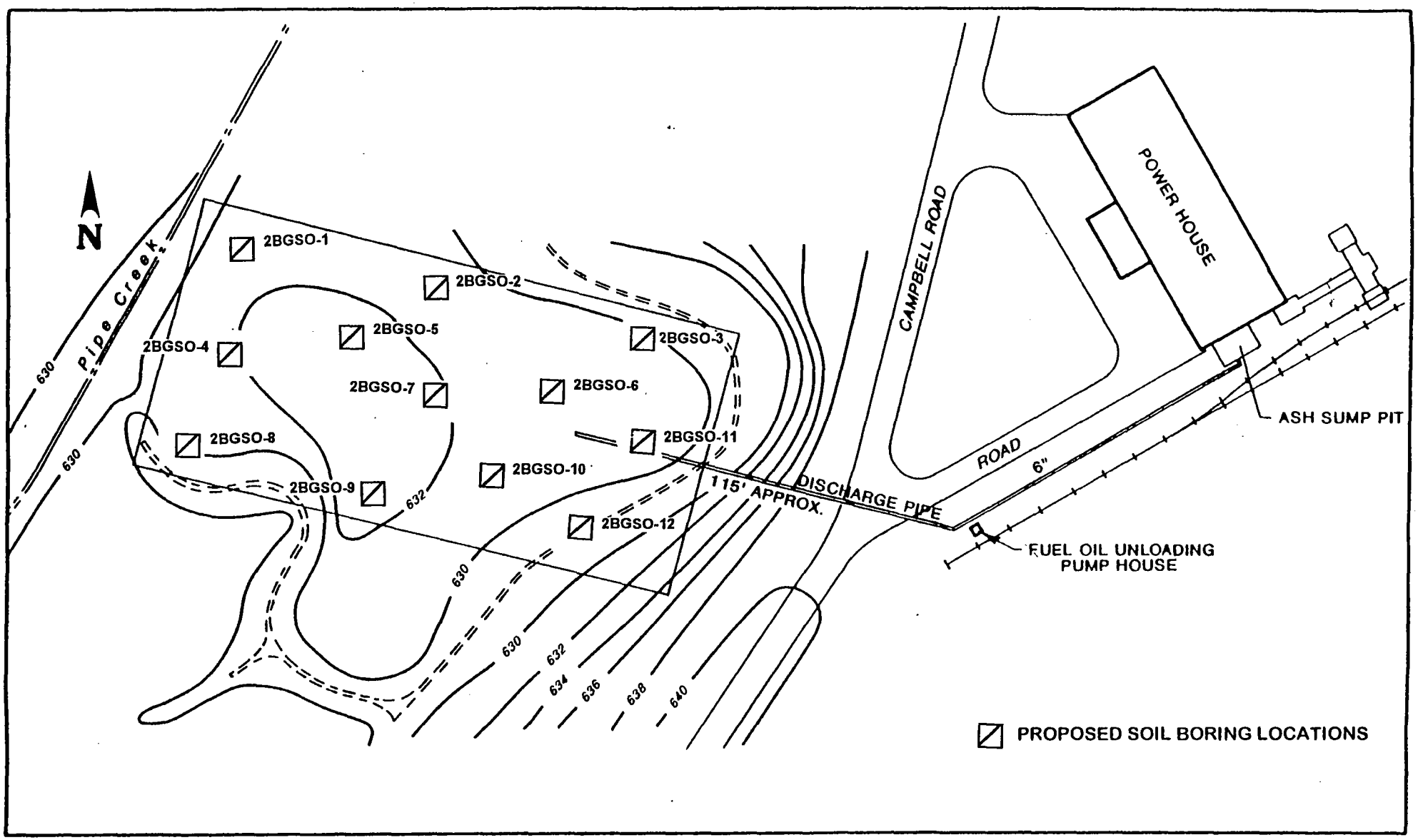
IV.3.3 Site-Specific Data Quality Objectives

Overview. The data quality objectives (DQO) process is followed to evaluate data requirements and to support the decision making process associated with the action selection for PH2 This section incorporates the components of the DQO process described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund*; the DQO process as applied to PBOW sites is described in more detail in Section 3.3 of the Site-wide SAP. The factors used to determine the sampling quantity and procedures necessary to meet the objectives of the SIs and to establish a basis for future action at the sites and a general decision-making process diagram are presented in Table 3-1 and in Figure 3-2 of the site-wide SAP, respectively. .

Data Users and Available Data. The intended data users and available data related to the SI at PH2 presented in Table 3-1 of the site-wide SAP have been used to formulate a site-specific conceptual model to support the development of this SSAP necessary to meet the objectives of the SI and to establish a basis for future action at the site. The data users for information generated during this SI are primarily the EPA, USACE, Ohio Environmental Protection Agency (OEPA), PBS, and the USACE's supporting contractors. This SSSAP, along with the necessary companion documents, has been designed to provide the regulatory agencies with sufficient detail to reach a determination as to the adequacy of the SSSAP. The program has also been designed to provide the USACE with the level of defensible information required to confirm or deny the existence and nature of residual chemical contamination in site media.

Conceptual Site Model. Four factors have been considered in defining the conceptual model for PH2:

- Potential contaminant sources
- Migration pathways



100 50 0 100 200 FEET

REFERENCE DRAWING: No. 1763-653 "Ash Disposal System for Plum Brook Ordnance Works, Sandusky, Ohio", E.B. Badger & Sons, 1941

(Modified from Figure 7-3, Records Review Report, Dames & Moore, 1995)

FIGURE IV-3

PROPOSED SOIL BORING LOCATIONS
SITE INVESTIGATION
POWER HOUSE #2 ASH PIT

Plum Brook Ordnance Works
Sandusky, Ohio

INTERNATIONAL TECHNOLOGY CORPORATION

- Potential receptors
- Contaminants of Concern.

Potential sources of contamination at PH2 include the use of the site for storage of coal ash during TNT manufacturing operations. The migration pathways include groundwater infiltration, soil, surface water runoff to the creek. The most likely receptors at PH2 are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants is unlikely at PH2 since the site is a portion of a secure NASA research station. However, potential receptors near the facility may include off-site water users. Potential contaminants of concern based on past use of the site may include VOCs, SVOCs, metals, pesticides/PCBs and total cyanide.

Decision-Making Process, Data Uses, and Needs. The decision-making process consists of a seven-step process which is presented in detail in Section 3.3.3 of the site-wide SAP and will be followed during the SI at PH2. Data uses and needs are summarized in Table 3-1 of the site-wide SAP.

Risk Evaluation. Confirmation of contamination at PH2 will be based upon a comparison of detected site contaminants to the most current guidance criteria. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in site media. Definitive data will be adequate for confirming the presence of site contamination and for supporting a feasibility study and risk assessment.

Data Quality, Types, and Quality. Soil will be sampled and analyzed in order to meet the objectives of the SI at PH2. QA/QC samples will be collected for all sample types as described in Section IV.4.2 of this SSSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the SI, data analyzed at this level of quality are appropriate for all phases of site characterization and risk assessment.

Precision. Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this SI are provided in Section 3.3.4.4.3 of the site-wide SAP.

IV.4.0 Field Activities

The primary field activity comprising the SI at PH2 include the collection of soil samples from 12 boring locations with required quality assurance/quality control (QA/QC) samples and followed by land survey of the 12 sampling locations. The rationale behind the sample locations and procedures to be followed in sample collection are presented in the following sections.

IV.4.1 Soil Boring Locations

Results of the field reconnaissance conducted by Dames & Moore personnel and USACE indicate that the eastern two-thirds of the ash pit impoundment is covered with cinders up to 1 foot in depth. Because a large portion of the site is covered with possible contaminant source material and since site history indicates that the entire impoundment was covered with potentially contaminated process wastewater during the operational period, there are no particular suspected source areas within the ash pit. Therefore, to construct a complete picture of site conditions, a systematic grid sampling strategy will be utilized. The approximate 200-by-400-foot ash pit impoundment will be divided into an 50-by-50-foot grid pattern. The sampling locations will be selected based on the grid as shown in Figure IV-3. The systematic grid sampling strategy is the more appropriate system for obtaining complete site coverage and minimizing sample location bias.

Two soil samples will be collected from each sampling location. The uppermost sample will be collected from 0 to 6 inches in native soil and the second sample will be collected from 2 to 3 feet below ground surface. QA/QC samples to be collected during this investigation include two samples collected in triplicate volume comprising one original, one field duplicate sample, and one QA sample. The QA sample will be submitted to the USACE-designated QA laboratory for analysis and evaluation. One additional sample will be collected in triplicate volume with the excess volume to serve as a matrix spike/matrix spike duplicate sample. Two equipment rinsates will be collected for laboratory analysis during the course of the soil investigation. All samples collected during the SI will be analyzed for volatile organic compounds (VOC), semivolatie organic compounds (SVOC), metals, and total cyanide. A summary of soil sample designation and QA/QC sample quantity is provided in Table IV-1.

All soil samples collected by IT field personnel will be documented through the use of Analysis Request/Chain of Custody Record forms (AR/COC, Figure 6-2 of the SAP) following field custody procedures specified in Section 5.1 of the QAPP (IT, 1996b).

Table IV-1
Summary of Soil Sample Designation and QA/QC Sample Quantity
Site Investigation at Power House No. 2 Ash Pit
Former Plume Brook Ordnance Works
Sandusky, Ohio

Soil Sample Designation	Soil Boring Designation	Sampling Depth Interval (feet, bgs)	QA/QC Sample Quantity			
			FD/FS	MS/MD	FB	ER
PBOW-96-SO-PH2-SO01-4010-(0-0.5)	PH2SO01	0-0.5				
PBOW-96-SO-PH2-SO01-4020-(2-3.0)		2-3.0				
PBOW-96-SO-PH2-SO01-4030-(0-0.5)	PH2SO02	0-0.5				
PBOW-96-SO-PH2-SO01-4040-(2-3.0)		2-3.0				
PBOW-96-SO-PH2-SO03-4050-(0-0.5)	PH2SO03	0-0.5				
PBOW-96-SO-PH2-SO03-4060-(2-3.0)		2-3.0				
PBOW-96-SO-PH2-SO04-4070-(0-0.5)	PH2SO04	0-0.5				
PBOW-96-SO-PH2-SO04-4080-(2-3.0)		2-3.0	X		X	X
PBOW-96-SO-PH2-SO05-4090-(0-0.5)	PH2SO05	0-0.5				
PBOW-96-SO-PH2-SO05-4100-(2-3.0)		2-3.0				
PBOW-96-SO-PH2-SO06-4110-(0-0.5)	PH2SO06	0-0.5				
PBOW-96-SO-PH2-SO06-4120-(2-3.0)		2-3.0				
PBOW-96-SO-PH2-SO07-4130-(0-0.5)	PH2SO07	0-0.5				
PBOW-96-SO-PH2-SO07-4140-(2-3.0)		2-3.0				
PBOW-96-SO-PH2-SO08-4150-(0-0.5)	PH2SO08	0-0.5				
PBOW-96-SO-PH2-SO08-4160-(2-3.0)		2-3.0	X	X	X	X
PBOW-96-SO-PH2-SO09-4170-(0-0.5)	PH2SO09	0-0.5				
PBOW-96-SO-PH2-SO09-4180-(2-3.0)		2-3.0				
PBOW-96-SO-PH2-SO10-4190-(0-0.5)	PH2SO10	0-0.5				
PBOW-96-SO-PH2-SO10-4200-(2--3.0)		2-3.0				
PBOW-96-SO-PH2-SO11-4210-(0-0.5)	PH2SO11	0-0.5				
PBOW-96-SO-PH2-SO11-4220-(2--3.0)		2-3.0				
PBOW-96-SO-PH2-SO12-4230-(0-0.5)	PH2SO12	0-0.5				
PBOW-96-SO-PH2-SO12-4240-(2--3.0)		2-3.0				

FD/FS - Field duplicate/field split sample
MS/MD - Matrix spike/matrix spike duplicate
FB - Field blank sample
ER - Equipment rinsate sample

IV.4.2 Sampling Procedures

Soil samples will be collected from the locations described in Section IV.4.1. Two samples will be collected from each location at depths from 0 to 6 inches and 2 to 3 feet in soil. However, if ash or cinders are encountered at depths of greater than 2 feet, samples will be collected from this material at the stated depths. Sample collection, logging and processing will proceed as described in the SAP (IT, 1996a) and as summarized in the following paragraph.

Hand augers with stainless-steel buckets or drive samplers with stainless-steel split spoons will be used to advance the borings and to collect the samples. Undisturbed samples will be collected for VOC analysis using a drive sampler. If a drive sampler cannot be used effectively due to the proximity of bedrock or weathered bedrock, then care will be used to collect a disturbed sample for VOC analysis. Subsequent to containerizing samples for VOC analysis, the remainder of the sample will be collected with either the drive sampler or the stainless-steel hand auger bucket and homogenized in a stainless-steel bowl using stainless-steel mixing equipment. If the quantity of soil collected from the necessary depth interval is not sufficient, then an additional boring will be advanced immediately adjacent to the original boring, and samples will be collected at the same interval as the original sample. Upon completion of sampling, soil borings will be backfilled with soil cuttings removed from the borehole. Each borehole will be staked, labeled, and surveyed . A summary of soil sample designation and QA/QC samples to be collected is provided in Table IV-1.

IV.4.3 Land Survey

The horizontal coordinates and elevations for each boring will be surveyed by a professional land surveyor registered in Ohio. The horizontal coordinates shall be to the closest 1.0 foot and referenced to the Ohio State Plane Coordinate System. Vertical coordinates (surface elevations) will be to the nearest 0.1 foot and referenced to the 1988 North America Geodetic Datum (NAGD). If the 1988 NAGD is not readily available, the existing local vertical datum shall be used. All survey data will be tabulated by the subcontractor.

IV.5.0 Sample Analysis and Decontamination Needs

IV.5.1 Sample Numbering System

The sample numbering system to be used during this investigation will conform to USACE Nashville District's numbering convention and be used in each of the site-specific investiga-

tions. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number consists of a group of letters and numbers, separated by hyphens. The sample media and numbering system to be used for the PH2 SI are described as follows:

Project Code	Year	Sample Type	Site Identification	Site Location	Sample Number	Depth
PBOW	96	XXXX	PH2	XXXX	XXXX	(XX-XX)

Sample types:

SO - Soil sample
MS - Matrix spike sample
MD - Matrix spike duplicate sample
FD - Field duplicate sample
FS - Field split sample
FB - Field blank
ER - Equipment rinsate.

"PBOW-96-SO-PH2-SO03-4050-(0-0.5)," signifies that this soil sample is collected at a depth between 0 and 0.5 foot below ground surface from soil boring 03 at PH2 with a laboratory sample number of 4050. The sample identification number will be recorded by the IT field geologist in the Field Activity Daily Log, Boring Log, and Sample Collection Log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

IV.5.2 Analytical Program

All soil samples designated for chemical analysis will be collected as described in Section IV.4.2. Soil samples collected from borings will be placed in appropriate sample containers, sealed, labeled, and shipped. These samples will be analyzed for chemical parameters including VOCs, SVOCs, metals, pesticides/PCBs, and total cyanide as listed in Table IV-2, along with analytical methods. All soil samples will be sent to Quanterra Environmental Services, located in Knoxville, Tennessee for analysis, using approved analytical methods listed in Table IV-2. Laboratory QA/QC protocol and data reporting requirements will follow procedures specified in Chapter 9.0 of the QAPP (IT, 1996b). Data validation will be performed by an independent subcontractor as stated in Chapter 8.0 of the QAPP.

IV.5.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SAP (IT, 1996a) and will be followed during the PH2 SI. The IT field coordinator will need to contact Plum Brook Station for access to potable water source for decontamination use. The following summarizes decontamination procedures for sampling equipment before site entry, between borings, and before site departure:

Equipment used not in contact with analytical samples:

- Steam-rinse with potable water, or wash and scrub using a brush with non-phosphate detergent, then rinse with potable water.

Equipment used to collect analytical samples:

- Wash and scrub using a brush with nonphosphate detergent.
- Rinse with potable water.
- Rinse with deionized water (American Society for Testing and Material Type II water).
- Rinse with methanol.
- Final rinse with deionized water. The volume of water used will be at least five times greater than the volume of methanol used.
- Air dry.
- Wrap in aluminum foil.

IV.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned containers from I-CHEM, made of materials recommended by the U.S. Environmental Protection Agency in Title 40 Code of Federal Regulations Part 136 and SW-846 (3rd Edition). Sample containers and preservative/preservation methods are summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that the sample is received by the laboratory.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimized the possibility of container breakage by using vermiculite or styrofoam peanuts to fill void space in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4 degrees Celsius and maintained at that temperature by means of blue ice or packaged ice from the time the shipping container is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of shipment. If this is not possible, the laboratory will be notified the following morning. Field split samples will be sent to the USACE-designated QA/QC laboratory following the same procedures as for other primary laboratory samples.

Completed AR/COC records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or

USACE QA Laboratory
Mr. John Adams (CEORD-PE-GL)
USACE Ohio River Division Laboratory
11275 Sebring Drive
Cincinnati, Ohio 45240-2714
Telephone: (513)-589-3604

IV.7.0 Investigation-Derived Waste Management Plan

Anticipated investigation-derived wastes (IDW) during the investigation include excess soil samples, decontamination fluid, and disposable personal protective equipment (PPE). Detailed procedures of IDW management is provided in Chapter 8.0 of the SAP (IT, 1996a). The following is a brief summary of the procedures for handling IDW.

Attachment IV

Site-Specific Safety and Health Plan
Site Investigation of
Powerhouse No. 2 Ash Pit (PH2)
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

September 1996

(This SSHP must be used in conjunction with the PBOW SHP)

Reviews and Approvals

Program Manager
IT Corporation

Donna S C Burton 12/12/96
Date

Health and Safety Manager
IT Corporation

Melissa G Smith 12/12/96
Date

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List of Acronyms

dBA	A-weighted decibels
DERP	Defense Environmental Restoration Program
IT	IT Corporation
PBOW	Plum Brook Ordnance Works
PH2	Powerhouse No. 2 Ash Pit
PPE	personal protective equipment
ppm	parts per million
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SI	site investigation
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
USACE	U.S. Army Corps of Engineers

IV.1.0 Site Work Plan Summary

The U.S Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S. Department of Defense properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW), located in Sandusky, Ohio, is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering services to conduct a site investigation (SI) at the Powerhouse No. 2 Ash Pit (PH2) at PBOW.

As an attachment to the PBOW sitewide safety and health plan (SHP), this site-specific safety and health plan (SSHP) has been prepared for the work to be carried out in support of the 2BG SI at PBOW. This SSHP must be used in conjunction with the SAP and the quality assurance project plan to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific sampling and analysis plan (SSAP) has also been prepared separately for this SI that must be used in conjunction with the sitewide sampling and analysis plan (SAP).

Project Objective. The specific objectives of the PH2 SI include:

- Determine the existence and nature of contamination in shallow soils
- Determine if soil contamination poses a threat to human health or the environment and if further investigation or cleanup of the site will be required.

Project Tasks

- Surface and subsurface soil sampling at 12 soil boring locations.

Personnel Requirements. Up to 15 employees will be needed. All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the PBOW SHP.

IV.2.0 Site Characterization and Analysis

IV.2.1 Anticipated Hazards

Chemical and Physical Hazards. The job hazard analysis in Section IV.4.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The job hazard analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment.

Employee Protection for Initial Site Entry. Level D protection is required with chemical-resistant gloves as specified in Chapter 5.0 and emergency equipment as specified in Chapter 11.0 of the SHP.

IV.2.2 General Site Information

Location and Approximate Size of Site. The PH2 is located west of Campbell Street approximately 1,000 feet south of its intersection with Patrol Road. The ash surface impoundment is approximately 200 feet wide by 400 feet long and surrounded by an earthen berm approximately 4 feet high and 5 feet wide. A site location map is provided in the SAP.

Duration of Planned Employee Activity. Planned employed activity is estimated at 2 to 6 months.

Site Topography. The site is covered by dense undergrowth and trees. Access to the site is impossible without cleaning and grubbing.

Site Accessibility (By Road). The site vicinity is accessed by Campbell Street.

Pathways for Hazardous Substance Dispersion. Possible pathways for hazardous substances in the area are groundwater, surface water, soils, and sediments.

IV.3.0 Site Monitoring

The environmental contaminants of concern include polynuclear aromatic hydrocarbons, volatile organic compounds, semivolatile organic compounds, and metals. Petroleum hydrocarbons were used in processes at the former TNT Manufacturing Area. The potential for exposure to these contaminants is unlikely; however, monitoring will be conducted as follows:

Chemical or Physical Agent	Permissible Exposure Limit	Action Level	Monitoring Equipment	Sampling and Analytical Method	Frequency of Analytical Method
Particulates	0.5 milligrams per cubic meter (mg/m^3) (trinitrolouene) 1.0 mg/m^3 (dinitrotoluene)	1 mg/m^3	Dust Monitor	Direct Reading	During Activities When Airborne Dust is Generated
Petroleum Hydrocarbons	100 parts per million (ppm) (Toluene) 100 ppm (Xylene)	20 ppm	photoionization detector or organic vapor analyzer	Direct Reading	During Ground-intrusive Activities
Noise	90 A-weighted decibels (dBA)	85 dBA	Sound Level Meter	Direct Reading	Not Necessary

If noticeable odors are present in the workplace but direct-reading instruments do not detect any volatile contaminants or if levels exceed the action level specified in the table, evacuate area and allow contaminant to dissipate. Don Level C PPE as described in PBOW SHP, and retest. If odors or levels continue, either postpone work until conditions return to background levels or contact the health and safety manager for assistance. In the case of noise, noise levels during similar operations have been characterized. Hearing protection will be required by all employees working near heavy equipment or drill rig in operation.

Attachment V

Site-Specific Sampling and Analysis Plan, Groundwater Investigation

Attachment V

Site-Specific Sampling and Analysis Plan
Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

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Revision 1

September 1996

(This SSAP must be used in conjunction with the PBOW SAP)

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List of Acronyms

ASTM	American Society for Testing and Material
bgs	Below ground surface
BNA	base/neutral and acid extractables
°C	degrees Celsius
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
EPA	U.S. Environmental Protection Agency
GWI	groundwater investigation
ID	inside diameter
IDW	investigation-derived waste
IT	IT Corporation
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyls
PPE	personal protective equipment
PVC	polyvinyl chloride
QAPP	quality assurance project plan
SAP	sitewide sampling and analysis plan
SHP	sitewide Safety and Health Plan
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
SVOC	semivolatile organic compounds
TAL	target analyte list
TCL	target compound list
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compounds
WARWP	West Area Red Water Pond

V.1.0 Project Description

The U.S Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S. Department of Defense properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW) is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering service to conduct a sitewide groundwater investigation (GWI) at the former PBOW site with a particular focus on the western portion of the installation.

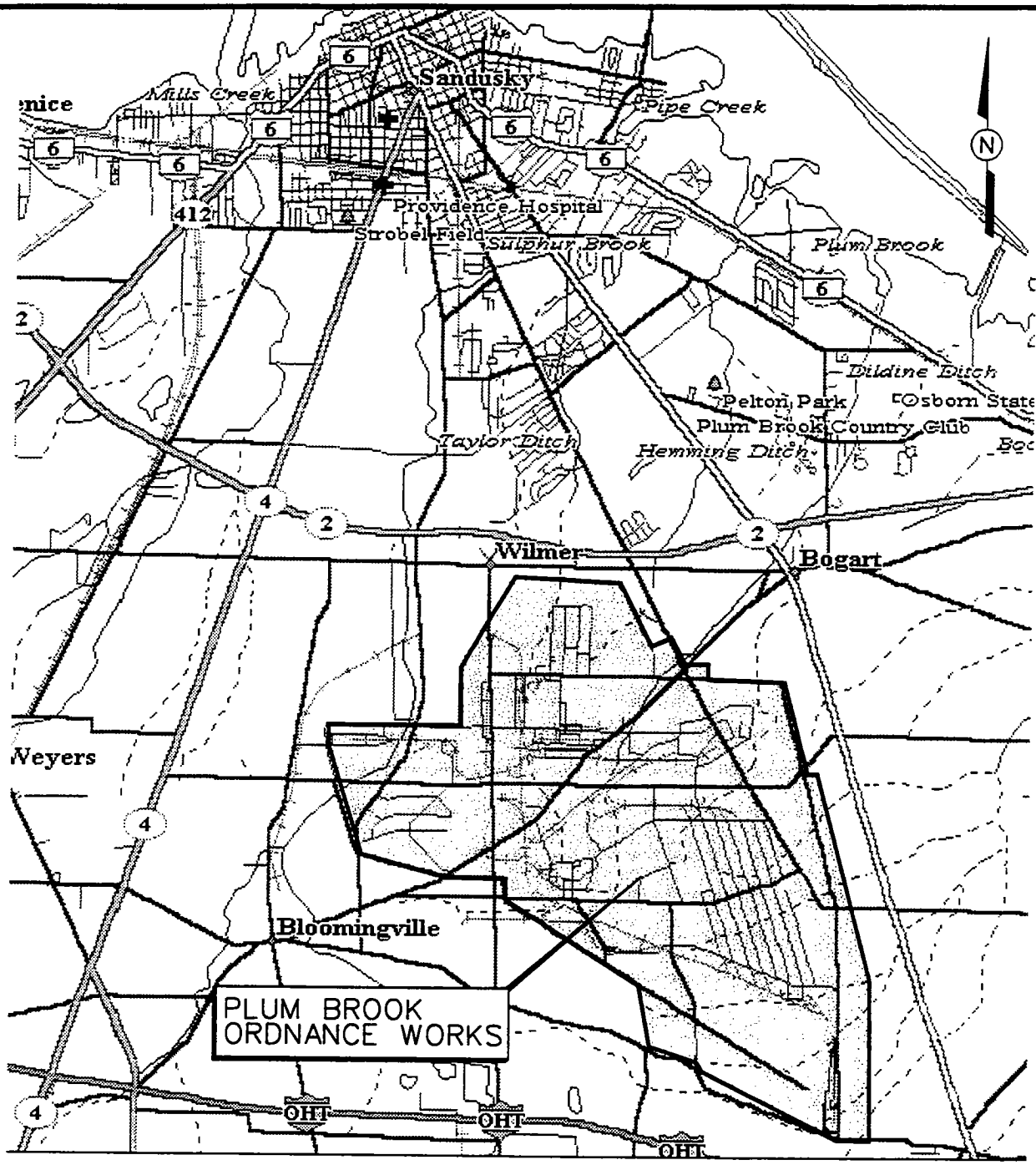
As an attachment to the PBOW sitewide sampling and analysis plan (SAP) (IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the GWI at PBOW. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP) (IT, 1996b) to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this investigation that must be used in conjunction with the sitewide safety and health plan (SHP) (IT, 1996c).

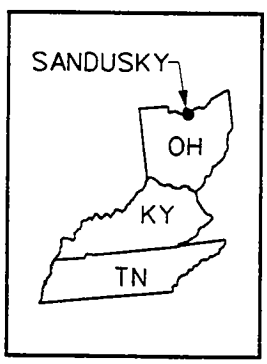
V.1.1 Site History

PBOW site, located in Sandusky Ohio (Figure V-1), was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to Ordnance Department, then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration. The National Aeronautics and Space Administration acquired the PBOW in 1963 and is presently utilizing the site.

V.1.2 Summary of Existing Site Data

The western portion of the PBOW generally refers to the area west of Ransom Road. The area is predominantly wooded with some cleared areas covered with grasses and brushes. Several areas have been identified by previous investigations as potential areas of contamination. These areas include Reservoir No. 2 Burning Ground, Waste Water Disposal Plant No. 2, Power House No. 2





NOT TO SCALE

FIGURE V -1

VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 6-11-96	DATE LAST REV.:	DRAFT. CHCK. BY: CET	INITIATOR: G. YU	DWG. NO.: 766952ES.005
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON	PROJ. NO.: 766952

766952ES.005 14:16:12 JUL. 1, 1996 KHB

Ash Pit, TNT Area C, West Area Red Water Pond (WARWP), and G-8 Burning Ground. Over the years, environmental studies were conducted in selected areas by several government agencies including U.S. Army Corps of Engineers (USACE), National Aeronautics and Space Administration, and Ohio Environmental Protection Agency. According to the results of these investigations, the chemicals of potential concern within the western portion of PBOW may include volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides/polychlorinated biphenyls (PCB), metals, and nitroaromatics. The findings of these investigations are summarized in Section 1.2.2 of the SAP (IT, 1996a).

In 1994, the USACE Nashville District conducted the most recent sitewide groundwater investigation of the overburden and bedrock hydrostratigraphic units at PBOW (Dames & Moore, 1996). Eleven groundwater monitoring wells were installed in the overburden unit and eight additional wells were installed in the bedrock unit (Table V-1). Groundwater sampling was conducted in 16 monitoring wells completed in the overburden unit and 9 wells completed in the bedrock. All groundwater samples were analyzed for nitroaromatic compounds, nitrates, and total and dissolved metals. Samples from bedrock wells were also analyzed for VOCs and base/neutral and acid extractables (BNA) to acquire baseline groundwater quality information of the bedrock aquifer. The major findings of this investigation are briefly summarized in the following paragraphs to facilitate the GWI planing process and to aid in field operations.

The overburden unit is composed of glacial outwash materials and its thickness increases from a few feet in the south to greater than 40 feet in some locations in the north. The bedrock unit consists of Devonian limestone and shale that dip to the southeast at approximately 35 feet per mile.

General groundwater flow in both unconsolidated overburden materials and consolidated bedrock (mainly limestone and shale) is to the north in the direction of Lake Erie. On the western side of the site, groundwater flow in the overburden aquifer is to the northwest, while groundwater in the bedrock aquifer shows a northeast flow direction. Table V-2 presents groundwater level elevation as measured in December 1994 and in March 1995.

The results of the groundwater quality analyses indicate significant levels of explosive residues in the groundwater in the overburden aquifer in the immediate vicinity of both former Red Water Pond areas. Low levels of explosives, several VOCs, and BNAs were also detected in several bedrock wells. The detected explosives and other contaminants in groundwater samples are

summarized in Table V-3. The locations of monitoring wells to be sampled during this GWI are provided in Figure V-2.

A site visit was conducted by IT project members on May 15 and 16, 1996 to acquire information regarding 28 existing monitoring wells to be sampled and to assess site accessibility for new monitoring well installation. All targeted existing wells are located and appear to be in good condition. Some wells are off road and some are in swampy areas. Access to these wells requires a all-terrain vehicle. Location of 28 existing wells is summarized in Table V-1.

V.2.0 Project Organization and Responsibility

The project organization for this GWI consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.

V.3.0 Scopes and Objectives

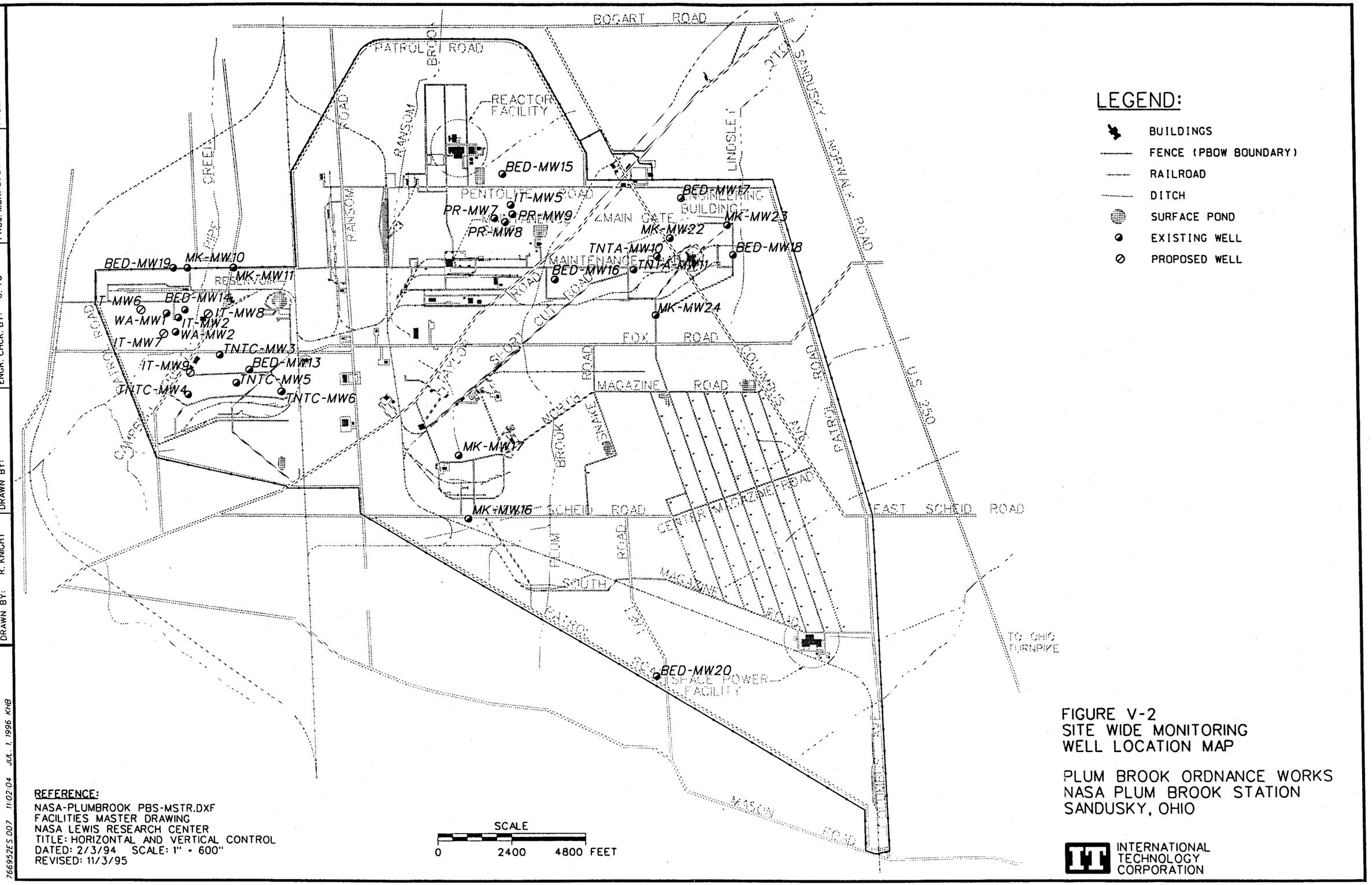
V.3.1 Scope

As specified in the statement of work (USACE, January, 1996), the scope for the groundwater investigation at PBOW consists of preparation of site-specific work plans; completion of field activities, including installation of monitoring wells and collection of groundwater samples from new and existing monitoring wells for chemical analysis, evaluation of analytical results; and preparation of investigation report of activities, conclusions, and recommendations for future actions.

V.3.2 Objectives

The general purpose of the PBOW site investigations and GWI has been stated in Section 3.2 of the SAP (IT, 1996a). Specific objectives of the groundwater investigation are summarized as follows:

- Resample existing wells to add to existing database with regard to groundwater levels and contaminant concentrations



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- EXISTING WELL
- PROPOSED WELL

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

SCALE
0 2400 4800 FEET

FIGURE V-2
SITE WIDE MONITORING
WELL LOCATION MAP

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 6-11-96	DATE LAST RE	DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: G. YU	DWG. NO.:	S.007
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON	PROJ. NO.: 766952	

766952ES.007 11:02:04 JUL. 1, 1996 KHB

- Install new monitoring wells to fill data gaps in groundwater levels and contaminant concentrations in the western portion of the PBOW, especially, in the vicinity of the West Area Red Water Ponds and TNT Area C.

V.3.3 Site-Specific Data Quality Objectives

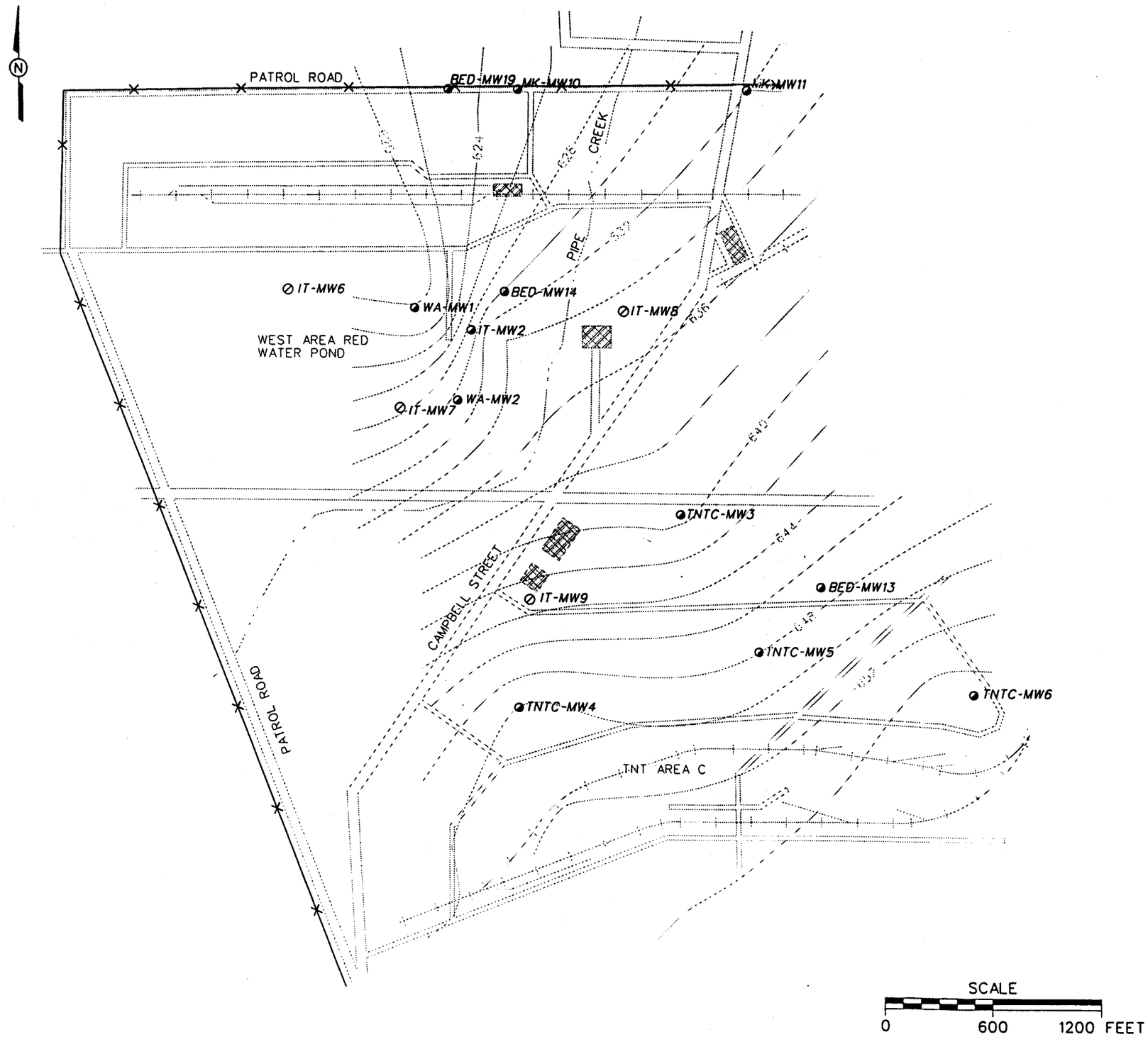
Overview. The data quality objectives (DQO) process is followed to evaluate data requirements and to support the decision making process associated with the action selection for the site-wide GWI This section incorporates the components of the DQO process described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 Data Quality Objectives Process for Superfund; the DQO process as applied to PBOW sites is described in more detail in Section 3.3 of the site-wide SAP. The factors used to determine the sampling quantity and procedures necessary to meet the objectives of the SIs and to establish a basis for future action at the sites and a general decision-making process diagram are presented in Table 3-1 and in Figure 3-2 of the site-wide SAP, respectively. .

Data Users and Available Data. The intended data users and available data related to the site-wide GWI presented in Table 3-1 of the site-wide SAP have been used to formulate a site-specific conceptual model to support the development of this SSAP necessary to meet the objectives of the SI and to establish a basis for future action at the site. The data users for information generated during this SI are primarily the EPA, USACE, Ohio Environmental Protection Agency (OEPA), PBS, and the USACE's supporting contractors. This SSSAP, along with the necessary companion documents, has been designed to provide the regulatory agencies with sufficient detail to reach a determination as to the adequacy of the SSSAP. The program has also been designed to provide the USACE with the level of defensible information required to confirm or deny the existence and nature of residual chemical contamination in site media.

Conceptual Site Model. Four factors have been considered in defining the conceptual model for the site-wide GWI:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Contaminants of Concern.

Potential sources of contamination at PBOW include the use of the site during TNT manufacturing operations. The migration pathways include groundwater infiltration, soil, surface



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- EXISTING WELL
- PROPOSED OVERBURDEN WELL
- 636 GROUNDWATER ELEVATION CONTOUR LINE (FEET, MARCH 1995)

FIGURE V -3
PROPOSED MONITORING WELL LOCATION MAP
WEST AREA RED WATER POND AND TNT AREA C

PLUM BROOK ORDNANCE WOR
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 6-25-96	DATE LAST REV.:	DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: G. YU
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON

DWG. NO.: 952ES.006
PROJ. NO.: 766952

766952ES.006 12:40:00 JUL 1, 1996 KHB

water runoff to the creek. The most likely receptors at PBOW are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants is unlikely at PBOW since the site is a secure NASA research station. However, potential receptors near the facility may include off-site water users. Potential contaminants of concern based on past use of the site may include VOCs, SVOCs, metals, pesticides/PCBs, nitroaromatics, and total cyanide.

Decision-Making Process, Data Uses, and Needs. The decision-making process consists of a seven-step process which is presented in detail in Section 3.3.3 of the site-wide SAP and will be followed during the site-wide GWI. Data uses and needs are summarized in Table 3-1 of the site-wide SAP.

Risk Evaluation. Confirmation of contamination at site-wide GWI will be based upon a comparison of detected the contaminants to the most current guidance criteria. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in the media. Definitive data will be adequate for confirming the presence of the contamination and for supporting a feasibility study and risk assessment.

Data Quality, Types, and Quality. Groundwater samples will be sampled and analyzed in order to meet the objectives of the site-wide GWI. QA/QC samples will be collected for all sample types as described in Section V.4.5 of this SSSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the , data analyzed at this level of quality are appropriate for all phases of the characterization and risk assessment.

Precision, Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this are provided in Section 3.3.4.4.3 of the site-wide SAP.

V.4.0 Field Activities

Field activities during the groundwater investigation at the PBOW include installation and development of 4 new monitoring wells (IT-MW06, -MW07, -MW08, and -MW09), redevelopment of 28 existing monitoring wells, collection of groundwater samples from 4 new and 28 existing wells, permeability test, management of investigation-derived waste (IDW), and land survey.

V.4.1 Monitoring Well Installation

V.4.1.1 Monitoring Well Locations and Rationale

Four new monitoring wells will be installed in the vicinity of the WARWP and TNT Area C to allow water level measurement and sample collection. The WARWP and TNT Area C are areas of know contamination. Nine existing monitoring wells are located in this general area. Of these, five wells are in the WARWP (WA-MW1, WA-MW2, IT-MW02, MK-MW10, and MK-MW11) and four and in the TNT Area C (TNTC-MW3, -MW4, -MW5, and -MW6). Based on the groundwater contour maps compiled for this area (Figures 5-14 and 5-16, Dames & Moore, 1996), general groundwater flow direction in the overburden aquifer in the vicinity of WARWP and TNT Area C is toward north and northwest and exhibits slight seasonal variations. It is also observed that there is a significant vertical flow component in the overburden aquifer believed to be controlled by the thickness of the overburden material and the local topography. Nitroaromatic compounds, metals, several VOCs, and BNAs were reported to have been detected in either the overburden wells or in the bedrock wells or both in WARAP and in TNT Area C. New monitoring wells will be placed in the vicinity of the two areas where both groundwater level and chemical data are spare. Specifically, monitoring well IT-MW06 will be placed approximately 800 feet west of existing well WA-MW1; well IT-MW07 will be placed approximately 650 feet south of WA-MW1 and the same distance west of WA-MW2; well IT-MW08 will be installed approximately 900 feet east of IT-MW02; and IT-MW09 will be installed approximately 700 feet north of TNTC-MW4.

Tentative locations of these monitoring wells are presented in Figure V-3. The locations may require adjustment if site condition warrants. In such case, the IT field coordinator will contact the USACE oversight representative and the project manager prior to changing well locations. Any changes from work plans will be recorded in chronological order in the variance log shown in Figure 9-1 of the SAP (IT, 1996a).

V.4.1.2 Drilling Methods

Boreholes for monitoring well installation will be installed in the unconsolidated overburden materials by the hollow-stem auger method using a nominal 4.25-inch inside diameter (ID) auger as specified in the following text. The borehole will be continuously sampled for descriptive logging and field screening purpose using low-carbon steel split spoons or continuous samplers. Three discrete soil samples will be collected from each borehole for geotechnical analysis. The borehole will be advanced to the top of bedrock with a 10-foot screen section placed 1 foot above the bottom. The estimated depth of each well is 25 feet below ground surface (bgs). If bedrock

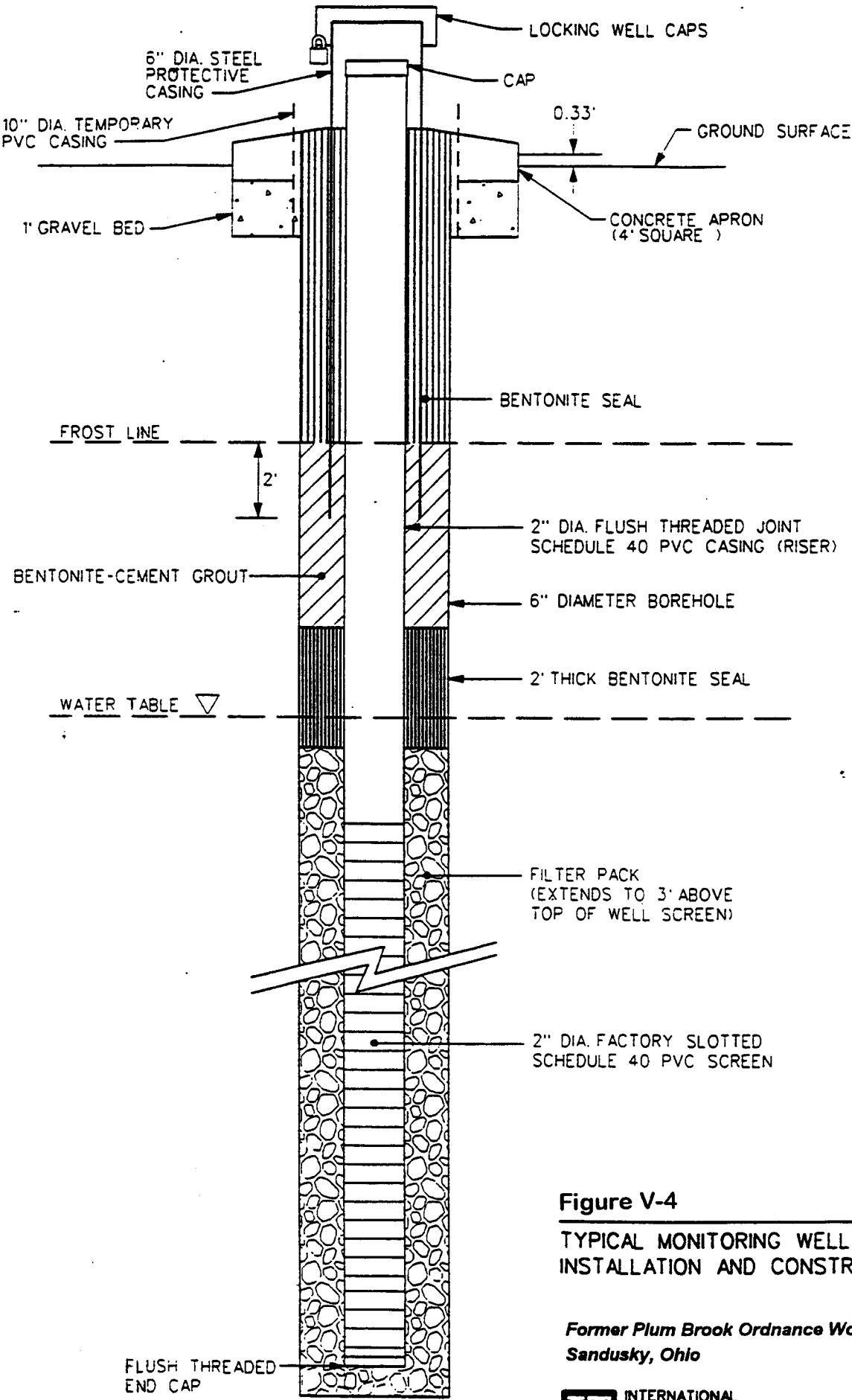


Figure V-4

TYPICAL MONITORING WELL INSTALLATION AND CONSTRUCTION

Former Plum Brook Ordnance Works
Sandusky, Ohio

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: 762430ES004	INITIATOR: G.YU	DRAFT. CHCK. BY: D.AGUILAR	DATE LAST REV.:	STARTING DATE: 05/16/95	
PROJ. NO.:	PROJ. MGR.: D.BURTON	ENGR. CHCK. BY: G.YU	DRAWN BY:	DRAWN BY D.AGUILAR	

762430LS004 15:45 Sep 20, 1995 KLW

is encountered at a depth of less than 6 feet bgs, a monitoring well will not be installed and the borehole will be abandoned by grouting from the bottom to the ground surface. A new well location will be sought per USACE instruction.

V.4.1.3 Soil Samples for Geologic Logging

Each monitoring well will be continuously sampled with a 3-to five-foot-long low-carbon steel split spoon sampler or continuous sampler as determined by the IT geologist. Samples will be collected for screening and lithologic logging in addition to geotechnical analysis. The soil samples will be logged in the field according to the Unified Soil Classification System nomenclature and in accordance with procedures described in the USACE engineer's manual EM 1110-1-4000, *Monitoring Well Installation at Hazardous Waste Sites* (USACE, 1994). Soil logging will be recorded in the hazardous toxic and radiologic waste drilling log as shown in Figure 4-11 in the SAP (IT, 1996a).

V.4.1.4 Soil Samples for Geotechnical Testing

Three soil samples per borehole will be collected for geotechnic testing. Of the three samples, one will be collected from the depth interval to be screened. Geotechnic testing includes the following:

- Grain-size distribution (American Society for Testing and Materials [ASTM] C117-90 & C136-92)
- Moisture content (ASTM-D 2216)
- Atterberg limits (ASTM-D 4318).

The results of geotechnic testing will be included in the investigation report along with drilling logs.

V.4.1.5 Monitoring Well Completion

The monitoring well will be completed using 2-inch-ID, Schedule 40 polyvinyl chloride (PVC) casing (ASTM F480-81, D1785) and screen using procedures specified in the Resource Conservation and Recovery Act Technical Enforcement Guidance Document (1986), the USACE EM-1110-1-4000, and the State of Ohio requirements. The construction details for the proposed monitoring wells are summarized in Table V-4. A typical monitoring well construction diagram is provided in Figure V-4.

V.4.1.6 Materials and Procedures

The groundwater monitoring well will be installed using the following materials and procedures:

- ***Well Screen.*** Two-inch ID, threaded Schedule 40 PVC with factory-slotted (continuous wrap design) 0.010 slots. This is in consistency with the screen specification for existing monitoring wells in the same area. Ten feet of screen with a PVC end cap will be placed in the well.

- ***Well Casing.*** Two-inch ID, flush-threaded Schedule 40 PVC (ASTM D1875) casing will be attached to the top of the screen. No glues or adhesives will be used. The casing string will extend approximately 2 feet above grade and will be certified by the manufacturer as being the material specified.
- ***Decontamination.*** All well completion materials, including screen and casing, will be decontaminated by steam, laboratory grade detergent, and distilled water rinse prior to installation.

- ***Filter Pack.*** Clean, inert, noncarbonate materials will be used to construct a uniform and continuous filter pack. The filter pack will be designed to prevent migration of formation fines into the well bore. The filter pack will be placed by tremie pipe from the bottom of the borehole to approximately 3 feet (if possible) above the top of the well screen.

- ***Bentonite Seal.*** A 2- to 5-foot bentonite seal consisting of xxxxtemped 0.25-inch bentonite pellets shall be tremied into the annular space between the well riser and the borehole wall immediately above the filter pack. If seal is constructed above the groundwater level, it will be sufficiently hydrated with clean, distilled water to preclude transmission of grout from above into the filter pack or well screen.

- ***Grout.*** Neat cement grout consisting of approximately 94 pounds Portland Type II cement (in accordance with ASTM C-150) and not more than 3 pounds powdered bentonite and 7 gallons of potable water will be used. The grout will be placed by tremie from the top of the bentonite seal to the ground surface.

- ***Surface Protection.*** Surface protection will consist of a 6-inch ID steel surface casing extending approximately 2.5 feet above the ground, a minimum of 0.2 feet and a maximum of 0.5 feet above the PVC riser and cap, with a lockable, hinged cover set into and surrounded by a concrete pad 4 feet square and 4 inches thick. To prevent frost heave damage to the well casing, the concrete pad will be constructed as shown in Figure V-4 and follow the following procedures. Initially, a pit 4 by 4 feet around the protective casing will be dug to a depth of approximately 1 foot, 4 inches. A 2-foot-long, 10-inch-diameter PVC casing will then be placed temporarily around the 6-inch steel casing; the annulus between the 10-inch PVC casing and the 6-inch steel casing and that between the 6-inch steel casing and the 2-inch riser will be filled with bentonite pellets. Bentonite will be hydrated up to 1 hour to form a "bentonite plug." Then a 1-foot-thick gravel base will be laid in the

pit. After the 10-inch temporary PVC casing is removed, concrete will be poured on top of the gravel base. The concrete pad will be sloped a minimum of 2 inches from the surface casing to the edge of the pad to provide positive drainage. A weep hole will be drilled in the surface casing at the top of the pad to allow drainage from inside the surface casing. Four 3-inch-diameter steel posts extending approximately 3 feet above the pad will be set into concrete approximately 3 feet bgs at equal spacing around the pad. The surface casing and the steel posts will be painted with a high visibility exterior grade paint. A metal well identification tag, showing well number, date of completion, USACE Nashville District, well bottom elevation, and inner casing elevation, will be permanently attached on to the side of the protective casing.

V.4.2 Monitoring Well Development

After each well has been constructed, but no sooner than 24 hours nor later than 7 days after grouting and placement of the concrete apron, each well will be developed. Existing wells to be sampled will also be developed in the same manner as the new wells but the development time will be limited to 1 hour. Well development will be in accordance with USACE EM 1110-1-4000 (USACE, 1994). Wells will be developed by raising and lowering a surge block throughout the length of screen, followed by pumping or bailing without using acids, flocculent, or dispersing agents. Water will not be added to a well as part of development once the well has been grouted and sealed. The development procedure will continue until the following conditions are met:

- Water is clear to the unaided eye, free of sand, and free of drilling fluids.
- The sediment thickness remaining within the well is less than 1 percent to the screen length or less than 0.1 foot for screens equal to or less than 10 feet long.
- Temperature, pH, and specific conductance values stabilize.
- A volume of water equal to at least five times standing water in the well including the well casing and screen, and the saturated annular space assuming 30 percent of porosity has been removed.

Each new well will be developed for a maximum of 6 hours and each existing well will be developed for up to 1 hour. If well is not satisfactorily developed within this time, the USACE will be contacted for consultation and further instructions.

Color photographs (35-millimeter color prints) will be taken of water from each monitoring well after development. Specifically, a 1-liter water sample will be collected of the last water removed during development and placed in a clear glass jar, labeled, and photographed. The photograph

will be submitted as part of the well development log. The photograph will be a suitably back-lit close-up to show the clarity of the water.

V.4.3 In Situ Permeability Testing

Field permeability will be evaluated for new wells by performing slug tests after well development. Slug tests will be performed by an IT hydrogeologist assisted by a technician and will consist of instantaneously removing a "slug" of water from the well by pulling out a section of pipe filled with sand or other ballast and closed with caps on both ends and monitoring the subsequent rate of rise of the water level. This method is known as a "rising head" slug test. A pressure transducer and a data logger will be used to record water level changes in the well during the test. Test data will be downloaded to a laptop computer and preprocessed by the IT hydrogeologist before departure from the site to ensure complete and usable data are collected. One test will be performed in each of the four new wells unless unreasonable data are obtained.

V.4.4 Redevelopment of Existing Wells

Prior to sample collection, 28 existing wells will be redeveloped following procedures described in Section V.4.2.

V.4.5 Groundwater Sampling

Groundwater samples will be collected from each of the 4 newly installed monitoring wells and 28 existing wells. Groundwater samples to be collected during this investigation and their designated sample numbers, along with required QA/QC sample quantities are listed in Table V-5.

Sampling of newly installed monitoring wells and existing wells will take place no sooner than 14 days after well development has been completed. Groundwater sampling will be done by using a disposable Teflon® bailer fitted with a bottom-emptying device and a new, clean nylon rope. All equipment used to purge wells and collect samples will be protected from ground surface contact and contamination by use of clean plastic sheeting. The following procedures will be followed when collecting groundwater samples from all monitoring wells:

- The well will be checked for proper identification and structural integrity.
- After unlocking the well and removing the well cap, a photoionization detector will be used to measure the concentration or organic vapors at the top of casing and in the breathing zone. If readings are above background, safety precautions outlined in the health and safety plans will be followed.

Table V-5
Summary of Groundwater and QA/QC Samples
Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Groundwater Sample ID	Monitoring Well ID	QA/QC Sample Quantity[a]			
		FD/FS	MS/MD	FB	ER
New Monitoring Wells					
PBOW-96-GW-ITMW06-5010	IT-MW06				
PBOW-96-GW-ITMW07-5020	IT-MW07	X	X	X	X
PBOW-96-GW-ITMW08-5030	IT-MW08				
PBOW-96-GW-ITMW09-5040	IT-MW09				
Existing Monitoring Wells					
PBOW-96-GW-TNTAMW10-5050	PB-TNTA-MW10				
PBOW-96-GW-TNTAMW11-5060	PB-TNTA-MW11				X
PBOW-96-GW-TNTCMW3-5070	PB-TNTC-MW3				
PBOW-96-GW-TNTCMW4-5080	PB-TNTC-MW4				
PBOW-96-GW-TNTCMW5-5090	PB-TNTC-MW5				X
PBOW-96-GW-TNTCMW6-5100	PB-TNTC-MW6				
PBOW-96-GW-WAMW1-5110	PB-WA-MW1				
PBOW-96-GW-WAMW2-5120	PB-WA-MW2				
PBOW-96-GW-PRMW7-5130	PB-PR-MW7	X	X	X	X
PBOW-96-GW-PRMW8-5140	PB-PR-MW8				
PBOW-96-GW-PRMW9-5150	PB-PR-MW9				
PBOW-96-GW-BEDMW13-5160	PB-BED-MW13				
PBOW-96-GW-BEDMW14-5170	PB-BED-MW14				X
PBOW-96-GW-BEDMW15-5180	PB-BED-MW15				
PBOW-96-GW-BEDMW16-5190	PB-BED-MW16				
PBOW-96-GW-BEDMW17-5200	PB-BED-MW17				
PBOW-96-GW-BEDMW18-5210	PB-BED-MW18				X
PBOW-96-GW-BEDMW19-5220	PB-BED-MW19				
PBOW-96-GW-BEDMW20-5230	PB-BED-MW20				
PBOW-96-GW-MKMW10-5240	MK-MW10				
PBOW-96-GW-MKMW11-5250	MK-MW11				
PBOW-96-GW-MKMW16-5260	MK-MW16				
PBOW-96-GW-MKMW17-5270	MK-MW17				X
PBOW-96-GW-MKMW22-5280	MK-MW22				
PBOW-96-GW-MKMW23-5290	MK-MW23				
PBOW-96-GW-MKMW24-5300	MK-MW24				
PBOW-96-GW-ITMW02-5310	IT-MW-02	X	X		X
PBOW-96-GW-ITMW05-5320	IT-MW-05				

a: Trip blanks will also be collected for VOC samples

FD/FS - field duplicates/field split; MS/MD - matrix spike/matrix spike duplicate;
FB - field blank; ER - equipment rinsate

- After unlocking the well and removing the well cap, a photoionization detector will be used to measure the concentration or organic vapors at the top of casing and in the breathing zone. If readings are above background, safety precautions outlined in the health and safety plans will be followed.

- The depth to water will be measured using a decontaminated water level indicator, then the volume of water in the well casing and screen, and the volume present in the saturated annulus (filter pack) will be calculated.

- Either a bailer or an appropriate submersible sampling pump will be used to remove five times the volume of the standing water in the well casing and saturated annulus.

- During purging, field measurement of pH, Eh (oxidation-reduction potential), turbidity, temperature, and conductivity will be performed.

- At the time of sampling, after collection of the sample for chemical analysis, a second sample will be collected for field measurement of temperature, pH, Eh, turbidity, dissolved oxygen, and conductivity.

- Sample containers will be labeled with appropriate identifying information (location, date, time, condition, added preservatives, etc.). Each sample will be logged in a field notebook at the time of collection. Sample containers of appropriate volume and composition will be prepared in advance to ensure the collection of sufficient volumes for all specified analyses.

- The sample will be collected so as to minimize aeration as water enters the bottle.

- Samples for volatile analysis will be collected in screw-cap, spetum-top glass vials and filled so that there are no air bubbles present to allow volatilization

- Samples for metal analysis will be collected in two separate containers; one will be filtered and the other will not be filtered. Samples will be filtered according to the following procedures:

  - Water sample will be filtered at the well site with portable sample filtering equipment or at the field office.

  - A Millipore filtration apparatus (or comparable equipment) equipped with a 0.45-micron filter will be used. The filtering apparatus will be cleaned following procedures set forth in Section 5.2 of the Site-Wide SAP before filtering each sample.

- All sample containers will be transferred to a cooler chest (keep at 4 degrees Celsius [°C]) and delivered to the laboratory in sufficient time so that specified holding times are not exceeded.

V.5.0 Sample Analysis and Decontamination Procedures

V.5.1 Sample Number System

Sample numbering system to be used during this investigation will conform to USACE Nashville District's numbering convention. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number consists of a group of letters and numbers, separated by hyphens. The numbering system to be used for GWI is described as follows:

Project Code	Year	Sample Type[a]	Site Identification[b]	Location (Well ID)	Sample Number	Sample Depth
PBOW	96	XX	XXX	XXXX	XXXX	____

[a]Sample types:

MS - Matrix spike sample
MD - Matrix spike duplicate sample
FD - Field duplicate sample
FS - Field Split sample
GW - Groundwater sample
ER - Equipment rinsate sample

[b]Site identification (refer to page 6-3 at the site-wide SAP).

"PBOW-96-GW-TNTC-BEDMW13-0235" signifies that this groundwater sample is collected from monitoring well BED-MW13 in TNT Area C with a laboratory number of 0235. The sample identification number will be recorded by the IT field geologist in the Field Activity Daily Log, Boring Log, and Sample Collection Log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

The identifications of groundwater samples to be collected for chemical analysis based on this number system are listed in Table V-5.

V.5.2 Analytical Program

All groundwater samples will be collected and analyzed for target compound list (TCL) VOCs, TCL SVOCs, pesticides/PCBS, total cyanide, and nitroaromatic compounds. Groundwater samples will also be analyzed for total target analyte list (TAL) metals (unfiltered) and dissolved

TAL metals (filtered). Table V-6 summarizes analytical parameters and methodologies. Laboratory quality control procedures and data quality requirements are specified in and referenced to appropriate sections of the QAPP (IT, 1996b).

V.5.3 Decontamination Procedures

Drilling and sampling equipment decontamination will be performed to maintain integrity of the groundwater sample collected. A temporary decontamination pad will be built on site. The station will be lined with three layers of at least 6-mil-thick Visqueen and will be bermed on all sides. The following decontamination procedures will be used to decontaminate drilling equipment, including drilling tools, equipment, and monitoring well materials, upon site entrance, between borings, and before site departure:

- Steam rinse.
- Steam wash using a brush with nonphosphate detergent.
- Steam rinse.
- Final rinse with distilled water.
- Air dry.

Groundwater sampling equipment including submersible pump and water level indicator will be decontaminated upon site entry, between wells, and before site departure following the procedures below:

- Rinse with potable water.
- Rinse with deionized water (ASTM Type II water).
- Rinse with methanol.
- Rinse with deionized water (ASTM Type II water). The volume of water used must be at least five times greater than the volume of methanol used.
- Air dry.

V.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as being precleaned, containers from I-CHEM, made of materials recommended by the U.S. Environmental Protection Agency (EPA) in Title 40 Code of Federal Regulations Part 136 and SW-846 (3rd Edition). Sample containers and preservatives/preservation methods are summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that it is received by the laboratory.

Unless prior arrangements are made, the sample containers will be shipped to the site with necessary preservatives added, except for the bottles to be used for dissolved metal analysis. Samples for dissolved metal analysis will be prepared after the water has been filtered.

Sample for geotechnical analysis need not be chemically preserved; however, the samples will be properly sealed to prevent moisture loss and will be packaged so that the material is adequately preserved in its natural state. Samples will be placed in sample containers that will be sealed with three wraps of electrical type or duct tape around the lid lip.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimize the possibility of container breakage by using Vermiculite or styrofoam peanuts to fill void spaces in the cooler. Sample will be cooled as promptly as feasible to a temperature of approximately 4°C and maintained at that temperature by means of blue ice or packaged ice from the time the shipping carton is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by a next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

Completed AR/COC records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or

USACE QA Laboratory
Mr. John Adams (CEORD-PE-GL)
USACE Ohio River Division Laboratory
11275 Sebring Drive
Cincinnati, Ohio 45240-2714
Telephone: (513)-589-3604

V.7.0 Investigation-Derived Waste Management Plan

IDW during field activities at PBOW include drill cuttings, development water, purge water, decon water, decon fluid, and disposable personal protective equipment (PPE). IDW will be handled following the EPA guidance document EPA\540\G-\91\009, *Management of Investigation-Derived Wastes During Site Inspection* (EPA, 1991). Specifically, IDW will be managed in the following manner:

- Drill cuttings from four wells will be placed separately in 55-gallon sealable drums and stored on site or in the designated IDW staging area. The options of disposal of cuttings will depend on the laboratory results of groundwater samples.
- Disposable PPE will be double-bagged and disposed of in the on-site dumpster.
- Decontamination water will be stored in 55-gallon drums and stored on site pending analytical results for proper disposal.
- Decontamination fluid will be kept in a stainless-steel pan and will be allowed to evaporate.
- Well development and purge water from each well will be stored separately in 55-gallon drums and kept on site pending analytical results of the water from each well for proper disposal.
- Purging water from existing wells will be poured in the ground upon completion of the field work.

V.8.0 Project Schedule

The project schedule will be provided upon submittal of the final work plan.

V.9.0 References

Dames & Moore, 1996, ***Draft Report, Site-Wide Groundwater Investigation, Plum Brook Ordnance Works***, May 1996.

IT Corporation (IT), 1996a, ***Site-Wide Sampling and Analysis Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1996b, ***Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1996c, ***Site-Wide Safety and Health Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

U.S. Army Corps of Engineers (USACE), 1996, Statement of Work, January 1996.

U.S. Army Corps of Engineers (USACE), 1994, ***Monitoring Well Installation of Hazardous Waste Sites***, EM1110-1-400, August 31, 1994.

U.S. Environmental Protection Agency (EPA), 1991, ***Management of Investigation-Derived Wastes During Site Investigation***, EPA/540/G-/91/009, May 1991.

Attachment V

Site-Specific Safety and Health Plan for the Groundwater Investigation (GWI) Former Plum Brook Ordnance Works Sandusky, Ohio

Prepared By:

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Knoxville, Tennessee 37923

Submitted To:

U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

Revision 1

September 1996

(This SSHP must be used in conjunction with the PBOW SHP)

Reviews and Approvals

Program Manager
IT Corporation

Donna C Sinton

12/12/96
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Health and Safety Manager
IT Corporation

Melissa G Smith

12/12/96
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List of Acronyms

dBA	A-weighted decibels
DERP	Defense Environmental Restoration Program
IT	IT Corporation
mg/m^3	milligram per cubic meter
PBOW	Plum Brook Ordnance Works
PPE	personal protective equipment
ppm	parts per million
2BG	Reservoir No. 2 Burning Grounds
SAP	sitewide sampling and analysis plan
SHP	sitewide safety and health plan
SI	site investigation
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers

V.1.0 Site Work Plan Summary

The U.S Army is conducting studies of environmental impact of suspected hazardous waste site at previously owned U.S. Department of Defense properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW), located in Sandusky, Ohio, is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering services to conduct a sitewide groundwater investigation (GWI) at the PBOW.

As an attachment to the PBOW sitewide safety and health plan (SHP), this site-specific safety and health plan (SSHP) has been prepared for the work to be carried out in support of the GWI SI at PBOW. This SSHP must be used in conjunction with the SAP and the quality assurance project plan to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific sampling and analysis plan (SSAP) has also been prepared separately for this SI that must be used in conjunction with the sitewide sampling and analysis plan (SAP).

Project Objective. The specific objectives of the GWI are summarized as follows:

- Resample existing wells to add to the existing data.
- Install new monitoring wells to fill data gaps in groundwater levels and contaminant concentrations in the western portion of PBOW, particularly in the vicinity of the West Area Red Water Ponds (WARWP) and TNT Area C.

Project Tasks

- Installation and development of four new monitoring wells
- Redevelopment of 28 existing monitoring wells
- Groundwater sampling of the 4 new and 28 existing wells
- In situ permeability testing.

Personnel Requirements. Up to 15 employees will be needed. All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the PBOW SHP.

V.2.0 Site Characterization and Analysis

V.2.1 Anticipated Hazards

Chemical and Physical Hazards. The job hazard analysis in Section V.4.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The job hazard analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment.

Employee Protection for Initial Site Entry. Level D protection is required, with chemical-resistant gloves as specified in Chapter 5.0 and emergency equipment as specified in Chapter 11.0 of the SHP.

V.2.2 General Site Information

Location and Approximate Size of Site. The WARWP are located in the western portion of PBOW north and west of Pipe Creek. Two ponds, the "eastern pond" and the "western pond," separated by a berm comprise the WARWP site. The western pond has existed and contained standing water from the 1940s to the present. The eastern pond has been dry since the late 1970s, except for small areas of standing water during wet weather. TNT Area C is located east of Campbell Street and approximately 2,500 feet north of Patrol Road. The buildings of TNT Area C were destroyed prior to transfer of PBOW to National Aeronautics and Space Administration in 1963. Proposed locations for the new monitoring wells and locations of the 28 existing wells to be sampled are provided in the SSAP (Attachment V to the SAP).

Duration of Planned Employee Activity. Planned employee activity is estimated at 2 to 6 months.

Site Topography. The sites are areas overgrown by brush and young trees.

Site Accessibility (By Road). The WARWP site is located west of Campbell Street. TNT Area C is located east of Campbell Street.

Pathways for Hazardous Substance Dispersion. Possible pathways for hazardous substances in the area are groundwater, surface water, soils, and sediments.

V.3.0 Site Monitoring

The environmental contaminants of concern include organic compounds, cyanide, metals, and nitroaromatics. Nitroaromatic contamination resulted from industrial sewer lines, process and refining facilities, materials, wastes or intermittent compounds associated with production of 2,4,6-trinitrotoluene (TNT). Petroleum hydrocarbons were used in processes at the former TNT Manufacturing Area. The potential for exposure to these contaminants is unlikely, however, monitoring will be conducted as follows:

Chemical or Physical Agent	Permissible Exposure Limit	Action Level	Monitoring Equipment	Sampling and Analytical Method	Frequency of Analytical Method
Particulates	0.5 milligrams per cubic meter (mg/m^3) (TNT) 1.0 mg/m^3 (dinitrotoluene)	1 mg/m^3	Dust Monitor	Direct Reading	During Activities When Airborne Dust is Generated
Petroleum Hydrocarbons	100 parts per million (ppm) (Toluene) 100 ppm (Xylene)	20 ppm	Photoionization detector or organic vapor analyzer	Direct Reading	During Ground-intrusive Activities
Noise	90 A-weighted decibels (dBA)	85 dBA	Sound Level Meter	Direct Reading	Not Necessary

If noticeable odors are present in the workplace but direct-reading instruments do not detect any volatile contaminants or if levels exceed the action level specified in the table, evacuate area and allow contaminant to dissipate. Don Level C PPE as described in PBOW SHP, and retest. If odors or levels continue, either postpone work until conditions return to background levels or contact the health and safety manager for assistance. In the case of noise, noise levels during similar operations have been characterized. Hearing protection will be required by all employees working near heavy equipment or drill rig in operation.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

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Project Description: Site-Wide Groundwater Investigation, Plum Brook Ordnance Works

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Attachment VI

Site-Specific Safety And Health Plan
Sitewide Groundwater Level 1 Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

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Submitted To:

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IT Project No. 771481
Control Copy No. 19

Revision 0

May 1997

This Site-Specific Safety and Health Plan Attachment must be used in conjunction with the Site-wide Safety and Health Plan for Site Investigations and Groundwater Investigations at the former Plum Brook Ordnance Works.

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Reviews and Approvals

Project Manager IT Corporation	5/19/97 Date
Health and Safety Manager IT Corporation	5/16/97 Date
Site Coordinator IT Corporation	Date
Site Safety and Health Officer IT Corporation	Date

Plum Brook Project Emergency Contacts

Note: All field crews will be provided 2-way radios from the Plum Brook Communications Center. In the event of an emergency, contact the Plum Brook Communications Center by radio and they will contact and coordinate emergency response personnel.

Fire Department	(419) 627-5837
Ambulance	911
Police Department	(419) 627-5863
Providence Hospital	(419) 621-7000
National Response Center	(800) 424-8802
Poison Control Center	(800) 462-0800
Ohio EPA Emergency Spill Number	(800) 282-9378
Don Burton, IT Program Manager	(423) 690-3211
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VI.1.0 Site Work Plan Summary

Project Objective. The objectives of this investigation at the former Plum Brook Ordnance Works, Sandusky, Ohio, are summarized as follows:

- Determine if there are hazardous substances present at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define site physical features and characteristics (aquifer background conditions).
- Evaluate fate and transport pathways (groundwater modeling).
- Determine current and future routes of exposure.

Project Tasks

- Installation of monitoring wells
- Well development
- In situ permeability testing
- Monitoring well groundwater sampling
- Disposal of investigation-derived wastes
- Periodic site-wide groundwater sampling.

Personnel Requirements. Up to 15 employees

Note: All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the site-wide safety and health plan (SHP) for site investigations at Plum Brook, and be familiar with the requirements of this site-specific SHP (SSHP).

VI.2.0 Site Characterization and Analysis

VI.2.1 Anticipated Hazards

The Activity Hazard Analysis in Chapter 5.0 contains project specific practices utilized to reduce or eliminate anticipated site hazards. The Job Hazard Analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

The potential chemical contaminants of concern include volatile and semivolatile chemicals listed below. Hydrogen sulfide may also be encountered in bedrock monitoring wells.

Chemical	Highest Concentration Detected in Previous Investigations (µg/L)
Benzene	1,300
Chlorobenzene	1.3
1,3-Dinitrobenzene (DNB)	0.66
2,4-Dinitrotoluene (DNT)	530
2,6-DNT	70
Ethyl benzene	180
Nitrobenzene	0.51
Toluene	800
Xylene	1,300

Table VI.2-1 contains chemicals anticipated and chemicals to be used during project activities.

VI.2.2 General Site Information

A description of the site including location, site topography, and site accessibility is presented in Section 1.3 of the Sitewide Sampling and Analysis Plan prepared by IT Corporation in September 1996.

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Acetone [67-64-1]	9.69	13–100	Inh Ing Con	Irritated eyes, nose, and throat; headache, dizziness; dermatitis.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	750 ppm 750 ppm 250 ppm	1,000 ppm 1,000 ppm	PEL TLV REL	2,500 ppm
Benzene [71-43-2]	9.24	34–119	Inh Abs Ing Con	Irritates eyes, nose, respiratory system; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude; dermatitis; bone-marrow depression. Carcinogenic.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (10 ppm) NIC–0.1 skin 0.1 ppm	5 ppm C1 ppm (Ca)	PEL TLV REL	Ca [500 ppm]* *OSHA
Chlorobenzene	9.06	1.3	Inh Ing Con	Irritation of eyes, skin, and nose, drowsiness, incoordination, CNS depression.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	75 ppm 10 ppm		PEL OLV	1,000 ppm
1,3-Dinitrobenzene [99-65-0]	10.43		Inh Abs Ing Con	Anoxia, cyanosis, visual disturbances, central blind spot of vision, bad taste, burning of mouth, dry throat, thirsty; yellowing hair, eyes, and skin; anemia, liver damage.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m³ (skin) 0.15 ppm (skin) 1 mg/m³ (skin)		PEL TLV REL	50 mg/m³
Dinitrotoluene (DNT)	N/A	-	Inh Abs Ing Con	Anoxia, cyanosis, anemia, jaundice; reproductive effects. Animal carcinogen.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/m³ (skin) NIC-0.2 mg/m³ (skin) 1.5 mg/m³ (skin)	- - -	PEL TLV REL	Ca [50 mg/m³]

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

(Page 2 of 5)

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Ethyl benzene [100-41-4]	8.76	0.09–0.6	Inh Ing Con	Irritates eyes, mucous membranes; headache; dermatitis; narcosis, coma.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	2,000 ppm
Gasoline [8006-61-9\	?	0.3	Inh Ing Con	Intoxication, headaches, blurred vision, dizziness, nausea; eye, nose, and throat irritation; potential kidney and other cancers. Carcinogenic.	Eye: Irrigate immediately (15 min) Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	300 ppm 300 ppm Ca, lowest feasible conc. (LOQ 15 ppm)	500 ppm 500 ppm	PEL TLV REL	?
Hydrogen chloride (hydrochloric acid) [74-90-8]	10.16	43-200	Inh Ing Con	Mild irritation of the eyes, nose, and throat; drowsiness, dizziness, headache; dry, cracked skin.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention		C5 ppm C5 ppm C5 ppm	PEL TLV REL	100 ppm
Hydrogen sulfide [7783-06-4]	10.46	0.001-0.13	Inh Con	Irritates eyes, respiratory system; apnea, coma, convulsion; conjunctivitis, eye pain, discharge of tears, visual intolerance to light; dizziness, headache, fatigue, GI disturbances.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	10 ppm	C20 pm 15 ppm C10 ppm	PEL TLV REL	100 ppm
Isopropyl alcohol (isopropanol) [67-63-0]	10.16	43-200	Inh Ing Con	Mild irritation of the eyes, nose, and throat; drowsiness, dizziness, headache; dry, cracked skin.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	400 ppm 400 ppm 400 ppm	500 ppm 500 ppm 500 ppm	PEL TLV REL	12,000 ppm

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Methanol	10.85	4.2-5960	Inh Abs Ing Con	Irritated eyes, headache, drowsiness, lightheadedness, nausea, vomiting, disturbance in vision, blindness.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Fresh air Swallow: Immediate medical attention		200 ppm (skin) 200 ppm (skin) 200 ppm	PEL TLV REL	25,000 ppm
Nitric acid [7697-37-2]	11.95	0.3-1	Inh Ing Con	Irritated eyes, mucous membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Respiratory support Swallow: Immediate medical attention	2 ppm 2 ppm 2 ppm	4 ppm 4 ppm 4 ppm	PEL TLV REL	100 ppm
Nitrobenzene [98-95-3]	9.92	0.37	Inh Abs Ing Con	Irritation of eyes, skin, anoxia; dermatitis; anemia; methemoglobinemia; testicular effects.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (skin) 1 ppm (skin) 1 ppm (skin)		PEL TLV REL	200 ppm
Portland cement			Inh	Fine gray powder that can be irritating if inhaled or in eyes.	Eye: Irrigate immediately Skin: Soap wash flush Breath: Respiratory support Swallow: Immediate medical attention		10 mg/m^3 10 mg/m^3/total dust 5 mg/m^3 respirable fraction	TLV PEL/REL	
Sodium hydroxide [1310-73-2]	NA	NA	Inh Ing Con	Irritated nose; pneumonitis; burns eyes and skin; temporary loss of hair.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention		C2 mg/m^3 C2 mg/m^3 C2 mg/m^3	PEL TLV REL	250 mg/m^3

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Sulfuric acid [7664-93-9]	?	0.15	Inh Ing Con	Irritated eyes, nose, and throat; pulmonary edema, bronchitis; emphysema; conjunctivitis; stomatitis; dental erosion; tracheobronchitis; skin and eye burns; dermatitis.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m³ 1 mg/m³ 1 mg/m³	3 mg/m³	PEL TLV REL	80 mg/m³
Toluene [108-88-3]	8.82	0.16–37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paralysis; dermatitis.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm 150 ppm	PEL TLV REL	2,000 ppm
Xylene (o-, m-, and p-isomers) [1330-20-7;95-47-6; 108-38-3;106-42-3]	8.56/ 8.56/ 8.44	1.1–20	Inh Abs Ing Con	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritated eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	150 ppm 150 ppm 150 ppm	PEL TLV REL	1,000 ppm

[a]IP = Ionization potential (electron volts).
[b]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA = Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a work day, even if the TWA is not exceeded.
[e]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
AEL = Airborne Exposure Limit.
TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value—TWA.
REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

[1]IDLH (NIOSH)—Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
? = Unknown.
LEL = Lower explosive limits.
LC_{50} = Lethal concentration for 50 percent of population tested.
LD_{50} = Lethal dose for 50 percent of population tested.
NIC = Notice of intended change (ACGIH).

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VI.3.0 Personal Protective Equipment

The work activities will begin in the following levels of protection.

Task	Initial Level of PPE
Staging equipment	Level D
Installation of monitoring wells	Modified Level D*
Well development, in-situ permeability testing, and groundwater sampling	Modified Level D*
Disposal of IDW	Modified Level D*
Periodic groundwater sampling	Modified Level D*

*Initial level will be raised to Level C or higher if air monitoring results in the worker's breathing zone are above action levels. Note: If unusual conditions or odors are encountered and air monitoring instruments do not detect volatile organic chemicals or hydrogen sulfide, turn equipment off, evacuate the work area, and contact the H&S Manager for further assistance.

A complete description of Level D, Modified Level D, and Level C follows.

Level D. The following equipment will be used for Level D protection:

- Coveralls or work clothing
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Modified Level D. The following equipment will be used for Modified Level D protection:

- Permeable Tyvek, Kleenguard, or its equivalent
- Latex boot covers
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Steel-toed safety boots
- Safety glasses
- Hard hat

- Hearing protection (when working near/adjacent to operating equipment).

Level C. Level C protection will not be used unless air monitoring data indicate the need for upgrade; however, the equipment shall be readily available on site. The following equipment will be used for Level C protection:

- National Institute of Occupational Safety and Health/Mine Safety and Health Agency (MSHA)-approved full face, air purifying respirators equipped with organic vapor/acid gas cartridge in combination with high-efficiency particulate air filter.
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level B. Level protection will not be used unless air monitoring data indicate the need for upgrade will be used for Level B protection:

- Pressure-demand NIOSH/MSHA-approved self-contained breathing apparatus
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

VI.4.0 Site Monitoring

The environmental contaminants of concern are volatile and semivolatile chemicals including benzene, chlorobenzene, 1,3-DNB, 2,4-DNT, 2,6-DNT, ethyl benzene, nitrobenzene, toluene, and xylene. Additionally, hydrogen sulfide may also be encountered in bedrock monitoring wells.

Table VI.4-1 contains action levels for site monitoring.

Monitoring will be performed by the site safety and health officer (SSHO) during the performance of invasive operations. A calibrated photo ionization detector and hydrogen sulfide analyzer will be utilized to monitor the wells and breathing zones, to determine if any organic material and/or hydrogen sulfide may be present that would necessitate upgrading of protection level.

Invasive operations include disturbing existing wells, sampling wells, installation of wells, and collection of samples.

Noninvasive operations that do not disturb existing materials include site setup, decontamination, and miscellaneous support zone activities.

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Table VI.4-1

Action Levels
Plum Brook Ordnance Works
Sandusky, Ohio

(Page 1 of 2)

When in Level B PPE

Analyte	Action Level	Required Action[a]
Volatile organic chemicals	≥ 100 ppm above background in breathing zone (BZ)	Stop work, evacuate work area
Hydrogen sulfide	≥ 100 ppm above background in BZ	Stop work, evacuate work area

When in Level C PPE

Analyte	Action Level	Required Action[a]
Volatile organic chemicals	≥ 50 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level B PPE.
Hydrogen sulfide	≥ 10 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level B PPE.

When in Level D Modified/D PPE

Analyte	Action Level	Required Action[b]
Volatile organic chemicals	≥ 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level C PPE.
Hydrogen sulfide	≥ 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level C PPE.

Table VI.4-1

Action Levels
Plum Brook Ordnance Works
Sandusky, Ohio

(Page 2 of 2)

When in Support Zone

Analyte	Action Level	Required Action
Volatile organic chemicals	≥ 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.
Hydrogen sulfide	≥ 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.

[a]Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.
[b]Contact with the H&S manager must be made prior to continuance of work. The H&S manager may then initiate perimeter/integrated air sampling along with additional engineering controls.

No one is permitted to downgrade levels of PPE without authorization from the H&S manager.

VI.5.0 Activity Hazard Analysis

The attached activity hazard analysis (Table VI.5-1) is provided for the following activities:

- Setup of equipment and general field activities
- Installation of monitoring wells
- Well development, in-situ permeability testing, groundwater sampling
- Disposal of IDW
- Periodic groundwater sampling.

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Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities	Slip, trip, and fall hazards	• Determine best access route before transporting equipment. • Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards. • Look before you step; ensure safe and secure footing.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment.
	Falling objects	• Stay alert and clear of materials suspended overhead; wear hard hat and steel-toed boots.
	Flying debris, dirt, dust, etc.	• Wear safety glasses/goggles; ensure that eye wash is in proper working condition.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cuts/bruises	• Use cotton or leather work gloves for material handling.
	Bees, spiders, and snakes	• Inspect work area carefully and avoid placing hands and feet into concealed areas.
	Fire	• Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow.
	Hazard communication	• Label all containers as to contents and dispose of properly. • Ensure Material Safety Data Sheets (MSDS) are available for hazardous chemicals used on site.
	Noise	• Sound levels above 85 A-weighted decibels (dBA) mandates hearing protection.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.
	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Ticks	• Wear light colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear insect repellant. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after exiting the work area.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool area.

Table VI.5-1

Activity Hazard Analysis
~~Plum~~ Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.
	Heat stroke	• Evaluate possibility of night work. • Perform physiological monitoring on workers during breaks. • Wear body cooling devices.
	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow. • Barricades shall be used on or around work areas when it is necessary to prevent the inadvertent intrusion of pedestrian traffic. • Barriers shall be used to protect workers from vehicular traffic. • Barriers shall be used to guard excavations adjacent to streets or roadways. • Flagging shall be used for the short term (less than 24 hours) to identify hazards until proper barricades or barriers are provided. • Heavy equipment shall have backup alarms.
	Forklift operations	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Portable electric tools	• Portable electric tools which are unsafe due to faulty plugs, damaged cords, or other reason, shall be tagged (do not use) and be removed from service. • Portable electric tools and all cord and plug connected equipment shall be protected by a ground fault circuit interrupter (GFCI) device. • Electrical tools shall be inspected daily prior to use.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Extension cords	• Extension cords that have faulty plugs, damaged insulation, or are unsafe in any way shall be removed from service. • Cords shall be protected from damage from sharp edges, projections, pinch points (doorways), and vehicular traffic. • Cords shall be suspended with a nonconductive support (rope, plastic ties, etc,). • Cords shall be designed for hard duty. • Cords shall be inspected daily.
	Lightning strikes	• Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than laying on the ground). • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Keep all body parts in contact with the ground as close as possible. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people.
	Thunderstorms, tornados	• Listen to radio or TV announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings. • Seek shelter. Do not try to outrun a tornado.
Drilling and installation of monitoring wells	Overhead hazards	• Make sure no obstacles are within radius of boom. Always stay a safe distance from power lines.
	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out. • Drill rigs shall be equipped with reverse signal alarm, backup warning lights, or the vehicle is backed up only when an observer signals it is safe to do so.

Table VI.5-1

Activity Hazard Analysis
~~Plum~~ Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Drilling and installation of monitoring wells (continued)	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to ensure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels choked. • Inspect brakes and tire pressure on drill rig before staging for work.
	Inexperienced operator	• Machinery and mechanized equipment shall be operated only by designated personnel. • Operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Jacks/outriggers	• Ensure proper footing and cribbing.
	Falling objects	• Remove unsecured tools and materials before raising or lowering the derrick. • Stay alert and clear of materials suspended overhead.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert at all times!
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.
	Fall hazards	• Personnel are not allowed to work off of machinery or use them as ladders. • Use fall protection when working above 6 feet.
	Noise	• Hearing protection is mandatory above 85 dBA.
	Contact with rotating or reciprocating machine parts	• Use machine guards; use long-handled shovels to remove auger cuttings. • Use safe lockout procedures for maintenance work.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Slip, trip, and fall hazards	• Practice good housekeeping, keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Drilling and installation of monitoring wells (continued)	Contact with potentially contaminated materials	• Real time air monitoring will take place. If necessary, proper personal protective clothing and equipment will be utilized. • Stop immediately at any sign of obstruction. • Do not breathe air surrounding boring unless necessary. • Upgrade to respirator if necessary. • Avoid skin contact with soil cuttings. Wear gloves. • Stay clear of moving parts of drill rig.
	Drum handling	• Be careful not to breathe air from around open drum any more than necessary. Monitor with photoionization detector/flame ionization detector (PID/FID) equipment and upgrade to respirator if necessary. • When filling a drum (with either soil or water), be careful not to make contact with the contained waste. Wear appropriate gloves. Make sure lid or bung of drum is secure. • If moving a drum unassisted, be sure to leverage properly, use proper lifting techniques, and wear safety glasses and steel-toed boots. • When using a drum dolly, make sure straps and lid catch are securely attached. Leverage properly when tilting drum. Be sure toes stay away from drum.
Well development permeability testing, groundwater sampling	Cross-contamination and contact with potentially contaminated materials	• Stop immediately at any sign of obstruction. • Sampling technicians will wear proper protective clothing and equipment to safeguard against potential contamination. • Only essential personnel will be in the work area. • Initial real-time air monitoring will take place before and during sampling activities. • All personnel will follow good hygiene practices. • Proper decontamination procedures will be followed. • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations.
	Cut hazards	• Use care when handling glassware. • Wear adequate hand protection.
	Slip, trip, fall	• Site workers will be required to wear hard hat, safety glasses with side shields, work gloves, and steel-toe/shank boots when working in the field. • Whenever possible, avoid routing cords and hoses across walkway pathways. • Flag or cover inconspicuous holes to protect against falls.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Well development permeability testing, groundwater sampling (continued)	Bees, spiders, and snakes	• Workers shall inspect the work area carefully and avoid placing hands and feet into concealed areas. • Evaluate need for sensitive workers to have prescribed antibiotic or medicine to combat of symptoms.
	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.
	Access/egress hazards	• Use qualified and trained bushhog operator. • Keep employees out of the bushhog work area. • Utilize good housekeeping practices. • Keep aisleways, pathways, and work areas free of obstruction. • Clean ice or snow off of walkways or work stations. • Use appropriate footwear for the task assigned.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool areas.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Well development permeability testing, groundwater sampling (continued)	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.
Periodic groundwater sampling	Cross-contamination and contact with potentially contaminated materials	• Sampling technicians will wear proper protective clothing and equipment to safeguard against potential contamination. • Avoid skin contact with water. • Handle samples with care. • Only essential personnel will be in the work area. • Real-time air monitoring will take place before and during sampling activities. • All personnel will follow good hygiene practices. • Proper decontamination procedures will be followed. • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations.
	Cut hazards	• Use care when handling glassware. • Wear adequate hand protection.
	Hazard communication	• MSDSs shall be obtained for chemicals brought on site. • Label all containers as to contents.
	Strains/sprains	• Use the proper tool for the job being performed. • Get assistance if needed. • Avoid twisting/turning while pulling on tools, moving equipment, etc.
	Spills/residual materials	• Absorbent material and containers will be kept available where leaks or spills may occur.
	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Unattended worker	• "Buddy System" - visual contact will be maintained with the sampling technician during sampling activities.

Table VI.5-1

Activity Hazard Analysis
~~Plum~~ Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Disposal of IDW	Forklift operation	• Use qualified and trained ~~forklift~~ operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Cuts, punctures, or abrasions	• Work (leather or cotton) gloves shall be worn by personnel. • The proper tool shall be utilized to open/close drums.
	Back injury	• Use mechanical equipment to lift and move items, when necessary. • Get assistance when necessary. • Size up the job. • Lift with your legs, not your back. • Do not lift awkwardly sized items and those items over 60 pounds. • If a worker loses control of item, STAND CLEAR ~~and~~ DO NOT try to prevent its fall.
	Pinch points	• Keep hands and feet clear of moving/suspended materials and equipment. • Wear hard toe/shank safety shoes/boots and hand protection.
	Strains/sprains	• Do not stand on drums. • Use the proper tool for the job being performed. • Get assistance if needed. • Avoid twisting/turning while pulling on tools, moving equipment, etc.
	Unattended worker	• "Buddy System" - visual contact will be maintained with the sampling technician during activities.
	Slip, trip, fall	• Site workers will be required to wear hard hats, safety glasses with side shields, work gloves, and steel-toed/shank boots when working in the field. • Whenever possible, avoid routing cords and hoses across walking pathways. • Flag or cover inconspicuous holes to protect against falls.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

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Attachment VI

Site-Specific Sampling and Analysis Plan
Sitewide Groundwater Level Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

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IT Project Number 771481
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May 1997

(This SSAP must be used in conjunction with the PBOW SAP)

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List of Acronyms

ASTM	American Society for Testing and Materials
bgs	below ground surface
BNA	base/neutral and acid extractables
CFR	Code of Federal Regulations
°C	degrees Celsius
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information System
GWI	groundwater elevation investigation
HSA	hollow-stem auger
ID	inside diameter
IDW	investigation-derived waste
IT	IT Corporation
NASA	National Aeronautic and Space Administration
OD	outside diameter
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyl
PPE	personal protective equipment
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SAP	sampling and analysis plan
SHP	safety and health plan
SI	site investigation
SOW	statement of work
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
SVOC	semivolatile organic compound

List of Acronyms *(Continued)*

TAL	target analyte list
TCL	target compound list
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	volatile organic compound
WARWP	West Area Red Water Pond

VI.1.0 Project Description

The U. S. Army is conducting studies of environmental impact of suspected hazardous waste sites at previously owned U.S. Department of Defense (DOD) properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). The Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio is a formerly used defense site under DERP currently being managed and technically overseen by the Nashville, Tennessee USACE District Office. IT Corporation (IT) is contracted to provide engineering service to conduct a sitewide groundwater level investigation (GWI), including quarterly groundwater level measurements, installation and development of 12 new wells, and two sampling events of new and existing monitoring wells.

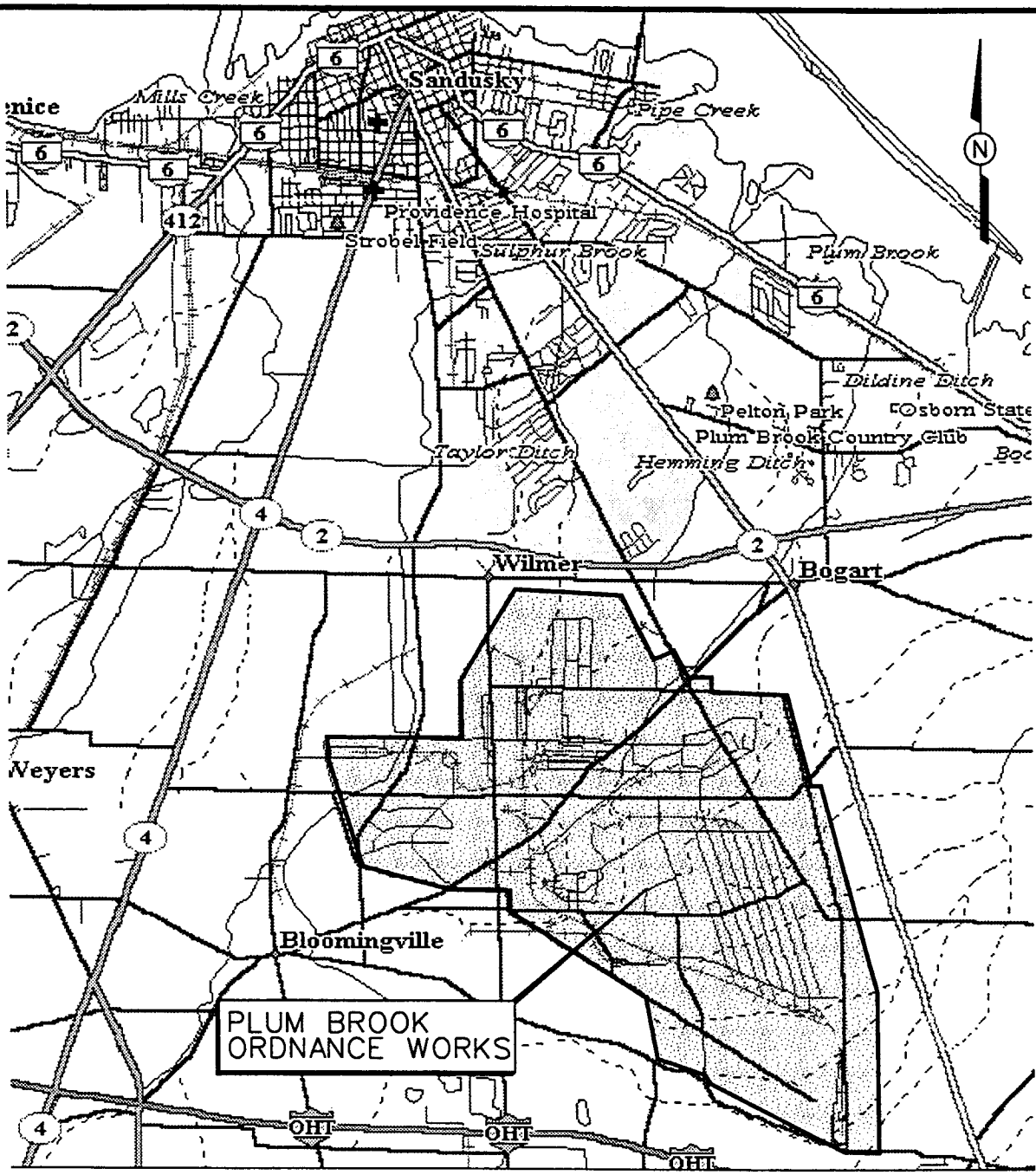
As an attachment to the PBOW sitewide sampling and analysis plan (SAP) (IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the GWI at PBOW. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP) (IT, 1996b) to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this investigation that must be used in conjunction with the sitewide safety and health plan (SHP) (IT, 1996c).

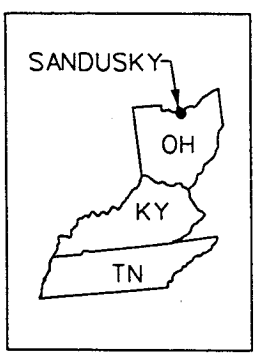
VI.1.1 Site History

The PBOW site, located in Sandusky Ohio (Figure VI-1), was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to Ordnance Department, then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration. The National Aeronautics and Space Administration (NASA) acquired the PBOW in 1963 and is presently utilizing the site.

VI.1.2 Summary of Existing Site Data

The western portion of the PBOW generally refers to the area west of Ransom Road. The area is predominantly wooded with some cleared areas covered with grasses and bushes. Several areas





NOT TO SCALE

FIGURE VI-1
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 5/8/97 | DATE LAST REV.: | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR: D.SEYMORE | DWG. NO.: 771481ES.003
DRAWN BY: R. KNIGHT | DRAWN BY: | ENGR. CHCK. BY: D. SEYMORE | PROJ. MGR.:D. BURTON | PROJ. NO.:771481

771481ES.003 14:06:48 MAY 08, 1997 RMK

have been identified by previous investigations as potential areas of contamination. These areas include Reservoir No. 2 Burning Ground, Waste Water Disposal Plant No. 2, Power House No. 2 Ash Pit, TNT Area C, West Area Red Water Pond (WARWP), and G-8 Burning Ground. According to additional investigations conducted by several government agencies, the chemicals of potential concern within the western portion of PBOW may include volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides/polychlorinated biphenyls (PCB), metals, and nitroaromatics. The findings of these investigations are summarized in Section 1.2.2 of SAP (IT, 1996a).

In 1994, the USACE Nashville District conducted the most recent sitewide groundwater investigation of the overburden and bedrock hydrostratigrahic units at PBOW (Dames & Moore, 1996). Eleven groundwater monitoring wells were installed in the overburden units and eight additional wells were installed in the bedrock unit. Groundwater sampling was conducted in 16 monitoring wells completed in the overburden unit and 8 additional wells were installed in the bedrock unit. Groundwater sampling was conducted in 16 monitoring wells completed in the overburden unit and 9 wells completed in the bedrock. All groundwater samples were analyzed for nitroaromatic compounds, nitrates, and total and dissolved metals. Samples from bedrock wells were also analyzed for VOCs and base/neutral and acid extractables (BNA) to acquire baseline groundwater quality information of the bedrock aquifer. The major findings of this investigation are briefly summarized in the following paragraphs to facilitate the GWI planning process and to aid in field operations. Table VI-1 summarizes the existing monitoring well construction details.

The overburden unit is composed of glacial outwash materials and its thickness increases from a few feet in the south to greater than 40 feet in some locations in the north. The bedrock unit consists of Devonian limestone and shale that dip to the southeast at approximately 35 feet per mile.

General groundwater flow in both unconsolidated overburden materials and consolidated bedrock (mainly limestone and shale) is to the north in the direction of Lake Erie. On the western side of the site, groundwater flow in the overburden aquifer is to the northwest, while groundwater in the bedrock aquifer shows a northeast flow direction. Table VI-2 presents historical groundwater level elevation data.

The results of the groundwater quality analyses indicated significant levels of explosive residues in the groundwater in the overburden aquifer in the immediate vicinity of both former Red Water

Table VI-1

Existing Monitoring Well Construction Details
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Well Depth (feet)	Date Installed	Installed By	Casing Type	Casing Diameter (inch)	Borehole Diameter (inch)	Screen Interval (feet, bgs)	Top of Filter Pack (feet, bgs)	TOC Elevation (feet, msl)	Ground Elevation (feet, msl)	Well Location
PB-TNTA-MW10	11.0	1994	D & M[a]	PVC (40)	2"	8"	3-11	2.5	640.17	637.5	Northwest side of TNT Area A
PB-TNTA-MW11	11.4	1994	D & M	PVC (40)	2"	8"	3.4-11.4	2.5	640.49	637.86	West side of TNT Area A
PB-TNTC-MW3	14.0	1994	D & M	PVC (40)	2"	8"	5-14	3.2	645.41	642.56	North of TNT Area C
PB-TNTC-MW4	18.8	1994	D & M	PVC (40)	2"	8"	8.8-18.8	6.0	654.42	651.89	West side of TNT Area C
PB-TNTC-MW5	29.7	1994	D & M	PVC (40)	2"	8"	4.7-29.7	3.7	651.81	649.07	North side of TNT Area C
PB-TNTC-MW6	12.2	1994	D & M	PVC (40)	2"	8"	3.2-12.2	2.5	659.40	65682	Northeast of TNT Area C
PB-WA-MW1	22.3	1994	D & M	PVC (40)	2"	8"	4.3-22.3	3.7	644.43	642.32	North of West area red water pond
PB-WA-MW2	12.0	1994	D & M	PVC (40)	2"	8"	3-12	2.5	633.65	631.15	Southeast side of West area red water pond
PB-PR-MW7	22.3	1994	D & M	PVC (40)	2"	8"	4.3-22.3	3.0	633.98	631.5	West side of Pentolite Road Red Water ponds
PB-PR-MW8	27.5	1994	D & M	PVC (40)	2"	8"	5-27.5	4.0	635.02	632.5	South side of Pentolite Road Red Water Ponds
PB-PR-MW9	19.0	1994	D & M	PVC (40)	2"	8"	4-19	3.0	633.69	630.7	East side of Pentolite Road Red Water Ponds
PB-BED-MW13	75.5	1994	D & M	PVC (40)	4" to 46	10" to 46	(3") 46-75.5[b]	---	648.27	645.81	North of TNT Area C
PB-BED-MW14	52.2	1994	D & M	PVC (40)	4" to 29	10" to 29	(3") 29-52.2[b]	---	646.04	643.05	East of West Area Red Water Pond, west of Campbell Street
PB-BED-MW15	74.4	1994	D & M	PVC (40)	4" to 31.5	10" to 31.5	(3") 31.5-74.4[b]	---	631.64	629.08	North of Pentolite Road, East of Reactor Facility
PB-BED-MW16	74.0	1994	D & M	PVC (40)	4" to 49.2	10" to 49.2	(3") 49.2-74[b]	---	636.02	633.68	South of Pentolite Road Red Water Pond, west of TNT Area A
PB-BED-MW17	64.4	1994	D & M	PVC (40)	4" to 45	10" to 45	(3") 45-64.4[b]	---	629.97	627.34	Northeast of TNT Area A
PB-BED-MW18	75.4	1994	D & M	PVC (40)	4" to 51	10" to 51	(3") 51-75.4[b]	---	651.50	648.83	East of TNT Area A
PB-BED-MW19	49.5	1994	D & M	PVC (40)	4" to 32	10" to 32	(3") 32-49.5[b]	---	643.07	640.5	On north side of Patrol Road along the northern property boundary
PB-BED-MW20	49.5	1994	D & M	PVC (40)	4" to 35	10" to 35	(3") 35-49.5[b]	---	676.33	673.57	Near intersection of Patrol Rd and TAFT Rd, west of a fence area
MK-MW10	14.0	1993	MK[c]	PVC (40)	2"	8"	4-14	2.0	641.25	638.23	Along Maintenance Rd, north of West Area Red Water Pond
MK-MW11	13.0	1993	MK	PVC (40)	2"	8"	3-13	2.0	638.00	634.88	Along Maintenance Rd, north of West Area Red Water Pond
MK-MW16	8.0	1993	MK	PVC (40)	2"	8"	3-8	2.0	674.64	671.45	Along West Scheid Rd directly behind TNT Area B
MK-MW17	6.0	1993	MK	PVC (40)	2"	8"	2-6	1.0	661.90	661.43	Along north side of North Magazine Rd in front of TNT Area B
MK-MW22	9.5	1993	MK	PVC (40)	2"	8"	4.5-9.5	3.5	638.95	635.84	North side of 7141 along Columbus Ave.
MK-MW23	16.0	1993	MK	PVC (40)	2"	8"	6-16	4.0	640.01	637.01	Loop Rd behind 7141
MK-MW24	9.5	1993	MK	PVC (40)	2"	8"	4.5-9.5	2.5	657.59	654.59	SW corner of PMU
IT-MW002	18.3	1989	IT[d]	PVC (40)	2"	8"	6-16	4.0	636.69	639.59	West area red water pond
IT-MW005	21.0	1989	IT	PVC (80)	2"	8"	8.5-18.5	6.5	634.99	631.91	north of Pentolite Road Red Water Pond
IT-MW007	5.5	1996	IT	PVC (40)	2"	4.25"	--	--	635.03	632.3	2" piezometer, 200 feet west of WA-MW2, in WARWP
IT-MW008	13.4	1996	IT	PVC (40)	2"	8.25"	3.1 - 13.1	3.6	633.16	630.6	36 feet North east of the pump house, west of Campbell Road
IT-MW009	14.5	1996	IT	PVC (40)	2"	8.25"	4.1 - 14.1	2.0	647.45	645.4	south of the red barn on east side of Campbell Road
IT-MW010	19.8	1996	IT	PVC (40)	2"	8.25"	9.3 - 19.3	8.6	644.80	642.2	West of the WARWP, next to a road intersects Patrol Rd to the west

Note: [a]Dames & Moore [b]Open hole interval in bedrock, no screen installed
[c]Morrison Knudsen Corporation [d]IT Corporation

Table VI-2

Groundwater Level Elevations
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Top Of Casing Elevation (feet, msl)	Ground Elevation (feet, msl)	Water Level Elevation Dec-94 (feet, msl)	Water Level Elevation Mar-95 (feet, msl)	Water Level Elevation Oct-96 (feet, msl)	Notes
PB-TNTA-MW10	640.18	637.50	633.71	637.04	635.62	
PB-TNTA-MW11	640.50	637.86	630.56	632.82	633.56	
PB-TNTC-MW3	645.41	642.57	Dry, <628.57	639.20	635.01	
PB-TNTC-MW4	654.43	651.89	634.87	651.07	648.51	
PB-TNTC-MW5	651.81	649.07	628.01	647.62	643.28	
PB-TNTC-MW6	659.40	656.82	651.93	655.20	654.56	
PB-WA-MW1	644.43	642.32	619.85	619.45	624.99	
PB-WA-MW2	633.65	631.16	629.59	631.91	628.75	
PB-PR-MW7	633.99	631.50	626.32	631.65	629.64	
PB-PR-MW8	635.02	632.50	624.55	629.98	627.56	
PB-PR-MW9	633.70	630.70	622.92	630.12	626.57	
PB-BED-MW13	648.27	645.81	607.85	619.29	621.79	
PB-BED-MW14	646.04	643.05	621.76	624.39	625.23	
PB-BED-MW15	631.64	629.08	603.54	598.91	610.22	
PB-BED-MW16	636.02	633.68	571.38	633.68	630.17	
PB-BED-MW17	629.97	627.34	602.57	602.90	602.76	
PB-BED-MW18	651.50	648.83	625.05	620.39	621.68	
PB-BED-MW19	643.07	640.50	621.07	623.52	622.92	
PB-BED-MW20	676.33	673.57	661.35	661.28	661.98	
MK-MW10	640.89	638.06	626.66	Not Measured	632.23	
MK-MW11	637.69	634.71	625.22	631.36	628.89	
MK-MW16	674.32	671.33	667.14	669.36	668.42	
MK-MW17	664.64	660.97	659.58	661.10	660.56	
MK-MW22	638.05	635.56	628.85	631.55	630.07	
MK-MW23	639.07	636.95	620.88	628.12	632.14	
MK-MW24	657.12	654.44	648.31	650.77	649.61	
IT-MW002	639.63	636.69	627.32	633.75	629.33	
IT-MW005	634.99	631.91	620.19	629.62	623.36	
IT-MW07	635.03	632.30	-	-	dry, < 627.30	piezometer
IT-MW08	633.16	630.60	-	-	619.96	new well/survey data
IT-MW09	647.45	645.40	-	-	dry, < 632	new well/survey data
IT-MW010	644.80	642.20	-	-	626.41	new well/survey data

Note: TOC and ground surface elevations were reported in Table 5-2 of Dames & Moore Site-Wide Groundwater Investigation report, (Dames & Moore, 1996) unless otherwise indicated.

Pond areas. Low levels of explosives, several VOCs, and BNAs were also detected in several bedrock wells. The locations of monitoring wells to be sampled during this GWI are provided on Figure VI-2.

A site visit was conducted by IT project members on May 15 and 16, 1996 to acquire information regarding 28 existing monitoring wells to be sampled and to assess site accessibility for new monitoring well installation. All targeted existing wells are located and appear to be in good condition. Some wells are off-road and some are in swampy areas that will require the use of an all-terrain vehicle.

VI.2.0 Project Organization and Responsibility

The project organization for this sitewide GWI consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.

VI.3.0 Scopes and Objectives

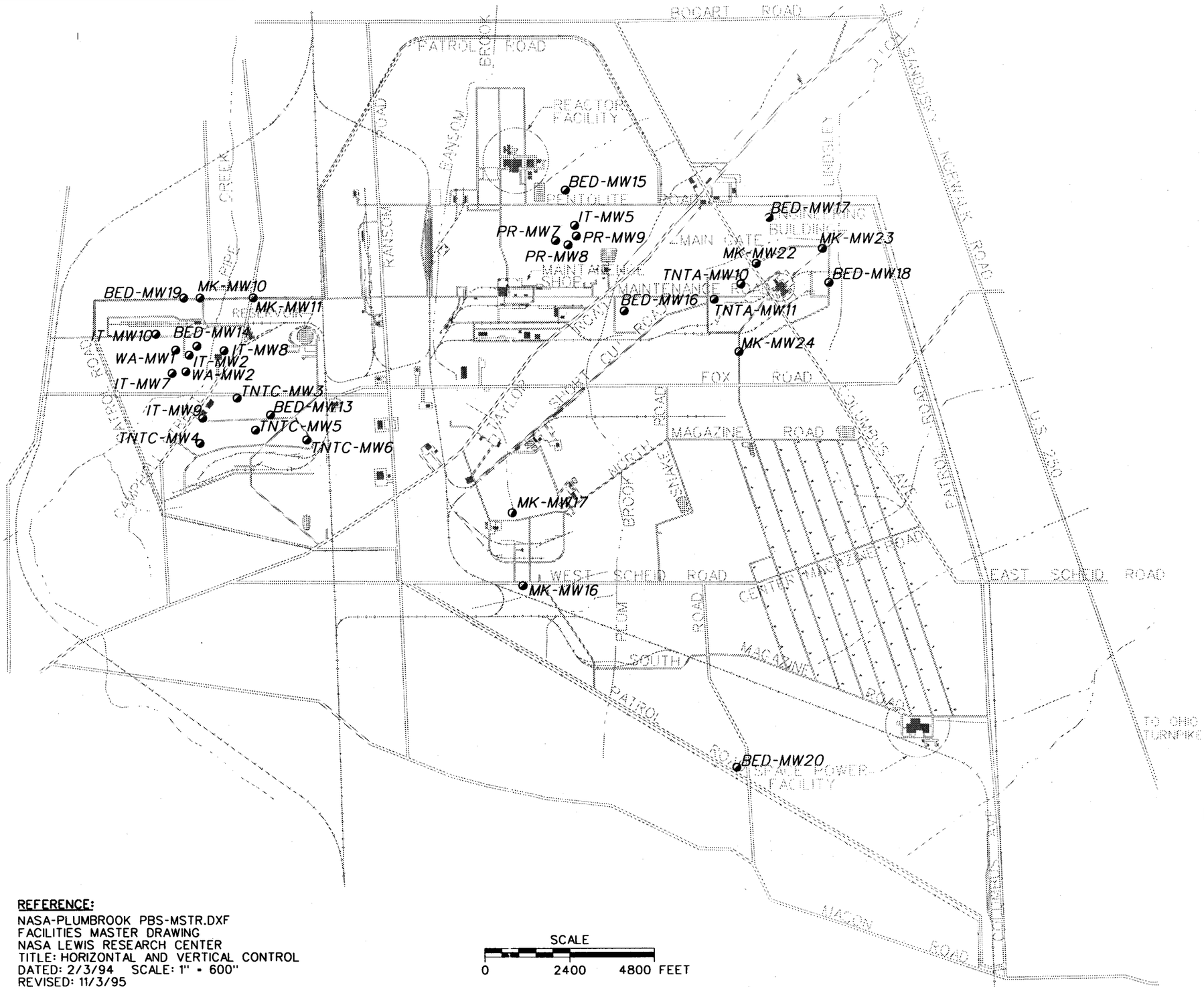
VI.3.1 Scope

As specified in the statement of work (SOW) (USACE, 1997), the scope for the groundwater investigation at PBOW consists of preparation of site-specific addendums to the sitewide SAP and SHP; completion of field activities, including installation of monitoring wells and collection of soil samples from new monitoring wells and groundwater samples from new and existing monitoring wells for chemical analysis, evaluation of analytical results; periodic sitewide water level measurements; preparation of investigation report of activities, conclusions, and recommendations for future actions, and a Geographic Information System (GIS) deliverable.

VI.3.2 Objectives

Specific objectives of the sitewide groundwater level investigation are summarized as follows:

- Determine if there are hazardous substances present at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define site physical features and characteristics (aquifer background conditions).



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- EXISTING WELL

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

SCALE
0 2400 4800 FEET

FIGURE VI-2
SITE WIDE MONITORING
WELL LOCATION MAP

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: D. SEYMORE	DWG. NO.:771481BES.001	
ENGR. CHCK. BY: D. SEYMORE	PROJ. MGR.: D. BURTON	PROJ. NO.:771481	
STARTING DATE: 5/8/97	DATE LAST REV.:		
DRAWN BY: R. KNIGHT	DRAWN BY:		

771481ES.001 11:05:13 MAY 08, 1997 RMK

- Evaluate fate and transport pathways (groundwater modeling).
- Determine current and future routes of exposure.

Evaluation of fate and transport pathways will not be completely satisfied during this investigation, but sufficient groundwater information will be collected so that a scope of work for groundwater modeling can be completed if required to determine fate and transport of hazardous substances in site groundwater. Additionally, the quality of the collected data will be such that it can be used to conduct a human health risk assessment.

VI.3.3 Site-Specific Data Quality Objectives

Overview. The data quality objectives (DQO) process is followed to evaluate data requirements and to support the decision making process associated with the action selection for the sitewide GWI. This section incorporates the components of the DQO process described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund* (EPA, 1993); the DQO process as applied to PBOW sites is described in more detail in Section 3.3 of the sitewide SAP. The factors used to determine the sampling quantity and procedures necessary to meet the objectives of the site investigations (SI) and to establish a basis for future action at the sites and a general decision-making process diagram are presented in Table 3-1 and in Figure 3-2 of the sitewide SAP (IT, 1996a), respectively.

Data Users and Available Data. The intended data users and available data related to the sitewide GWI presented in Table 3-1 of the sitewide SAP have been used to formulate a site-specific conceptual model to support the development of this SSAP necessary to meet the objectives of the SI and to establish a basis for future action at the site. The data users for information generated during this SI are primarily the EPA, USACE, Ohio Environmental Protection Agency, Plum Brook Station, and the USACE's supporting contractors. This SSAP, along with the necessary companion documents, has been designed to provide the regulatory agencies with sufficient detail to reach a determination as to the adequacy of the SSAP. The program has also been designed to provide the USACE with the level of defensible information required to confirm or deny the existence and nature of residual contamination in site media.

Conceptual Site Model. Four factors have been considered in defining the conceptual model for the sitewide GWI:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Contaminants of concern.

Potential sources of contamination at PBOW include the use of the site during TNT manufacturing operations. The migration pathways include groundwater infiltration, soil, and surface water runoff to the creek. The most likely receptors at PBOW are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants is unlikely at PBOW since the site is a secure NASA research station. However, potential receptors near the facility may include off-site water users. Potential contaminants of concern based on past use of the site may include VOCs, SVOCs, metals, pesticides/PCBs, nitroaromatics, and total cyanide.

Decision-Making Process, Data Uses, and Needs. The decision-making process consists of a seven-step process, which is presented in detail in Section 3.3.3 of the sitewide SAP (IT, 1996a) and will be followed during the additional sitewide GWI. Data uses and needs are summarized in Table 3-1 of the sitewide SAP (IT, 1996a).

Risk Evaluation. Confirmation of contamination at the additional sitewide GWI will be based upon a comparison of detected contaminants to the most current guidance criteria. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in the media. Definitive data will be adequate for confirming the presence of the contamination and for supporting a feasibility study and risk assessment.

Data Quality, Types, and Quality. Soil and groundwater samples will be collected and analyzed in order to meet the objectives of the additional sitewide GWI. Quality assurance/quality control (QA/QC) samples will be collected for all sample types as described in Section VI.4.5 of this SSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the SI, data analyzed at this level of quality are appropriate for all phases of the characterization and risk assessment.

Precision, Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this are provided in Section 3.3.4.4.3 of the sitewide SAP (IT, 1996a).

VI.4.0 Field Activities

Field activities during the additional groundwater level investigation at PBOW include the installation, development, geotechnical sampling, and groundwater sampling of 8 new bedrock wells (IT-BG8-BEDGW-001, TNTB-BEDGW-001, TNTB-BEDGW-002, MNTA-BEDGW-001, AA1-BEDGW-001, AA2-BEDGW-001, AA3-BEDGW-001, and ABG-BEDGW-001) and 4 new overburden wells (IT-AA1-GW-002, AA2-GW-002, AA3-GW-002, ABG-GW-002); the groundwater sampling of 12 existing bedrock wells and 35 existing overburden wells, with QA/QC samples, followed by sitewide water level measurements, surveying, and management of investigation-derived waste (IDW).

VI.4.1 Monitoring Well Installation

VI.4.1.1 Monitoring Well Locations and Rationale

Twelve new monitoring wells will be installed during the investigation of groundwater at PBOW. Eight monitoring wells will be installed as bedrock wells, while the remaining four monitoring wells will be installed as overburden wells. Table VI-3 provides a summary of the wells to be installed, including anticipated well depths, locations, and construction details. Monitoring well installation in the referenced locations will allow for additional characterization of the aquifer conditions, evaluation of fate and transport pathways, determination of whether the hazardous substances pose an unacceptable risk to human health and the environment, and definition of current and future routes of exposure. Additional rationale for placement of monitoring wells comes from previous analytical results/contaminant plumes and the need to fill data gaps.

Tentative locations of these monitoring wells are presented on Figure VI-3. The locations may require adjustment if site conditions warrant. In that event, the IT field coordinator will contact the USACE oversight representative and the project manager prior to changing well locations. Any changes from the work plans will be recorded in chronological order in the variance log shown in Figure 9-1 of the SAP (IT, 1996a).

Table VI-3

Construction Details for Proposed Monitoring Wells
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Total Depth (feet bgs)	Casing Diameter (inches)	Screen Interval (feet bgs)	Proposed Well Location
Bedrock Monitoring Wells				
IT-BG8-BEDGW-001	75.0	2"	60-75	G8 Burning Grounds
IT-TNTB-BEDGW-001	75.0	2"	60-75	TNT Area B near MK-MW16
IT-TNTB-BEDGW-002	75.0	2"	60-75	TNT Area B near MK-MW17
IT-MNTA-BEDGW-001	75.0	2"	60-75	Maintenance
Nested Monitoring Well Pairs				
IT-AA1-BEDGW-001	75.0	2"	60-75	Acids Area 1
IT-AA1-GW-002	15.0	2"	5-15	Acids Area 1
IT-AA2-BEDGW-001	75.0	2"	60-75	Acids Area 2
IT-AA2-GW-002	15.0	2"	5-15	Acids Area 2
IT-AA3-BEDGW-001	75.0	2"	60-75	Acids Area 3
IT-AA3-GW-002	15.0	2"	5-15	Acids Area 3
IT-ABG-BEDGW-01	75.0	2"	60-75	Additional Burn Ground
IT-ABG-GW-002	15.0	2"	5-15	Additional Burn Ground

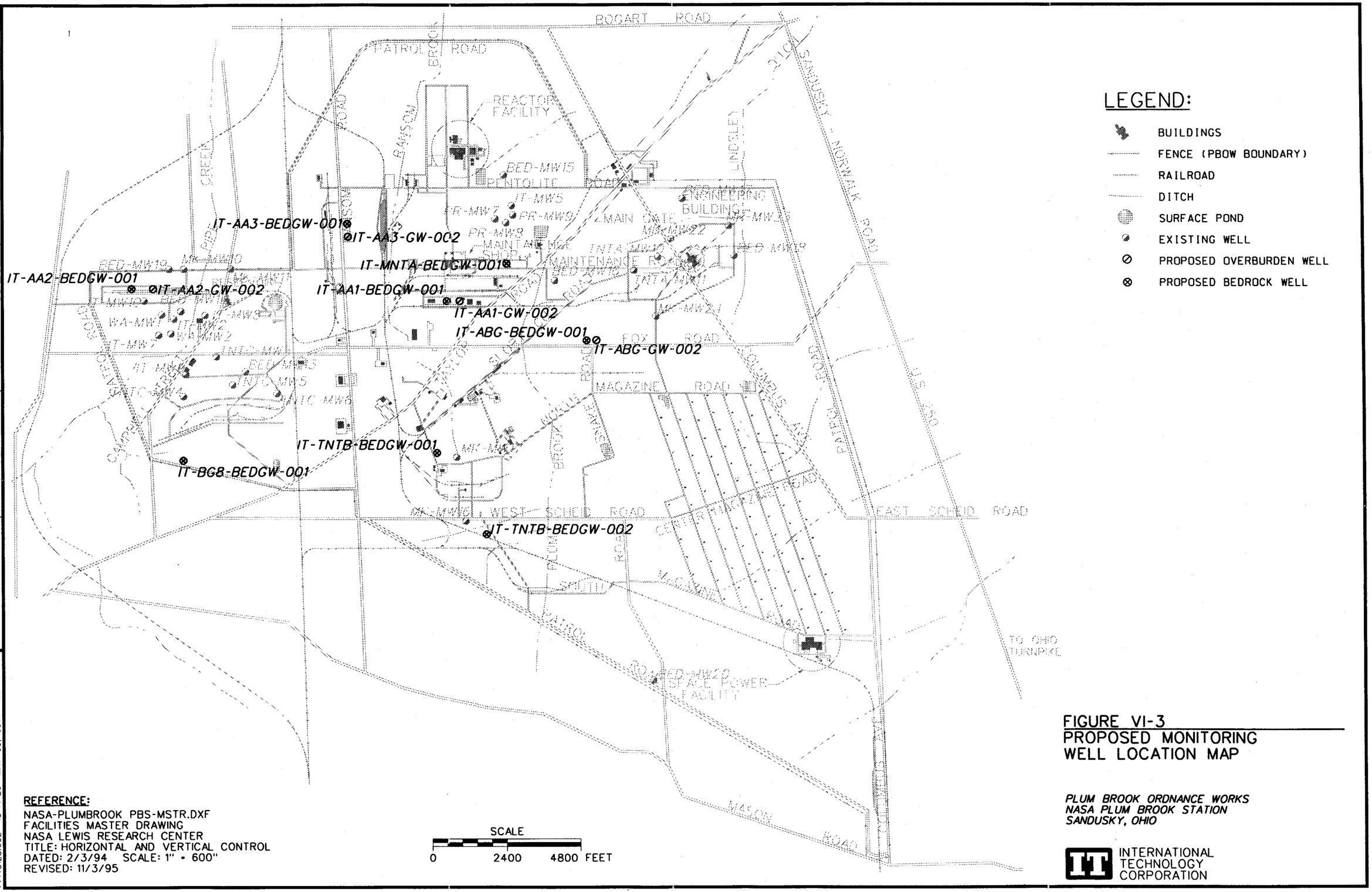


FIGURE VI-3
PROPOSED MONITORING WELL LOCATION MAP

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

STARTING DATE: 5/8/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: D. SEYMORE	DWG. NO.:771481ES.002
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: D. SEYMORE	PROJ. MGR.:D. BURTON	PROJ. NO.:771481

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Bedrock monitoring wells will be installed to an assumed total depth of 75 feet below ground surface (bgs), while overburden monitoring wells will be installed to an assumed total depth of 15 feet bgs.

VI.4.1.2 Drilling Methods for Overburden Monitoring Wells

A total of four boreholes for monitoring well installation will be installed in the unconsolidated overburden materials by the hollow-stem auger (HSA) method using nominal 8.25-inch inside diameter (ID) augers as specified in the following text. Continuous soil sampling and rock coring will be conducted in each borehole from the surface to the total depth for lithological description. All soil samples will be visually inspected and logged by an IT field geologist using the Unified Soil Classification System (USCS). Three soil samples will be collected from each borehole and submitted for geotechnical analysis; at least one of the samples will be collected from the aquifer material in the screened interval. Geotechnical samples will be analyzed by a geotechnical testing laboratory for sieve analysis, Atterberg limits, soil density, and moisture content. In addition, one sample will be collected of the filter pack material and submitted for sieve analysis only. The borehole will be advanced to first water with a 10-foot screen section placed 1 foot above the bottom. The estimated depth of each overburden well is 15 feet bgs. If bedrock is encountered at a depth of less than 6 feet bgs, a monitoring well will not be installed and the borehole will be abandoned by grouting from the bottom to the ground surface. A new well location will then be identified and coordinated with the USACE.

VI.4.1.3 Drilling Methods for Bedrock Monitoring Wells

A total of eight new bedrock monitoring wells will be installed during the investigation of groundwater at PBOW. The bedrock monitoring wells will be installed as double-cased wells, drilled using HSA methodology. Initially, 14-inch-diameter HSA will be used to drill through the overburden material to bedrock and 5 feet into bedrock at an assumed depth of 50 feet bgs. A 10-inch ID low-carbon steel surface casing will then be installed into the borehole through the augers and pressure-grouted in place using 3,000 pounds per square inch (psi) concrete to prevent frost damage. The surface casing will be permitted to cure for a minimum of 48 hours, after which the borehole will be advanced through the surface casing to the estimated total depth of 75 feet bgs (25 feet into bedrock) using 6-inch outside diameter (OD) air rotary drilling techniques.

Continuous soil sampling and rock coring will be conducted in each borehole from the surface to the total depth for lithological description. All soil samples will be visually inspected and logged by an IT field geologist using the USCS. Two soil samples will be collected from each borehole

and submitted for geotechnical analysis. Geotechnical samples will be analyzed by a geotechnical testing laboratory for sieve analysis, Atterberg limits, soil density, and moisture content. In addition, one sample will be collected of the filter pack material and submitted for sieve analysis only.

Drilling and installation of all monitoring wells will follow the requirements of USACE EM-1110-1-4000, *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites* (USACE, 1994).

VI.4.1.4 Soil Samples for Geologic Logging

The soil and rock sampling shall be continuous for the entire monitoring well boring. Visual classification and logging of borehole material in the field shall be in accordance with USCS nomenclature and procedures described in USACE EM 1110-1-4000 (USACE, 1994), including making a photographic record of the core. Soil overburden material shall be split-spoon sampled for the purpose of visual geotechnical classification of the borehole material.

VI.4.1.5 Soil Samples for Geotechnical Testing

Sample collection for geotechnical analysis according to the USACE scope of work is summarized in Table VI-4.

Two soil samples from each of the eight bedrock wells will be collected. The sieve analysis number includes screened interval samples from overburden wells.

The results of geotechnical analysis will be included in the investigation report along with drilling logs.

VI.4.1.6 Monitoring Well Completion

All monitoring wells will be completed using 2-inch-ID, schedule 40 polyvinyl chloride (PVC) casing (American Society for Testing and Materials [ASTM] F480-81, D1785), and screen for overburden and bedrock wells, using procedures specified in the Resource Conservation and Recovery Act groundwater monitoring technical enforcement guidance document (EPA, 1986), the USACE EM-1110-1-4000 (USACE, 1994), and the State of Ohio requirements.

Table VI-4

Geotechnical Samples for the New Well Installations
Former Plum Brook Ordnance Works, Sandusky, Ohio

Geotechnical Test	ASTM Method	Number of Samples
Moisture content	D2216	16
Atterberg limits	D4318	16
Sieve analysis	D422	16 + 4
Soil density	D2487	16

DRAFT

VI.4.1.7 Materials and Procedures for Overburden Monitoring Wells

A typical overburden monitoring well construction diagram is provided as Figure VI-4. The overburden groundwater monitoring wells will be installed using the following materials and procedures:

- ***Well Screens.*** A 2-inch ID, flush-jointed threaded schedule 40 PVC continuous wrap slots. The slot size will be determined based upon historical site data and confirmed through sieve analyses. Ten feet of screen with a PVC end cap will be placed in each overburden well.

- ***Well Casing.*** A 2-inch ID, flush-jointed threaded schedule 40 PVC (ASTM D1875) casing will be attached to the top of the screen. Glues or adhesives will not be used. The casing string will extend approximately 2.5 feet above grade and will be certified by the manufacturer as being the material specified.

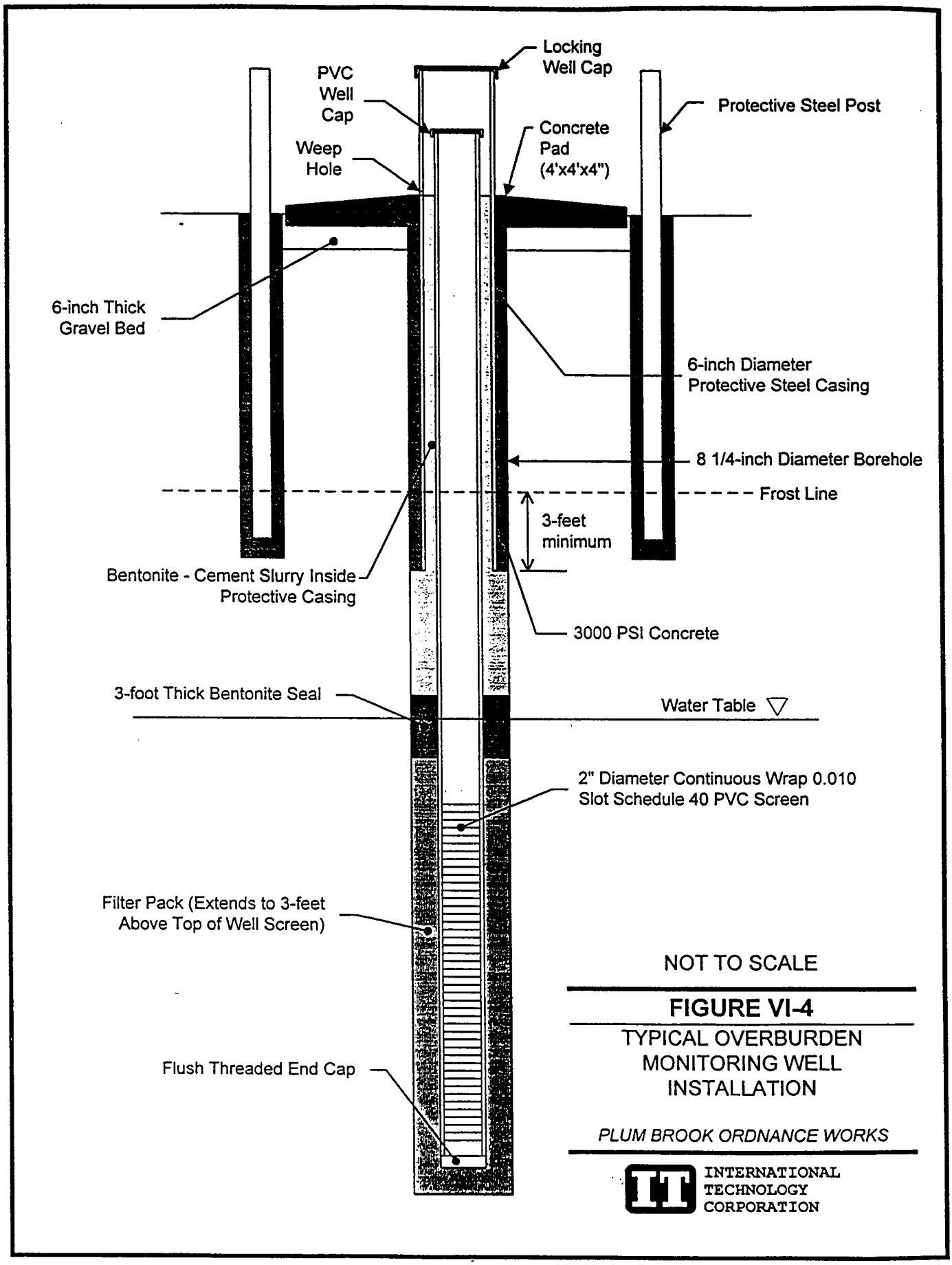
- ***Decontamination.*** All well completion materials, including screen and casing, will be decontaminated by steam, laboratory grade detergent, and distilled water rinse prior to installation.

- ***Filter Pack.*** Clean, inert, noncarbonate materials will be used to construct a uniform and continuous filter pack. The filter pack will be designed to prevent migration of formation fines into the well bore. The filter pack will be placed by pipe from the bottom of the borehole to approximately 36 inches above the top of the well screen. A sieve analysis will be performed on the filter pack material.

- ***Bentonite Seal.*** A 3-foot seal consisting of tamped 1/4-inch bentonite pellets will be tremied into the annular space between the well riser and the borehole wall immediately above the filter pack. If the seal is constructed above the groundwater, it will be sufficiently hydrated with clean, nonchlorinated water to preclude transmission of grout from above into the filter pack or well screen.

- ***Frost Protection.*** All monitoring wells will be constructed to prevent frost damage. The protective steel casing will be installed to a depth of 3 feet below the frost line (7 feet bgs), and 3,000-psi concrete will be placed in the annular space between the protective casing and the borehole wall. Figure VI-4 provides construction details for frost protection.

- ***Grout.*** Neat cement grout consisting of approximately 94 pounds Portland Type II cement (in accordance with ASTM C-150) and not more than 3 pounds powdered bentonite and 7 gallons of water will be used. The grout will be placed using a tremie pipe from the top of the bentonite seal to the ground surface (except where 3,000-psi concrete is used for frost protection).


Locking Well Cap
PVC Well Cap
Protective Steel Post
Concrete Pad (4'x4'x4")
Weep Hole
6-inch Thick Gravel Bed
6-inch Diameter Protective Steel Casing
8 1/4-inch Diameter Borehole
Frost Line
3-feet minimum
Bentonite - Cement Slurry Inside Protective Casing
3000 PSI Concrete
3-foot Thick Bentonite Seal
Water Table
2" Diameter Continuous Wrap 0.010 Slot Schedule 40 PVC Screen
Filter Pack (Extends to 3-feet Above Top of Well Screen)
Flush Threaded End Cap
NOT TO SCALE
FIGURE VI-4
TYPICAL OVERBURDEN MONITORING WELL INSTALLATION
PLUM BROOK ORDNANCE WORKS
INTERNATIONAL TECHNOLOGY CORPORATION

- ***Surface Protection.*** Surface protection will consist of a 6-inch-OD steel surface casing extending approximately 7 feet into the ground and approximately 2.5 feet above the ground (a maximum of 0.2 feet above the top of the PVC well casing) with a lockable cap set into and surrounded by a concrete pad 4 feet square and approximately 4 inches thick. The pad will be sloped a minimum of 2 inches from the surface casing to the edge of the pad to provide positive drainage and will be placed on a 6-inch-thick gravel bed. USACE specifications to prevent frost heave will be used in well construction. Four 3-inch-diameter, concrete-filled steel posts extending approximately 3 feet above the ground surface will be set in concrete approximately 5 feet into the ground at equal spacing around the concrete pad. All of the locks on the new wells will be keyed alike. A permanent tag will be affixed to the outer protective casing or cap and will clearly identify the well number, the USACE, Nashville District, and the adjusted top of casing elevation.

VI.4.1.8 Materials and Procedures for Bedrock Monitoring Wells

A typical bedrock monitoring well construction diagram is provided as Figure VI-5. The bedrock groundwater monitoring wells will be installed using the following materials and procedures:

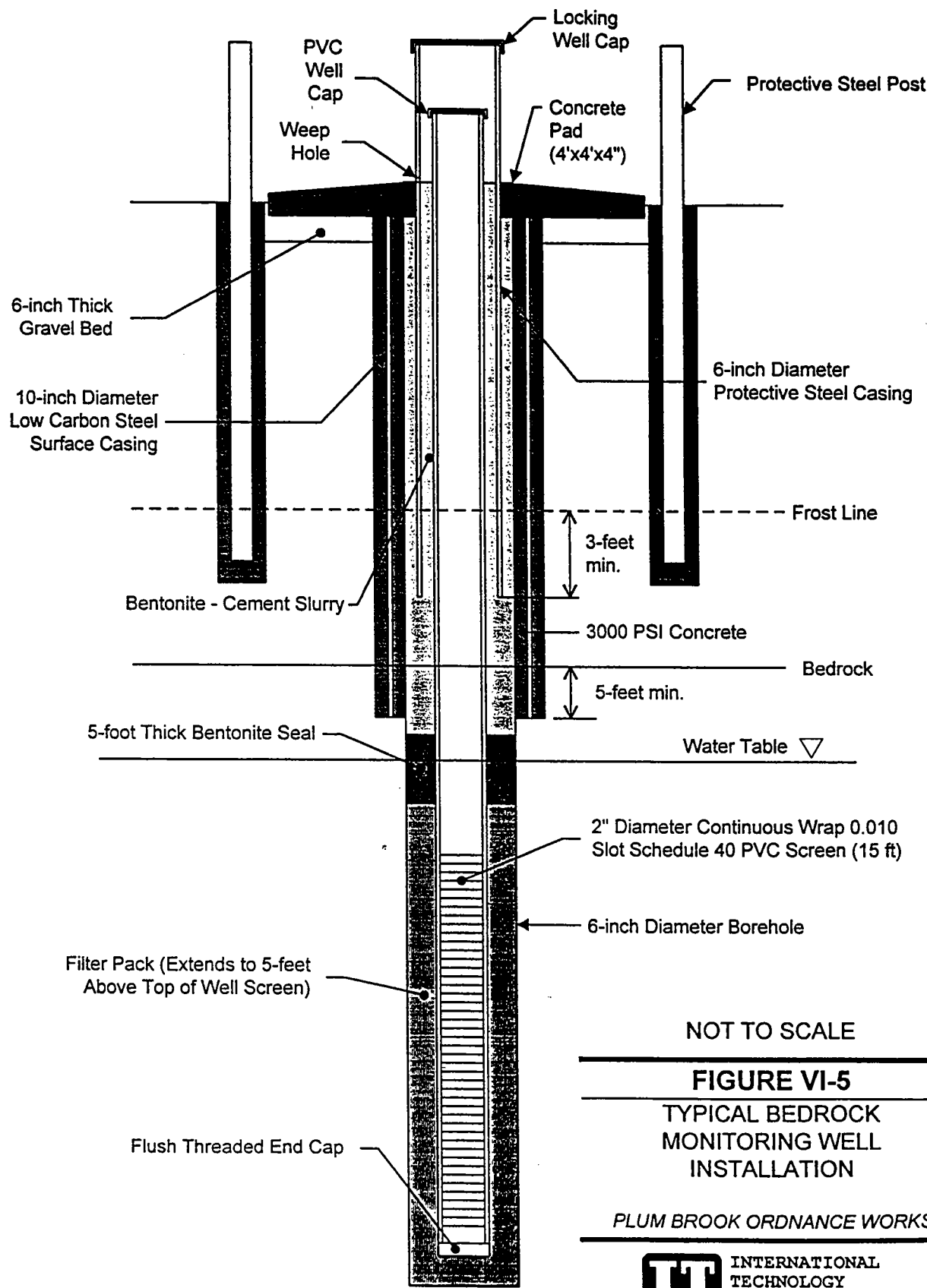
- ***Surface Casing.*** A 14-inch-diameter HSA will be used to drill through the overburden material to bedrock and 5 feet into the bedrock. A 10-inch-ID, low-carbon steel surface casing will be installed through the augers 5 feet into the bedrock and pressure grouted into place using 3,000-psi concrete.

- ***Well Screens.*** A 2-inch ID, flush-jointed threaded schedule 40 PVC continuous wrap slots. The slot size will be determined based upon historical site data and confirmed through sieve analyses. Fifteen feet of screen with a PVC end cap will be placed in each bedrock well.

- ***Well Casing.*** A 2-inch-ID, flush-jointed threaded schedule 40 PVC (ASTM D1875) casing will be attached to the top of the screen. Glues or adhesives will not be used. The casing string will extend approximately 2.5 feet above grade and will be certified by the manufacturer as being the material specified.

- ***Decontamination.*** All well completion materials, including screen and casing, will be decontaminated by steam, laboratory grade detergent, and distilled water rinse prior to installation.

- ***Filter Pack.*** Clean, inert, noncarbonate materials will be used to construct a uniform and continuous filter pack. The filter pack will be designed to prevent migration of formation fines into the well bore. The filter pack will be placed by pipe from the bottom of the borehole to approximately 60 inches above the top of the well screen. A sieve analysis will be performed on the filter pack material.



NOT TO SCALE

FIGURE VI-5

TYPICAL BEDROCK MONITORING WELL INSTALLATION

PLUM BROOK ORDNANCE WORKS

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- ***Bentonite Seal.*** A 5-foot seal consisting of tamped 1/4-inch bentonite pellets will be tremied into the annular space between the well riser and the borehole wall immediately above the filter pack. If the seal is constructed above the groundwater, it will be sufficiently hydrated with clean, nonchlorinated water to preclude transmission of grout from above into the filter pack or well screen.

- ***Frost Protection.*** All monitoring wells will be constructed to prevent frost damage. For bedrock wells, 3,000-psi concrete will be used to set the surface casing in place. Figure VI-5 provides construction details for frost protection.

- ***Grout.*** Neat cement grout consisting of approximately 94 pounds Portland Type II cement (in accordance with ASTM C-150) and not more than 3 pounds powdered bentonite and 7 gallons of water will be used. The grout will be placed using a tremie pipe from the top of the bentonite seal to the ground surface (except where 3,000-psi concrete is used for frost protection).

- ***Surface Protection.*** Surface protection will consist of a 6-inch-OD steel surface casing extending approximately 3 feet into the ground and approximately 2.5 feet above the ground (a maximum of 0.2 feet above the top of the PVC well casing) with a lockable cap set into and surrounded by a concrete pad 4 feet square and approximately 4 inches thick. The pad will be sloped a minimum of 2 inches from the surface casing to the edge of the pad to provide positive drainage and will be placed on a 6-inch-thick gravel bed. USACE specifications to prevent frost heave will be used in well construction. Four 3-inch-diameter, concrete-filled steel posts extending approximately 3 feet above the ground surface will be set in concrete approximately 5 feet into the ground at equal spacing around the concrete pad. All of the locks on the new wells will be keyed alike. A permanent tag will be affixed to the outer protective casing or cap and will clearly identify the well number, the USACE, Nashville District, and the adjusted top of casing elevation.

VI.4.2 Monitoring Well Development

New monitoring wells will be developed not sooner than 48 hours after installation, but not more than 7 days after internal mortar collar (grout) placement. Existing wells to be sampled, if not sampled in the past 12 months will be redeveloped in the same manner as the new wells, but the development time will be limited to 2 hours. Well development will be conducted in accordance with the procedures and requirements of EM-1100-1-4000, EM 200-1-3, the sitewide SAP, and the SOW. Wells will be developed by raising and lowering a surge block throughout the length of screen, followed by pumping or bailing without using acids, flocculent, or dispersing agents. Water will not be added to a well as part of development once the well has been grouted and sealed. The development procedure will continue until the following conditions are met:

- Water is clear to the unaided eye, free of sand, and free of drilling fluids.
- The sediment thickness remaining within the well is less than 1 percent to the screen length or less than 0.1 foot for screens equal to or less than 10 feet long.
- Temperature, pH, and specific conductance values stabilize.
- A volume of water equal to at least five times standing water in the well including the well casing and screen, and the saturated annular space assuming 30 percent of porosity has been removed.

Each new well will be developed for a maximum of 6 hours and each existing well will be developed for up to 2 hours. If the well is not satisfactorily developed within this time, the USACE will be contacted for consultation and further instructions.

Color photographs (35-millimeter color prints) will be taken of water from each monitoring well after development. Specifically, a 1-liter water sample will be collected of the last water removed during development and placed in a clear glass jar, labeled, and photographed. The photograph will be submitted as part of the well development log. The photograph will be a suitably back-lit close-up to show the clarity of the water.

VI.4.3 In Situ Permeability Testing

In situ permeabilities of each newly installed monitoring well will be determined using a "rising head" slug test. Each test will consist of instantaneously extracting a slug from the well and monitoring the subsequent recovery of the groundwater level. Transducers and a data logger will be used to record water level changes in the well during the tests. After completion of the test, data will be downloaded to a computer to generate a "time-drawdown" curve, which will be analyzed by the hydrogeologist to obtain the hydraulic conductivity of the tested aquifer.

VI.4.4 Redevelopment of Existing Wells

Prior to sample collection, up to 20 existing wells will require redevelopment following the procedures described in Section VI.4.2. If wells have not been sampled with the last 12 months, redevelopment will be conducted.

VI.4.5 Groundwater Sampling

Groundwater samples will be collected from each of the 8 newly installed and 12 existing bedrock wells and 4 newly installed and 35 existing overburden wells. Groundwater samples

will be collected from all specified wells during two sampling events: once during the wet season and once during the dry season. Groundwater samples to be collected during this investigation and their designated sample numbers, along with required QA/QC sample quantities are listed in Table VI-5.

Existing overburden wells that have not been sampled within the previous 12 months at the time of sampling will be redeveloped for a period of up to 2 hours prior to sampling. In the event that the field parameters have not stabilized at the end of this time, the contracting officer will be contacted for consultation and guidance.

During groundwater sampling, field measurements of pH, turbidity, specific conductance, dissolved oxygen, reduction-oxidation potential, and temperature will be made. These measurements will be taken prior to purging, periodically during purging, and immediately prior to sample collection.

Sampling of newly installed monitoring wells and existing wells will take place no sooner than 14 days after well development has been completed. Groundwater sampling will be done by using a disposable Teflon® bailer fitted with a bottom-emptying device and a new, clean nylon rope. All equipment used to purge wells and collect samples will be protected from ground surface contact and contamination by use of clean plastic sheeting. The following procedures will be followed when collecting groundwater samples from all monitoring wells:

- The well will be checked for proper identification and structural integrity.
- After unlocking the well and removing the well cap, a photoionization detector will be used to measure the concentration of organic vapors at the top of casing and in the breathing zone. If readings are above background, safety precautions outlined in the health and safety plans will be followed.
- The depth to water will be measured using a decontaminated water level indicator, then the volume of water in the well casing and screen, and the volume present in the saturated annulus (filter pack) will be calculated.
- Either a bailer or an appropriate submersible sampling pump will be used to remove three times the volume of the standing water in the well casing and saturated annulus.

Table VI-5

Summary of Groundwater and QA/QC Samples
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

(Page 2 of 2)

Groundwater Sample ID	Monitoring Well ID	QA/QC Sample Quantity [a]					
		FD/FS[b]		MS/MSD[c]		FB[d]	
		Sampling Round					
		1	2	1	2	1	2
Existing Overburden Monitoring Wells (con't)							
PBOW-97-GW-MKMW10-5730	MK-MW10	X					
PBOW-97-GW-MKMW11-5740	MK-MW11		X				
PBOW-97-GW-MKMW12-5750	MK-MW12						
PBOW-97-GW-MKMW14-5760	MK-MW14						
PBOW-97-GW-MKMW15-5770	MK-MW15						
PBOW-97-GW-MKMW16-5780	MK-MW16						
PBOW-97-GW-MKMW17-5790	MK-MW17						
PBOW-97-GW-MKMW19-5800	MK-MW19						
PBOW-97-GW-MKMW20-5810	MK-MW20						
PBOW-97-GW-MKMW22-5820	MK-MW22						
PBOW-97-GW-MKMW23-5830	MK-MW23						
PBOW-97-GW-MKMW24-5840	MK-MW24						
PBOW-97-GW-GCLMW01-5850	GCL-MW01		X				
PBOW-97-GW-GCLMW02-5860	GCL-MW02	X					
PBOW-97-GW-GCLMW03-5870	GCL-MW03						
Existing Bedrock Monitoring Wells							
PBOW-97-GW-BEDMW13-5880	PB-BED-MW13						
PBOW-97-GW-BEDMW14-5890	PB-BED-MW14						
PBOW-97-GW-BEDMW15-5900	PB-BED-MW15						
PBOW-97-GW-BEDMW16-5910	PB-BED-MW16	X		X			
PBOW-97-GW-BEDMW17-5920	PB-BED-MW17		X		X		
PBOW-97-GW-BEDMW18-5930	PB-BED-MW18						
PBOW-97-GW-BEDMW19-5940	PB-BED-MW19						
PBOW-97-GW-BEDMW20-5950	PB-BED-MW20						
PBOW-97-GW-REACTOR1-5960	REACTOR1	X					
PBOW-97-GW-REACTOR2-5970	REACTOR2		X				
PBOW-97-GW-REACTOR3-5980	REACTOR3						
PBOW-97-GW-REACTOR4-5990	REACTOR4						

[a]Laboratory prepared trip blanks will be submitted for VOC samples.
[b]Field duplicate/field split.
[c]Matrix spike/matrix spike duplicate.
[d]Field blank.

- During purging, field measurement of pH, Eh (oxidation-reduction potential), turbidity, temperature, and conductivity will be performed periodically and logged.

- At the time of sampling, after collection of the sample for chemical analysis, a second sample will be collected for field measurement of temperature, pH, Eh, turbidity, dissolved oxygen, and conductivity and logged.

- Sample containers will be labeled with appropriate identifying information (location, date, time, condition, added preservatives, etc.). Each sample will be logged in a field notebook at the time of collection. Sample containers of appropriate volume and composition will be prepared in advance to ensure the collection of sufficient volumes for all specified analyses.

- The sample will be collected so as to minimize aeration as water enters the bottle.

- Samples for volatile analysis will be collected in screw-cap, septum-top glass vials and filled so that there are no air bubbles present to allow volatilization

- Samples for metal analysis will be collected in two separate containers; one will be filtered and the other will not be filtered. Samples will be filtered according to the following procedures:

  - Water sample will be filtered at the well site with portable sample filtering equipment or at the field office.

  - A millipore filtration apparatus (or comparable equipment) equipped with a 0.45-micron filter will be used. The filtering apparatus will be cleaned following procedures set forth in Section 5.2 of the sitewide SAP before filtering each sample.

- All sample containers will be transferred to a cooler chest (keep at 4 degrees Celsius [°C]) and delivered to the laboratory in sufficient time so that specified holding times are not exceeded.

VI.5.0 Sample Analysis and Decontamination Procedures

VI.5.1 Sample Number System

Sample numbering system to be used during this investigation will conform to USACE Nashville District's numbering convention. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number consists of a group of letters and numbers, separated by hyphens. The numbering system to be used for GWI is described as follows:

Project Code	Year	Sample Type[a]	Site Identification[b]	Location (Well ID)	Sample Number	Sample Depth (Feet)
PBOW	97	XX	XXX	XXXX	XXXX	XXX

[a]Sample types:

ER - Equipment rinsate sample
FB - Field blank
FD - Field duplicate sample
FS - Field Split sample
GW - Groundwater sample
MD - Matrix spike duplicate sample
MS - Matrix spike sample
SO - Soil

[b]Site identification (refer to page 6-3 at the sitewide SAP).

"PBOW-97-GW-BG8-BEDGW01-0235" signifies that this groundwater sample is collected from groundwater well BEDGW-001 in the G-8 Burning Ground with a laboratory number of 0235. The sample identification number will be recorded by the IT field geologist in the field activity daily log, boring log, and sample collection log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

VI.5.2 Analytical Program

All groundwater samples will be collected for target compound list (TCL) VOCs, TCL SVOCs, PCBs, total cyanide, and nitroaromatic compounds. Groundwater samples will also be analyzed for total target analyte list (TAL) metals (unfiltered) and dissolved TAL metals (filtered). In addition, groundwater samples will be analyzed by the laboratory for the water quality parameters specified in Table VI-6. Laboratory QC procedures and data quality requirements are specified in and referenced to appropriate sections of the QAPP (IT, 1996b).

VI.5.3 Decontamination Procedures

Drilling and sampling equipment decontamination will be performed to maintain integrity of the groundwater sample collected. A temporary decontamination pad will be built on site. The station will be lined with three layers of at least 6-mil-thick Visqueen and will be bermed on all sides. The following decontamination procedures will be used to decontaminate drilling

Table VI-6

Summary of Groundwater Analytical Parameters and Methods
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Parameter	Analytical Method	Number of Field Samples	Field Duplicates (10%)	Matrix Spike (5%)	Matrix Spike Duplicate (5%)	Field Blank	Trip Blank	Total Number of Samples
TCL Volatile Organic Compound	8260 A	118	12	6	6	2	15	159
TCL Semivolatile Organic Compound	3520B / 8270B	118	12	6	6	2		144
Total TAL Metals	3005A / 6010A	118	12	6	6	2		144
Dissolved TAL Metals	3005A / 6010A	118	12	6	6	2		144
Nitroaromatic Compounds	Mod. 8330	118	12	6	6	2		144
PCBs	3520B / 8081	118	12	6	6	2		144
Water Quality								
Hardness	EPA 130.1	118						118
Alkalinity	EPA 310.1	118						118
Total Organic Carbon	9060	118						118
Total Dissolved Solids	EPA 160.1	118						118
Total Suspended Solids	EPA 160.2	118						118
Chloride	EPA 325.3	118						118
Total Cyanide	9010A / 9012	118						118
Nitrate	EPA 352.1	118						118
Sulfate	EPA 375.3	118						118
Column Totals		1770	72	36	36	12	15	1941

Notes:

(1) Field parameters to be performed include pH, dissolved oxygen, specific conductance, reduction-oxidation potential, turbidity, and temperature.

(2) Equipment rinsates are not required as groundwater samples will be collected using dedicated/disposable bailers.

equipment, including drilling tools, equipment, and monitoring well materials, upon site entrance, between borings, and before site departure:

- Steam rinse.
- Steam wash using a brush with nonphosphate detergent.
- Steam rinse.
- Final rinse with distilled water.
- Air dry.

Groundwater sampling equipment including submersible pump and water level indicator will be decontaminated upon site entry, between wells, and before site departure following the procedures below:

- Wash in soapy water.
- Rinse with potable water.
- Rinse with nitric acid (10 percent solution).
- Rinse with a volume of deionized water (ASTM Type II water) five times greater than the volume of nitric acid.
- Rinse with hexane.
- Rinse with deionized water (ASTM Type II water) five times greater than the volume of hexane.
- Rinse with methanol.
- Rinse with deionized water (ASTM Type II water) five times greater than the volume of methanol.
- Air dry.

VI.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as being precleaned, containers made of materials recommended by the EPA in Title 40 Code of Federal Regulations (CFR) Part 136 and SW-846 (3rd Edition). Sample containers and preservatives/preservation methods are

summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that it is received by the laboratory.

Unless prior arrangements are made, the sample containers will be shipped to the site with necessary preservatives added, except for the bottles to be used for metal analysis. Samples for dissolved metal analysis will be prepared after the water has been filtered.

Samples for geotechnical analysis need not be chemically preserved; however, the samples will be properly sealed to prevent moisture loss and will be packaged so that the material is adequately preserved in its natural state. Samples will be placed in sample containers that will be sealed with three wraps of electrical type or duct tape around the lid lip.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimize the possibility of container breakage by using Vermiculite or styrofoam peanuts to fill void spaces in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4°C and maintained at that temperature by means of blue ice or packaged ice from the time the shipping carton is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by a next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

Completed Analysis Request/Chain of Custody records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or

USACE QA Laboratory

Mr. John Adams (CEORD-PE-GL)
USACE Ohio River Division Laboratory
11275 Sebring Drive
Cincinnati, Ohio 45240-2714
Telephone: (513)-589-3604

VI.7.0 Investigation-Derived Waste Management Plan

IDW during field activities at PBOW includes drill cuttings, development water, purge water, decon water, decon fluid, and disposable personal protective equipment (PPE). IDW will be handled following the EPA guidance document EPA\540\G-\91\009, *Management of Investigation-Derived Wastes During Site Inspection* (EPA, 1991). Specifically, IDW will be managed in the following manner:

- Drill cuttings from 12 wells will be placed separately in 55-gallon sealable drums and stored on site or in the designated IDW staging area. The options of disposal of cuttings will depend on the laboratory results of groundwater samples.
- Disposable PPE will be double-bagged and disposed of in the on-site dumpster.
- Decontamination water will be stored in 55-gallon drums and stored on site pending analytical results for proper disposal.
- Decontamination fluid will be kept in a stainless-steel pan and will be allowed to evaporate.
- Well development and purge water from each well will be stored separately in 55-gallon drums and kept on site pending analytical results of the water from each well for proper disposal.
- Purge water from existing wells will be poured onto the ground upon completion of the field work.

Analytical parameters for IDW disposal are presented in Table VI-7.

For monitoring wells installed as clusters, only one sample will be collected for disposal characteristics.

Table VI-7

Analytical Parameters for IDW Disposal Groundwater Investigation Former Plum Brook Ordnance Works, Sandusky, Ohio

Parameter	Analytical Method	Number of Samples
Hazardous waste characterisitcs (ignitability, corrosivity, and reactivity)	CLP	8
TCLP volatiles	CLP	8
TCLP semivolatiles	CLP	8
TCLP metals	CLP	8

DRAFT

VI.8.0 Project Schedule

The project schedule will be provided upon submittal of the final work plan.

VI.9.0 References

Dames & Moore, 1996, ***Draft Report, Sitewide Groundwater Investigation, Plum Brook Ordnance Works***, May 1996.

IT Corporation (IT), 1996a, ***Sitewide Sampling and Analysis Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1996b, ***Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1996c, ***Sitewide Safety and Health Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

U.S. Army Corps of Engineers (USACE), 1997, ***Statement of Work***, January 1997.

U.S. Army Corps of Engineers (USACE), 1994, ***Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites,*** EM1110-1-4000, August 1994.

U.S. Environmental Protection Agency (EPA), 1993, ***Data Quality Objectives Process for Superfund***, EPA/J40/G-93/071, Publication 9377.9.01, September 1993.

U.S. Environmental Protection Agency (EPA), 1991, ***Management of Investigation-Derived Wastes During Site Investigation***, EPA/540/G-/91/009, May 1991.

U.S. Environmental Protection Agency (EPA), 1986, ***RCRA Groundwater Monitoring Technical Enforcement Guidance Document***, OSWER 9950.1, Washington, DC, September 1986.

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August 12, 1997

Commander
U.S. Army Engineer District, Nashville
ATTN: CELRN-EP-R-M (Mrs. Linda Ingram)
Estes Kefauver Federal Building
801 Broadway
Nashville, Tennessee 37202-1070

Submittal of the Final Site-Specific Sampling and Analysis Plan (SSAP) and the Final Site-Specific Safety and Health Plan (SSHP) for the Groundwater Investigation at the Former Plum Brook Ordnance Works, Sandusky, Ohio; Contract Number DACA62-94-D-0030; IT Project Number 771481

Dear Ms. Hejazi:

In accordance with the requirements of Delivery Order Number 0023 of Contract Number DACA62-94-D-0030, IT Corporation is pleased to submit the final SSAP and SSHP for the Groundwater Investigation at the Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio.

Enclosed are 15 copies of the final documents and five (5) copies of the responses to technical review comments received on the draft work plan documents. Should you have any questions or require additional information regarding this submittal, please do not hesitate to call myself or Mikael Spangberg at (423) 690-3211.

Sincerely,

Donnie C. Burton

Donnie C. Burton, P.E.
Program Manager

Enclosures

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN,
SITEWIDE INVESTIGATION OF GROUNDWATER,
FORMER PLUM BROOK ORDNANCE WORKS,
SANDUSKY, OHIO

Comments of Jim Beaujon dated May 1997

Comment 1: **Pg VI-1, first paragraph: After "(DERP)" add, "Formerly Used Defense Sites (FUDS)." Change appropriate sentence to "The Former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio is a DERP FUDS project currently being managed and technically overseen by the Nashville District of USACE." Change "groundwater level investigation (GWI)" to "groundwater investigation (GWI)."**

Response 1: The paragraph has been revised as requested.

Comment 2: **Pg VI-1, second paragraph, last line: change "investigation that must be" to "investigation and must be."**

Response 2: The sentence has been revised as requested.

Comment 3: **Figure VI-1: Can Ransom Road be labeled?**

Response 3: Ransom Road is labeled on Figure VI-2, while Figure VI-1 is intended to provide the site location relative to surrounding communities. No changes made.

Comment 4: **Pg VI-2, paragraph beginning with "In 1994:" Rewrite for clarity the second, third, and fourth sentences.**

Response 4: The paragraph has been revised.

Comment 5: **Pg VI-2, paragraph beginning with "In 1994," last sentence, and Table VI-1: clarify whether these are: all the wells at PBOW; only the PBOW wells for which there are construction details; or, details only for the wells to be sampled under this SSAP.**

Response 5: The text has been revised to indicate that Table VI-1 shows existing wells that are to be sampled during the GWI. Table VI-1 has been revised to include all existing wells to be sampled.

Comment 6: **Pg VI-2, paragraph beginning with "General groundwater," last sentence, and Table VI-2: clarify whether these are: all the wells at PBOW; only the**

PBOW wells for which there is groundwater level elevation data; or, groundwater level elevations only for the wells to be sampled under this SSAP.

Response 6: The text has been revised to indicate that Table VI-2 shows available elevation data for selected existing wells that are to be sampled during the GWI. This is a smaller set of wells than the total number of wells to be sampled due to limited historical data.

Comment 7: **Pg VI-12, Section VI.4.4, second line: change "sampled with the last" to "sampled within the last."**

Response 7: The sentence has been changed.

Comment 8: **Pg VI-13, second bullet item, "If readings are above background:" It would be better to state a trigger level rather than "background."**

Response 8: The statement has been revised to "If readings exceed action levels specified in Table VI.4-1 of the SSHP..."

Comment 9: **Table VI-5: This reviewer's copy only had "Page 2 of 2" for this table.**

Response 9: Page 1 of 2 of Table VI-5 was inadvertently omitted from the draft document and has been added.

Comment 10: **Pg VI-17 and 18: the USACE Ohio River Division Lab will be closing in the near future, Please contact the project chemist, Becky Terry, for coordination.**

Response 10: The USACE QA laboratory referenced has been changed to "To be determined"; submittal of QA samples will be coordinated with Becky Terry as suggested.

Comment 11: **Pg VI-18, last sentence on page: Will the "one sample" collected for disposal characteristics be a grab or a composite sample? Composite seems to me to be more appropriate. Please clarify the text.**

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN,
SITEWIDE INVESTIGATION OF GROUNDWATER,
FORMER PLUM BROOK ORDNANCE WORKS,
SANDUSKY, OHIO

Response 11: The text has been revised to state that one composite sample will be collected.

Comments of Doug Mullendore dated May 1997

Comment 1: **Page VI-1, Section VI.1.1, 1st Sentence: change sentence to "The PBOW facility, built in early 1941, manufactured 2,4,6 trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite.**

Response 1: The sentence has been changed.

Comment 2: **Page VI-1, section VI.1.2, Last Sentence: Change sentence to "Several areas identified by previous investigations as potential areas of contamination are Reservoir Number 2 Burning Ground,...and G-8 Burning Ground.**

Response 2: The sentence has been changed as requested.

Comment 3: **Page VI-2, section VI.1.2, 1st Complete Sentence: If pesticides are a contaminant of concern why aren't we testing for them during the GWI?**

Response 3: The statement has been changed from "pesticides/polychlorinated biphenyls" to "polychlorinated biphenyls."

Comment 4: **Page VI-2, 2nd Complete Paragraph 1st Sentence: Change sentence to "The overburden unit composed of glacial outwash materials has a thickness from a few feet in the south to greater than 40 feet in some locations in the north."**

Response 4: The sentence has been changed as requested.

Comment 5: **Page VI-2, 3rd Complete Paragraph, 1st Sentence: change sentence to "In general groundwater flows in a northerly direction toward Lake Erie, in both the unconsolidated overburden material and consolidated bedrock."**

Response 5: The sentence has been revised.

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN,
SITEWIDE INVESTIGATION OF GROUNDWATER,
FORMER PLUM BROOK ORDNANCE WORKS,
SANDUSKY, OHIO

Comment 6: **Page VI-2, 3rd Complete Paragraph, 2nd Sentence: change sentence to "On the western side of the site groundwater in the overburden water bearing zone flows to the northwest, while groundwater in the bedrock aquifer flows to the northeast."**

Response 6: The sentence has been changed.

Comment 7: **Page VI-3, 1st Complete Paragraph: change paragraph to "A site visit conducted by IT project members on May 15 and 16, 1996 acquired information regarding 28 existing monitoring wells to be sampled and assessed site accessibility for new monitoring well installation. All targeted existing wells were located and appeared to be in good condition. Some wells are off-road and some are in swampy areas that require the use of an all terrain vehicle."**

Response 7: The paragraph has been revised as suggested.

Comment 8: **Page VI-4, 2nd Sentence: change sentence to "Additionally the collected data can be used to conduct a human health and ecological risk assessment, if necessary.**

Response 8: The sentence has been revised.

Comment 9: **Page VI-4, "Overview:" Change paragraph to "The data quality objectives process (DO) followed during the planing stages of the investigation evaluated data requirements needed to support the decision making process and selected the best action to satisfy these requirements. Incorporated components of the DO process, described in U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund* (EPA, 1993), are discussed in detail in Section 3.3 of the sitewide SAP. Determining factors for procedures necessary to satisfy investigative objectives and to establish the basis of future actions at PBOW are presented in Table 3-1 and Figure 3-2 of the sitewide SAP (IT, 1996)."**

Response 9: The paragraph has been changed. See also comment 16.

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN,
SITEWIDE INVESTIGATION OF GROUNDWATER,
FORMER PLUM BROOK ORDNANCE WORKS,
SANDUSKY, OHIO

Comment 10: **Page VI-4, "Data Users and Available Data;" change paragraph to "A site specific conceptual model, developed using existing data, helped to identify data gaps. During the project planning process, effective methodologies for filling the data gaps were designed and reviewed by the data users, with the most efficient data collection design being implemented. The SSAP records the rationale or the design, including the location, number, and type of sampling necessary to "fill" the data gaps and to satisfy the data quality objectives. The SSAP, along with companion documents, provides the regulatory agencies with sufficient detail, so they can conclude whether the investigative effort is adequate to satisfy the study objectives."**

Response 10: The paragraph has been changed.

Comment 11: **page VI-5, "Conceptual Site Model," 1st Sentence: Change sentence to "Four factors considered in defining the conceptual model for the sitewide GWI are:...concern."**

Response 11: The sentence has been changed.

Comment 12: **Page VI-5, "conceptual site Model," 2nd Sentence: change sentence to "a potential source of contamination at PBOW are past TNT manufacturing activities."**

Response 12: The sentence has been changed.

Comment 13: **Page VI-5, "conceptual site Model," 4th Sentence: Change sentence to "Likely receptors at PBOW are limited to aquatic organisms in creeks and wildlife."**

Response 13: The sentence has been changed.

Comment 14: **Page VI-5, "conceptual site Model," 5th Sentence: Is this sentence only concerned with groundwater and the current use scenario" what about possible future use scenarios?**

Response 14: The sentence has been revised to indicate that it relates to the current land use.

Potential future use of the site has not been addressed here due to the proposed language in the draft consent order, but can be addressed at a later date.

Comment 15: **Page VI-5,"Conceptual site Model," 6th Sentence: change sentence to "Potential receptors near the facility include off-site water users.**

Response 15: The sentence has been changed as suggested.

Comment 16: **Page VI-5,"Decision Making Process, Data Uses, and Needs:" change paragraph to "The decision making process, presented in detail in Section 3.3.3 of the sitewide SAP, consists of a seven step process which will be followed during the sitewide GWI." How can the data uses and needs for this study be presented in a previously prepared document?**

Response 16: The paragraph has been changed as requested. A table presenting the revised DQOs for the GWI, including data uses and needs, has been added to the SSAP.

Comment 17: **Page VI-5, "Risk Evaluation," Last Sentence: Switch "risk assessment" and "feasibility study."**

Response 17: The sentence has been revised as requested.

Comment 18: **Table VI-3: Include the rationale for locating the wells.**

Response 18: The rationale for well locations have been added to the table, now Table VI-4.

Comments of Becky Terry dated May 1997

Comment 1: **Page VI-iii. List of Acronyms. GWI. Change Groundwater Elevation Investigation to Groundwater Investigation.**

Response 1: The acronym definition has been changed.

Comment 2: **Page VI-4. Section VI.3.3. Second para. Be consistent with usage of EPA. Use Ohio and US EPA.**

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN,
SITEWIDE INVESTIGATION OF GROUNDWATER,
FORMER PLUM BROOK ORDNANCE WORKS,
SANDUSKY, OHIO

Response 2: The sentence has been rewritten (see D. Mullendore Comment 9).

Comment 3: **Page VI-5. Section VI.3.3. Risk Evaluation. Detected contaminants from this investigation or detected contaminants from this study plus all previous investigations will be compared to the most current guidance criteria? Describe the component that make data definitive.**

Response 3: The sentence has been revised to state that detected contaminants from the GWI and previous investigations will be evaluated. Definitive data is defined by the USEPA in EPA 540-R-93-071, Data Quality Objectives Process for Superfund, which is referenced on Table VI.3.

Comment 4: **Page VI-7, Section VI.4.1.2. State the form which will be utilized for the logging of the soil classification system.**

Response 4: The statement has been revised to indicate that the HTRW Drilling Log as presented in the Site-Wide SAP will be used.

Comment 5: **Page VI-7. Section VI.4.21.2. State the section of EM 200-1-3 which lists the requirements for well development. State the criteria for stabilization in EM 200-1-3.**

Response 5: Appendix C of EM 200-1-3 provides general requirements for monitoring well development and the reference is included here as it is specifically identified in the scope of work for the GWI. The sentence has been revised to reference Appendix C of EM 200-1-3.

Comment 6: **Page VI-17. Section VI.6.0 Fourth para. Last sentence. Containers will be sealed with electrical or duct tape?**

Response 6: The referenced paragraph presents packaging requirements for geotechnical samples, which are not subject to the same packaging requirements as chemical samples. Because the geotechnical samples are to be tested for moisture content and other parameters where the natural moisture content of the sample is of importance, these containers will be sealed with electrical tape or duct tape to minimize moisture loss.

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN,
SITEWIDE INVESTIGATION OF GROUNDWATER,
FORMER PLUM BROOK ORDNANCE WORKS,
SANDUSKY, OHIO

Comment 7: **Page VI-18. Section VI.7.0. Fourth bullet. Be specific the decontamination fluid that will be allowed to evaporate.**

Response 7: The bullet has been revised to reference Section 8.5 of the Site-Wide SAP which identifies the types of decontamination fluids that will be permitted to evaporate.

Comments of Angela Levert dated May 1997

Comment 1: **This document provides the elements specified for site-specific addenda in the Site-Wide Safety and Health Plan (September 1996).**

Response 1: No response required.

Comment 2: **Table VI.4-1. Check the application of the footnotes "a" and "b." It appears that both footnotes apply to the *Required Action* heading for Levels B, C, and D. The title block for Level D should be "when in Level D/Modified D PPE."**

Response 2: Both footnotes were added to Level B, C, and D headings as suggested. The title block for Level D was revised as suggested.

Comment 3: **Table VI.5-1. "Contact with moving equipment/vehicles" is repeated under the activity Setup of equipment and general field activities (pages 1 of 9 and 3 of 9). The second entry is more complete. Please delete the first entry.**

Response 3: The text was deleted as suggested.

RESPONSE TO COMMENTS
DRAFT SITE-SPECIFIC SAMPLING AND ANALYSIS PLAN AND HEALTH PLAN FOR THE SITEWIDE INVESTIGATION OF GROUNDWATER (ATTACHMENT VI), DATED MAY 1997
FORMER PLUM BROOK ORDNANCE WORKS,
SANDUSKY, OHIO

Comments of USACE Huntington District

Comment 1: **It is noted that this document refers to the PBOW Sampling and Analysis Plan and the Quality Assurance Project Plan. It is not clear at this point whether these documents have been finalized and approved by EPA.**

Response 1: The Ohio EPA has reviewed and commented on the Site-Wide SAP on two occasions (September 5 and November 11, 1996). Comments provided were addressed and incorporated into the SAP, with formal response documents presented as an attachment to the final SAP, dated September 1996.

Comment 2: **Section VI.3.2, Objectives. The statement (...the quality of the collected data will be such that it can be used to support a human health risk assessment.) Could be revised as a bulleted item to clearly show that this is an objective,**

Response 2: The statement is intended to convey that the quality of all data collected will be of sufficient quality to support a risk assessment if necessary. As the current scope does not include conducting such a risk assessment, the stated project objectives have not been changed.

Comment 3: **Section VI.4.5, Groundwater Sampling. Decontamination procedures for the bailer and nylon rope are not clear. Will dedicated equipment be used or will this equipment be taken to the decon pad? Revise this section for clarity.**

Response 3: Disposable bailers and new nylon rope will be used at each well; therefore, decontamination of these items will not be required. The statement has been revised to clarify.

Comment 4: **Table VI-5. Part of this table is missing. Revise to include the entire table in the report.**

Response 4: The second page was inadvertently omitted and has been included.

Comment 5: **Section VI.4.5., Groundwater Sampling. Groundwater samples should be filtered in the field. Waiting until samples are taken back to the field office may alter the analytical results of the samples. Therefore, the statement that indicates that the samples will be filtered at the field office should be deleted.**

Response 5: Samples collected in the field in clean sample containers are immediately placed on ice in coolers until brought to the field office where they are filtered, preserved, and packaged for shipment. The short period of time from sample collection to filtration will have no impact on the sample quality or sample results. Conversely, filtration of samples in the field add other concerns, including power supplies for vacuum pumps used in the filtration and decontamination of filtration equipment. In addition, the use of dedicated bailers for groundwater sampling precludes the use of in-line filtering.

Comment 6: **Section VI.5.2, Analytical Program. This section should address deliverables.**

Response 6: Analytical deliverables are addressed in the QAPP and in the SOW; including them in the SSAP is not consistent with the purpose of the SSAP.

Comment 7: **Section VI.5.3, Decontamination procedures. Further explanation of the decon location is needed. Will this pad be in one fixed location on-site or will it be moved and set up next to each well? If this pad is to be in one fixed location, explain the logistics of having to return to the decon pad during sampling of a well. Will the bailer and nylon rope be returned to the decon station after each well is sampled or will dedicated sampling equipment be used?**

Response 7: The text has been revised to indicate that multiple temporary decon pads will be placed near the drilling locations. These pads will be used primarily for decontamination of drilling equipment. During groundwater sampling, disposable bailers and nylon rope will be used, thus eliminating decontamination requirements for these items. Other items, such as water level indicators and submersible pumps, will be brought to the nearest decon pad for decontamination between wells.

Comment 8: **Section VI.5.4..., Decontamination procedures. Will disassembly be required for the decontamination of any of the equipment?**

Response 8: With the exception of drilling equipment and removal of disposable tubing from the submersible pump(s), disassembly of equipment is not anticipated.

Comment 9: **Table VI-6. Explain the rationale for the number of quality control samples listed in this table. It does not appear that two field blanks are sufficient considering the number of field samples that are to be taken since field blanks should be taken at a frequency of one per day.**

Response 9: Field blanks, as defined in section 4.9.3 of the Site-Wide QAPP, are collected from the source water for the steam cleaner and the final decontamination water. Thus, two samples are normally collected during one sample event; one sample of the potable water source (used for steam cleaner) and one sample of the deionized/distilled water used for decontamination, unless multiple lots of deionized/ditilled water are used. Equipment rinsates are collected from the final decontamination rinse water from sampling equipment at the rate of one per day per sampling team. However, because sampling equipment will be disposable (i.e., used one time for collection of one sample and disposed), equipment rinsates will not be required.

Comment 10: **Table VI-6. Re: Modified Method No. 8330. In reviewing this method, it appears that the procedure does not include the low-level salting out extraction necessary for groundwater samples. This method needs revised to include this extraction procedure.**

Response 10: The reason the method is quoted as 'Modified Method 8330' in all references is due to the omission of the salting out extraction from the procedure performed. The USACE-MRD is aware of this modification and has approved the SOP as written. All USACE-MRD Performance Evaluation samples are performed using the modified method with successful results.

Comment 11: **Section VI.7.0, Investigation Derived Waste Management Plan.**

Comment 11a: **It appears that the drill cuttings will be characterized using the analytical results of water samples. It would be advisable to analyze a sample of the drill cuttings.**

Response 11a: Drill cuttings will be characterized through the collection and analysis of composite soil cutting samples collected from each well or nested well pair. Sample analysis will be as specified in Table VI-8. The text has been revised to clarify.

Comment 11b: **Define decontamination fluids. Specify whether this is water and soap or nitric acid and hexane. The nitric acid and hexane should not be allowed to evaporate.**

Response 11b: Because of the small quantities of these solvents that are to be used, and

considering that most sampling equipment will be disposable and will not require decontamination, decon water containing solvents will be placed in stainless steel pans and allowed to evaporate. This is consistent with the Site-Wide SAP (Section 8.5) which is now referenced in the text.

Comment 11c: **It is noted that purge water from existing wells will be poured onto the ground but purge water and well development water from new wells will be stored and kept on site pending analytical results for proper disposal. Has there been an agreement made to pour water from the existing wells on the ground? Explain the rationale for the difference in procedure for the water form new versus existing wells.**

Response 11c: The provision for pouring purge water from wells onto the ground has been removed. All purge and development water will be placed in 55-gallon drums and stored for characterization and disposal.

Comment 11d: **Clarify the statement (For monitoring wells installed as clusters, only one sample will be collected for disposal characteristics.) What type of sample will be collected for disposal characteristics, soil or groundwater?**

Response 11d: One composite soil sample will be collected from the monitoring well drilling cuttings; for nested well pairs, one composite sample will be collected from the cuttings from both wells. Soil cuttings will be tested for the parameters shown on Table VI-8.

Comment 12: **Table VI-7. It is not clear from Table VI-7 whether eight (8) additional groundwater samples will be taken in addition to the 118 groundwater samples listed in Table VI-6. Please clarify.**

Response 12: The title of Table VI-8 (previously VI-7) has been changed to clarify that the samples are soil cuttings from monitoring wells installed during the GWI.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CEORN-ER-M

Project Description: Site-Wide Groundwater Investigation, Plum Brook Ordnance Works

Contract Number: DACA62-94-D-0030 Delivery Order Number: 0023

Project Number: 771481 Task / Phase Number: 04000000

Document Type	Identify specific section or segment covered by this checkprint	Document Origin
☐ Technical / Cost Proposal		☒ Originator Developed
☐ RFP		☐ Edited Standard
☐ Contract / Subcontract		☐ Client Furnished
☒ SAP, SSAP, CDAP, or QAPP	SSAP, Sitewide GWI, Rev. 1, July 1997	
☐ SHP or SSHP		**Document Status**
☐ _____ Report		☐ Preliminary
☐ Risk Assessment / Evaluation		☐ Internal Draft
☐ Specifications & Plans		☐ Draft
☐ Design Calculations		☐ Draft Final
☐ Tables		☒ Final
☐ Drawings / Figures		☐ Other: _____
☐ Other: _____		

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Project Manager	M. Spangberg	M. Spangberg	7-31-97
Program Manager	D. Burton	D. Burton	8/5/97

Attachment VI

Site-Specific Sampling and Analysis Plan
Sitewide Investigation of Groundwater
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

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Submitted To:

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IT Project Number 771481
Control Copy No. 19

Revision 1

July 1997

(This SSAP must be used in conjunction with the PBOW SAP)

Reviews and Approvals

Project Manager IT Corporation	7-31-97 Date
Health and Safety Manager IT Corporation	8-5-97 Date
Site Coordinator IT Corporation	8/5/97 Date
Site Safety and Health Officer IT Corporation	Date

Distribution List

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Control Copy No. 21	D. Seymore
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Control Copy No. 23	K. Arrant
Control Copy Nos. 24 and 25	Field personnel

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List of Acronyms

ASTM	American Society for Testing and Materials
bgs	below ground surface
BNA	base/neutral and acid extractables
CFR	Code of Federal Regulations
°C	degrees Celsius
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FUDS	Formerly Used Defense Sites
GIS	Geographic Information System
GWI	groundwater investigation
HSA	hollow-stem auger
ID	inside diameter
IDW	investigation-derived waste
IT	IT Corporation
NASA	National Aeronautic and Space Administration
OD	outside diameter
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyl
PPE	personal protective equipment
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SAP	sampling and analysis plan
SHP	safety and health plan
SI	site investigation
SOW	statement of work
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan

List of Acronyms *(Continued)*

SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	volatile organic compound
WARWP	West Area Red Water Pond

VI.1.0 Project Description

The U. S. Army is conducting studies of environmental impact of suspected hazardous waste sites at previously owned U.S. Department of Defense (DOD) properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP) Formerly Used Defense Sites (FUDS). The former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio (Figure VI-1) is a DERP FUDS project currently being managed and technically overseen by the Nashville District of USACE. IT Corporation (IT) is contracted to provide engineering services to conduct a sitewide groundwater investigation (GWI), including quarterly groundwater level measurements, installation and development of 12 new wells, and two sampling events of new and existing monitoring wells.

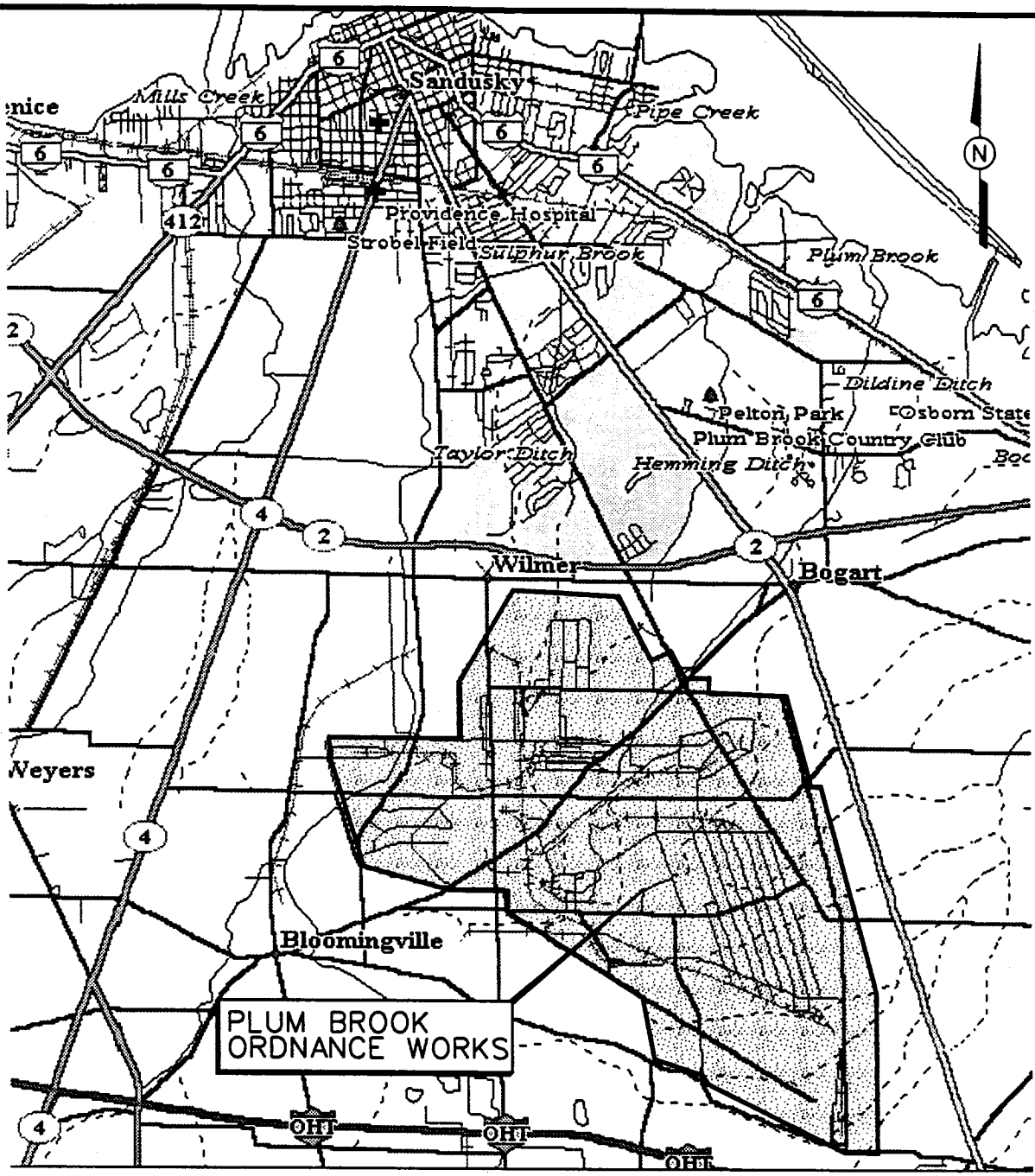
As an attachment to the PBOW sitewide sampling and analysis plan (SAP) (IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the GWI at PBOW. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP) (IT, 1996b) to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this investigation and must be used in conjunction with the sitewide safety and health plan (SHP) (IT, 1996c).

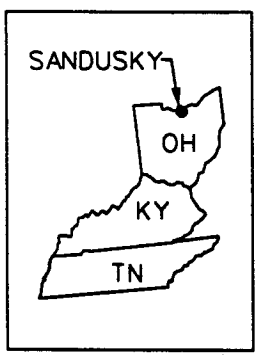
VI.1.1 Site History

The PBOW site, built in early 1941, manufactured 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to Ordnance Department, then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration. The National Aeronautics and Space Administration (NASA) acquired the PBOW in 1963 and is presently utilizing the site.

VI.1.2 Summary of Existing Site Data

The western portion of the PBOW generally refers to the area west of Ransom Road. The area is predominantly wooded with some cleared areas covered with grasses and bushes. Several areas identified by previous investigations as potential areas of contamination include Reservoir No. 2





NOT TO SCALE

FIGURE VI-1
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 5/8/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: D.SEYMORE
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: D. SEYMORE	PROJ. MGR.:D. BURTON
DWG. NO.: 771481ES.003	PROJ. NO.:771481		

771481ES.003 14:06:48 MAY 08, 1997 RMK

Burning Ground, Waste Water Disposal Plant No. 2, Power House No. 2 Ash Pit, TNT Area C, West Area Red Water Pond (WARWP), and G-8 Burning Ground. According to additional investigations conducted by several government agencies, the chemicals of potential concern within the western portion of PBOW may include volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), polychlorinated biphenyls (PCB), metals, and nitro-aromatics. The findings of these investigations are summarized in Section 1.2.2 of SAP (IT, 1996a).

In 1994, the USACE Nashville District conducted the most recent sitewide groundwater investigation of the overburden and bedrock hydrostratigrahic units at PBOW (Dames & Moore, 1996). Eleven overburden groundwater monitoring wells and eight bedrock wells were installed during the 1994 investigation. Groundwater samples were collected from 16 overburden wells and 8 bedrock wells. All groundwater samples were analyzed for nitroaromatic compounds, nitrates, and total and dissolved metals. Samples from bedrock wells were also analyzed for VOCs and base/neutral and acid extractables (BNA) to acquire baseline groundwater quality information of the bedrock aquifer. The major findings of this investigation are briefly summarized in the following paragraphs to facilitate the GWI planning process and to aid in field operations. Table VI-1 summarizes monitoring well construction details for existing monitoring wells to be sampled during the GWI.

The overburden unit, composed of glacial outwash materials, has a thickness ranging from a few feet in the south to greater than 40 feet in some locations in the north. The bedrock unit consists of Devonian limestone and shale that dip to the southeast at approximately 35 feet per mile.

In general, groundwater flows in a northerly direction, towards Lake Erie, in both the unconsolidated overburden material and consolidated bedrock. On the western side of the site groundwater in the overburden water-bearing zone flows to the northwest, while groundwater in the bedrock aquifer flows to the northeast. Table VI-2 presents available historical groundwater level elevation data for selected existing monitoring wells to be sampled during the GWI.

The results of the groundwater quality analyses indicated significant levels of explosive residues in the groundwater in the overburden aquifer in the immediate vicinity of both former Red Water Pond areas. Low levels of explosives, several VOCs, and BNAs were also detected in several bedrock wells. The locations of monitoring wells to be sampled during this GWI are provided on Figure VI-2.

Table VI-1

Existing Monitoring Well Construction Details
Wells to be Sampled During the Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Well Depth (feet)	Date Installed	Installed By	Casing Type	Casing Diameter (inches)	Borehole Diameter (inches)	Screen Interval (feet bgs)	Top of Filter Pack (feet bgs)	TOC Elevation (feet msl)	Ground Elevation (feet msl)	Well Location
Overburden Monitoring Wells											
IT-MW01	9.5	1989	IT	PVC	2	8	4.0 - 9.0	2.0	678.24	674.52	Scheid Road Burn Grd
IT-MW02	18.3	1989	IT	PVC	2	8	6.0 - 16.0	3.8	639.63	636.53	West Area RWP
IT-MW05	21.0	1989	IT	PVC	2	8	8.5 - 18.5	6.5	634.99	631.91	Pentolite Road RWP
IT-MW06	18.5	1989	IT	PVC	2	8	6.0 - 16.0	4.4	632.97	628.90	Reactor Facility / PRA
IT-MW07	5.5	1996	IT	PVC	2	4.25	0.5 - 5.5	none	635.03	632.30	West Area RWP, temporary
IT-MW08	13.4	1996	IT	PVC	2	8.25	3.1 - 13.1	3.6	633.16	630.60	West Area RWP
IT-MW09	14.5	1996	IT	PVC	2	8.25	4.1 - 14.1	2.0	647.45	645.40	TNT Area C
IT-MW10	19.8	1996	IT	PVC	2	8.25	9.3 - 19.3	8.6	644.80	642.20	West Area RWP
PB-TNTA-MW10	11.0	1994	D&M	PVC	2	8	3.0 - 11.0	2.5	640.18	637.50	TNT Area A
PB-TNTA-MW11	11.4	1994	D&M	PVC	2	8	3.4 - 11.4	2.5	640.50	637.86	TNT Area A
PB-TNTC-MW03	14.0	1994	D&M	PVC	2	8	5.0 - 14.0	3.2	645.41	642.57	TNT Area C
PB-TNTC-MW04	18.8	1994	D&M	PVC	2	8	8.8 - 18.8	6.0	654.43	651.89	TNT Area C
PB-TNTC-MW05	29.7	1994	D&M	PVC	2	8	4.7 - 29.7	3.7	651.81	649.07	TNT Area C
PB-TNTC-MW06	12.2	1994	D&M	PVC	2	8	3.2 - 12.2	2.5	659.40	656.82	TNT Area C
PB-WA-MW01	22.3	1994	D&M	PVC	2	8	4.3 - 22.3	3.7	644.43	642.32	West Area RWP

Table VI-1

Existing Monitoring Well Construction Details
Wells to be Sampled During the Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Well Depth (feet)	Date Installed	Installed By	Casing Type	Casing Diameter (inches)	Borehole Diameter (inches)	Screen Interval (feet bgs)	Top of Filter Pack (feet bgs)	TOC Elevation (feet msl)	Ground Elevation (feet msl)	Well Location
PB-WA-MW02	13.0	1994	D&M	PVC	2	8	3.0 - 12.0	2.5	633.65	631.16	West Area RWP
PB-PR-MW07	22.3	1994	D&M	PVC	2	8	4.3 - 22.3	3.0	633.99	631.50	Pentolite Road RWP
PB-PR-MW08	27.5	1994	D&M	PVC	2	8	5.0 - 27.5	4.0	635.02	632.50	Pentolite Road RWP
PB-PR-MW09	19.0	1994	D&M	PVC	2	8	4.0 - 19.0	3.0	633.70	630.70	Pentolite Road RWP
MK-MW09	15.0	1993	MK	PVC	2	10	5.0 - 15.0	3.0	645.91	643.04	West Area RWP
MK-MW10	14.0	1993	MK	PVC	2	10	4.0 - 14.0	2.0	641.25	638.23	West Area RWP
MK-MW11	13.0	1993	MK	PVC	2	10	3.0 - 13.0	2.0	638.00	634.88	West Area RWP
MK-MW12	13.0	1993	MK	PVC	2	10	3.0 - 13.0	2.0	641.73	673.78	Pipe Creek
MK-MW14	11.5	1993	MK	PVC	2	10	4.0 - 9.0	2.0	681.93	679.04	Toluene Tank No. 645
MK-MW15	9.0	1993	MK	PVC	2	10	4.0 - 9.0	2.0	681.45	678.35	Toluene Tank No. 655
MK-MW16	8.0	1993	MK	PVC	2	10	2.0 - 7.0	1.0	674.64	671.45	TNT Area B
MK-MW17	6.0	1993	MK	PVC	2	10	2.0 - 6.0	1.0	661.90	661.43	TNT Area B
MK-MW19	13.0	1993	MK	PVC	2	10	3.0 - 13.0	2.0	639.85	636.82	Garage Maintenance Area
MK-MW20	23.0	1993	MK	PVC	2	10	5.0 - 20.0	3.0	637.86	635.04	Toluene Tank No. 265
MK-MW22	9.5	1993	MK	PVC	2	10	2.5 - 7.5	1.5	638.95	635.84	TNT Area A
MK-MW23	16.0	1993	MK	PVC	2	10	6.0 - 16.0	4.0	640.01	637.01	TNT Area A

Table VI-1

Existing Monitoring Well Construction Details
Wells to be Sampled During the Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Well Depth (feet)	Date Installed	Installed By	Casing Type	Casing Diameter (inches)	Borehole Diameter (inches)	Screen Interval (feet bgs)	Top of Filter Pack (feet bgs)	TOC Elevation (feet msl)	Ground Elevation (feet msl)	Well Location
MK-MW24	9.5	1993	MK	PVC	2	10	4.5 - 9.5	2.5	657.59	654.57	TNT Area A
GCL-MW01	NA	1992	H+GLC	NA	NA	NA	NA	NA	674.74	671.31	Snake Rd. Burn Grd (BG)
GCL-MW02A	NA	1992	H+GLC	NA	NA	NA	NA	NA	672.66	669.68	Snake Rd. Burn Grd
GCL-MW02B	NA	1992	H+GLC	NA	NA	NA	NA	NA	673.07	669.60	Snake Rd. Burn Grd
GCL-MW03	NA	1992	H+GLC	NA	NA	NA	NA	NA	671.52	668.67	Snake Rd. Burn Grd
Bedrock Monitoring Wells											
PB-BED-MW13	75.5	1994	D&M	PVC	4	3 (A)	29.5 (B)	none	648.27	645.81	TNT Area C
PB-BED-MW14	52.2	1994	D&M	PVC	4	3 (A)	23.2 (B)	none	646.04	643.05	West Area RWP
PB-BED-MW15	74.4	1994	D&M	PVC	4	3 (A)	42.9 (B)	none	631.64	629.08	Pentolite Road RWP
PB-BED-MW16	74.0	1994	D&M	PVC	4	3 (A)	24.8 (B)	none	636.02	633.68	Pentolite Road RWP
PB-BED-MW17	64.4	1994	D&M	PVC	4	3 (A)	19.4 (B)	none	629.97	627.37	TNT Area A
PB-BED-MW18	75.4	1994	D&M	PVC	4	3 (A)	24.4 (B)	none	651.50	648.83	TNT Area A
PB-BED-MW19	49.5	1994	D&M	PVC	4	3 (A)	17.5 (B)	none	643.07	640.51	West Area RWP
PB-BED-MW20	49.5	1994	D&M	PVC	4	3 (A)	14.5 (B)	none	676.33	673.57	BG Well - Southern PBS
REACTOR1	NA	NA	NA	NA	NA	NA	NA	NA	630.12	630.21	Reactor Facility / PRA
REACTOR2	NA	NA	NA	NA	NA	NA	NA	NA	630.68	630.72	Reactor Facility / PRA

Table VI-1

Existing Monitoring Well Construction Details
Wells to be Sampled During the Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Well Depth (feet)	Date Installed	Installed By	Casing Type	Casing Diameter (inches)	Borehole Diameter (inches)	Screen Interval (feet bgs)	Top of Filter Pack (feet bgs)	TOC Elevation (feet msl)	Ground Elevation (feet msl)	Well Location
REACTOR3	NA	NA	NA	NA	NA	NA	NA	NA	630.88	630.73	Reactor Facility / PRA
REACTOR4	NA	NA	NA	NA	NA	NA	NA	NA	631.15	630.76	Reactor Facility / PRA

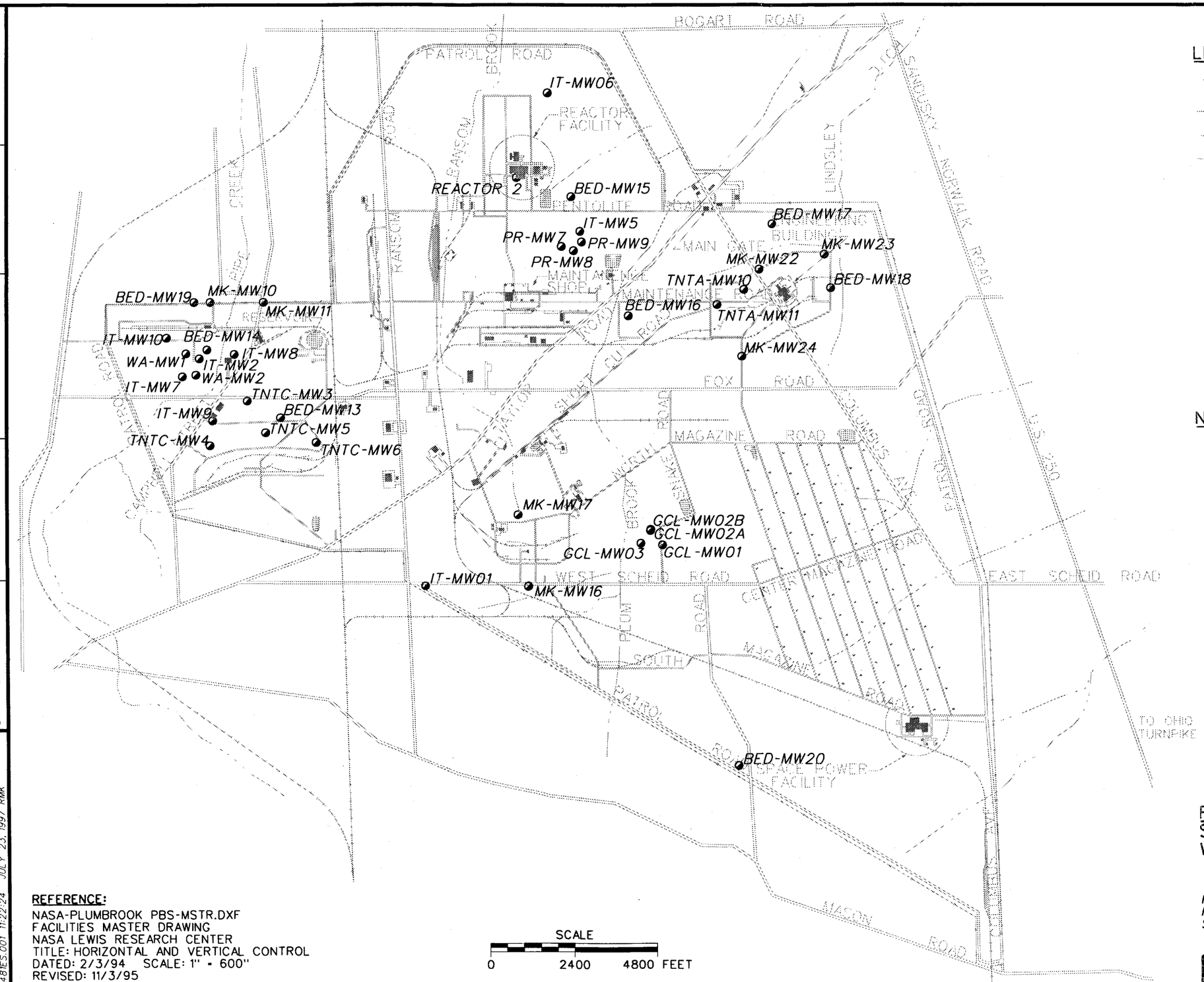
A - 3-inch diameter open borehole into bedrock.
B - Depth at which PVC casing ends; remainder of well is open borehole in bedrock.
RWP - Red Water Ponds
PRA - Pentolite Road Area
BG - Background location
PBS - Plum Brook Station
NA - Information not available

Table VI-2

Groundwater Level Elevations
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Top Of Casing Elevation (feet, msl)	Ground Elevation (feet, msl)	Water Level Elevation Dec-94 (feet, msl)	Water Level Elevation Mar-95 (feet, msl)	Water Level Elevation Oct-96 (feet, msl)	Notes
PB-TNTA-MW10	640.18	637.50	633.71	637.04	635.62	
PB-TNTA-MW11	640.50	637.86	630.56	632.82	633.56	
PB-TNTC-MW3	645.41	642.57	Dry, <628.57	639.20	635.01	
PB-TNTC-MW4	654.43	651.89	634.87	651.07	648.51	
PB-TNTC-MW5	651.81	649.07	628.01	647.62	643.28	
PB-TNTC-MW6	659.40	656.82	651.93	655.20	654.56	
PB-WA-MW1	644.43	642.32	619.85	619.45	624.99	
PB-WA-MW2	633.65	631.16	629.59	631.91	628.75	
PB-PR-MW7	633.99	631.50	626.32	631.65	629.64	
PB-PR-MW8	635.02	632.50	624.55	629.98	627.56	
PB-PR-MW9	633.70	630.70	622.92	630.12	626.57	
PB-BED-MW13	648.27	645.81	607.85	619.29	621.79	
PB-BED-MW14	646.04	643.05	621.76	624.39	625.23	
PB-BED-MW15	631.64	629.08	603.54	598.91	610.22	
PB-BED-MW16	636.02	633.68	571.38	633.68	630.17	
PB-BED-MW17	629.97	627.34	602.57	602.90	602.76	
PB-BED-MW18	651.50	648.83	625.05	620.39	621.68	
PB-BED-MW19	643.07	640.50	621.07	623.52	622.92	
PB-BED-MW20	676.33	673.57	661.35	661.28	661.98	
MK-MW10	640.89	638.06	626.66	Not Measured	632.23	
MK-MW11	637.69	634.71	625.22	631.36	628.89	
MK-MW16	674.32	671.33	667.14	669.36	668.42	
MK-MW17	664.64	660.97	659.58	661.10	660.56	
MK-MW22	638.05	635.56	628.85	631.55	630.07	
MK-MW23	639.07	636.95	620.88	628.12	632.14	
MK-MW24	657.12	654.44	648.31	650.77	649.61	
IT-MW002	639.63	636.69	627.32	633.75	629.33	
IT-MW005	634.99	631.91	620.19	629.62	623.36	
IT-MW07	635.03	632.30	-	-	dry, < 627.30	piezometer
IT-MW08	633.16	630.60	-	-	619.96	new well/survey data
IT-MW09	647.45	645.40	-	-	dry, < 632	new well/survey data
IT-MW010	644.80	642.20	-	-	626.41	new well/survey data

Note: TOC and ground surface elevations were reported in Table 5-2 of Dames & Moore Site-Wide Groundwater Investigation report, (Dames & Moore, 1996) unless otherwise indicated.



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- EXISTING WELL

NOTES:

SURVEY COORDINATES ARE NOT AVAILABLE FOR MONITORING WELLS MK-MW09, MK-MW12, MK-MW14, MK-MW15, MK-MW19, MK-MW20, REACTOR-1, REACTOR-3, AND REACTOR-4.

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

FIGURE VI-2
SITE WIDE MONITORING WELL LOCATION MAP

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 5/8/97	DATE LAST REV.:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: D. SEYMORE	DWG. NO.:7714BIES.001
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: D. SEYMORE	PROJ. MGR.:D. BURTON	PROJ. NO.:771481

7714BIES.001 11:22:24 JULY 23, 1997 RMK

A site visit conducted by IT project members on May 15 and 16, 1996 acquired information regarding 28 existing monitoring wells to be sampled and assessed site accessibility for new monitoring well installation. All targeted existing wells were located and appeared to be in good condition. Some wells are off-road and some are in swampy areas that require the use of an all-terrain vehicle.

VI.2.0 Project Organization and Responsibility

The project organization for this sitewide GWI consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.

VI.3.0 Scopes and Objectives

VI.3.1 Scope

As specified in the statement of work (SOW) (USACE, 1997), the scope for the groundwater investigation at PBOW consists of preparation of site-specific addendums to the sitewide SAP and SHP; completion of field activities, including installation of monitoring wells and collection of soil samples from new monitoring wells and groundwater samples from new and existing monitoring wells for chemical analysis, evaluation of analytical results; periodic sitewide water level measurements; preparation of investigation report of activities, conclusions, and recommendations for future actions, and a Geographic Information System (GIS) deliverable.

VI.3.2 Objectives

Specific objectives of the sitewide groundwater level investigation are summarized as follows:

- Determine if there are hazardous substances present at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define site physical features and characteristics (aquifer background conditions).
- Evaluate fate and transport pathways (groundwater modeling).
- Determine current and future routes of exposure.

Evaluation of fate and transport pathways will not be completely satisfied during this investigation, but sufficient groundwater information will be collected so that a scope of work for groundwater modeling can be completed if required to determine fate and transport of hazardous substances in site groundwater. Additionally, the collected data can be used to conduct a human health and ecological risk assessment, if necessary.

VI.3.3 Site-Specific Data Quality Objectives

Overview. The data quality objectives (DQO) process followed during the planning stages of the investigation evaluated data requirements needed to support the decision making process and selected the best action to satisfy these requirements. Incorporated components of the DQO process, described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund* (EPA, 1993), are discussed in detail in Section 3.3 of the sitewide SAP. Determining factors for procedures necessary to satisfy investigative objectives and to establish the basis of future actions at PBOW are presented in Table VI-3 and Figure 3-2 of the sitewide SAP (IT, 1996a).

Data Users and Available Data. A site-specific conceptual model, developed using existing data, helped to identify data gaps. During the project planning process, effective methodologies for filling the data gaps were designed and reviewed by the data users, with the most efficient data collection design being implemented. The SSAP records the rationale for the design, including the location, number, and type of sampling necessary to fill the data gaps and to satisfy the data quality objectives. The SSAP, along with companion documents, provides the regulatory agencies with sufficient detail so that they can conclude whether the investigative effort is adequate to satisfy the study objectives.

Conceptual Site Model. Four factors considered in defining the conceptual model for the sitewide GWI are:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Contaminants of concern.

A potential source of contamination at PBOW are past TNT manufacturing activities. The migration pathways include groundwater infiltration, soil, and surface water runoff to the creek.

Table VI-3

Summary of Data Quality Objectives for the Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Potential Data Users	Available Data	Conceptual Model	Media of Concern	Data Uses and Objectives	Data Types	Analytical Level	Data Quantity
EPA OEPA DOD USACE NASA IT Corporation Other Contractors Possible Future Land Users	<u>Overburden Wells:</u> Nitroaromatic compounds exceed RBCs in the overburden water bearing zone in the West Area Red Water Pond Area (WARWP), Pentolite Road Red Water Pond Area (PRRWP), TNT Area A (TNTA), and TNT Area B (TNTB). Metals exceed RBCs in overburden wells in WARWP, PRRWP, TNTA, TNTB, and TNTC. <u>Bedrock Wells:</u> Organic compounds exceed RBCs in PRRWP, TNTA, and TNTC. Nitroaromatics exceed RBCs in PRRWP, TNTA, and TNTC. Metals exceed RBCs in WARWP, PRRWP, TNTA, and TNTC. H_2S in bedrock wells. <u>Data Gaps:</u> 8 bedrock & 4 overburden wells needed to accurately define nature and extent of contamination.	<u>Contaminated Sources:</u> TNT Areas, Burning Grounds, and Wastewater Ponds. <u>Migration Pathways:</u> Soil, sediment, surface water, and groundwater. <u>Potential Receptors:</u> Wildlife and humans. <u>Potential Contaminants of Concern:</u> VOCs, SVOCs, metals, nitroaromatics, and PCBs.	Groundwater	Determine if hazardous substances are present at levels posing a threat to human health and environment. Define physical features and characteristics (aquifer background conditions). Evaluate fate and transport pathways (modeling). Determine current and future routes of exposure.	TAL Total Metals TAL Dissolved Metals Explosives TCL VOCs TCL SVOCs PCBs Water Quality Parameters (hardness, alkalinity, TOC, TDS, TSS, chloride, total cyanide, nitrate, and sulfate)	Definitive Data[a]	118 + QA

a Definitive data as defined in EPA/540/G-93/071, *Data Quality Objectives Process for Superfund* (EPA 1993).

Likely receptors at PBOW are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants under current land use at PBOW is unlikely since the site is a secure NASA research station. Potential receptors near the facility include off-site water users. Potential contaminants of concern based on past use of the site may include VOCs, SVOCs, metals, pesticides/PCBs, nitroaromatics, and total cyanide.

Decision-Making Process, Data Uses, and Needs. The decision-making process, presented in detail in Section 3.3.3 of the sitewide SAP (IT, 1996a), consists of a seven-step process that will be followed during the sitewide GWI. Data uses and needs are summarized in Table VI-3.

Risk Evaluation. Confirmation of contamination at the additional sitewide GWI will be based upon a comparison of detected contaminants from this and previous investigations to the most current guidance criteria. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in the media. Definitive data will be adequate for confirming the presence of the contamination and for supporting a risk assessment and feasibility study.

Data Quality, Types, and Quality. Soil and groundwater samples will be collected and analyzed in order to meet the objectives of the additional sitewide GWI. Quality assurance/ quality control (QA/QC) samples will be collected for all sample types as described in Section VI.4.5 of this SSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the SI, data analyzed at this level of quality are appropriate for all phases of the characterization and risk assessment.

Precision, Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this are provided in Section 3.3.4.4.3 of the sitewide SAP (IT, 1996a).

VI.4.0 Field Activities

Field activities during the additional groundwater level investigation at PBOW include the installation, development, geotechnical sampling, and groundwater sampling of 8 new bedrock wells (IT-BG8-BEDGW-001, TNTB-BEDGW-001, TNTB-BEDGW-002, MNTA-BEDGW-001,

AA1-BEDGW-001, AA2-BEDGW-001, AA3-BEDGW-001, and ABG-BEDGW-001) and 4 new overburden wells (IT-AA1-GW-002, AA2-GW-002, AA3-GW-002, ABG-GW-002); the groundwater sampling of 12 existing bedrock wells and 35 existing overburden wells, with QA/QC samples, followed by sitewide water level measurements, surveying, and management of investigation-derived waste (IDW).

VI.4.1 Monitoring Well Installation

VI.4.1.1 Monitoring Well Locations and Rationale

Twelve new monitoring wells will be installed during the investigation of groundwater at PBOW. Eight monitoring wells will be installed as bedrock wells, while the remaining four monitoring wells will be installed as overburden wells. Table VI-4 provides a summary of the wells to be installed, including anticipated well depths, locations, construction details, and rationale. Monitoring well installation in the referenced locations will allow for additional characterization of the aquifer conditions, evaluation of fate and transport pathways, determination of whether the hazardous substances pose an unacceptable risk to human health and the environment, and definition of current and future routes of exposure. Additional rationale for placement of monitoring wells comes from previous analytical results/contaminant plumes and the need to fill data gaps.

Tentative locations of these monitoring wells are presented on Figure VI-3. The locations may require adjustment if site conditions warrant. In that event, the IT field coordinator will contact the USACE oversight representative and the project manager prior to changing well locations. Any changes from the work plans will be recorded in chronological order in the variance log shown in Figure 9-1 of the SAP (IT, 1996a).

Bedrock monitoring wells will be installed to an assumed total depth of 75 feet below ground surface (bgs), while overburden monitoring wells will be installed to an assumed total depth of 15 feet bgs.

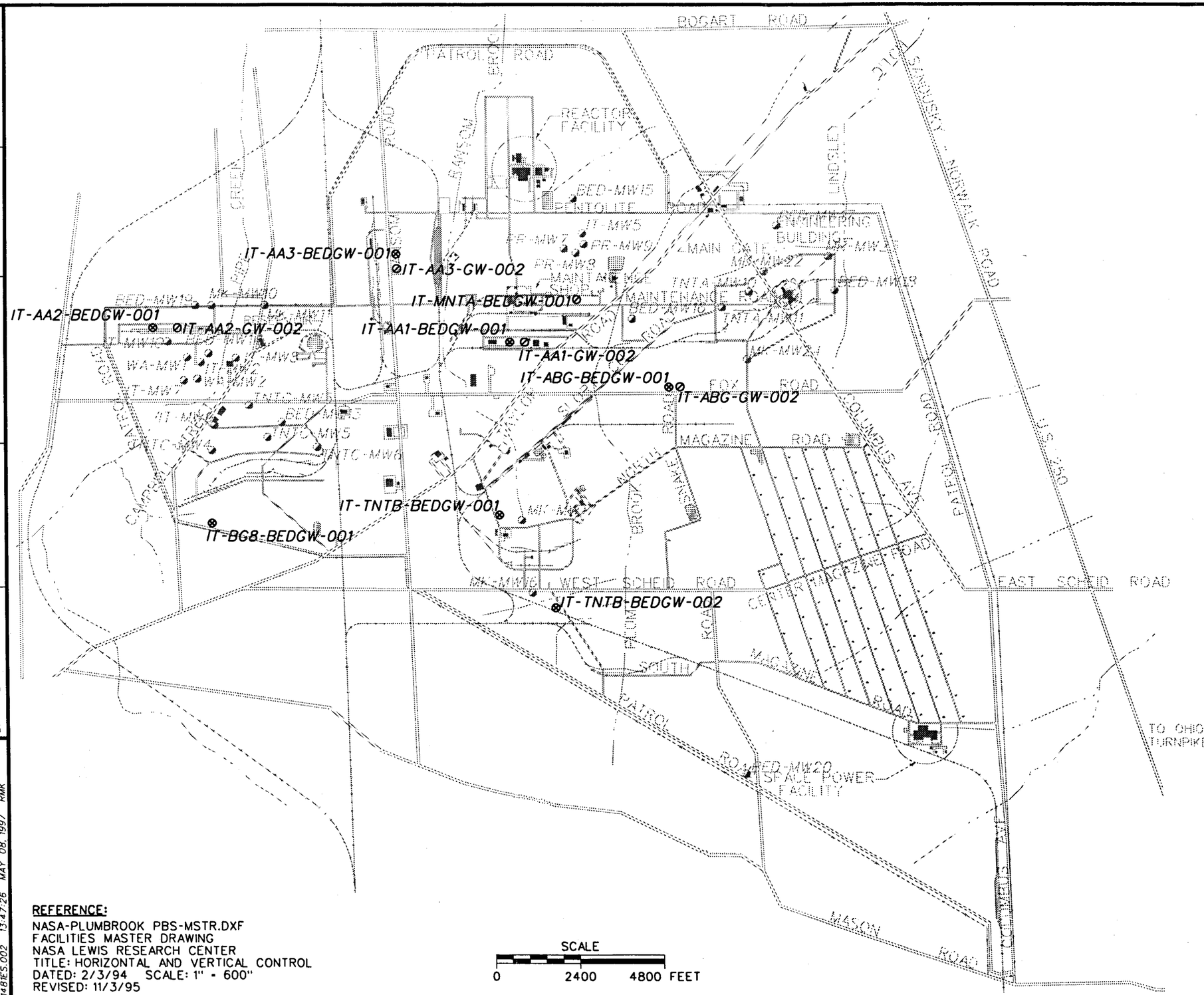
VI.4.1.2 Drilling Methods for Overburden Monitoring Wells

A total of four boreholes for monitoring well installation will be installed in the unconsolidated overburden materials by the hollow-stem auger (HSA) method using nominal 8.25-inch inside diameter (ID) augers as specified in the following text. Continuous soil sampling and rock coring will be conducted in each borehole from the surface to the total depth for lithological

Table VI-4

Construction Details and Location Rationale for Proposed Monitoring Wells Groundwater Investigation Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Total Depth (feet bgs)	Casing Diameter (inches)	Screen Interval (feet bgs)	Proposed Well Location	Rationale / Purpose
Bedrock Monitoring Wells					
IT-BG8-BEDGW-001	75.0	2	60 - 75	G8 Burning Grounds (corner of Campbell Road and Patrol Road)	Upgradient water quality data, West Area Red Water Ponds and TNT Area C
IT-TNTB-BEDGW-001	75.0	2	60 - 75	TNT Area B near MK-MW16	Upgradient water quality data, TNT Area B
IT-TNTB-BEDGW-002	75.0	2	60 - 75	TNT Area B near MK-MW17	Downgradient water quality data, TNT Area B
IT-MNTA-BEDGW-001	75.0	2	60 - 75	Maintenance Area	Upgradient water quality data, Pentolite Road Red Water Pond Area
Nested Monitoring Well Pairs					
IT-AA1-BEDGW-001	75.0	2	60 - 75	Acids Area 1	Bedrock water quality data, Acids Area 1
IT-AA1-GW-002	15.0	2	5 - 15	Acids Area 1	Overburden water quality data, Acids Area 1
IT-AA2-BEDGW-001	75.0	2	60 - 75	Acids Area 2	Bedrock water quality data, Acids Area 2
IT-AA2-GW-002	15.0	2	5 - 15	Acids Area 2	Overburden water quality data, Acids Area 2
IT-AA3-BEDGW-001	75.0	2	60 - 75	Acids Area 3	Bedrock water quality data, Acids Area 3
IT-AA3-GW-002	15.0	2	5 - 15	Acids Area 3	Overburden water quality data, Acids Area 3
IT-ABG-BEDGW-001	75.0	2	60 - 75	Additional Burning Ground	Bedrock water quality data, Additional Burning Ground
IT-ABG-GW-002	15.0	2	5 - 15	Additional Burning Ground	Overburden water quality data, Additional Burning Ground



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- EXISTING WELL
- PROPOSED OVERBURDEN WELL
- PROPOSED BEDROCK WELL

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

FIGURE VI-3
PROPOSED MONITORING WELL LOCATION MAP

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: D. SEYMORE	DWG. NO.:771481ES.002	
ENGR. CHCK. BY: D. SEYMORE	PROJ. MGR.: D. BURTON	PROJ. NO.:771481	
STARTING DATE: 5/8/97	DATE LAST REV.:		
DRAWN BY: R. KNIGHT	DRAWN BY:		

771481ES.002 13:47:26 MAY 08, 1997 RMK

description. All soil samples will be visually inspected and logged on the HTRW Drilling Log (Figure 4-11 of the Site-Wide SAP) by an IT field geologist using the Unified Soil Classification System (USCS). Three soil samples will be collected from each borehole and submitted for geotechnical analysis; at least one of the samples will be collected from the aquifer material in the screened interval. Geotechnical samples will be analyzed by a geotechnical testing laboratory for sieve analysis, Atterberg limits, soil density, and moisture content. In addition, one sample will be collected of the filter pack material and submitted for sieve analysis only. The borehole will be advanced to first water with a 10-foot screen section placed 1 foot above the bottom. The estimated depth of each overburden well is 15 feet bgs. If bedrock is encountered at a depth of less than 6 feet bgs, a monitoring well will not be installed and the borehole will be abandoned by grouting from the bottom to the ground surface. A new well location will then be identified and coordinated with the USACE.

VI.4.1.3 Drilling Methods for Bedrock Monitoring Wells

A total of eight new bedrock monitoring wells will be installed during the investigation of groundwater at PBOW. The bedrock monitoring wells will be installed as double-cased wells, drilled using HSA methodology. Initially, 14-inch-diameter HSA will be used to drill through the overburden material to bedrock and 5 feet into bedrock at an assumed depth of 50 feet bgs. A 10-inch ID low-carbon steel surface casing will then be installed into the borehole through the augers and pressure-grouted in place using 3,000 pounds per square inch (psi) concrete to prevent frost damage. The surface casing will be permitted to cure for a minimum of 48 hours, after which the borehole will be advanced through the surface casing to the estimated total depth of 75 feet bgs (25 feet into bedrock) using 6-inch outside diameter (OD) air rotary drilling techniques.

Continuous soil sampling and rock coring will be conducted in each borehole from the surface to the total depth for lithological description. All soil samples will be visually inspected and logged by an IT field geologist using the USCS. Two soil samples will be collected from each borehole and submitted for geotechnical analysis. Geotechnical samples will be analyzed by a geotechnical testing laboratory for sieve analysis, Atterberg limits, soil density, and moisture content. In addition, one sample will be collected of the filter pack material and submitted for sieve analysis only.

Drilling and installation of all monitoring wells will follow the requirements of USACE EM-1110-1-4000, *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites* (USACE, 1994).

VI.4.1.4 Soil Samples for Geologic Logging

The soil and rock sampling shall be continuous for the entire monitoring well boring. Visual classification and logging of borehole material in the field shall be in accordance with USCS nomenclature and procedures described in USACE EM 1110-1-4000 (USACE, 1994), including making a photographic record of the core. Soil overburden material shall be split-spoon sampled for the purpose of visual geotechnical classification of the borehole material.

VI.4.1.5 Soil Samples for Geotechnical Testing

Sample collection for geotechnical analysis according to the USACE scope of work is summarized in Table VI-5.

Two soil samples from each of the eight bedrock wells will be collected. The sieve analysis number includes screened interval samples from overburden wells.

The results of geotechnical analysis will be included in the investigation report along with drilling logs.

VI.4.1.6 Monitoring Well Completion

All monitoring wells will be completed using 2-inch-ID, schedule 40 polyvinyl chloride (PVC) casing (American Society for Testing and Materials [ASTM] F480-81, D1785), and screen for overburden and bedrock wells, using procedures specified in the Resource Conservation and Recovery Act groundwater monitoring technical enforcement guidance document (EPA, 1986), the USACE EM-1110-1-4000 (USACE, 1994), and the State of Ohio requirements.

VI.4.1.7 Materials and Procedures for Overburden Monitoring Wells

A typical overburden monitoring well construction diagram is provided as Figure VI-4. The overburden groundwater monitoring wells will be installed using the following materials and procedures:

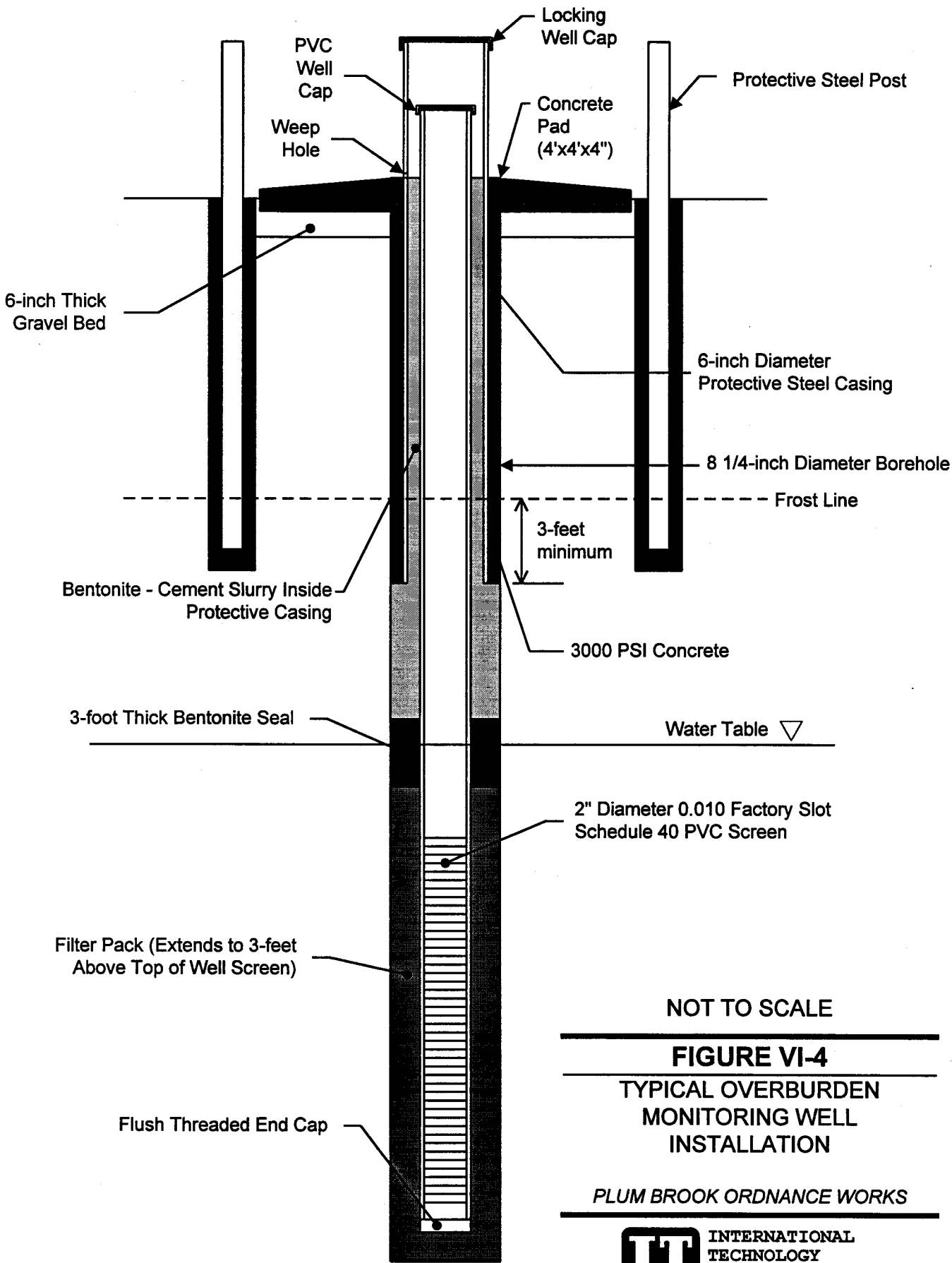
- ***Well Screens.*** A 2-inch ID, flush-jointed threaded schedule 40 PVC factory slot screen. The slot size will be determined based upon historical site data and confirmed through sieve analyses. Ten feet of screen with a PVC end cap will be placed in each overburden well.

- ***Well Casing.*** A 2-inch ID, flush-jointed threaded schedule 40 PVC (ASTM D1875) casing will be attached to the top of the screen. Glues or adhesives will not

Table VI-5

Geotechnical Samples for the New Well Installations
Former Plum Brook Ordnance Works, Sandusky, Ohio

Geotechnical Test	ASTM Method	Number of Samples
Moisture content	D2216	16
Atterberg limits	D4318	16
Sieve analysis	D422	16 + 4
Soil density	D2487	16



NOT TO SCALE

FIGURE VI-4

TYPICAL OVERBURDEN MONITORING WELL INSTALLATION

PLUM BROOK ORDNANCE WORKS

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be used. The casing string will extend approximately 2.5 feet above grade and will be certified by the manufacturer as being the material specified.

- ***Decontamination.*** All well completion materials, including screen and casing, will be decontaminated by steam, laboratory grade detergent, and distilled water rinse prior to installation.

- ***Filter Pack.*** Clean, inert, noncarbonate materials will be used to construct a uniform and continuous filter pack. The filter pack will be designed to prevent migration of formation fines into the well bore. The filter pack will be placed by pipe from the bottom of the borehole to approximately 36 inches above the top of the well screen. A sieve analysis will be performed on the filter pack material.

- ***Bentonite Seal.*** A 3-foot seal consisting of tamped 1/4-inch bentonite pellets will be tremied into the annular space between the well riser and the borehole wall immediately above the filter pack. If the seal is constructed above the groundwater, it will be sufficiently hydrated with clean, nonchlorinated water to preclude transmission of grout from above into the filter pack or well screen.

- ***Frost Protection.*** All monitoring wells will be constructed to prevent frost damage. The protective steel casing will be installed to a depth of 3 feet below the frost line (7 feet bgs), and 3,000-psi concrete will be placed in the annular space between the protective casing and the borehole wall. Figure VI-4 provides construction details for frost protection.

- ***Grout.*** Neat cement grout consisting of approximately 94 pounds Portland Type II cement (in accordance with ASTM C-150) and not more than 3 pounds powdered bentonite and 7 gallons of water will be used. The grout will be placed using a tremie pipe from the top of the bentonite seal to the ground surface (except where 3,000-psi concrete is used for frost protection).

- ***Surface Protection.*** Surface protection will consist of a 6-inch-OD steel surface casing extending approximately 7 feet into the ground and approximately 2.5 feet above the ground (a maximum of 0.2 feet above the top of the PVC well casing) with a lockable cap set into and surrounded by a concrete pad 4 feet square and approximately 4 inches thick. The pad will be sloped a minimum of 2 inches from the surface casing to the edge of the pad to provide positive drainage and will be placed on a 6-inch-thick gravel bed. USACE specifications to prevent frost heave will be used in well construction. Four 3-inch-diameter, concrete-filled steel posts extending approximately 3 feet above the ground surface will be set in concrete approximately 5 feet into the ground at equal spacing around the concrete pad. All of the locks on the new wells will be keyed alike. A permanent tag will be affixed to the outer protective casing or cap and will clearly identify the well number, the USACE, Nashville District, and the adjusted top of casing elevation.

VI.4.1.8 Materials and Procedures for Bedrock Monitoring Wells

A typical bedrock monitoring well construction diagram is provided as Figure VI-5. The bedrock groundwater monitoring wells will be installed using the following materials and procedures:

- ***Surface Casing.*** A 14-inch-diameter HSA will be used to drill through the overburden material to bedrock and 5 feet into the bedrock. A 10-inch-ID, low-carbon steel surface casing will be installed through the augers 5 feet into the bedrock and pressure grouted into place using 3,000-psi concrete.

- ***Well Screens.*** A 2-inch ID, flush-jointed threaded schedule 40 PVC factory slot screen. The slot size will be determined based upon historical site data and confirmed through sieve analyses. Fifteen feet of screen with a PVC end cap will be placed in each bedrock well.

- ***Well Casing.*** A 2-inch-ID, flush-jointed threaded schedule 40 PVC (ASTM D1875) casing will be attached to the top of the screen. Glues or adhesives will not be used. The casing string will extend approximately 2.5 feet above grade and will be certified by the manufacturer as being the material specified.

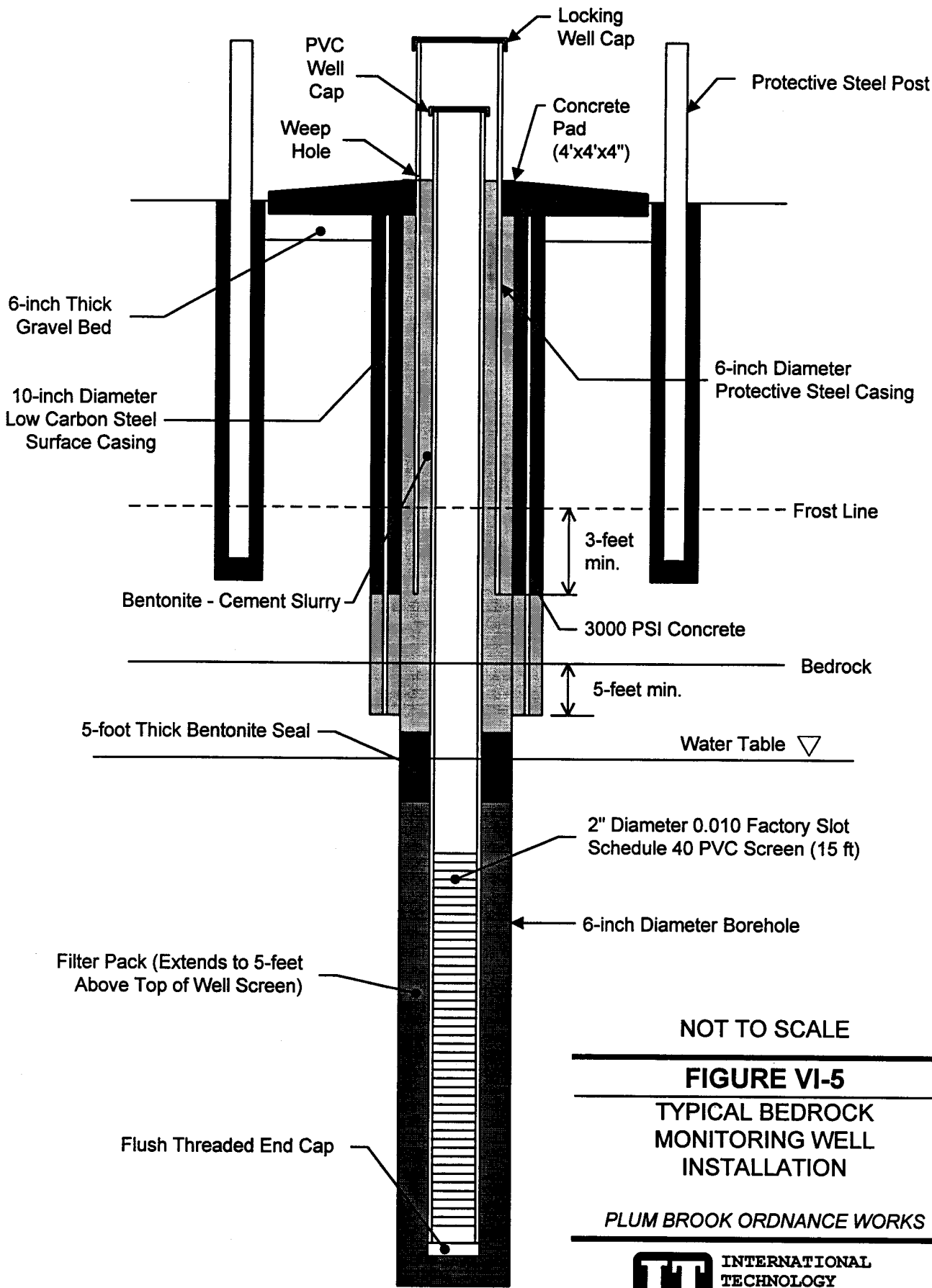
- ***Decontamination.*** All well completion materials, including screen and casing, will be decontaminated by steam, laboratory grade detergent, and distilled water rinse prior to installation.

- ***Filter Pack.*** Clean, inert, noncarbonate materials will be used to construct a uniform and continuous filter pack. The filter pack will be designed to prevent migration of formation fines into the well bore. The filter pack will be placed by pipe from the bottom of the borehole to approximately 60 inches above the top of the well screen. A sieve analysis will be performed on the filter pack material.

- ***Bentonite Seal.*** A 5-foot seal consisting of tamped 1/4-inch bentonite pellets will be tremied into the annular space between the well riser and the borehole wall immediately above the filter pack. If the seal is constructed above the groundwater, it will be sufficiently hydrated with clean, nonchlorinated water to preclude transmission of grout from above into the filter pack or well screen.

- ***Frost Protection.*** All monitoring wells will be constructed to prevent frost damage. For bedrock wells, 3,000-psi concrete will be used to set the surface casing in place. Figure VI-5 provides construction details for frost protection.

- ***Grout.*** Neat cement grout consisting of approximately 94 pounds Portland Type II cement (in accordance with ASTM C-150) and not more than 3 pounds powdered bentonite and 7 gallons of water will be used. The grout will be placed using a tremie pipe from the top of the bentonite seal to the ground surface (except where 3,000-psi concrete is used for frost protection).



NOT TO SCALE

FIGURE VI-5

TYPICAL BEDROCK MONITORING WELL INSTALLATION

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- ***Surface Protection.*** Surface protection will consist of a 6-inch-OD steel surface casing extending approximately 3 feet into the ground and approximately 2.5 feet above the ground (a maximum of 0.2 feet above the top of the PVC well casing) with a lockable cap set into and surrounded by a concrete pad 4 feet square and approximately 4 inches thick. The pad will be sloped a minimum of 2 inches from the surface casing to the edge of the pad to provide positive drainage and will be placed on a 6-inch-thick gravel bed. USACE specifications to prevent frost heave will be used in well construction. Four 3-inch-diameter, concrete-filled steel posts extending approximately 3 feet above the ground surface will be set in concrete approximately 5 feet into the ground at equal spacing around the concrete pad. All of the locks on the new wells will be keyed alike. A permanent tag will be affixed to the outer protective casing or cap and will clearly identify the well number, the USACE, Nashville District, and the adjusted top of casing elevation.

VI.4.2 Monitoring Well Development

New monitoring wells will be developed not sooner than 48 hours after installation, but not more than 7 days after internal mortar collar (grout) placement. Existing wells to be sampled, if not sampled in the past 12 months will be redeveloped in the same manner as the new wells, but the development time will be limited to 2 hours. Well development will be conducted in accordance with the procedures and requirements of EM-1100-1-4000, Appendix C of EM 200-1-3, the sitewide SAP, and the SOW. Wells will be developed by raising and lowering a surge block throughout the length of screen, followed by pumping or bailing without using acids, flocculent, or dispersing agents. Water will not be added to a well as part of development once the well has been grouted and sealed. The development procedure will continue until the following conditions are met:

- Water is clear to the unaided eye, free of sand, and free of drilling fluids.
- The sediment thickness remaining within the well is less than 1 percent to the screen length or less than 0.1 foot for screens equal to or less than 10 feet long.
- Temperature, pH, and specific conductance values stabilize.
- A volume of water equal to at least five times standing water in the well including the well casing and screen, and the saturated annular space assuming 30 percent of porosity has been removed.

Each new well will be developed for a maximum of 6 hours and each existing well will be developed for up to 2 hours. If the well is not satisfactorily developed within this time, the USACE will be contacted for consultation and further instructions.

Color photographs (35-millimeter color prints) will be taken of water from each monitoring well after development. Specifically, a 1-liter water sample will be collected of the last water removed during development and placed in a clear glass jar, labeled, and photographed. The photograph will be submitted as part of the well development log. The photograph will be a suitably back-lit close-up to show the clarity of the water.

VI.4.3 In Situ Permeability Testing

In situ permeabilities of each newly installed monitoring well will be determined using a "rising head" slug test. Each test will consist of instantaneously extracting a slug from the well and monitoring the subsequent recovery of the groundwater level. Transducers and a data logger will be used to record water level changes in the well during the tests. After completion of the test, data will be downloaded to a computer to generate a "time-drawdown" curve, which will be analyzed by the hydrogeologist to obtain the hydraulic conductivity of the tested aquifer.

VI.4.4 Redevelopment of Existing Wells

Prior to sample collection, up to 20 existing wells will require redevelopment following the procedures described in Section VI.4.2. If wells have not been sampled within the last 12 months, redevelopment will be conducted.

VI.4.5 Groundwater Sampling

Groundwater samples will be collected from each of the 8 newly installed and 12 existing bedrock wells and 4 newly installed and 35 existing overburden wells. Groundwater samples will be collected from all specified wells during two sampling events: once during the wet season and once during the dry season. Groundwater samples to be collected during this investigation and their designated sample numbers, along with required QA/QC sample quantities are listed in Table VI-6.

Existing overburden wells that have not been sampled within the previous 12 months at the time of sampling will be redeveloped for a period of up to 2 hours prior to sampling. In the event that the field parameters have not stabilized at the end of this time, the contracting officer will be contacted for consultation and guidance.

Table VI-6

Summary of Groundwater and QA/QC Samples
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Groundwater Sample ID	Monitoring Well ID	QA/QC Sample Quantity [a]					
		FD/FS[b]		MS/MSD[c]		FB[d]	
		Sampling Round					
		1	2	1	2	1	2
New Bedrock Monitoring Wells							
PBOW-97-GW-BG8-BEDGW-001-5410	IT-BG8-BEDGW-001	X					
PBOW-97-GW-TNTB-BEDGW-001-5420	IT-TNTB-BEDGW-001		X				
PBOW-97-GW-TNTB-BEDGW-002-5430	IT-TNTB-BEDGW-002			X			
PBOW-97-GW-MNTA-BEDGW-001-5440	IT-MNTA-BEDGW-001				X		
PBOW-97-GW-AA1-BEDGW-001-5450	IT-AA1-BEDGW-001	X					
PBOW-97-GW-AA2-BEDGW-001-5460	IT-AA2-BEDGW-001		X				
PBOW-97-GW-AA3-BEDGW-001-5470	IT-AA3-BEDGW-001						
PBOW-97-GW-ABG-BEDGW-001-5480	IT-ABG-BEDGW-001						
New Overburden Monitoring Wells							
PBOW-97-GW-AA1-GW-002-5490	IT-AA1-GW-002						
PBOW-97-GW-AA2-GW-002-5500	IT-AA2-GW-002			X		X	
PBOW-97-GW-AA3-GW-002-5510	IT-AA3-GW-002				X		X
PBOW-97-GW-ABG-GW-002-5520	IT-ABG-GW-002						
Existing Overburden Monitoring Wells							
PBOW-97-GW-ITMW01-5530	IT-MW01						
PBOW-97-GW-ITMW02-5540	IT-MW02	X			X		
PBOW-97-GW-ITMW05-5550	IT-MW05		X	X			
PBOW-97-GW-ITMW06-5560	IT-MW06	X					
PBOW-97-GW-ITMW07-5570	IT-MW07		X	X			
PBOW-97-GW-ITMW08-5580	IT-MW08				X		
PBOW-97-GW-ITMW09-5590	IT-MW09						
PBOW-97-GW-ITMW10-5600	IT-MW10						
PBOW-97-GW-TNTAMW10-5610	PB-TNTA-MW10	X					
PBOW-97-GW-TNTAMW11-5620	PB-TNTA-MW11		X				
PBOW-97-GW-TNTCMW3-5630	PB-TNTC-MW3						
PBOW-97-GW-TNTCMW4-5640	PB-TNTC-MW4	X					
PBOW-97-GW-TNTCMW5-5650	PB-TNTC-MW5		X				
PBOW-97-GW-TNTCMW6-5660	PB-TNTC-MW6						
PBOW-97-GW-WAMW1-5670	PB-WA-MW1	X					
PBOW-97-GW-WAMW2-5680	PB-WA-MW2		X				
PBOW-97-GW-PRMW7-5690	PB-PR-MW7			X		X	
PBOW-97-GW-PRMW8-5700	PB-PR-MW8	X			X		X
PBOW-97-GW-PRMW9-5710	PB-PR-MW9		X				
PBOW-97-GW-MKMW09-5720	MK-MW09						

Table VI-6

Summary of Groundwater and QA/QC Samples
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Groundwater Sample ID	Monitoring Well ID	QA/QC Sample Quantity [a]					
		FD/FS[b]		MS/MSD[c]		FB[d]	
		Sampling Round					
		1	2	1	2	1	2
Existing Overburden Monitoring Wells (con't)							
PBOW-97-GW-MKMW10-5730	MK-MW10	X					
PBOW-97-GW-MKMW11-5740	MK-MW11		X				
PBOW-97-GW-MKMW12-5750	MK-MW12						
PBOW-97-GW-MKMW14-5760	MK-MW14						
PBOW-97-GW-MKMW15-5770	MK-MW15						
PBOW-97-GW-MKMW16-5780	MK-MW16						
PBOW-97-GW-MKMW17-5790	MK-MW17						
PBOW-97-GW-MKMW19-5800	MK-MW19						
PBOW-97-GW-MKMW20-5810	MK-MW20						
PBOW-97-GW-MKMW22-5820	MK-MW22						
PBOW-97-GW-MKMW23-5830	MK-MW23						
PBOW-97-GW-MKMW24-5840	MK-MW24						
PBOW-97-GW-GCLMW01-5850	GCL-MW01		X				
PBOW-97-GW-GCLMW02A-5860	GCL-MW02A	X					
PBOW-97-GW-GCLMW02B-5870	GCL-MW02B						
PBOW-97-GW-GCLMW03-5880	GCL-MW03						
Existing Bedrock Monitoring Wells							
PBOW-97-GW-BEDMW13-5890	PB-BED-MW13						
PBOW-97-GW-BEDMW14-5900	PB-BED-MW14						
PBOW-97-GW-BEDMW15-5910	PB-BED-MW15						
PBOW-97-GW-BEDMW16-5920	PB-BED-MW16	X		X			
PBOW-97-GW-BEDMW17-5930	PB-BED-MW17		X		X		
PBOW-97-GW-BEDMW18-5940	PB-BED-MW18						
PBOW-97-GW-BEDMW19-5950	PB-BED-MW19						
PBOW-97-GW-BEDMW20-5960	PB-BED-MW20						
PBOW-97-GW-REACTOR1-5970	REACTOR1	X					
PBOW-97-GW-REACTOR2-5980	REACTOR2		X				
PBOW-97-GW-REACTOR3-5990	REACTOR3						
PBOW-97-GW-REACTOR4-6000	REACTOR4						

[a]Laboratory prepared trip blanks will be submitted for VOC samples.
[b]Field duplicate/field split.
[c]Matrix spike/matrix spike duplicate.
[d]Field blank.

During groundwater sampling, field measurements of pH, turbidity, specific conductance, dissolved oxygen, reduction-oxidation potential, and temperature will be made. These measurements will be taken prior to purging, periodically during purging, and immediately prior to sample collection.

Sampling of newly installed monitoring wells and existing wells will take place no sooner than 14 days after well development has been completed. Groundwater sampling will be completed using dedicated sampling equipment, including a disposable Teflon® bailer fitted with a bottom-emptying device and a new, clean nylon rope at each well. All equipment used to purge wells and collect samples will be protected from ground surface contact and contamination by use of clean plastic sheeting. The following procedures will be followed when collecting groundwater samples from all monitoring wells:

- The well will be checked for proper identification and structural integrity.
- After unlocking the well and removing the well cap, a photoionization detector and a hydrogen sulfide detector will be used to measure the concentration of organic vapors and hydrogen sulfide at the top of casing and in the breathing zone. If readings exceed action levels specified in Table VI.4-1 of the SSHP, safety precautions outlined in the health and safety plans will be followed.
- The depth to water will be measured using a decontaminated water level indicator, then the volume of water in the well casing and screen, and the volume present in the saturated annulus (filter pack) will be calculated.
- Either a bailer or an appropriate submersible sampling pump will be used to remove three times the volume of the standing water in the well casing and saturated annulus.
- During purging, field measurement of pH, Eh (oxidation-reduction potential), turbidity, temperature, and conductivity will be performed periodically and logged.
- At the time of sampling, after collection of the sample for chemical analysis, a second sample will be collected for field measurement of temperature, pH, Eh, turbidity, dissolved oxygen, and conductivity and logged.
- Sample containers will be labeled with appropriate identifying information (location, date, time, condition, added preservatives, etc.). Each sample will be logged in a field notebook at the time of collection. Sample containers of appropriate volume and composition will be prepared in advance to ensure the collection of sufficient volumes for all specified analyses.

- The sample will be collected so as to minimize aeration as water enters the bottle.
- Samples for volatile analysis will be collected in screw-cap, septum-top glass vials and filled so that there are no air bubbles present to allow volatilization
- Samples for metal analysis will be collected in two separate containers; one will be filtered and the other will not be filtered. Samples will be filtered according to the following procedures:
  - Water sample will be filtered at the well site with portable sample filtering equipment or at the field office.
  - A millipore filtration apparatus (or comparable equipment) equipped with a 0.45-micron filter will be used. The filtering apparatus will be cleaned following procedures set forth in Section 5.2 of the sitewide SAP before filtering each sample.
- All sample containers will be transferred to a cooler chest (keep at 4 degrees Celsius [°C]) and delivered to the laboratory in sufficient time so that specified holding times are not exceeded.

VI.5.0 Sample Analysis and Decontamination Procedures

VI.5.1 Sample Number System

Sample numbering system to be used during this investigation will conform to USACE Nashville District's numbering convention. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number consists of a group of letters and numbers, separated by hyphens. The numbering system to be used for GWI is described as follows:

Project Code	Year	Sample Type[a]	Site Identification[b]	Location (Well ID)	Sample Number	Sample Depth (Feet)
PBOW	97	XX	XXX	XXXX	XXXX	XXX

[a]Sample types:

ER - Equipment rinsate sample
FB - Field blank
FD - Field duplicate sample
FS - Field Split sample

GW - Groundwater sample
MD - Matrix spike duplicate sample
MS - Matrix spike sample
SO - Soil

[b]Site identification (refer to page 6-3 at the sitewide SAP).

"PBOW-97-GW-BG8-BEDGW01-0235" signifies that this groundwater sample is collected from groundwater well BEDGW-001 in the G-8 Burning Ground with a laboratory number of 0235. The sample identification number will be recorded by the IT field geologist in the field activity daily log, boring log, and sample collection log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

VI.5.2 Analytical Program

All groundwater samples will be collected for target compound list (TCL) VOCs, TCL SVOCs, PCBs, total cyanide, and nitroaromatic compounds. Groundwater samples will also be analyzed for total target analyte list (TAL) metals (unfiltered) and dissolved TAL metals (filtered). In addition, groundwater samples will be analyzed by the laboratory for the water quality parameters specified in Table VI-7. Laboratory QC procedures and data quality requirements are specified in and referenced to appropriate sections of the QAPP (IT, 1996b).

VI.5.3 Decontamination Procedures

Drilling and sampling equipment decontamination will be performed to maintain integrity of the groundwater sample collected. Temporary decontamination pad(s) will be built on site in proximity to new monitoring well locations. The stations will be lined with three layers of at least 6-mil-thick Visqueen and will be bermed on all sides. The following decontamination procedures will be used to decontaminate drilling equipment, including drilling tools, equipment, and monitoring well materials, upon site entrance, between borings, and before site departure:

- Steam rinse.
- Steam wash using a brush with nonphosphate detergent.
- Steam rinse.
- Final rinse with distilled water.
- Air dry.

Groundwater sampling equipment including submersible pump and water level indicator will be decontaminated upon site entry, between wells, and before site departure following the procedures below:

Table VI-7

Summary of Groundwater Analytical Parameters and Methods
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Parameter	Analytical Method	Number of Field Samples	Field Duplicates (10%)	Matrix Spike (5%)	Matrix Spike Duplicate (5%)	Field Blank	Trip Blank	Total Number of Samples
TCL Volatile Organic Compound	8260 A	118	12	6	6	2	15	159
TCL Semivolatile Organic Compound	3520B / 8270B	118	12	6	6	2		144
Total TAL Metals	3005A / 6010A	118	12	6	6	2		144
Dissolved TAL Metals	3005A / 6010A	118	12	6	6	2		144
Nitroaromatic Compounds	Mod. 8330	118	12	6	6	2		144
PCBs	3520B / 8081	118	12	6	6	2		144
Water Quality								
Hardness	EPA 130.1	118						118
Alkalinity	EPA 310.1	118						118
Total Organic Carbon	9060	118						118
Total Dissolved Solids	EPA 160.1	118						118
Total Suspended Solids	EPA 160.2	118						118
Chloride	EPA 325.3	118						118
Total Cyanide	9010A / 9012	118						118
Nitrate	EPA 352.1	118						118
Sulfate	EPA 375.3	118						118
Column Totals		1770	72	36	36	12	15	1941

Notes:

(1) Field parameters to be performed include pH, dissolved oxygen, specific conductance, reduction-oxidation potential, turbidity, and temperature.

(2) Equipment rinsates are not required as groundwater samples will be collected using dedicated/disposable bailers.

- Wash in soapy water.
- Rinse with potable water.
- Rinse with nitric acid (10 percent solution).
- Rinse with a volume of deionized water (ASTM Type II water) five times greater than the volume of nitric acid.
- Rinse with hexane.
- Rinse with deionized water (ASTM Type II water) five times greater than the volume of hexane.
- Rinse with methanol.
- Rinse with deionized water (ASTM Type II water) five times greater than the volume of methanol.
- Air dry.

VI.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as being precleaned, containers made of materials recommended by the EPA in Title 40 Code of Federal Regulations (CFR) Part 136 and SW-846 (3rd Edition). Sample containers and preservatives/preservation methods are summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that it is received by the laboratory.

Unless prior arrangements are made, the sample containers will be shipped to the site with necessary preservatives added, except for the bottles to be used for metal analysis. Samples for dissolved metal analysis will be prepared after the water has been filtered.

Samples for geotechnical analysis need not be chemically preserved; however, the samples will be properly sealed to prevent moisture loss and will be packaged so that the material is adequately preserved in its natural state. Samples will be placed in sample containers that will be sealed with three wraps of electrical type or duct tape around the lid lip.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimize the possibility of container breakage by using Vermiculite or styrofoam peanuts to fill void spaces in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4°C and maintained at that temperature by means of blue ice from the time the shipping carton is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by a next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

Completed Analysis Request/Chain of Custody records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or

USACE QA Laboratory - to be determined

VI.7.0 Investigation-Derived Waste Management Plan

IDW during field activities at PBOW includes drill cuttings, development water, purge water, decon water, decon fluid, and disposable personal protective equipment (PPE). IDW will be handled following the EPA guidance document EPA\540\G-\91\009, *Management of Investigation-Derived Wastes During Site Inspection* (EPA, 1991). Specifically, IDW will be managed in the following manner:

- Drill cuttings from 12 wells will be placed separately in 55-gallon sealable drums and stored on site or in the designated IDW staging area. The options of disposal of cuttings will depend on the laboratory results of drill cutting samples.
- Disposable PPE will be double-bagged and disposed of in the on-site dumpster.
- Decontamination water will be stored in 55-gallon drums and stored on site pending analytical results for proper disposal.
- Decontamination fluid as specified in Section 8.5 of the Site-Wide SAP will be kept in a stainless-steel pan and will be allowed to evaporate.
- Well development and purge water from each well will be stored separately in 55-gallon drums and kept on site pending analytical results of the water from each well for proper disposal.

Analytical parameters for drill cuttings from new monitoring wells for IDW disposal are presented in Table VI-8. For monitoring wells installed as clusters, one composite sample will be collected for disposal characteristics.

VI.8.0 Project Schedule

The project schedule is presented in Figure VI-6.

VI.9.0 References

Dames & Moore, 1996, ***Draft Report, Sitewide Groundwater Investigation, Plum Brook Ordnance Works***, May 1996.

IT Corporation (IT), 1996a, ***Sitewide Sampling and Analysis Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1996b, ***Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1996c, ***Sitewide Safety and Health Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

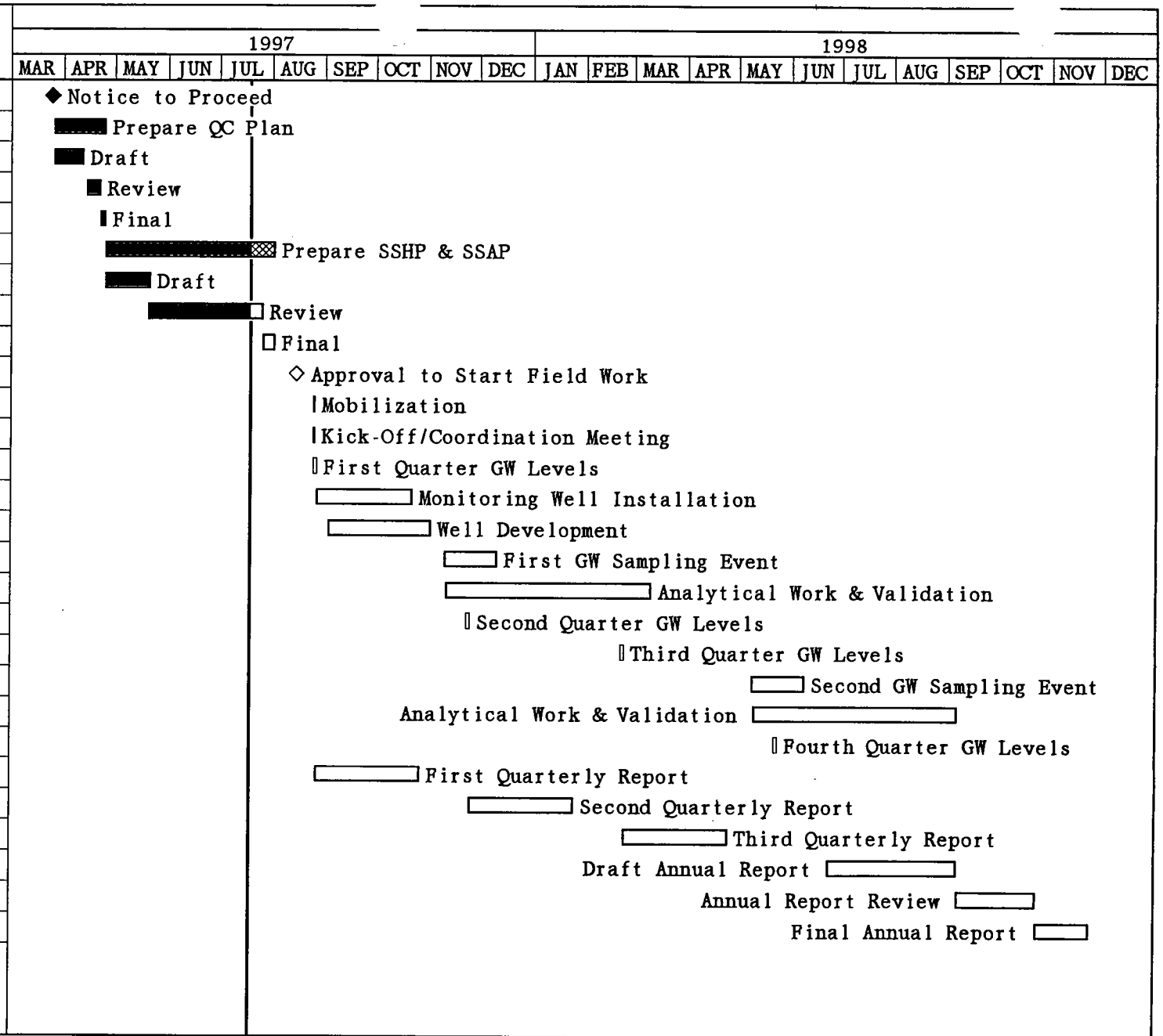
U.S. Army Corps of Engineers (USACE), 1997, ***Statement of Work***, January 1997.

Table VI-8

Analytical Parameters for IDW Disposal Monitoring Well Drill Cuttings, Groundwater Investigation Former Plum Brook Ordnance Works, Sandusky, Ohio

Parameter	Analytical Method	Number of Samples
Hazardous waste characterisitcs (ignitability, corrosivity, and reactivity)	CLP	8
TCLP volatiles	CLP	8
TCLP semivolatiles	CLP	8
TCLP metals	CLP	8

EARLY START	EARLY FINISH	REM DUR
25MAR97A		0
26MAR97A	24APR97A	0
26MAR97A	11APR97A	0
14APR97A	21APR97A	0
22APR97A	24APR97A	0
25APR97A	1AUG97	14
25APR97A	20MAY97A	0
20MAY97A	25JUL97	7
26JUL97	1AUG97	7
15AUG97		0
25AUG97	25AUG97	1
25AUG97	25AUG97	1
25AUG97	26AUG97	2
27AUG97	21OCT97	56
3SEP97	1NOV97	60
10NOV97	10DEC97	31
11NOV97	10MAR98	120
23NOV97	24NOV97	2
21FEB98	22FEB98	2
9MAY98	8JUN98	31
10MAY98	6SEP98	120
22MAY98	23MAY98	2
27AUG97	26OCT97	61
25NOV97	24JAN98	61
23FEB98	24APR98	61
23JUN98	6SEP98	76
7SEP98	22OCT98	46
23OCT98	22NOV98	31



Activity Classification: CONSTRAINT
HAMMOCK

Plot Date 23JUL97
Data Date 19JUL97
Project Start 11MAR97
Project Finish 19DEC98

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

NCOB PBGS

Sheet 1 of 1

USACE - Nashville District
PBOW - Groundwater Investigation
Proposed Project Schedule

Date	Revision	Checked	Approved

U.S. Army Corps of Engineers (USACE), 1994, ***Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites,*** EM1110-1-4000, August 1994.

U.S. Environmental Protection Agency (EPA), 1993, ***Data Quality Objectives Process for Superfund***, EPA/J40/G-93/071, Publication 9377.9.01, September 1993.

U.S. Environmental Protection Agency (EPA), 1991, ***Management of Investigation-Derived Wastes During Site Investigation***, EPA/540/G-/91/009, May 1991.

U.S. Environmental Protection Agency (EPA), 1986, ***RCRA Groundwater Monitoring Technical Enforcement Guidance Document***, OSWER 9950.1, Washington, DC, September 1986.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CEORN-ER-M

Project Description: Site-Wide Groundwater Investigation, Plum Brook Ordnance Works

Contract Number: DACA62-94-D-0030 Delivery Order Number: 0023

Project Number: 771481 Task / Phase Number: 04000000

Document Type	Identify specific section or segment covered by this checkprint	Document Origin
☐ Technical / Cost Proposal		☐ Originator Developed
☐ RFP		☒ Edited Standard
☐ Contract / Subcontract		☐ Client Furnished
☐ SAP, SSAP, CDAP, or QAPP		
☒ SHP or SSHP	SSHP, Sitewide GWI, Rev. 1, July 1997	**Document Status**
☐ _____ Report		☐ Preliminary
☐ Risk Assessment / Evaluation		☐ Internal Draft
☐ Specifications & Plans		☐ Draft
☐ Design Calculations		☐ Draft Final
☐ Tables		☒ Final
☐ Drawings / Figures		☐ Other: _____
☐ Other: _____		

	Required Person	Signature	Date
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Backchecker			
Updater			
Rechecker			
Technical Reviewer	H. Pullum	Jim Baldew	8-5-97
Technical Reviewer			
Technical Reviewer			
Technical Reviewer			
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Project Manager	M. Spangberg	[illegible]	7/31/97
Program Manager	D. Burton	[illegible]	8/5/97

Attachment VI

Site-Specific Safety And Health Plan
Sitewide Investigation of Groundwater
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

Commander
U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

IT Project No. 771481
Control Copy No. 19

Revision 1

July 1997

This Site-Specific Safety and Health Plan Attachment must be used in conjunction with the Site-wide Safety and Health Plan for Site Investigations and Groundwater Investigations at the former Plum Brook Ordnance Works.

Reviews and Approvals

Project Manager
IT Corporation

7-31-97
Date

James A. Bolden
Health and Safety Manager
IT Corporation

8-5-97
Date

Site Coordinator
IT Corporation

8/5/97
Date

Site Safety and Health Officer
IT Corporation

Date

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Control Copy No. 17	M. Spangberg
Control Copy No. 18	S. Muffler
Control Copy No. 19	G. Yu
Control Copy No. 20	T. Smith
Control Copy No. 21	D. Seymore
Control Copy No. 22	M. Smith
Control Copy No. 23	K. Arrant
Control Copy Nos. 24 and 25	Field personnel

Plum Brook Project Emergency Contacts

Note: All field crews will be provided 2-way radios from the Plum Brook Communications Center. In the event of an emergency, contact the Plum Brook Communications Center by radio and they will contact and coordinate emergency response personnel.

Fire Department	(419) 627-5837
Ambulance	911
Police Department	(419) 627-5863
Providence Hospital	(419) 621-7000
National Response Center	(800) 424-8802
Poison Control Center	(800) 462-0800
Ohio EPA Emergency Spill Number	(800) 282-9378
Don Burton, IT Program Manager	(423) 690-3211
Mike Spangberg, IT Project Manager	(423) 690-3211
George Yu, IT Site Manager	(423) 690-3211
Melissa Smith, IT H&S Manager	(423) 690-3211
Dr. Elaine Theriault, IT Occupational Physician	(800) 299-3674

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VI.1.0 Site Work Plan Summary

Project Objective. The objectives of this investigation at the former Plum Brook Ordnance Works, Sandusky, Ohio, are summarized as follows:

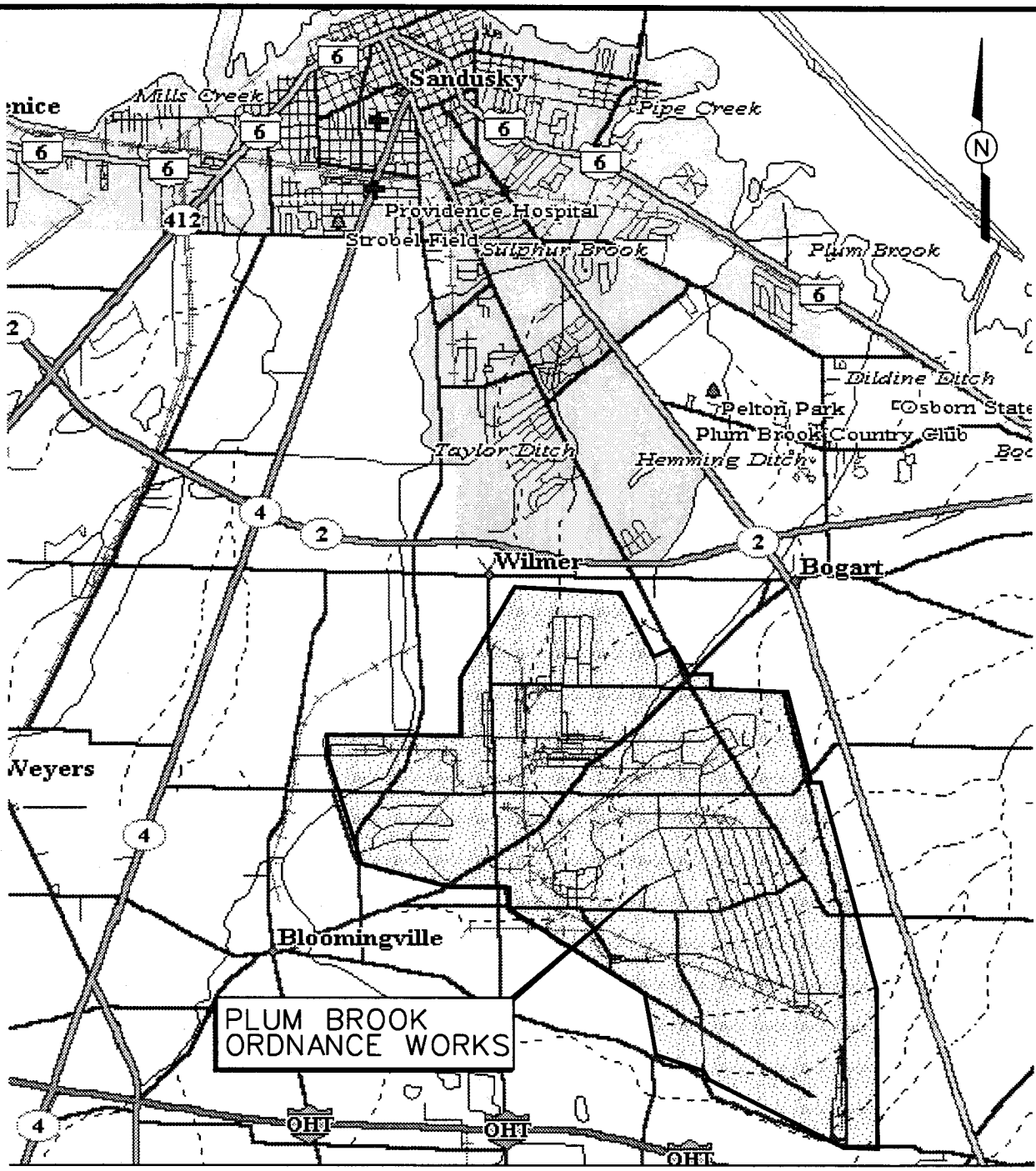
- Determine if there are hazardous substances present at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define site physical features and characteristics (aquifer background conditions).
- Evaluate fate and transport pathways (groundwater modeling).
- Determine current and future routes of exposure.

Project Tasks

- Installation of monitoring wells
- Well development
- In situ permeability testing
- Monitoring well groundwater sampling
- Disposal of investigation-derived wastes
- Periodic site-wide groundwater sampling.

Personnel Requirements. Up to 15 employees

Note: All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the site-wide safety and health plan (SHP) for site investigations at Plum Brook, and be familiar with the requirements of this site-specific SHP (SSHP). Figure VI.1-1 presents the site and hospital location map.



NOT TO SCALE

FIGURE VI.1-1
SITE AND HOSPITAL
LOCATION MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 5/8/97 | DATE LAST REV.:23 JUL | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR: M. SPANGBERG | DWG. NO.: \771484ES.004
DRAWN BY: R. KNIGHT | DRAWN BY: RKNIGHT | ENGR. CHCK. BY: M. SPANGBERG | PROJ. MGR.: D. BURTON | PROJ. NO.: 771481

771481ES.004 11:33:19 JULY 23, 1997 RMK

VI.2.0 Site Characterization and Analysis

VI.2.1 Anticipated Hazards

The Activity Hazard Analysis in Chapter 5.0 contains project specific practices utilized to reduce or eliminate anticipated site hazards. The Job Hazard Analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

The potential chemical contaminants of concern include volatile and semivolatile chemicals listed below. Hydrogen sulfide may also be encountered in bedrock monitoring wells.

Chemical	Highest Concentration Detected in Previous Investigations (µg/L)
Benzene	1,300
Chlorobenzene	1.3
1,3-Dinitrobenzene (DNB)	0.66
2,4-Dinitrotoluene (DNT)	530
2,6-DNT	70
Ethyl benzene	180
Nitrobenzene	0.51
Toluene	800
Xylene	1,300

Table VI.2-1 contains chemicals anticipated and chemicals to be used during project activities.

VI.2.2 General Site Information

A description of the site including location, site topography, and site accessibility is presented in Section 1.3 of the Sitewide Sampling and Analysis Plan prepared by IT Corporation in September 1996.

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Acetone [67-64-1]	9.69	13–100	Inh Ing Con	Irritated eyes, nose, and throat; headache, dizziness; dermatitis.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	750 ppm 750 ppm 250 ppm	1,000 ppm 1,000 ppm	PEL TLV REL	2,500 ppm
Benzene [71-43-2]	9.24	34–119	Inh Abs Ing Con	Irritates eyes, nose, respiratory system; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude; dermatitis; bone-marrow depression. Carcinogenic.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (10 ppm) NIC–0.1 skin 0.1 ppm	5 ppm C1 ppm (Ca)	PEL TLV REL	Ca [500 ppm]* *OSHA
Chlorobenzene	9.06	1.3	Inh Ing Con	Irritation of eyes, skin, and nose, drowsiness, incoordination, CNS depression.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	75 ppm 10 ppm		PEL OLV	1,000 ppm
1,3-Dinitrobenzene [99-65-0]	10.43		Inh Abs Ing Con	Anoxia, cyanosis, visual disturbances, central blind spot of vision, bad taste, burning of mouth, dry throat, thirsty; yellowing hair, eyes, and skin; anemia, liver damage.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 (skin) 0.15 ppm (skin) 1 mg/m^3 (skin)		PEL TLV REL	50 mg/m^3
Dinitrotoluene (DNT)	N/A	-	Inh Abs Ing Con	Anoxia, cyanosis, anemia, jaundice; reproductive effects. Animal carcinogen.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/^{3} (skin) NIC-0.2 mg/m^3 (skin) 1.5 mg/m^3 (skin)	- - -	PEL TLV REL	Ca [50 mg/m^3)

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Ethyl benzene [100-41-4]	8.76	0.09–0.6	Inh Ing Con	Irritates eyes, mucous membranes; headache; dermatitis; narcosis, coma.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	2,000 ppm
Gasoline [8006-61-9\	?	0.3	Inh Ing Con	Intoxication, headaches, blurred vision, dizziness, nausea; eye, nose, and throat irritation; potential kidney and other cancers. Carcinogenic.	Eye: Irrigate immediately (15 min) Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	300 ppm 300 ppm Ca, lowest feasible conc. (LOQ 15 ppm)	500 ppm 500 ppm	PEL TLV REL	?
Hydrogen chloride (hydrochloric acid) [74-90-8]	10.16	43-200	Inh Ing Con	Mild irritation of the eyes, nose, and throat; drowsiness, dizziness, headache; dry, cracked skin.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention		C5 ppm C5 ppm C5 ppm	PEL TLV REL	100 ppm
Hydrogen sulfide [7783-06-4]	10.46	0.001-0.13	Inh Con	Irritates eyes, respiratory system; apnea, coma, convulsion; conjunctivitis, eye pain, discharge of tears, visual intolerance to light; dizziness, headache, fatigue, GI disturbances.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	10 ppm	C20 pm 15 ppm C10 ppm	PEL TLV REL	100 ppm
Isopropyl alcohol (isopropanol) [67-63-0]	10.16	43-200	Inh Ing Con	Mild irritation of the eyes, nose, and throat; drowsiness, dizziness, headache; dry, cracked skin.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	400 ppm 400 ppm 400 ppm	500 ppm 500 ppm 500 ppm	PEL TLV REL	12,000 ppm

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Methanol	10.85	4.2-5960	Inh Abs Ing Con	Irritated eyes, headache, drowsiness, lightheadedness, nausea, vomiting, disturbance in vision, blindness.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Fresh air Swallow: Immediate medical attention		200 ppm (skin) 200 ppm (skin) 200 ppm	PEL TLV REL	25,000 ppm
Nitric acid [7697-37-2]	11.95	0.3-1	Inh Ing Con	Irritated eyes, mucous membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Respiratory support Swallow: Immediate medical attention	2 ppm 2 ppm 2 ppm	4 ppm 4 ppm 4 ppm	PEL TLV REL	100 ppm
Nitrobenzene [98-95-3]	9.92	0.37	Inh Abs Ing Con	Irritation of eyes, skin, anoxia; dermatitis; anemia; methemoglobinemia; testicular effects.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (skin) 1 ppm (skin) 1 ppm (skin)		PEL TLV REL	200 ppm
Portland cement			Inh	Fine gray powder that can be irritating if inhaled or in eyes.	Eye: Irrigate immediately Skin: Soap wash flush Breath: Respiratory support Swallow: Immediate medical attention		10 mg/m^3 10 mg/m^3/total dust 5 mg/m^3 respirable fraction	TLV PEL/REL	
Sodium hydroxide [1310-73-2]	NA	NA	Inh Ing Con	Irritated nose; pneumonitis; burns eyes and skin; temporary loss of hair.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention		C2 mg/m^3 C2 mg/m^3 C2 mg/m^3	PEL TLV REL	250 mg/m^3

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Sulfuric acid [7664-93-9]	?	0.15	Inh Ing Con	Irritated eyes, nose, and throat; pulmonary edema, bronchitis; emphysema; conjunctivitis; stomatitis; dental erosion; tracheobronchitis; skin and eye burns; dermatitis.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 1 mg/m^3 1 mg/m^3	3 mg/m^3	PEL TLV REL	80 mg/m^3
Toluene [108-88-3]	8.82	0.16–37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paralysis; dermatitis.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm 150 ppm	PEL TLV REL	2,000 ppm
Xylene (o-, m-, and p-isomers) [1330-20-7;95-47-6; 108-38-3;106-42-3]	8.56/ 8.56/ 8.44	1.1–20	Inh Abs Ing Con	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritated eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	150 ppm 150 ppm 150 ppm	PEL TLV REL	1,000 ppm

[a]IP = Ionization potential (electron volts).
[b]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA = Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a work day, even if the TWA is not exceeded.
[e]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
AEL = Airborne Exposure Limit.
TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value—TWA.
REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.

Table VI.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

[1]IDLH (NIOSH)—Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
? = Unknown.
LEL = Lower explosive limits.
LC_{50} = Lethal concentration for 50 percent of population tested.
LD_{50} = Lethal dose for 50 percent of population tested.
NIC = Notice of intended change (ACGIH).

VI.3.0 Personal Protective Equipment

The work activities will begin in the following levels of protection.

Task	Initial Level of PPE
Staging equipment	Level D
Installation of monitoring wells	Modified Level D*
Well development, in-situ permeability testing, and groundwater sampling	Modified Level D*
Disposal of IDW	Modified Level D
Periodic groundwater sampling	Modified Level D*

*Initial level will be raised to Level C or higher if air monitoring results in the worker's breathing zone are above action levels. Note: If unusual conditions or odors are encountered and air monitoring instruments do not detect volatile organic chemicals or hydrogen sulfide, turn equipment off, evacuate the work area, and contact the H&S Manager for further assistance.

A complete description of Level D, Modified Level D, and Level C follows.

Level D. The following equipment will be used for Level D protection:

- Coveralls or work clothing
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Modified Level D. The following equipment will be used for Modified Level D protection:

- Permeable Tyvek, Kleenguard, or its equivalent
- Latex boot covers
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Steel-toed safety boots
- Safety glasses
- Hard hat

- Hearing protection (when working near/adjacent to operating equipment).

Level C. Level C protection will not be used unless air monitoring data indicate the need for upgrade; however, the equipment shall be readily available on site. The following equipment will be used for Level C protection:

- National Institute of Occupational Safety and Health/Mine Safety and Health Agency (MSHA)-approved full face, air purifying respirators equipped with organic vapor/acid gas cartridge in combination with high-efficiency particulate air filter.
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level B. Level protection will not be used unless air monitoring data indicate the need for upgrade will be used for Level B protection:

- Pressure-demand NIOSH/MSHA-approved self-contained breathing apparatus
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

VI.4.0 Site Monitoring

The environmental contaminants of concern are volatile and semivolatile chemicals including benzene, chlorobenzene, 1,3-DNB, 2,4-DNT, 2,6-DNT, ethyl benzene, nitrobenzene, toluene, and xylene. Additionally, hydrogen sulfide may also be encountered in bedrock monitoring wells.

Table VI.4-1 contains action levels for site monitoring.

Monitoring will be performed by the site safety and health officer (SSHO) during the performance of invasive operations. A calibrated photoionization detector and hydrogen sulfide analyzer will be utilized to monitor the wells and breathing zones, to determine if any organic material and/or hydrogen sulfide may be present that would necessitate upgrading of protection level.

Invasive operations include disturbing existing wells, sampling wells, installation of wells, and collection of samples.

Noninvasive operations that do not disturb existing materials include site setup, decontamination, and miscellaneous support zone activities.

Table VI.4-1

Action Levels
Plum Brook Ordnance Works
Sandusky, Ohio

When in Level B PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 100 ppm above background in breathing zone (BZ)	Stop work, evacuate work area
Hydrogen sulfide	≥ 100 ppm above background in BZ	Stop work, evacuate work area

When in Level C PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 50 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level B PPE.
Hydrogen sulfide	≥ 10 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level B PPE.

When in Level D/Modified D PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level C PPE.
Hydrogen sulfide	≥ 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level C PPE.

Table VI.4-1

Action Levels
Plum Brook Ordnance Works
Sandusky, Ohio

When in Support Zone

Analyte	Action Level	Required Action
Volatile organic chemicals	≥ 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.
Hydrogen sulfide	≥ 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.

[a]Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.
[b]Contact with the H&S manager must be made prior to continuance of work. The H&S manager may then initiate perimeter/integrated air sampling along with additional engineering controls.

No one is permitted to downgrade levels of PPE without authorization from the H&S manager.

VI.5.0 Activity Hazard Analysis

The attached activity hazard analysis (Table VI.5-1) is provided for the following activities:

- Setup of equipment and general field activities
- Installation of monitoring wells
- Well development, in-situ permeability testing, groundwater sampling
- Disposal of IDW
- Periodic groundwater sampling.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities	Slip, trip, and fall hazards	• Determine best access route before transporting equipment. • Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards. • Look before you step; ensure safe and secure footing.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment.
	Falling objects	• Stay alert and clear of materials suspended overhead; wear hard hat and steel-toed boots.
	Flying debris, dirt, dust, etc.	• Wear safety glasses/goggles; ensure that eye wash is in proper working condition.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cuts/bruises	• Use cotton or leather work gloves for material handling.
	Bees, spiders, and snakes	• Inspect work area carefully and avoid placing hands and feet into concealed areas.
	Fire	• Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Hazard communication	• Label all containers as to contents and dispose of properly. • Ensure Material Safety Data Sheets (MSDS) are available for hazardous chemicals used on site.
	Noise	• Sound levels above 85 A-weighted decibels (dBA) mandates hearing protection.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.
	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Ticks	• Wear light colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear insect repellant. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after exiting the work area.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool area.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.
	Heat stroke	• Evaluate possibility of night work. • Perform physiological monitoring on workers during breaks. • Wear body cooling devices.
	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow. • Barricades shall be used on or around work areas when it is necessary to prevent the inadvertent intrusion of pedestrian traffic. • Barriers shall be used to protect workers from vehicular traffic. • Barriers shall be used to guard excavations adjacent to streets or roadways. • Flagging shall be used for the short term (less than 24 hours) to identify hazards until proper barricades or barriers are provided. • Heavy equipment shall have backup alarms.
	Forklift operations	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Portable electric tools	• Portable electric tools which are unsafe due to faulty plugs, damaged cords, or other reason, shall be tagged (do not use) and be removed from service. • Portable electric tools and all cord and plug connected equipment shall be protected by a ground fault circuit interrupter (GFCI) device. • Electrical tools shall be inspected daily prior to use.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Extension cords	• Extension cords that have faulty plugs, damaged insulation, or are unsafe in any way shall be removed from service. • Cords shall be protected from damage from sharp edges, projections, pinch points (doorways), and vehicular traffic. • Cords shall be suspended with a nonconductive support (rope, plastic ties, etc,). • Cords shall be designed for hard duty. • Cords shall be inspected daily.
	Lightning strikes	• Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than laying on the ground). • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Keep all body parts in contact with the ground as close as possible. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people.
	Thunderstorms, tornados	• Listen to radio or TV announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings. • Seek shelter. Do not try to outrun a tornado.
Drilling and installation of monitoring wells	Overhead hazards	• Make sure no obstacles are within radius of boom. Always stay a safe distance from power lines.
	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out. • Drill rigs shall be equipped with reverse signal alarm, backup warning lights, or the vehicle is backed up only when an observer signals it is safe to do so.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Drilling and installation of monitoring wells (continued)	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to ensure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels choked. • Inspect brakes and tire pressure on drill rig before staging for work.
	Inexperienced operator	• Machinery and mechanized equipment shall be operated only by designated personnel. • Operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Jacks/outriggers	• Ensure proper footing and cribbing.
	Falling objects	• Remove unsecured tools and materials before raising or lowering the derrick. • Stay alert and clear of materials suspended overhead.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert at all times!
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.
	Fall hazards	• Personnel are not allowed to work off of machinery or use them as ladders. • Use fall protection when working above 6 feet.
	Noise	• Hearing protection is mandatory above 85 dBA.
	Contact with rotating or reciprocating machine parts	• Use machine guards; use long-handled shovels to remove auger cuttings. • Use safe lockout procedures for maintenance work.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Slip, trip, and fall hazards	• Practice good housekeeping, keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Drilling and installation of monitoring wells (continued)	Contact with potentially contaminated materials	• Real time air monitoring will take place. If necessary, proper personal protective clothing and equipment will be utilized. • Stop immediately at any sign of obstruction. • Do not breathe air surrounding boring unless necessary. • Upgrade to respirator if necessary. • Avoid skin contact with soil cuttings. Wear gloves. • Stay clear of moving parts of drill rig.
	Drum handling	• Be careful not to breathe air from around open drum any more than necessary. Monitor with photoionization detector/flame ionization detector (PID/FID) equipment and upgrade to respirator if necessary. • When filling a drum (with either soil or water), be careful not to make contact with the contained waste. Wear appropriate gloves. Make sure lid or bung of drum is secure. • If moving a drum unassisted, be sure to leverage properly, use proper lifting techniques, and wear safety glasses and steel-toed boots. • When using a drum dolly, make sure straps and lid catch are securely attached. Leverage properly when tilting drum. Be sure toes stay away from drum.
Well development permeability testing, groundwater sampling	Cross-contamination and contact with potentially contaminated materials	• Stop immediately at any sign of obstruction. • Sampling technicians will wear proper protective clothing and equipment to safeguard against potential contamination. • Only essential personnel will be in the work area. • Initial real-time air monitoring will take place before and during sampling activities. • All personnel will follow good hygiene practices. • Proper decontamination procedures will be followed. • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations.
	Cut hazards	• Use care when handling glassware. • Wear adequate hand protection.
	Slip, trip, fall	• Site workers will be required to wear hard hat, safety glasses with side shields, work gloves, and steel-toe/shank boots when working in the field. • Whenever possible, avoid routing cords and hoses across walkway pathways. • Flag or cover inconspicuous holes to protect against falls.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Well development permeability testing, groundwater sampling (continued)	Bees, spiders, and snakes	• Workers shall inspect the work area carefully and avoid placing hands and feet into concealed areas. • Evaluate need for sensitive workers to have prescribed antibiotic or medicine to combat of symptoms.
	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.
	Access/egress hazards	• Use qualified and trained bushhog operator. • Keep employees out of the bushhog work area. • Utilize good housekeeping practices. • Keep aisleways, pathways, and work areas free of obstruction. • Clean ice or snow off of walkways or work stations. • Use appropriate footwear for the task assigned.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool areas.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Well development permeability testing, groundwater sampling (continued)	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.
Periodic groundwater sampling	Cross-contamination and contact with potentially contaminated materials	• Sampling technicians will wear proper protective clothing and equipment to safeguard against potential contamination. • Avoid skin contact with water. • Handle samples with care. • Only essential personnel will be in the work area. • Real-time air monitoring will take place before and during sampling activities. • All personnel will follow good hygiene practices. • Proper decontamination procedures will be followed. • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations.
	Cut hazards	• Use care when handling glassware. • Wear adequate hand protection.
	Hazard communication	• MSDSs shall be obtained for chemicals brought on site. • Label all containers as to contents.
	Strains/sprains	• Use the proper tool for the job being performed. • Get assistance if needed. • Avoid twisting/turning while pulling on tools, moving equipment, etc.
	Spills/residual materials	• Absorbent material and containers will be kept available where leaks or spills may occur.
	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Unattended worker	• "Buddy System" - visual contact will be maintained with the sampling technician during sampling activities.

Table VI.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Disposal of IDW	Forklift operation	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Cuts, punctures, or abrasions	• Work (leather or cotton) gloves shall be worn by personnel. • The proper tool shall be utilized to open/close drums.
	Back injury	• Use mechanical equipment to lift and move items, when necessary. • Get assistance when necessary. • Size up the job. • Lift with your legs, not your back. • Do not lift awkwardly sized items and those items over 60 pounds. • If a worker loses control of item, STAND CLEAR and DO NOT try to prevent its fall.
	Pinch points	• Keep hands and feet clear of moving/suspended materials and equipment. • Wear hard toe/shank safety shoes/boots and hand protection.
	Strains/sprains	• Do not stand on drums. • Use the proper tool for the job being performed. • Get assistance if needed. • Avoid twisting/turning while pulling on tools, moving equipment, etc.
	Unattended worker	• "Buddy System" - visual contact will be maintained with the sampling technician during activities.
	Slip, trip, fall	• Site workers will be required to wear hard hats, safety glasses with side shields, work gloves, and steel-toed/shank boots when working in the field. • Whenever possible, avoid routing cords and hoses across walking pathways. • Flag or cover inconspicuous holes to protect against falls.

Regional Office

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March 13, 1998

Commander
U.S. Army Engineer District, Nashville
ATTN: CELRN-EP-R-M (Mrs. Linda Ingram)
Estes Kefauver Federal Building
801 Broadway
Nashville, Tennessee 37202-1070

Submittal of the Final Site-Specific Sampling and Analysis Plan (SSAP) and the Final Site-Specific Safety and Health Plan (SSHP) for the Site Investigation of the Acid Areas at the Former Plum Brook Ordnance Works, Sandusky, Ohio; Contract Number DACA62-94-D-0030; IT Project Number 773206

Dear Mrs. Ingram:

In accordance with the requirements of Delivery Order Number 0030 of Contract Number DACA62-94-D-0030, IT Corporation is pleased to submit the final SSAP and SSHP for the Site Investigation of the Acid Areas at the former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio. These documents have been revised based upon technical review comments received on the draft submittals from the OEPA and USACE.

Enclosed are 15 copies of the final SSAP and SSHP documents, as well as 15 copies of the responses to technical review comments received on the draft submittals. Should you have any questions or require additional information regarding this submittal, please do not hesitate to call me at (423) 694-7477.

Sincerely,

Mikael L. Spangberg
Project Manager

Enclosures

bcc: D. Burton
S. Muffler
G. Yu
Central Files

Responses to Technical Review Comments
Draft Site-Specific Sampling and Analysis Plan
Site Investigation of the Acid Areas, Plum Brook Ordnance Works
Sandusky, Ohio

Reference: *Fax from Linda S. Ingram, CELRN-EP-R-M, dated February 23, 1998.*

Comment from Keith Peecook, NASA Plum Brook Station

Comment 1: Three of the sampling sites at Acid Area No. 3 are within the exclusion zone around our "K Site" test facility, which is located in former Building No. 901. What this means is these locations would be off limits during testing.

Currently there is no testing planned for the time the sampling should be going on, but I would like to add the following guidance to the end of paragraph VII.4.3.3, page VII-7.

"Prior to collecting samples at locations SB-08, SB-09, and SB-10, contact a NASA representative to confirm no NASA testing is being conducted in the area."

Response: *The suggested text has been added to section VII.4.3.3 of the SSAP.*

Comments by Ronald E. Nabors, OEPA DERR, dated February 20, 1998.

Site-Specific Sampling and Analysis Plan

Comment 1: Part II.3.0 Scopes and Objectives, Section VII.3.2 Objectives: Page VII-3 of the SAP states that one objective of the site investigation (SI) is to determine if there are any hazardous substances in soil at concentrations that could pose an unacceptable risk to human health and the environment. IT has proposed the installation of 15 soil borings at each acid area (Acid Area No.1, No. 2, and No. 3) which will allow for the collection of two samples; 1 surface sample (0-6 inches below land surface [bls]); and 1 subsurface sample (9-10 feet bls). Surface soil samples will be analyzed for TCL VOCs and SVOCs, TAL metals, PCBs, nitroaromatics, pH, nitrate, and sulfate. Subsurface samples will be analyzed for TCL VOCs and SVOCs, TAL metals, nitroaromatics, pH, nitrate, and sulfate.

IT has failed to include methodologies in the SAP which address the investigation of ground water if soil contamination is determined at or below the water table at the NPBS. It is reasonable to assume that if contaminants in

soil are identified at or below a zone of significant saturation, the potential exists for these contaminants to leach into ground water. In addition, page VII-5 of the SAP states that soil and ground water samples will be collected to meet the objectives of the SI. As such, IT should include a discussion in the SAP which discusses how the facility will investigate ground water at the NPBS during the SI at the three acid areas.

Response: *It is agreed that soil contamination present at or below the water table would potentially leach into groundwater. However, the current investigation has been designed to address whether or not contaminants are present in surface and subsurface soils at the three acid areas. Groundwater is currently being monitored at the sites in overburden and bedrock monitoring wells installed during the on-going site-wide groundwater investigation. The results of the two groundwater sampling events at the acid areas will be presented in the second quarterly groundwater monitoring report (to be issued in March 1998) and the annual groundwater monitoring report (to be issued July/August 1998), respectively. Data from the groundwater investigation will be considered during the reporting of results from the acid areas investigation and incorporated/referenced as necessary. In addition, should the soils investigation indicate the possibility of groundwater contamination not adequately addressed by the two wells installed at each site, additional groundwater sampling efforts would obviously be recommended. Note also that the statement indicating that soil and groundwater samples will be collected has been changed to clarify the segregation of the sampling efforts.*

Comment 2: Part II.3.0 Scopes and Objectives, Section VII.3.3 Site-Specific Data quality Objectives, Page VII-4, General Comment: The Ohio EPA Division of Emergency and Remedial Response Program has not adopted the use of Region III RBCs or Region IX PRGs as appropriate site screening agents. It is important to note that Region III RBCs do not account for cumulative risk from multiple exposure pathways and media. Ohio EPA recommends using the criteria outline in Part A of the 1989 *USEPA Risk Assessment Guidance for Superfund (RAGS).*

Response: *As discussed in response to OEPA comments on previous PBOW reports issued by IT, the published U.S. EPA Region 3 RBCs reflect a cancer risk of 1 x 10^{-6} and a noncancer hazard index (HI) of 1.0. The cancer risk of 1 x 10^{-6} is the lower end of generally accepted risk range (1 x 10^{-4} to 1 x 10^{-6}), and does provide additional protection for simultaneous exposure to multiple potential carcinogens. While the published RBCs based on noncancer endpoints do not provide for simultaneous exposure to multiple chemicals, the RBCs used for PBOW are based on an HI of 0.1 (not 1.0 as published) and do provide for multiple exposures.*

It should be noted that U.S. EPA (1989) ***Risk Assessment Guidance for Superfund (RAGS) Part A*** *does not recommend criteria, or methodology for*

developing criteria, for risk screening of analytical data. U.S. EPA (1991) ***Development of Risk-Based Preliminary Remediation Goals (RAGS Part B)*** *does provide the methodology, which is reflected in the Region 3 RBCs adapted as screening criteria for this and other PBOW investigations.*

It is the opinion of IT and the USACE that the use of these adapted RBCs as a screening tool to determine the need for further investigation or action at a particular site is appropriate and consistent with their intended use.

Comment 3: Part II.3.0 Scopes and Objectives, Section VII.3.3 Site-Specific Data Quality Objectives, Page VII-4: One objective of the SI is to determine soil background concentrations. IT proposes to complete 6 soil borings along the NPBS facility boundaries for background determinations. The soil boring locations were located in areas thought to be the least affected by past activities at the NPBS. The Ohio EPA recommends that the following areas be avoided for background soil sampling:

(A) Past waste management areas where solid and/or hazardous wastes or wastewater may have placed on the ground, areas of concentrated air pollutant deposition (from a definable localized source), or areas affected by runoff;

(B) Roads, roadsides, parking lots, areas surrounding parking lots or other paved areas, railroad tracks or railway areas or other areas affected by their runoff;

(C) Storm drains or ditches, presently or historically receiving industrial or urban runoff;

(D) Spill areas;

(E) Material handling area, such as truck or rail car loading areas, or near pipelines; or

(F) Fill areas.

Background soil samples should be of the same type of geologic unit at approximately the same depth below land surface. Use an appropriate statistical methodology to determine background soil values dependent upon the number of samples collected. Please include a discussion detailing how background soil concentrations are going to be determined in the SAP.

Response: *Concur. A discussion presenting the methodologies planned to determine background concentrations has been added to the text.*

Comment 4: Part VII.40. Field Activities, Page VII-6, Section VII.4.2 Soil Sampling Methodology and Procedures: Ohio EPA believes that ten foot sampling intervals is inappropriate. Soil samples should be collected from the surface (0 to 6 inches) and from five (5) foot intervals to the maximum depth of ten (10) feet below ground surface. If the soil/bedrock is encountered above the proposed total depth of 10 feet, then the deep sample from the boring will be collected at the soil/bedrock interface.

Response: *The purpose of this investigation is to determine whether or not soils in the investigated areas exhibit impacts from past DOD operations. It is agreed that the use of five foot sampling intervals would provide better vertical coverage of potential site contaminants. However, as this effort represents the initial sampling event in these areas, such a comprehensive sampling scheme is not considered to be the most efficient use of limited resources. Instead, the sampling scheme has been changed to (1) the collection of surface samples from all locations as previously specified and (2) the collection of subsurface samples from a depth not to exceed 10 feet but determined in the field based on visual observation of stratigraphic changes and/or evidence of possible contamination. This approach should then result in subsurface samples being collected from a variety of depths within the 2 to 10 foot range, thus providing a better indication of possible site contaminants and their distribution in subsurface soils.*

Comment 5: Please include analytical method detection limits on Table VII-7 of the SAP. Ensure that the laboratory that has been contracted to perform the analytical services can achieve method detection limits for soil analyses below appropriate regulatory limits.

Response: *Analytical reporting limits and standard operating procedures for Quanterra are provide in the Site-Wide QAPP (IT 1996). A reference to the QAPP has been added to the table.*

Comment 6: The Ohio EPA recommends that water level measurements be collected from monitoring wells installed at the facility (bedrock and shallow glacial tills) on a regular basis. The collection of this data will allow the NPBS to determine ground water flow directions and variability (potentiometric maps), ground water flow velocities, and horizontal and vertical ground water gradients in the bedrock and shallow saturated zones. This data can also be used to and in the determination of rate of migration of contaminants at the site and for the selection of appropriate remedial techniques if they are warranted.

Response: *Groundwater water levels are being collected from monitoring wells across the PBOW on a quarterly basis under the site-wide groundwater investigation currently in progress.*

Comment 7: Please provide a more detailed discussion of how geotechnical soil samples will be collected at the NPBS during the SI. The Ohio EPA recommends that IT perform analyses of hydraulic conductivity and porosity on geotechnical samples in addition to the analyses listed on page VII-6 of the SAP.

Response: *The discussion of how geotechnical soil samples will be collected has been expanded. However, the addition of porosity and hydraulic conductivity as analyses for geotechnical samples is not considered appropriate at this time.*

Comment 8: Page VII-12 of the SAP discusses how investigation-derived waste (IDW) will be collected and stored but not how IDW liquids will be disposed of. IT should submit a discussion of the disposal methods for IDW to this Ohio EPA for review and for incorporation into the SAP.

Response: *Handling and disposal of IDW generated at PBOW are addressed in the IDW Management Plan of the Site-Wide SAP (IT, 1996). Any IDW liquids generated during the current investigation will be summarized and evaluated in a letter report to the OEPA with recommended disposal actions for approval.*

Reference: *Fax from Linda S. Ingram, CELRN-EP-R-M, dated February 26, 1998.*

<u>Comments on SAP from Michael F. Zoccola, CELRN-EP-R-N, dated February 23.</u>

Comment 1: Pg VII-1, section VII.1.2: It would be worthwhile to mention the November 1997 records review for these areas and the results (i.e., did it help in deciding where to place borings?).

Response: *Text has been revised to reference the 1997 record review for those areas.*

Comment 2: Pg VII-4, last line: It is our understanding that the EPA has switched to using Arabic Numerals to designate each region. Thus, change "EPA Region III" to "EPA Region 3".

Response: *Concur. Text has been revised.*

Comment 3: Table VII-1, footnote b, second line: Change "QA/AC" to "QA/QC".

Response: *This typographic error has been corrected.*

Comment 4: Tables VII-2 thru 6: to reduce potential confusion, please consider including the site identification (AA1, AA2, AA3, MNT, PSB, or BCG) in the Soil Boring Identification column. If the Acid Areas are displayed on the same map these additional designations will be necessary.

Response: *Concur. Table VII-2 through -6 have been revised to include more specific site identifications.*

Comment 5: Table VII-5: For the Maintenance Shop Area, Soil Sample Identification numbers, please correct the Boring Numbers (SB14). They should not all be the same, and "SB14" is probably not correct either.

Response: *Table VII-5 has been revised to show correct soil sample identifications.*

Comment 6: Pg VII-9, top of page (Sample Number System): In Tables VII-2 thru 6 the sample ID numbers lack a "Sample type" designation. Also, the box under "Boring Number" should have 4 X's.

Response: *Tables have been modified.*

Comment 7: Pg VI-9, Section VII.5.2: What is a "TAT acid Tank"? The acronym "TAT" has not been defined.

Response: *It should be "TNT Acid Tank". Text has been corrected.*

Comment 8: Pg VII-13, References: Please change the reference for *Statement of Work* to:

U.S. Army Corps of Engineers, Nashville District (USACE), 1997, *Scope of Work, Site Investigation of Acid Areas, Former Plum Brook Ordnance Works (PBOW), Sandusky, Ohio*, August, 1997.

Response: *Concur. Reference has been changed as requested.*

Comment 9: In the text, change "Statement of Work" to "Scope of Work".

Response: *Text has been changed.*

Comment 10: Sampling Strategy: Please document in the report why in acids areas 1 and 3 samples are collected in the immediate vicinity of tank cradles and process buildings (reference figures VII 3 and VII 5), but in acid area 2 samples are collected away from process buildings and tank cradles (reference VII-4).

Response: *Figure VII-4 has been revised to relocate some of the proposed boring locations closer to the process building and tank cradles.*

Comment 11: Figure VII-5: What is the rationale for sampling location SB08, SB09 and SB10?

Response: *Rationale for the sample placement at these locations have been added to Section VII.4.3.*

Comment 12: Section VII.4.3, Page VII-6: Please include rationale for the selection of background sampling locations.

Response: *A paragraph has been added in VII.4.3.5 to include rationale for the background soil boring placement.*

Comment 13: Section VII.4.3: This section needs to detail what analytical methods are associated with each boring. Also a general discussion is needed to identify why certain analyses (nitroaromatics and PCBs) were not required at every boring.

Response: *The purpose of this soil investigation is to determine whether or not soils in the investigated areas exhibit impacts from past DOD operations. As this effort represents the initial sampling event in these areas, a full suite analysis at every boring location is not considered to be the most efficient use of limited resources. For this reason, selective parameters, mostly nitroaromatics and PCBs, have been included at certain locations. These locations are thought to have been most likely impacted by these chemicals during PBOW operations. Analyses to be performed by area are presented in Table VII-1. Section VII.5.2 (Analytical Program) has been revised for clarification.*

Comment 14: Page VII-4. Conceptual Site Model. Middle of page. Please include sediments as one of the migration pathways.

Response: *Concur. Sediments have been added as one of the migration pathways.*

Comment 15: Page VII-5. Precision, Accuracy, and Completeness. Reference Section 12 of the QAPP (IT, 1996a).

Response: *Concur. Reference has been included.*

Comment 16: Figure VII-4. Some of the building numbers have been omitted.

Response: *Building numbers have been added to the figure.*

Comment 17: Page VII-6. Section VII.4.3. Clarify the number of samples to be collected in the sentence that begins with "Two soil samples".

Response: *Text has been revised for clarification.*

Comment 18: Page VII-9. Section VII.5.1. Middle of page. Change "laboratory" to "sample number" to be consistent.

Response: *Concur. Text has been revised as suggested.*

Comments from Michael F. Zoccola, CELRN-EP-R-N, dated February 25.

Comment 1: Section 3.3 -- Risk Evaluation: A comparison to Oak Ridge national Laboratory Ecological Benchmark values may be appropriate to this phase of the project. Please consider adding a statement about comparing detected site constituents to benchmark values.

Response: *As discussed in the SSAP, analytical results will be evaluated using RBCs adapted from EPA Region 3 risk-based concentrations. However, the current scope does not include human health or ecological risk assessments. If an ecological risk evaluation is required at a later time, IT ecological risk assessors will propose methodologies for regulatory approval, which may include the Oak Ridge National Laboratory Ecological Benchmark values as suggested.*

Responses to Technical Review Comments on Draft Site-Specific Safety and Health Plan Site Investigation of the Acid Areas Plum Brook Ordnance Works, Sandusky, Ohio

Comments on SSHP from Michael F. Zoccola, CELRN-EP-R-N, dated February 25.

Comment 1: Cover Page: Add the date of the final Site-Wide Safety and Health Plan for Site Investigations and Groundwater Investigations at the Former Plum Brook Ordnance Works.

Response *The date was added as requested.*

Comment 2: Section 1.0 Site Work Plan Summary: Add the time of year for the investigation in this section.

Response *The project schedule was added as suggested.*

Comment 3: Section 2.2 General Site Information: A map showing roads, approximate area size, approximate equipment staging area, exclusion zone, decontamination zone, support zone, first aid station, and emergency response equipment storage area for this phase of investigation should be in the SSHP.

Response *Maps were provided as suggested.*

Comment 4: Table 2-1 Toxicological and Physical Properties of Chemicals: Add a physical description (e.g., colorless liquid) and odor description (e.g., sweet aromatic) of each substance so that on-site personnel may identify when potential contact may happen.

Response *The table was revised as suggested.*

Comment 5: Table 2-1 Toxicological and Physical properties of Chemicals: Correct text brackets for DNT IDLH and gasoline CAS. Change hydrogen chloride IP to 12.74, and check odor thresholds for hydrogen chloride and isopropyl alcohol. Add methanol CAS of 67-56-1, portland cement of 65997-15-1, and TNT of 1118-96-7. Add portland cement REL of 10 mg/m^3, and IDLH of 5000 mg/m^3.

Response *The table was revised as suggested.*

Comment 6: Table 2-1 Toxicological and physical Properties of Chemicals: The CAS number listed for hydrogen chloride is actually the CAS number of hydrogen

cyanide. The CAS number for hydrogen chloride is 7647-01-0. Please check and correct this section of the table.

Response *The table was corrected as requested.*

Comment 7: Section 3.0 Personal Protective Equipment: Remove spacing between bulleted items under Level C.

Response *Spacing was revised as suggested.*

Comment 8: Section 3.0 Personal Protective Equipment: Donning and doffing Level D, Modified Level D and Level B procedures should be included in this section, and list how decontamination stations (Section 7 of the Site-Wide SHP) will be used.

Response *The text was revised as suggested.*

Comment 9: Emergency Equipment: "IT-approved" first-aid kits must adhere to the minimum standards of U.S. Army Corps of Engineers EM 385-1-1 (U.S.ACE, 1996) 16-unit first-aid kit. Please add a statement about the first-aid kit fulfilling the minimum EM 385-1-1 requirements.

Response *The "IT-approved first aid kits are in compliance with the minimum standards of USACE EM 385-1-1.*

Comment 10: Section 4.0 Site Monitoring: Elaborate on timing and duration of the Safety and health Officer's duties for VOC in breathing zone monitoring.

Response *The text was revised as suggested.*

Comment 11: Section 5.0 Activity Hazard analysis: All underground utilities and conduits should be delineated and flagged in the work area. Please add a statement that underground utilities will be mapped and marked on site. Add a line item in Table 5-1 under the subsurface sampling heading regarding underground utility lines.

Response *The text was revised under "uneven terrain, poor ground support, inadequate clearances, contact with utilities" section.*

Comments by Ronald E. Nabors, OEPA DERR, dated February 20, 1998.

Site-Specific Safety and Health Plan

Comment 1: Part VII.2.0 Site Characterization and Analysis, Page VII-2, Section VII.2.2 General Site Information: Please include a map of the referenced Acid Areas.

Response: *A figure showing the locations of the acid areas has been added to the SSHP.*

Comment 2: Part VII.2.0 Site Characterization and Analysis, Section VII.2.2 General Site Information, Figure VII.1-1: Please identify U.S. Route 250 on the site and hospital location map.

Response: *U.S. Route 250 has been identified as requested.*

Comment 3: Part VII.2.0 Site Characterization and Analysis, Page VII-2, Section VII.2.2 General Site Information: Due to the size of the Plum Brook Ordnance Works facility please include a map identifying the most direct routes on the facility from the Acid Areas to the Main Gate.

Response: *The requested route information has been added.*

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CELRN-EP-R-M

Project Description: Site Investigation of Acid Areas, Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract Number: DACA62-94-D-0030 Delivery Order Number: 0030

Project Number: 773206 Task / Phase Number: 03000000

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☐ Contract / Subcontract		☐ Client Furnished
☒ SAP, SSAP, CDAP, or QAPP	SSAP, Revision 1, March 1998	
☐ SHP or SSHP		**Document Status**
☐ _____ Report		☐ Preliminary
☐ Risk Assessment / Evaluation		☐ Internal Draft
☐ Specifications & Plans		☐ Draft
☐ Design Calculations		☐ Draft Final
☐ Tables		☒ Final
☐ Drawings / Figures		☐ Other: _____
☐ Other: _____		

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Quality Assurance Officer	T. Smith	Terri Robinson for T. Smith	3-13-98
Project Manager	M. Spangberg		3-13-98
Program Manager	D. Burton		3-13-98

Attachment VII

Site-Specific Sampling and Analysis Plan
Site Investigation of Acid Areas
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

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Submitted To:

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IT Project Number 773206
Control Copy No. ____

Revision 1

March 1998

(This SSAP must be used in conjunction with the PBOW SAP)

Reviews and Approvals

Program Manager
IT Corporation

Date 3/13/98

Project Manager
IT Corporation

Date 3/13/98

Site Coordinator
IT Corporation

Date 3/12/98

Jerri Robinson for
Tony Smith
QA/QC Officer
IT Corporation

Date 3-12-98

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Control Copy No. 22	Project File
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List of Acronyms

AA1	Acid Area No. 1
AA2	Acid Area No. 2
AA3	Acid Area No. 3
AR/COC	Analysis Request/Chain of Custody (Record)
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FUDS	Formerly Used Defense Sites
GIS	Geographic Information System
IDW	investigation-derived waste
IT	IT Corporation
NASA	National Aeronautic and Space Administration
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyl
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
SAP	sampling and analysis plan
SHP	safety and health plan
SI	site investigation
SOW	statement of work
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TNT	trinitrotoluene
UCL	upper confidence level
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	volatile organic compound

VII.1.0 Project Description

The U.S. Army is conducting studies of environmental impact of suspected hazardous waste sites at previously owned U.S. Department of Defense (DOD) properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP) Formerly Used Defense Sites (FUDS) funding. The former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio (Figure VII-1) is a DERP FUDS project currently being managed and technically overseen by the Nashville District of USACE. IT Corporation (IT) is contracted to provide engineering services to conduct a site investigation (SI) of soils at three former Acid Areas.

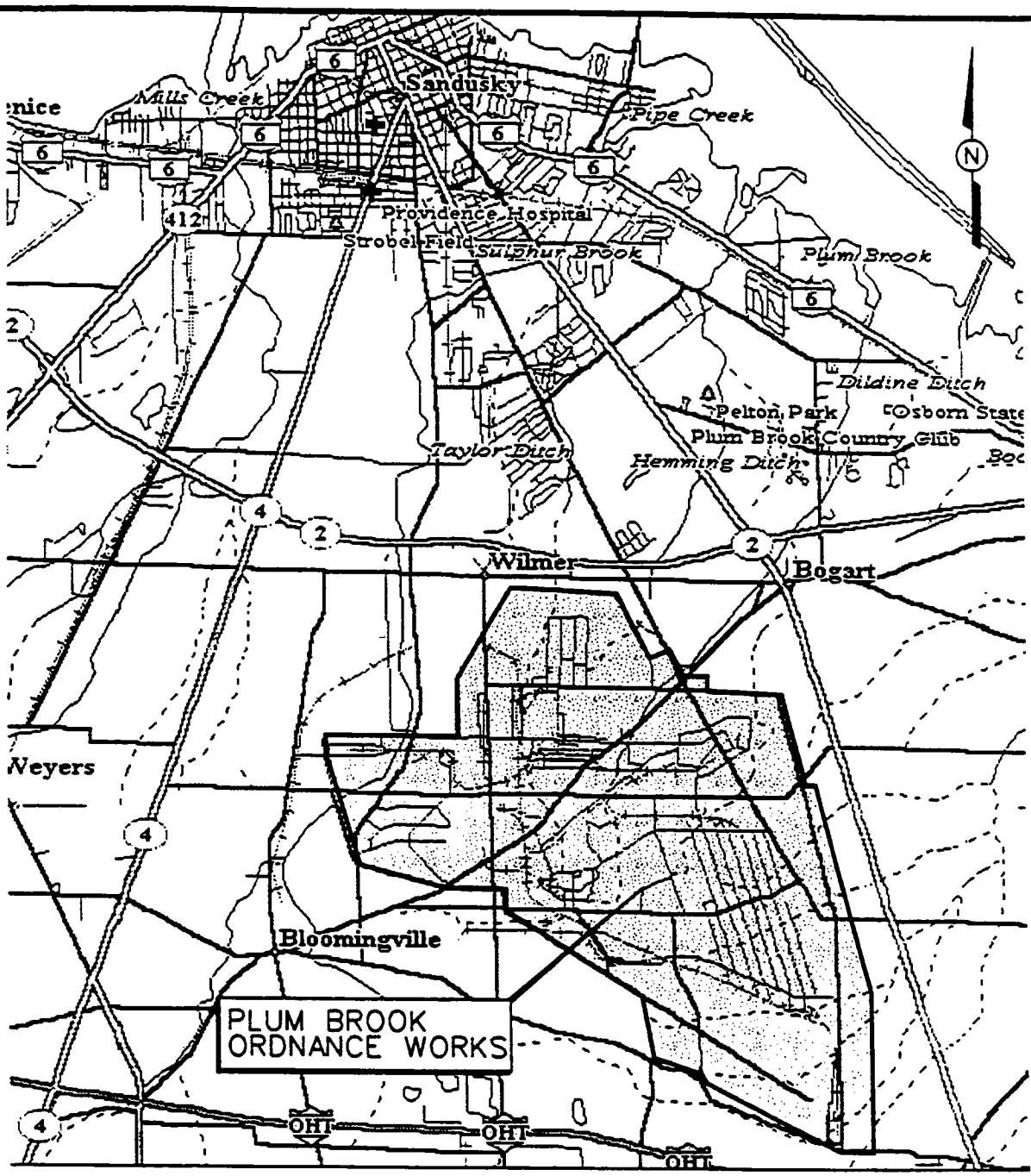
As an attachment to the PBOW site-wide sampling and analysis plan (SAP) (IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the Acid Areas SI at PBOW. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP) (IT, 1996b) to ensure that work to be performed at these sites will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this investigation and must be used in conjunction with the site-wide safety and health plan (SHP) (IT, 1996c).

VII.1.1 Site History

The PBOW site, built in early 1941, manufactured 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to Ordnance Department, then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration. The National Aeronautics and Space Administration (NASA) acquired the PBOW in 1963 and is presently utilizing the site.

VII.1.2 Summary of Existing Site Data

Three formerly used Acid Areas, the Maintenance Shop, and the Power Substation are located as shown in Figure VII-2. The Acid Areas were used to produce oleum and nitric acid for the manufacture of TNT. In November 1997, IT conducted a records review for the three acid areas and no previous investigations at these locations were found.



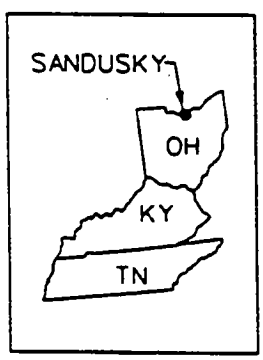


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FIGURE VII-1
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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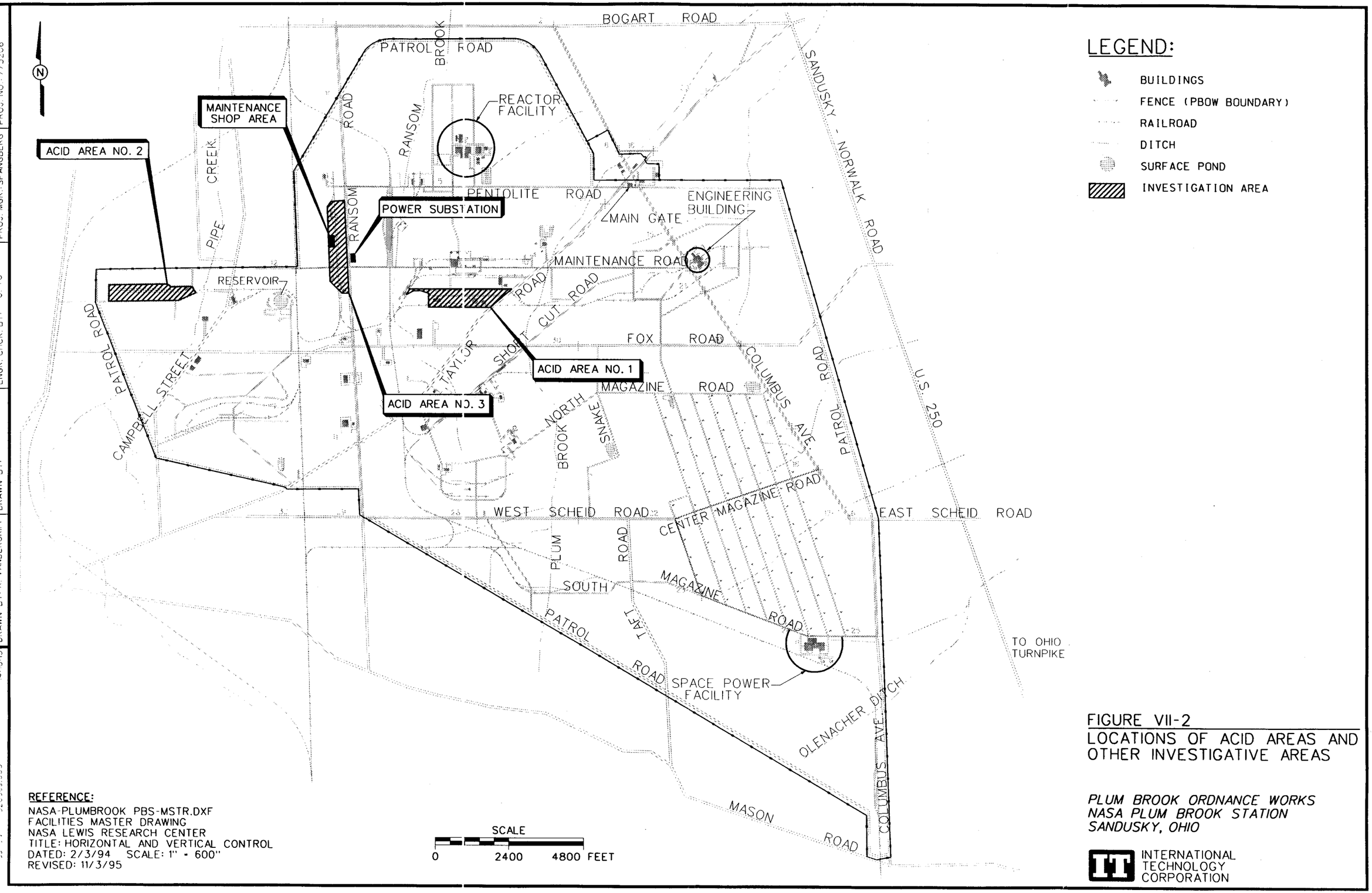


REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600'
REVISED: 11/3/95

FIGURE VII-2
LOCATIONS OF ACID AREAS AND OTHER INVESTIGATIVE AREAS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: G. YU	DWG. NO.	
ENGR. CHCK. BY: G. YU	PROJ. MGR.: SPANGBERG	PROJ. NO. 773206	
DATE LAST RE.:			
DRAWN BY:			
STARTING DATE: 12/18/97			
DRAWN BY: R. VANDERGRIFF			

The records review included review of all available historical drawings and a one-day site walk to locate old buildings and process lines. Most of the buildings and process lines were no longer in place and the acids areas are covered with trees and bushes. The records review findings have been used in placement of soil borings.

Two monitoring wells were installed at each Acid Area by IT in September 1997 as part of the site-wide groundwater investigation. Groundwater samples that were collected during the investigation are currently being evaluated and will provide site-specific information regarding groundwater quality at each location.

Acid Area No.1 (AA1) is located south of the NASA Shipping and Receiving building (NASA Building No. 9209) and is bordered on the east by Taylor Road. Acid Area No.2 (AA2) is located between Patrol Road and Campbell Street on the northwest corner of the facility. Acid Area No. 3 (AA3) is located north of Fox Road and is bordered on the east by Ransom Road in the northwest portion of the facility. Two other areas for investigation are associated with AA3: the Maintenance Shop (Building No. 809) is located in the west central portion of AA3 and the Power Substation is located across Ransom Road and east of Building No. 808. All targeted investigation areas are readily accessible by vehicle.

Two hydro-lithologic units are known to exist in PBOW site. The overburden unit, composed of glacial outwash materials, has a thickness ranging from a few feet in the south to greater than 40 feet in some locations in the north. The bedrock unit consists of Devonian limestone and shale that dip to the southeast at approximately 35 feet per mile.

In general, groundwater flows in a northerly direction, towards Lake Erie, in both the unconsolidated overburden material and consolidated bedrock. On the western side of the site, groundwater in the overburden water-bearing zone flows to the northwest, while groundwater in the bedrock aquifer flows to the northeast. Groundwater flow regime in the overburden unit shows a strong seasonal variation.

VII.2.0 Project Organization and Responsibility

The project organization for this SI consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.

VII.3.0 Scope of Work and Objectives

VII.3.1 Scope of Work

As specified in the scope of work (SOW) (USACE, 1997), the scope for the SI at the three PBOW Acid Areas consists of preparation of site-specific addendums to the site-wide SAP and SHP; completion of field activities, including installation of soil borings and collection of soil samples from selected locations for chemical analysis; evaluation of analytical results; report preparation; and a Geographic Information System (GIS) deliverable.

VII.3.2 Objectives

The overall objective of the SI is to determine the presence of potential contaminants of concern in the soils of the three Acid Areas, the Maintenance Shop, and the Power Substation. Specific objectives of the SI are summarized as follows:

- Determine if there are hazardous substances present in soils at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define physical site features and characteristics (soil background conditions).
- Determine current and future routes of exposure.

Sufficient surface and subsurface soil information will be collected so that a management decision can be made concerning the necessity of additional study of the sites. Additionally, the collected data can be used to conduct human health and ecological risk assessments, if necessary.

VII.3.3 Site-Specific Data Quality Objectives

Overview. The data quality objectives (DQO) process followed during the planning stages of the investigation evaluated data requirements needed to support the decision-making process and selected the best action to satisfy these requirements. Incorporated components of the DQO

process, described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund* (EPA, 1993), are discussed in detail in Section 3.3 of the SAP. Determining factors for procedures necessary to satisfy investigative objectives and to establish the basis of future actions at PBOW are presented in Figure 3-2 of the SAP (IT, 1996a).

Data Users and Available Data. A site-specific conceptual model, developed using existing data, helped to identify data gaps. During the project planning process, effective methodologies for filling the data gaps were designed and reviewed by the data users, with the most efficient data collection design being implemented. The SSAP records the rationale for the design, including the location, number, and type of sampling necessary to fill the data gaps and to satisfy the DQOs. The SSAP, along with companion documents, provides the regulatory agencies with sufficient detail so that they can conclude whether the investigative effort is adequate to satisfy the study objectives.

Conceptual Site Model. Four factors considered in defining the conceptual model for the SI are:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Contaminants of concern.

A potential source of contamination at PBOW is past TNT manufacturing activities, including the production and storage of raw materials. Potential sources at the proposed areas of investigation result from acid production and storage, vehicle and equipment maintenance, and the storage and use of transformers. The migration pathways include groundwater, soil, sediment, and surface water runoff to the creek. Likely receptors at PBOW are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants under current land use at PBOW is unlikely since the site is a secure NASA research station. Potential receptors near the facility include off-site water users. Potential contaminants of concern based on past use of the site may include volatile organic compounds (VOC), semivolatile organic compounds (SVOC), metals, pesticides/polychlorinated biphenyls (PCB), nitroaromatics, and total cyanide.

Decision-Making Process, Data Uses, and Needs. The decision-making process, presented in detail in Section 3.3.3 of the SAP (IT, 1996a), consists of a seven-step process that will be followed during the SI. Data uses and needs are summarized in Table 3-1 of the SAP (IT, 1996a).

Risk Evaluation. Confirmation of contamination during the SI will be based upon a comparison of detected contaminants from this investigation to risk-based screening concentrations (RBC) adapted from the most current risk-based concentrations developed by EPA Region 3. Specifically, RBCs used will reflect a cancer risk of 10^{-6} or a hazard index (HI) of 0.1. EPA definitive data will be used to achieve detection limits sufficient to determine whether or not the established guidance criteria are exceeded in the media. Definitive data will be adequate for confirming the presence of the contamination and for supporting a risk assessment and feasibility study, if necessary.

Data Quality, Types, and Quantities. Soil samples will be collected and analyzed to meet the objectives of the SI. Quality assurance/quality control (QA/QC) samples will be collected for all sample types as described in Section VII.4.3 of this SSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the SI, data analyzed at this level of quality are appropriate for all phases of the characterization and risk assessment.

Precision, Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for this are provided in Section 12 of the QAPP (IT, 1996b).

VII.4.0 Field Activities

Field activities at the Acids Areas, Maintenance Shop, and Power Substation will include soil borings with surface and subsurface soil sample collection, a land survey, and investigation-derived waste (IDW) management. Additionally, six soil borings with surface and subsurface soil sample collection will be conducted to fill spatial data gaps in establishing background constituent concentrations.

VII.4.1 Soil Boring Locations

A total of 15 soil borings will be installed at each of the three Acid Areas; 3 soil borings will be installed in the Maintenance Shop area; 6 soil borings will be installed for background constituent determination in areas thought to be unaffected by former DOD and/or NASA activities; and 2 surface soil locations will be sampled at the Power Substation Area. The borings will allow collection of a surface and subsurface soil sample at each designated location, except for the Power Substation Area, where only two surface soil samples will be collected. A total of 56 surface and 54 subsurface field soil samples for chemical analysis will be collected, along with the required QA/QC and geotechnical samples. The soil boring locations, including background borings, have been selected based on a review of original site structure layout maps and areas of potential contamination concern. Figures VII-3 through VII-6 show the tentative boring locations that are subject to change if site conditions warrant.

VII.4.2 Soil Sampling Methodology and Procedures

Soil samples will be collected from the surface (0 to 6 inches) and from a depth not to exceed 10 feet. The subsurface soil sample depth will ultimately be determined by site lithology and soil vapor monitoring results. If the soil/bedrock interface is encountered above the proposed total depth of 10 feet, then the deep sample from the boring will be collected at the soil/bedrock interface.

Either a hand auger, a portable gas-powered drill rig, or a truck-mounted drill rig will be used to drill borings to the specific depth. Soil samples for field screening and laboratory analysis will be collected using stainless-steel split spoons or hand augers; undisturbed samples will be collected for VOC analysis using a drive sampler. If a drive sampler cannot be used effectively due to the proximity of bedrock or weathered bedrock, then care will be used to collect a minimally disturbed sample and place it in the appropriate container. If the quantity of soil in the split spoon is not sufficient, then an additional boring will be advanced immediately adjacent to the original boring, and samples will be collected at the same interval as the original sample. Upon completion of sampling, soil borings will be backfilled with soil cuttings removed from the borehole during drilling. Each borehole will be staked, labeled, and surveyed. A summary of soil sample designations and QA/QC samples to be collected is provided in Table VII-1.

All soil samples collected by IT field personnel will be documented through the use of Analysis Request/Chain of Custody Record forms (AR/COC, Figure 6-2 of the SAP [IT, 1996a]) following field custody procedures specified in Section 5.1 of the QAPP (IT, 1996b).

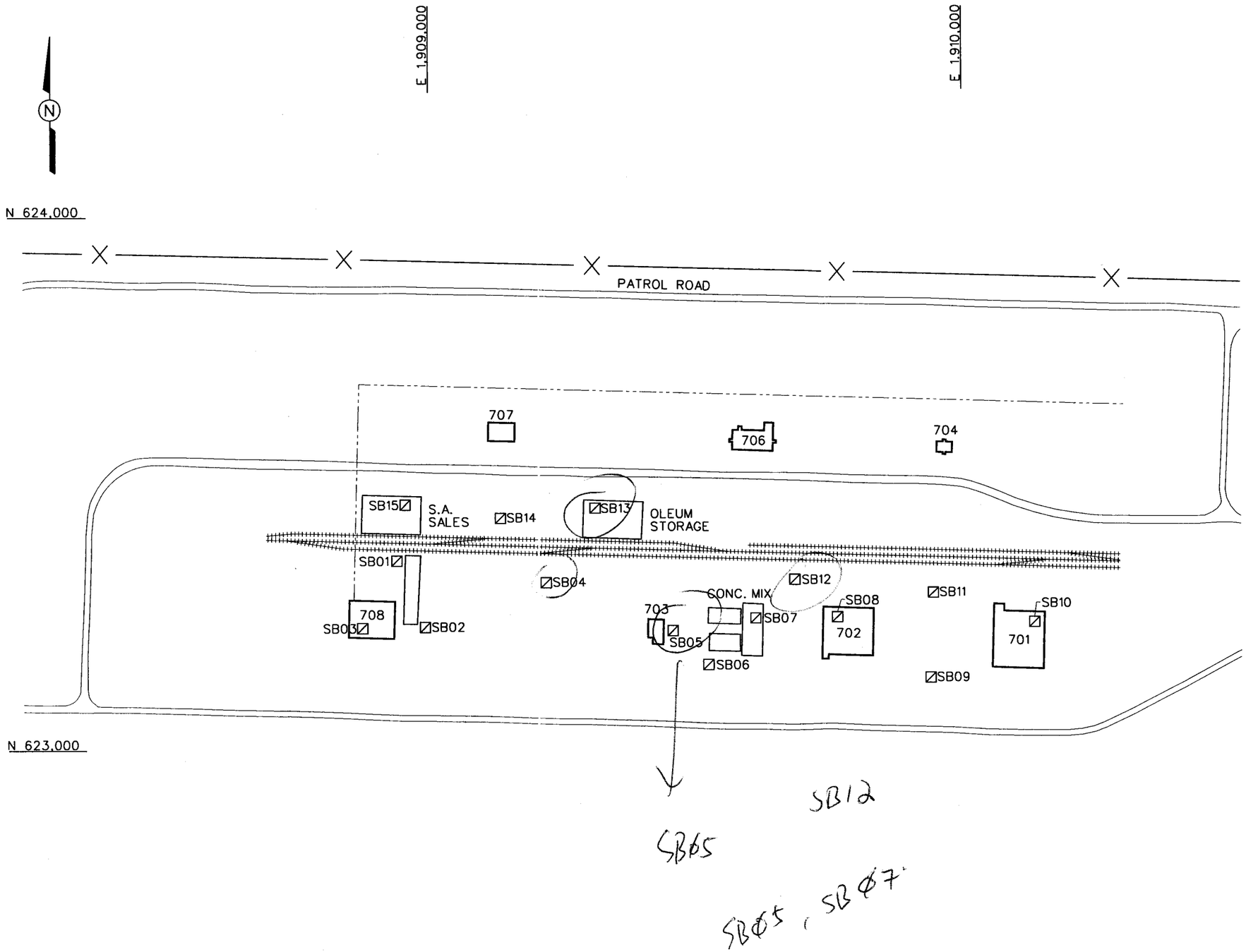
Table VII - 1

Soil Sample and QA/QC Sample Quantities[a]
Site Investigation of Acid Areas
Former Plum Brook Ordnance Works, Sandusky, Ohio

Investigation Site	Analytical Parameters	Number of Primary Samples	Field Duplicates[b] & Splits	Matrix Spike	Matrix Spike Duplicate	Field Blank	Equipment Rinsate	Trip Blank[c]
Acid Area No. 1 (15 Soil Borings)	TCL VOCs/SVOCs	30	1	1	1	1	1	
	TAL Metals	30	1	1	1	1	1	
	PCBs[d]	15	1	1	1			
	Nitroaromatics[e]	4	1					
	pH, Nitrate, Sulfate	30	1	1	1			
Acid Area No. 2 (15 Soil Borings)	TCL VOCs/SVOCs	30	1	1	1	1	1	
	TAL Metals	30	1	1	1	1	1	
	PCBs[d]	15	1	1	1			
	Nitroaromatics[e]	4		1	1			
	pH, Nitrate, Sulfate	30	1	1	1			
Acid Area No. 3 (15 Soil Borings)	TCL VOCs/SVOCs	30	1	1	1	1	1	
	TAL Metals	30	1	1	1	1	1	
	PCBs[d]	15	1					
	Nitroaromatics[e]	4						
	pH, Nitrate, Sulfate	30	1	1	1			
Power Substation (2 Surface Soil Locations)	TCL VOCs/SVOCs	2	1	1	1	1	1	
	TAL Metals	2	1	1	1	1	1	
	PCBs[d]	2	1					
Maintenance Shop (3 Soil Borings)	TCL VOCs/SVOCs	6	1	1	1	1	1	
	TAL Metals	6	1			1	1	
	PCBs[d]	3	1					
Background Locations (6 Soil Borings)	TCL VOCs/SVOCs	12	1	1	1	1	1	
	TAL Metals	12	1			1	1	
	PCBs[d]	6	1	1	1			
	Nitroaromatics[e]	12	1	1	1			
	pH, Nitrate, Sulfate	12	1	1	1			
Total		402	24	19	19	12	12	

[a]QA/QC samples are collected at a rate of 5 percent of the primary samples.
[b]QA/QC samples for VOC\SVOCs analyses will be collected as discrete replicate samples.
QA/QC samples for non-VOC analyses will be collected as homogenized replicates and split between the designated laboratory and the USACE QA laboratory.
[c]Trip blank sample is not required for soils.
[d]PCB analysis will be conducted on surface samples only
[e]Nitroaromatics analysis will be conducted only on samples from the TNT tank areas at each Acid Area and all background samples

PCB - Polychlorinated biphenyl.
SVOC - Semivolatile organic compound.
TAL - Target analyte list.
TCL - Target compound list.
VOC - Volatile organic compound.



LEGEND:

- RAILROAD
- BUILDINGS
- AREA OF STORAGE TANKS
- NATURAL GAS
- SB01 PROPOSED SOIL BORING (PBOW-98-AA2-SB01)

SCALE

0 200 400 FEET

FIGURE VII-4
PROPOSED SOIL BORING
LOCATION MAP
ACID AREA NO. 2

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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DRAWN BY: R. VANDERGRIFF | DRAWN BY: | ENGR. CHCK. BY: GEORGE YU | PROJ. MGR.: SPANGBERG | PROJ. NO.: 773206

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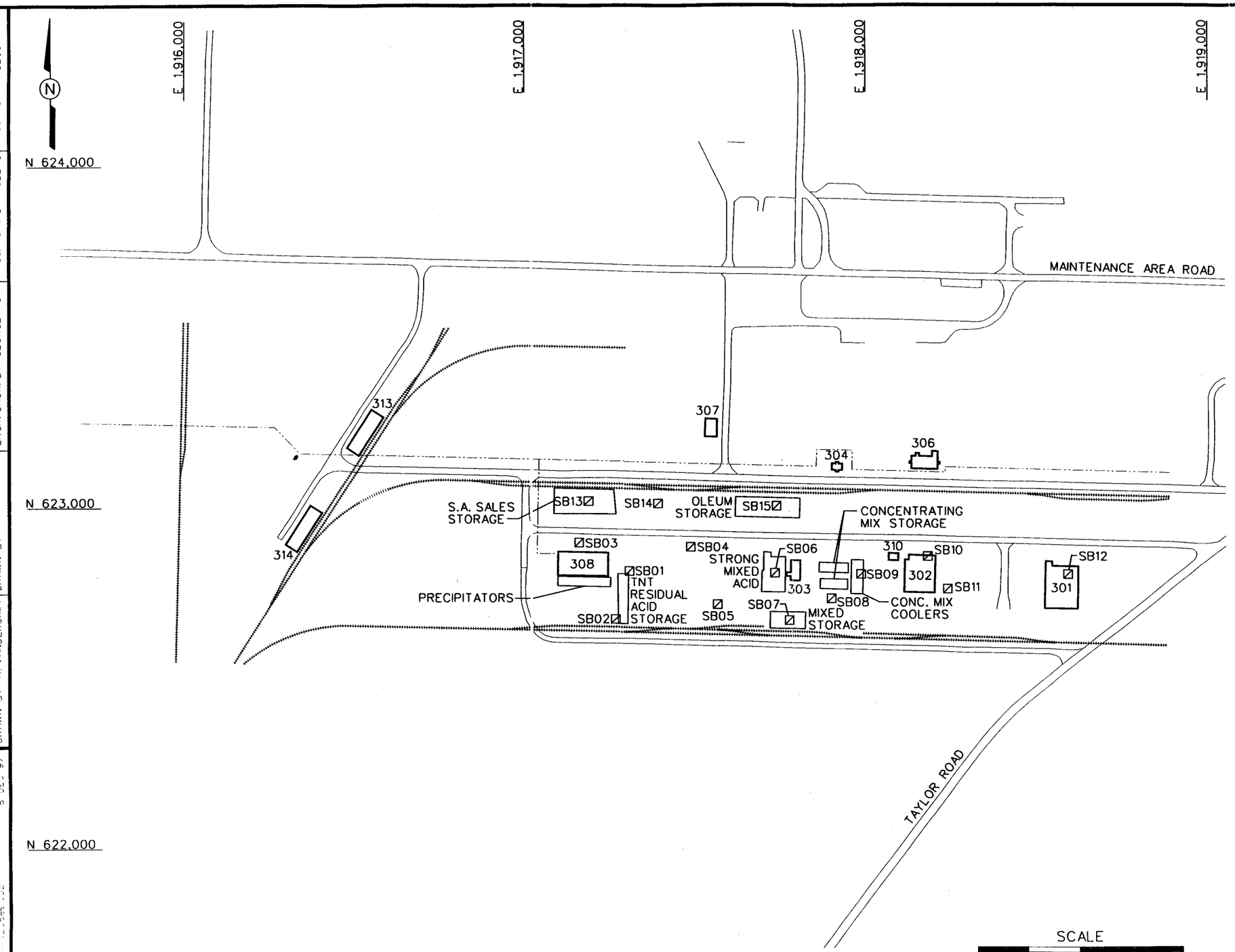

LEGEND:

- RAILROAD
- BUILDINGS
- AREAS OF STORAGE TANKS
- NATURAL GAS
- ⊠SB01 PROPOSED SOIL BORING (PBOW-98-AA1-SB01)

FIGURE VII-3
PROPOSED SOIL BORING LOCATION MAP
ACID AREA NO. 1

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 12/11/97	DATE LAST REV.	DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: M. SPANGBERG
DRAWN BY: R. VANDERGRIFF	DRAWN BY:	ENGR. CHCK. BY: GEORGE YU	PROJ. MGR.: SPANGBERG
			DWG. NO.:
			PROJ. NO.: 773206

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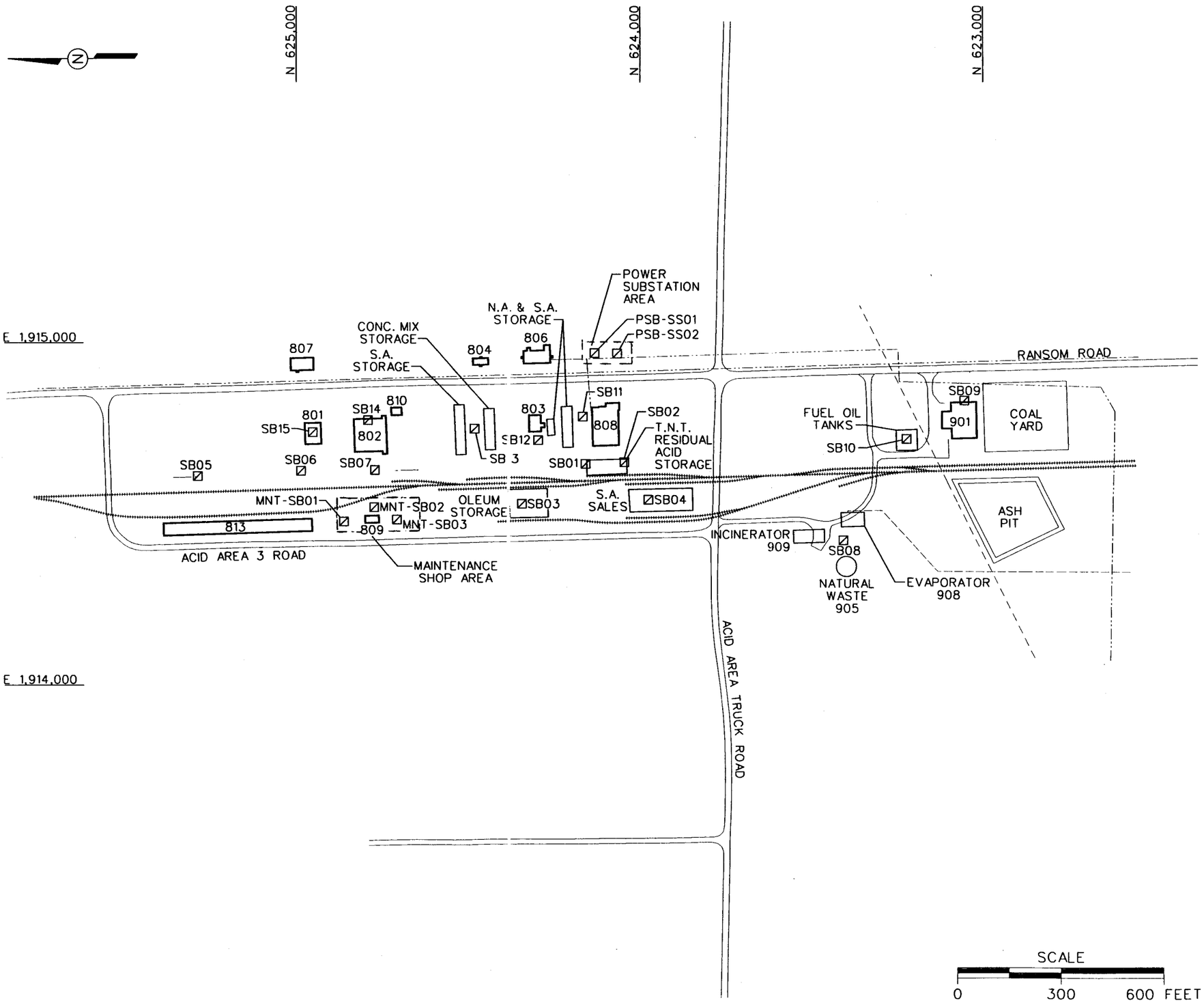
18 DEC 97



LEGEND:

- RAILROAD
- BUILDINGS
- AREA OF STORAGE TANKS
- NATURAL GAS
- RAW WATER
- EVAPORATOR LINES
- FORMER SEWER LINE
- SB01 — PROPOSED SOIL BORING (PBOW-98-AA3-SB01) (PBOW-98-MNT-SB01) (PBOW-98-PSB-SS01)

NOTE:

SB-05, -06, AND -07 ARE LOCATED ALONG THE FORMER SEWER LINE.

SCALE

0 300 600 FEET

FIGURE VII-5
PROPOSED SOIL BORING LOCATIONS
ACID AREA NO. 3 AND ASSOCIATED SITES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: M. SPANGBERG | DWG. NO.: 773206
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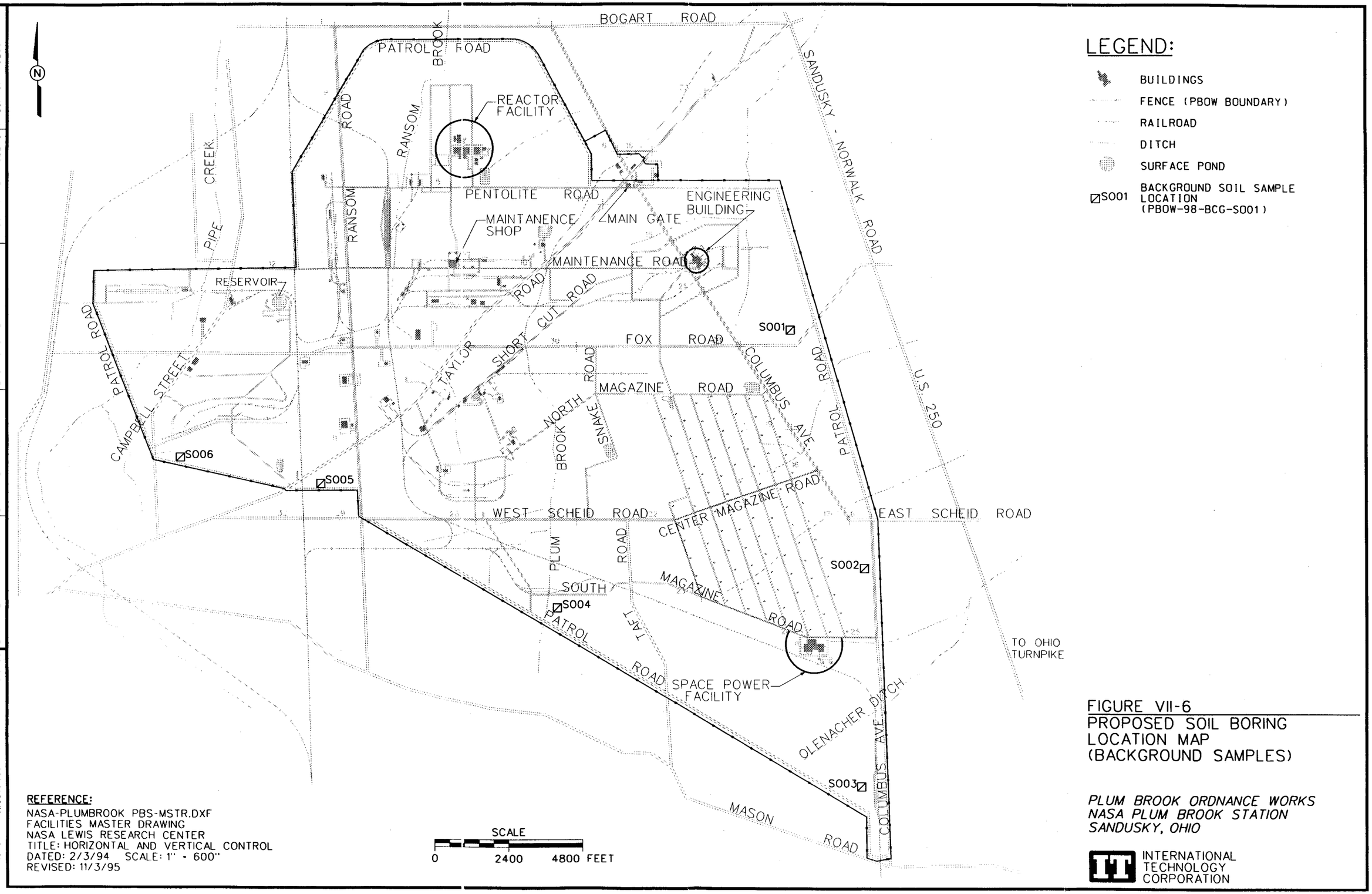
STARTING DATE: 12/11/97 | DATE LAST REV.:
DRAWN BY: R. VANDERGRIFF | DRAWN BY:



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- S001 BACKGROUND SOIL SAMPLE LOCATION (PBOW-98-BCG-S001)

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600'
REVISED: 11/3/95

FIGURE VII-6
PROPOSED SOIL BORING LOCATION MAP
(BACKGROUND SAMPLES)

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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DATE LAST REV.			
DRAWN BY:			
STARTING DATE: 12/18/97			
DRAWN BY: R. VANDERGRIFF			
18 DEC 97	15-0138		

Any changes from the work plans will be recorded in chronological order in the variance log shown in Figure 9-1 of the SAP (IT, 1996a).

VII.4.3 Rationale for Soil Boring Placement

Continuous soil sampling will be conducted in each borehole from the surface to the total depth for lithological description. All soil samples will be visually inspected and logged on the hazardous, toxic, radiologic waste drilling log (Figure 4-11 of the SAP) by an IT field geologist using the Unified Soil Classification System (USCS). Two soil samples each will be collected from two soil borings at each of the three Acid Areas (total of 12 samples) for geotechnical analysis following procedures specified in Section VII.4.2. Geotechnical samples will be analyzed by a geotechnical testing laboratory for sieve analysis or Atterberg limits, soil density, and moisture content. A summary of geotechnical soil sample designations to be collected is provided in Table VII-2.

VII.4.3.1 Acid Area No. 1

The placement of soil borings at AA1 is based upon review of original site structure location maps and areas of potential concern. Two of the 15 boring locations will be placed in the area where the TNT acid storage tanks were located. The remaining 13 borings will be placed at locations known to have been used for acid production and storage of raw materials. A summary of soil sample designations and QA/QC samples to be collected is provided in Table VII-3. Figure VII-3 shows the proposed soil boring locations.

VII.4.3.2 Acid Area No. 2

The placement of soil borings at AA2 is based upon review of original site structure location maps and areas of potential concern. Two of the 15 boring locations will be placed in the area where the TNT acid storage tanks were located. The remaining 13 borings will be placed at locations known to have been used for acid production and storage of raw materials. A summary of soil sample designations and QA/QC samples to be collected is provided in Table VII-4. Figure VII-4 shows the proposed soil boring locations.

VII.4.3.3 Acid Area No. 3

The placement of soil borings at AA3 is based upon review of original site structure location maps and areas of potential concern. Two of the 15 boring locations will be placed in the area where the TNT acid storage tanks were located. The remaining 13 borings will be placed at locations known to have been used for acid production and storage of raw materials, as shown on

Table VII-2

Geotechnical Soil Sample Designations
Site Investigation of Acids Areas
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Identification	Soil Boring Identification	Sample Depth (feet bgs)[a]
Acid Area 1		
PBOW-98-SO-AA1-SBxx-Geot-(depth)	AA1-SBxx	TBD[b]
PBOW-98-SO-AA1-SBxx-Geot-(depth)		TBD
PBOW-98-SO-AA1-SBxx-Geot-(depth)	AA1-SBxx	TBD
PBOW-98-SO-AA1-SBxx-Geot-(depth)		TBD
Acid Area 2		
PBOW-98-SO-AA2-SBxx-Geot-(depth)	AA2-SBxx	TBD
PBOW-98-SO-AA2-SBxx-Geot-(depth)		TBD
PBOW-98-SO-AA2-SBxx-Geot-(depth)	AA2-SBxx	TBD
PBOW-98-SO-AA2-SBxx-Geot-(depth)		TBD
Acid Area 3		
PBOW-98-SO-AA3-SBxx-Geot-(depth)	AA3-SBxx	TBD
PBOW-98-SO-AA3-SBxx-Geot-(depth)		TBD
PBOW-98-SO-AA3-SBxx-Geot-(depth)	AA3-SBxx	TBD
PBOW-98-SO-AA3-SBxx-Geot-(depth)		TBD

[a]Feet bgs denotes feet below ground surface.
[b]TBD denotes to be determined

Table VII - 3

Primary and QA/QC Soil Samples to be Collected from Acid Area No. 1
Site Investigation of Acid Areas
Former Plum Brook Ordnance Works, Sandusky, Ohio

Soil Sample Identification	Soil boring Identification	Sample Depth[a] (feet bgs)	QA/QC sample Quantity		
			FD/FS	MS/MSD	FB
PBOW-98-SO-AA1-SB01-6010-(depth)	AA1-SB-01	0 -1			
PBOW-98-SO-AA1-SB01-6020-(depth)		9-10	X		
PBOW-98-SO-AA1-SB02-6030-(depth)	AA1-SB-02	0 -1			
PBOW-98-SO-AA1-SB02-6040-(depth)		9-10		X	
PBOW-98-SO-AA1-SB03-6050-(depth)	AA1-SB-03	0 -1			
PBOW-98-SO-AA1-SB03-6060-(depth)		9-10			X
PBOW-98-SO-AA1-SB04-6070-(depth)	AA1-SB-04	0 -1			
PBOW-98-SO-AA1-SB04-6080-(depth)		9-10			
PBOW-98-SO-AA1-SB05-6090-(depth)	AA1-SB-05	0 -1			
PBOW-98-SO-AA1-SB05-6100-(depth)		9-10			
PBOW-98-SO-AA1-SB06-6110-(depth)	AA1-SB-06	0 -1			
PBOW-98-SO-AA1-SB06-6120-(depth)		9-10			
PBOW-98-SO-AA1-SB07-6130-(depth)	AA1-SB-07	0 -1			
PBOW-98-SO-AA1-SB07-6140-(depth)		9-10			
PBOW-98-SO-AA1-SB08-6150-(depth)	AA1-SB-08	0 -1			
PBOW-98-SO-AA1-SB08-6160-(depth)		9-10			
PBOW-98-SO-AA1-SB09-6170-(depth)	AA1-SB-09	0 -1			
PBOW-98-SO-AA1-SB09-6180-(depth)		9-10			
PBOW-98-SO-AA1-SB10-6190-(depth)	AA1-SB-10	0 -1			
PBOW-98-SO-AA1-SB10-6200-(depth)		9-10			
PBOW-98-SO-AA1-SB11-6210-(depth)	AA1-SB-11	0 -1			
PBOW-98-SO-AA1-SB11-6220-(depth)		9-10			
PBOW-98-SO-AA1-SB12-6230-(depth)	AA1-SB-12	0 -1			
PBOW-98-SO-AA1-SB12-6240-(depth)		9-10			
PBOW-98-SO-AA1-SB13-6250-(depth)	AA1-SB-13	0 -1			
PBOW-98-SO-AA1-SB13-6260-(depth)		9-10			
PBOW-98-SO-AA1-SB14-6270-(depth)	AA1-SB-14	0 -1			
PBOW-98-SO-AA1-SB14-6280-(depth)		9-10			
PBOW-98-SO-AA1-SB15-6290-(depth)	AA1-SB-15	0 -1			
PBOW-98-SO-AA1-SB15-6300-(depth)		9-10			

[a]Subsurface soil sampling depth is tentative and exact depth will be determined during sampling based on lithology and soil vapor monitoring.

bgs - Below ground surface.
FB - Field blank.
FD/FS - Field duplicate/field split.
MS/MSD - Matrix spike/matrix spike duplicate
QA/QC - Quality assurance/quality control.

Table VII - 4

Primary and QA/QC Soil Samples to be Collected from Acid Area No. 2
Site Investigation of Acid Areas
Former Plum Brook Ordnance Works, Sandusky, Ohio

Soil Sample Identification	Soil boring Identification	Sample Depth[a] (feet bgs)	QA/QC sample Quantity		
			FD/FS	MS/MSD	FB
PBOW-98-SO-SO-AA2-SB01-6310-(depth)	AA2-SB-01	0 -1	X		
PBOW-98-SO-SO-AA2-SB01-6320-(depth)		9-10			
PBOW-98-SO-SO-AA2-SB02-6330-(depth)	AA2-SB-02	0 -1			
PBOW-98-SO-SO-AA2-SB02-6340-(depth)		9-10		X	
PBOW-98-SO-SO-AA2-SB03-6350-(depth)	AA2-SB-03	0 -1			
PBOW-98-SO-SO-AA2-SB03-6360-(depth)		9-10			X
PBOW-98-SO-SO-AA2-SB04-6370-(depth)	AA2-SB-04	0 -1			
PBOW-98-SO-SO-AA2-SB04-6380-(depth)		9-10			
PBOW-98-SO-SO-AA2-SB05-6390-(depth)	AA2-SB-05	0 -1			
PBOW-98-SO-SO-AA2-SB05-6400-(depth)		9-10			
PBOW-98-SO-SO-AA2-SB06-6410-(depth)	AA2-SB-06	0 -1			
PBOW-98-SO-SO-AA2-SB06-6420-(depth)		9-10			
PBOW-98-SO-SO-AA2-SB07-6430-(depth)	AA2-SB-07	0 -1			
PBOW-98-SO-SO-AA2-SB07-6440-(depth)		9-10			
PBOW-98-SO-SO-AA2-SB08-6450-(depth)	AA2-SB-08	0 -1			
PBOW-98-SO-SO-AA2-SB08-6460-(depth)		9-10			
PBOW-98-SO-AA2-SB09-6470-(depth)	AA2-SB-09	0 -1			
PBOW-98-SO-AA2-SB09-6480-(depth)		9-10			
PBOW-98-SO-AA2-SB10-6490-(depth)	AA2-SB-10	0 -1			
PBOW-98-SO-AA2-SB10-6500-(depth)		9-10			
PBOW-98-SO-AA2-SB11-6510-(depth)	AA2-SB-11	0 -1			
PBOW-98-SO-AA2-SB11-6520-(depth)		9-10			
PBOW-98-SO-AA2-SB12-6530-(depth)	AA2-SB-12	0 -1			
PBOW-98-SO-AA2-SB12-6540-(depth)		9-10			
PBOW-98-SO-AA2-SB13-6550-(depth)	AA2-SB-13	0 -1			
PBOW-98-SO-AA2-SB13-6560-(depth)		9-10			
PBOW-98-SO-AA2-SB14-6570-(depth)	AA2-SB-14	0 -1			
PBOW-98-SO-AA2-SB14-6580-(depth)		9-10			
PBOW-98-SO-AA2-SB15-6590-(depth)	AA2-SB-15	0 -1			
PBOW-98-SO-AA2-SB15-6600-(depth)		9-10			

[a]Subsurface soil sampling depth is tentative and exact depth will be determined during sampling based on lithology and soil vapor monitoring.

bgs - Below ground surface.
FB - Field blank.
FD/FS - Field duplicate/field split.
MS/MSD - Matrix spike/matrix spike duplicate
QA/QC - Quality assurance/quality control.

Figure VII-5. A summary of soil sample designations and QA/QC samples to be collected is provided in Table VII-5.

Soil boring SB-08, SB-09, and SB-10 will be placed in the southern portion of the AA3 in the vicinity of the former evaporator (Building 908), the fuel oil tanks, and the coal yard (next to Building 901), respectively. These borings will allow initial assessment of the soil contamination, if any, that are associated with these facilities. Prior to collecting samples at SB-08, SB-09, and SB-10, the IT site coordinator will contact a NASA PBS representative to confirm that no NASA testing is being conducted in the area since these three locations are within the exclusion zone of the NASA "K site" test facility.

VII.4.3.4 Maintenance Shop and Power Substation Area

The placement of soil borings at the Maintenance Shop (Building 809) Area and Power Substation (east of Building 808) is based upon review of the original site structure location maps and areas of potential concern. These two areas are associated with the operation of AA3. A summary of soil sample designations and QA/QC samples to be collected is provided in Table VII-5. Figure VII-5 shows the proposed soil boring locations.

VII.4.3.5 Background Soil Borings

The placement of background soil borings is based upon previous background soil boring locations installed by Dames & Moore, Inc. (1996) in areas thought to be unaffected by former DOD and/or NASA activities, and in locations that will fill spatial data gaps. All background soil borings are located along the PBOW facility boundary where soils are believed to be least affected by PBOW operation and by post PBOW activities.

Surface and subsurface soil background levels will be established based exclusively on U.S. Environmental Protection Agency (EPA) guidance (1989, 1992). Different lithological units will be considered if possible. The specific statistical methodology will be selected based on the data and specific comparison type for which the background data will be used.

Background data sets will first be analyzed for distribution using the Shapiro-Wilk test for normality. A maximum of three data sets will be analyzed. The Shapiro-Wilk test is recommended as a superior alternative to the Chi-square test for testing normality of the data (EPA, 1992). The Shapiro-Wilk test is based on the premise that if a set of data is normally distributed, the ordered values should be highly correlated with corresponding quantiles taken from a normal

Table VII - 5

Primary and QA/QC Soil Samples to be Collected from Acid Area No. 3, Maintenance Shop, and Power Substation Site Investigation of Acid Areas Former Plum Brook Ordnance Works, Sandusky, Ohio

Soil Sample Identification	Soil boring Identification	Sample Depth[a] (feet bgs)	QA/QC Sample Quantity		
			FD/FS	MS/MSD	FB
Acid Area No. 3					
PBOW-98-SO-AA3-SB01-6610-(depth)	AA3-SB-01	0 -1			
PBOW-98-SO-AA3-SB01-6620-(depth)		9-10	X		
PBOW-98-SO-AA3-SB02-6630-(depth)	AA3-SB-02	0 -1			
PBOW-98-SO-AA3-SB02-6640-(depth)		9-10		X	
PBOW-98-SO-AA3-SB03-6650-(depth)	AA3-SB-03	0 -1			
PBOW-98-SO-AA3-SB03-6660-(depth)		9-10			X
PBOW-98-SO-AA3-SB04-6670-(depth)	AA3-SB-04	0 -1			
PBOW-98-SO-AA3-SB04-6680-(depth)		9-10			
PBOW-98-SO-AA3-SB05-6690-(depth)	AA3-SB-05	0 -1			
PBOW-98-SO-AA3-SB05-6700-(depth)		9-10			
PBOW-98-SO-AA3-SB06-6710-(depth)	AA3-SB-06	0 -1			
PBOW-98-SO-AA3-SB06-6720-(depth)		9-10			
PBOW-98-SO-AA3-SB07-6730-(depth)	AA3-SB-07	0 -1			
PBOW-98-SO-AA3-SB07-6740-(depth)		9-10			
PBOW-98-SO-AA3-SB08-6750-(depth)	AA3-SB-08	0 -1			
PBOW-98-SO-AA3-SB08--6760-(depth)		9-10			
PBOW-98-SO-AA3-SB09-6770-(depth)	AA3-SB-09	0 -1			
PBOW-98-SO-AA3-SB09-6780-(depth)		9-10			
PBOW-98-SO-AA3-SB10-6790-(depth)	AA3-SB-10	0 -1			
PBOW-98-SO-AA3-SB10-6800-(depth)		9-10			
PBOW-98-SO-AA3-SB11-6810-(depth)	AA3-SB-11	0 -1			
PBOW-98-SO-AA3-SB11-6820-(depth)		9-10			
PBOW-98-SO-AA3-SB12-6830-(depth)	AA3-SB-12	0 -1			
PBOW-98-SO-AA3-SB12-6840-(depth)		9-10			
PBOW-98-SO-AA3-SB13-6850-(depth)	AA3-SB-13	0 -1			
PBOW-98-SO-AA3-SB13-6860-(depth)		9-10			
PBOW-98-SO-AA3-SB14-6870-(depth)	AA3-SB-14	0 -1			
PBOW-98-SO-AA3-SB14-6880-(depth)		9-10			
PBOW-98-SO-AA3-SB15-6890-(depth)	AA3-SB-15	0 -1			
PBOW-98-SO-AA3-SB15-6900-(depth)		9-10			
Maintenance Shop Area					
PBOW-98-SO-MNT-SB01-6910-(depth)	MNT-SB-01	0 -1			
PBOW-98-SO-MNT-SB01-6920-(depth)		9-10	X		
PBOW-98-SO-MNT-SB02-6930-(depth)	MNT-SB-02	0 -1			
PBOW-98-SO-MNT-SB02-6940-(depth)		9-10		X	
PBOW-98-SO-MNT-SB03-6950-(depth)	MNT-SB-03	0-1			
PBOW-98-SO-MNT-SB03-6960-(depth)		9-10			X
Power Substation					
PBOW-98-SO-PSB-SS01-6970-(depth)	PSB-SS-01	0-1	X	X	X
PBOW-98-SO-PSB-SS02-6980-(depth)	PSB-SS-02	0-1			

[a]Subsurface soil sampling depth is tentative and exact depth will be determined during sampling based on lithology and soil vapor monitoring.

bgs - Below ground surface.
FB - Field blank.
FD/FS - Field duplicate/field split.
MS/MSD - Matrix spike/matrix spike duplicate
QA/QC - Quality assurance/quality control.

distribution (Shapiro and Wilk, 1965). If the data set fails tests for normality, or lognormality, it will be assumed to be a nonparametric distribution.

After the data set has been tested for a distribution, it will be tested for statistical outliers (EPA, 1989). A statistical outlier is an observation that does not belong to the same population from which the rest of the data set was drawn. Outlier testing on analytical data ensures that background and baseline summary statistics are not biased towards higher values.

Following the distribution analysis and outlier testing, the following statistics will be compiled on the data sets:

- Frequency of detection
- Range of detected concentrations
- Mean concentrations
- Standard deviations
- 95 percent upper confidence limit (UCL) on the mean
- 95 percent UCL of the data set
- Range of detection limits.

If statistical analysis indicates data sets are similar, they will be combined to form one or more background distributions. Summary statistics will be based on the best fit distribution after outliers are eliminated from the data set. In addition to summary statistics on the background and baseline data sets, analysis of variance procedures (EPA, 1989) will be used in the comparison of site data with background data to determine if site data and background/baseline data are statistically distinguishable. Lacking definitive criteria for determining the extent of contamination for a given medium at a contaminated site, the 95 percent UCL on background soil samples can be used as a screening concentration.

Other available site-specific background soil sampling data will be compared to the background ranges established through the current background soil sampling effort. If distributions and ranges are found to be similar, then some portion of existing site-specific sampling data may be incorporated into the current study data set.

A summary of soil sample designations and QA/QC samples to be collected is provided in Table VII-6. Figure VII-6 shows the proposed background soil boring locations.

Table VII - 6

Primary and QA/QC Soil Samples to be Collected from Background Locations
Site Investigation of Acid Areas
Former Plum Brook Ordnance Works, Sandusky, Ohio

Background Soil Sample Identification	Soil boring Identification	Sample Depth[a] (feet bgs)	QA/QC Sample Quantity		
			FD/FS	MS/MSD	FB
PBOW-98-SO-BCG-SB01-6990-(depth)	BCG-SB-01	0 -1			
PBOW-98-SO-BCG-SB01-7000-(depth)		9-10	X		
PBOW-98-SO-BCG-SB02-7010-(depth)	BCG-SB-02	0 -1			
PBOW-98-SO-BCG-SB02-7020-(depth)		9-10		X	
PBOW-98-SO-BCG-SB03-7030-(depth)	BCG-SB-03	0 -1			
PBOW-98-SO-BCG-SB03-7040-(depth)		9-10			X
PBOW-98-SO-BCG-SB04-7050-(depth)	BCG-SB-04	0 -1			
PBOW-98-SO-BCG-SB04-7060-(depth)		9-10			
PBOW-98-SO-BCG-SB05-7070-(depth)	BCG-SB-05	0 -1			
PBOW-98-SO-BCG-SB05-7080-(depth)		9-10			
PBOW-98-SO-BCG-SB06-7090-(depth)	BCG-SB-06	0 -1			
PBOW-98-SO-BCG-SB06-7100-(depth)		9-10			

[a]Subsurface soil sampling depth is tentative and exact depth will be determined during sampling based on lithology and soil vapor monitoring.

bgs - Below ground surface.
FB - Field blank.
FD/FS - Field duplicate/field split.
MS/MSD - Matrix spike/matrix spike duplicate
QA/QC - Quality assurance/quality control.

VII.4.3.6 Geotechnical Samples

Geotechnical samples will be collected to determine the geotechnical nature of the different unconsolidated lithological units. Four geotechnical samples representing significantly different soil materials will be obtained from each Acid Area. The sampling location and depth for each geotechnical sample will be determined by the IT field geologist based on visual inspection of soil materials.

Geotechnical samples will be collected using a thin-walled metal tube to recover relatively undisturbed soil sample from a boring location, following procedures described in ASTM D 1587-94. Briefly, a thin-walled metal tube (generally known as shelby tube) is pressed into the soil using a drill rig, removing the soil-filled tube, and sealing the ends to prevent the soil from being disturbed or losing moisture. Samples will be sent to the laboratory in sealed tube for moisture content, grain size distribution, Atterberg limits testing, and USCS classification.

VII.4.4 Boring Abandonment

Upon completion of soil sampling, soil borings will be abandoned by grouting from the bottom of the boring to ground surface. The type of grout to be used will be bentonite-cement slurry grout with approximately 5 percent bentonite powder and 95 percent Type 1 portland cement, mixed with 5 to 6 gallons of clean water. The IT field geologist will check the abandoned boring after 24 hours for any grout settlement depression and add more grout if necessary. Due to the shallow boring depth, use of a tremie pipe is optional.

VII.4.5 Land Survey

Soil boring locations will be surveyed by a licensed land surveyor to establish coordinates and elevation of soil borings. All elevation will be surveyed to the closest 0.01 foot and referenced to the 1988 North American Vertical Datum. Horizontal coordinates will be surveyed to the closest 1 foot and referenced to the Ohio State Plane Coordinate System.

VII.5.0 Sample Analysis and Decontamination Procedures

VII.5.1 Sample Number System

The sample numbering system to be used during this investigation will conform to the USACE Nashville District's numbering convention. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number

consists of a group of letters and numbers, separated by hyphens. The numbering system to be used for SI is described as follows:

Project Code	Year	Sample Type[a]	Site Identification[b]	Boring Number	Sample Number	Sample Depth (ft)
PBOW	1998	XX	XXX	XXXX	XXXX	XX-XX

[a]Sample types:

ER - Equipment rinsate sample
FB - Field blank
FD - Field duplicate sample
FS - Field split sample
MD - Matrix spike duplicate sample
MS - Matrix spike sample
SO - Soil.

[b]Site identifications for the sampling areas are:

AA1 - Acid Area No. 1
AA2 - Acid Area No. 2
AA3 - Acid Area No. 3
MNT- Maintenance Shop Area
PSB - Power Substation
BCG - Background Location.

"PBOW-98-SO-AA1-SB01-0560- 5'-6"' signifies that this soil sample is collected from soil boring SB01 in AA1 with a sample number of 0560. The sample identification number will be recorded by the IT field geologist in the field activity daily log, boring log, and sample collection log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

VII.5.2 Analytical Program

The analytical program has been designed to acquire sufficient and defensible data to determine whether or not soils in the investigated areas exhibit impact from past land use.

All soil samples will be analyzed for target compound list (TCL) VOCs, TCL SVOCs, and target analyte list (TAL) metals as summarized in Table VII-7. In addition, soil samples collected from selected areas will be analyzed for PCBs (surface samples only), nitroaromatic compounds (TNT acid tank and background samples only), and inorganic constituents such as nitrate and sulfate as well as pH (excluding samples from Maintenance Shop and Power Substation areas) as specified

Table VII -7

Summary of Soil Analytical Parameters and Methods
Site Investigation of Acid Areas
Former Plum Brook Ordnance Works, Sandusky, Ohio

Analytical Parameters	Analytical Method
TCL Volatile Organic Compounds	EPA SW-846 8260A[a]
TCL Semivolatile Organic Compounds	EPA SW-846 3540B/8270B[a]
TAL Metals	SW-846 3050A/6010A[b] for Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn 7471A[a] for Hg
PCBs	EPA SW-846 3540B/8081
Nitroaromatic Compounds	EPA SW-846/8330[c]
pH	EPA SW-846 9045B
Nitrate	EPA SW-846 9056
Sulfate	EPA SW-846 9056

[a]Test Method for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, update II September 1994.
[b]Test Method for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, update I July 1992.
[c]Test Method for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, Revision 1 December 1990.

PCB - Polychlorinated biphenyl.
TCL - Target compound list.
TAL - Target analyte list.

Note: For analytical reporting limits associated with each method, please refer to the site-wide QAPP (IT, 1996).

in Table VII-1. Laboratory QC procedures and data quality requirements are specified in and referenced to appropriate sections of the QAPP (IT, 1996b).

VII.5.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SAP (IT, 1996a) and will be followed during the current investigation of the Acid Areas, Maintenance Shop, Power Substation, and background sample locations. The IT field coordinator must contact Plum Brook Station for access to a potable water source for decontamination use. The following summarizes decontamination procedures for sampling equipment before site entry, between borings, and before site departure:

Equipment used not in contact with analytical samples:

- Steam-rinse with potable water, or wash and scrub using a brush with nonphosphate detergent, and then rinse with potable water.

Equipment used to collect analytical samples:

- Wash and scrub using a brush with nonphosphate detergent.
- Rinse with potable water.
- Rinse with deionized water (American Society for Testing and Materials Type II water).
- Rinse with methanol.
- Final rinse with deionized water. The volume of water used will be at least five times greater than the volume of methanol used.
- Air dry.
- Wrap in aluminum foil.

VII.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned containers from I-CHEM, made of materials recommended by the EPA in Title 40, Code of Federal Regulations, Part 136 and SW-846 (3rd Edition). Sample containers and preservatives/preservation methods are sum-

marized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that it is received by the laboratory.

Samples for geotechnical analysis need not be chemically preserved; however, the samples will be properly sealed to prevent moisture loss and will be packaged so that the material is adequately preserved in its natural state. Geotechnical samples will be placed in sample containers that will be sealed with three wraps of electrical type or duct tape around the lid lip, or in double plastic bags.

Samples for chemical analysis will be placed in coolers as soon as possible after collection and will be packed so as to minimize the possibility of container breakage by using Vermiculite or styrofoam peanuts to fill void spaces in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4°C and maintained at that temperature by means of blue ice or double-bagged ice from the time the shipping carton is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by a next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

Completed AR/COC Records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or (for QA samples)

USACE Northwest Division Laboratory
CENWO-LB
Attention: Mr. Douglas Taggart
420 South 18th Street
Omaha, NE 68102-2586
Telephone: (402) 444-4300

VII.7.0 Investigation-Derived Waste Management Plan

Anticipated IDW during field activities includes excess soil samples, decontamination fluid, and disposable personal protective equipment. Detailed procedures of IDW management is provided in Chapter 8.0 of the SAP (IT, 1996a). The following is a brief summary of the procedures for handling IDW.

VII.7.1 Surface Soil

Residual surface soil will be used as backfill or spread out on the surface at the point of origin.

VII.7.2 Drill Cuttings From Borings

Soil cuttings from soil borings and excess soil samples will be returned immediately after sample collection to the point of origin (backfill).

VII.7.3 Decontamination Fluid

Decontamination fluid, including wash water, nonphosphate soapy water, and final rinse water, will be kept in plastic tubs during the decontamination process, and will be placed in 55-gallon drums upon completion of field sampling. Decontamination fluid containing small quantities of solvents such as methanol or hexane will be collected in metal pans for evaporation. IDW drums will be labeled to indicate project name, date collected, and contents and stored on pallets in the staging area located east of the Building 9201 on Pentolite Road.

VII.8.0 Project Schedule

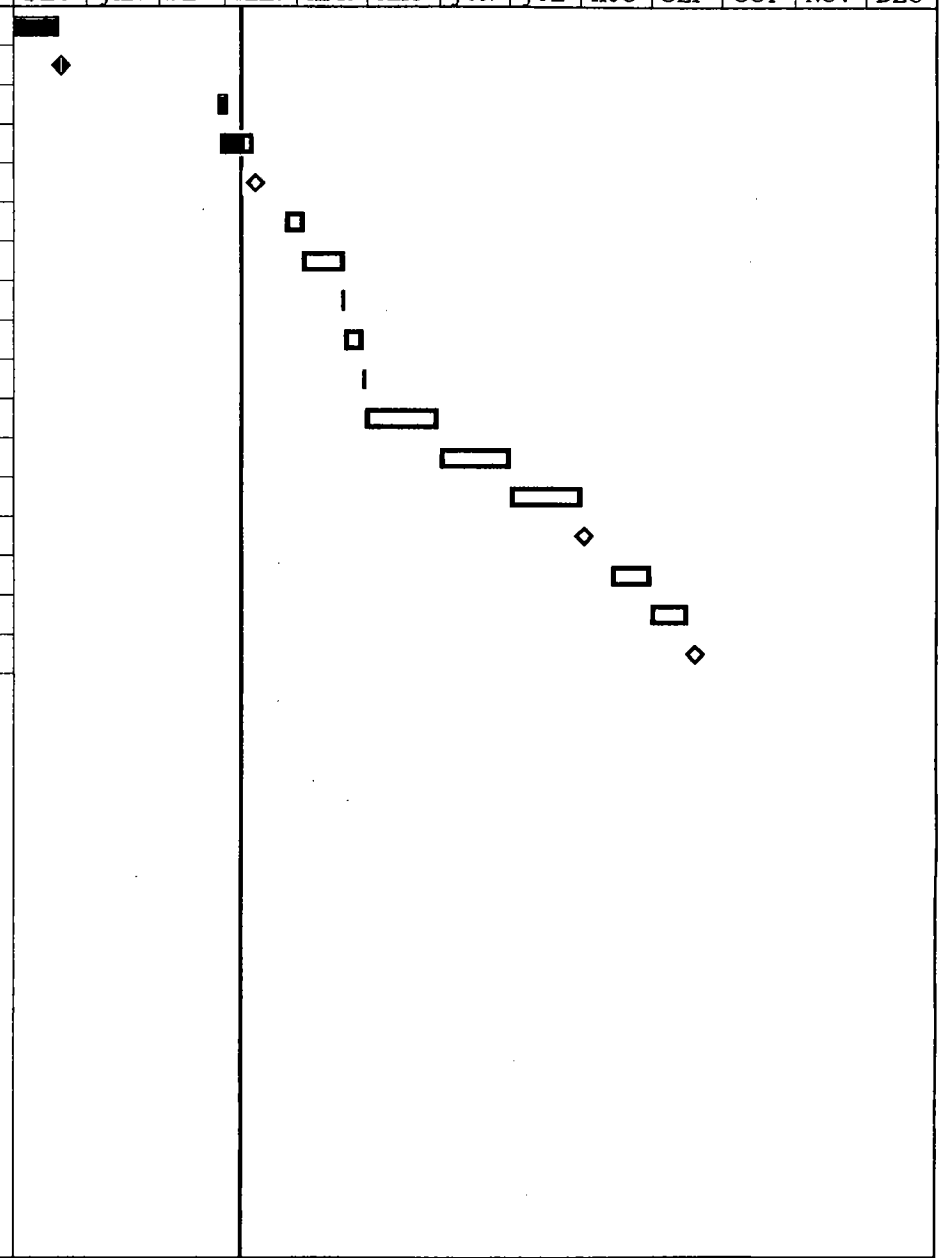
The project schedule is provided in Table VII-8.

VII.9.0 References

Dames & Moore, 1996, ***Draft Report, Site-wide Groundwater Investigation, Plum Brook Ordnance Works***, May 1996.

IT Corporation (IT), 1996a, ***Site-Wide Sampling and Analysis Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
Draft SSAP & SSHP	1DEC97A	19DEC97A	30
Submittal of Draft SSAP/SSHP		20DEC97A	0
Receive Comments	26FEB98A	1MAR98A	1
Revise SSAP/SSHP	27FEB98A	12MAR98	14
Submittal of Final SSAP/SSHP		13MAR98	0
Receive Approval of SSAP/SSH	27MAR98	3APR98	8
Field Preparation/Subcontrac	3APR98	20APR98	18
Mobilization to PBOW	20APR98	20APR98	1
Soil Borings & Soil Sampling	21APR98	28APR98	8
Demobilization	29APR98	29APR98	1
Laboratory Analysis	30APR98	30MAY98	31
Data Validation	1JUN98	30JUN98	30
Draft SI Report	1JUL98	31JUL98	31
Submittal of Draft SI Report		1AUG98	0
Receive Comments	14AUG98	30AUG98	17
Revise SI Report	31AUG98	15SEP98	16
Submittal of Final SI Report		18SEP98	0



Plot Date 9MAR98
Data Date 8MAR98
Project Start 30JUL97
Project Finish 18SEP98

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

NCOB PBAA

Sheet 1 of 1

USACE - Nashville District
Proposed Schedule
PBOW - Acid Areas

Table VII-8

Date	Revision	Checked	Approved

IT Corporation (IT), 1996b, ***Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1996c, ***Site-Wide Safety and Health Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

Shapiro, S. S. and Wilk, M. B., 1965, "An Analysis of Variance Test for Normality (Complete Samples)," ***Biometrika***, 52:591-611.

U.S. Army Corps of Engineers (USACE), Nashville District, 1997, ***Scope of Work, Site Investigation of Acid Areas, Former Plum Brook Ordnance Works (PBOW), Sandusky, Ohio,*** August 1997.

U.S. Environmental Protection Agency (EPA), 1993, ***Data Quality Objectives Process for Superfund***, EPA/J40/G-93/071, Publication 9377.9.01, September 1993.

U.S. Environmental Protection Agency (EPA), 1992, ***Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance***, July 1992, EPA/530-R-93-003.

U. S. Environmental Protection Agency (EPA), 1989, ***Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance***, February 1989, EPA/530/SW-89/026.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CELRN-EP-R-M

Project Description: Site Investigation of Acid Areas, Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract Number: DACA62-94-D-0030 Delivery Order Number: 0030

Project Number: 773206 Task / Phase Number: 03000000

Document Type	Identify specific section or segment covered by this checkprint	Document Origin
☐ Technical / Cost Proposal		☐ Originator Developed
☐ RFP		☒ Edited Standard
☐ Contract / Subcontract		☐ Client Furnished
☐ SAP, SSAP, CDAP, or QAPP		
☒ SHP or SSHP	SSHP, Revision 1, March 1998	**Document Status**
☐ _____ Report		☐ Preliminary
☐ Risk Assessment / Evaluation		☐ Internal Draft
☐ Specifications & Plans		☐ Draft
☐ Design Calculations		☐ Draft Final
☐ Tables		☒ Final
☐ Drawings / Figures		☐ Other: _____
☐ Other: _____		

	Required Person	Signature	Date
Originator	M. Smith	M Smith	3/13/98
Checker			
Backchecker			
Updater			
Rechecker			
Technical Reviewer	H. Pullum	For HHP	3-13-98
Technical Reviewer			
Technical Reviewer			
Technical Reviewer			
Quality Assurance Officer	T. Smith	Terri Rafferson for T. Smith	3-13-98
Project Manager	M. Spangberg		3-13-98
Program Manager	D. Burton		3-13-98

Attachment VII

Site-Specific Safety And Health Plan
Site Investigation of Acid Areas
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

Commander
U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

IT Project No. 773206
Control Copy No. ____

Revision 1

March 1998

This Site-Specific Safety and Health Plan Attachment must be used in conjunction with the Site-wide Safety and Health Plan for Site Investigations and Groundwater Investigations at the former Plum Brook Ordnance Works, dated July 1997.

Reviews and Approvals

Project Manager
IT Corporation

3/13/98
Date

Melissa G. Smith

Health and Safety Manager
IT Corporation

3/13/98
Date

Site Coordinator
IT Corporation

3/13/98
Date

Site Safety and Health Officer
IT Corporation

Date

Distribution List

Control Copy Nos. 1 through 15	Mrs. Linda Hejazi
Control Copy No. 16	D. Burton
Control Copy No. 17	M. Spangberg
Control Copy No. 18	S. Muffler
Control Copy No. 19	G. Yu
Control Copy No. 20	K. Arrant
Control Copy No. 21	Project File
Control Copy Nos. 22 and 23	Field personnel

Plum Brook Project Emergency Contacts

Note: All field crews will be provided 2-way radios from the Plum Brook Communications Center. In the event of an emergency, contact the Plum Brook Communications Center by radio and they will contact and coordinate emergency response personnel.

Fire Department	(419) 627-5837
Ambulance	911
Police Department	(419) 627-5863
Providence Hospital	(419) 621-7000
National Response Center	(800) 424-8802
Poison Control Center	(800) 462-0800
Ohio EPA Emergency Spill Number	(800) 282-9378
Don Burton, IT Program Manager	(423) 690-3211
Mike Spangberg, IT Project Manager	(423) 690-3211
George Yu, IT Site Manager	(423) 690-3211
Melissa Smith, IT H&S Manager	(423) 690-3211
Dr. Elaine Theriault, IT Occupational Physician	(800) 299-3674

The following personnel have read and fully understand the contents of this Safety and Health Plan and further agree to the requirements contained here.

Name	Affiliation	Date	Signature

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VII.1.0 Site Work Plan Summary

Project Objective. The objective of this investigation at the former Plum Brook Ordnance Works, Sandusky, Ohio, is to collect soil samples to address potential contamination of soils in the Acids Area.

Project Tasks

- Surveying
- Surface and subsurface soils sampling and soils borings
- Disposal of investigation-derived wastes.

Personnel Requirements. Up to 15 employees

Note: All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the site-wide safety and health plan (SHP) for site investigations at Plum Brook, and be familiar with the requirements of this site-specific SHP (SSHP).

Project Schedule. Late Spring 1998.

VII.2.0 Site Characterization and Analysis

VII.2.1 Anticipated Hazards

The Activity Hazard Analysis in Chapter 5.0 contains project specific practices utilized to reduce or eliminate anticipated site hazards. The Job Hazard Analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

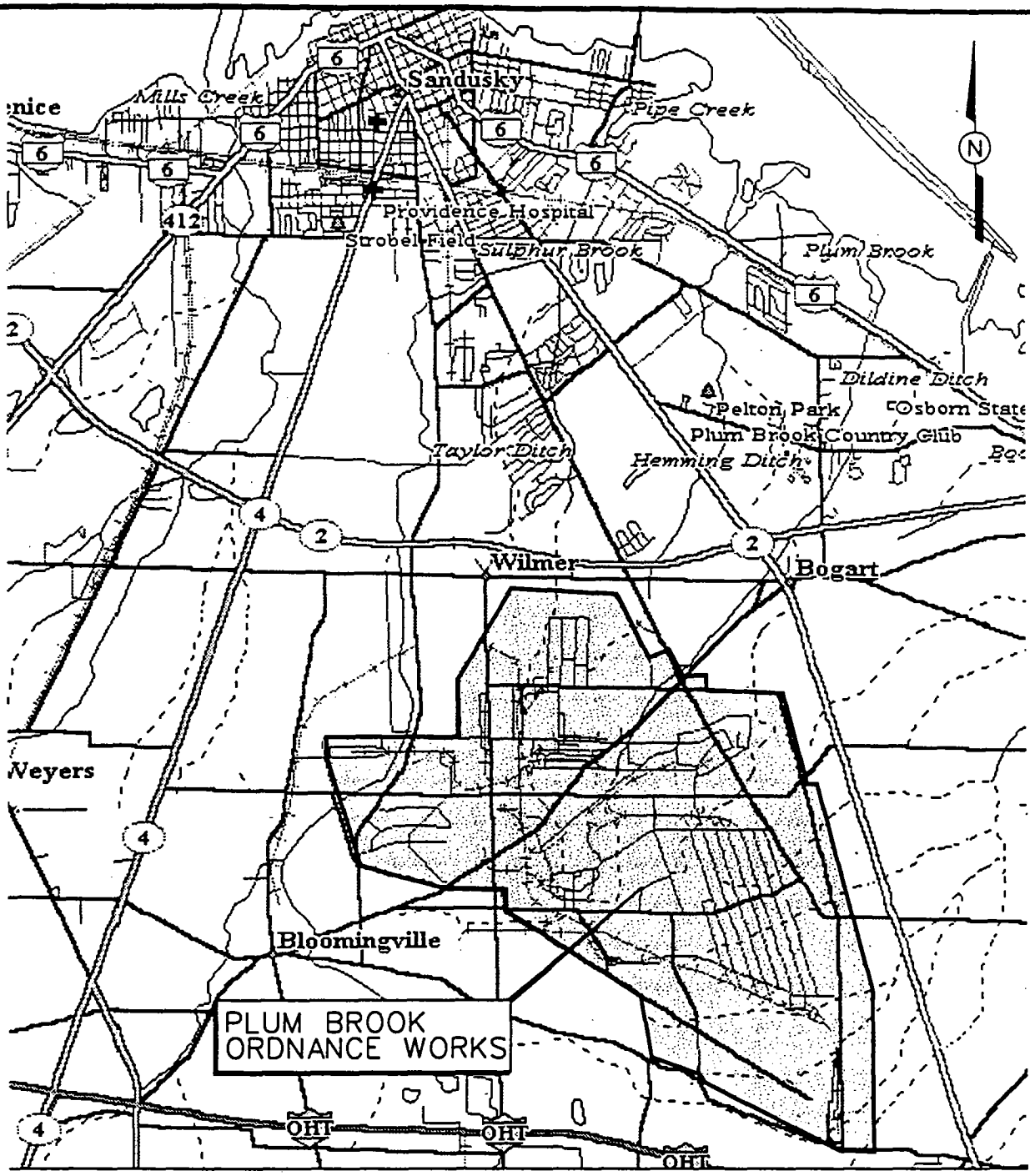
No previous investigations have been performed at the Acids Area, therefore, no analytical data was available. The potential chemical contaminants of concern include nitric acid and sulfuric acid. Nitroaromatic contamination is not anticipated in soils, however, groundwater may contain trace amounts of nitroaromatic compounds (2,4-dinitrotoluene, 2,6-dinitrotoluene, and 2,4,6-trinitrotoluene).

Table VII.2-1 contains chemicals anticipated and chemicals to be used during project activities.

VII.2.2 General Site Information

Acid Area No.1 (AA1) is located south of the NASA Shipping and Receiving building (NASA Building No. 9209) and is bordered on the east by Taylor Road. Acid Area No.2 (AA2) is located between Patrol Road and Campbell Street on the northwest corner of the facility. Acid Area No. 3 (AA3) is located north of Fox Road and is bordered on the east by Ransom Road in the northwest portion of the facility. Two other areas for investigation are associated with AA3: the Maintenance Shop (Building No. 809) is located in the west central portion of AA3 and the Power Substation is located across Ransom Road and east of Building No. 808. All targeted investigation areas are readily accessible by vehicle.

Figure VII.1-1 shows the location of the designated hospital in relation to the site. Figures VII.1-2 through VII.1-5 show the sites, sample locations, and work zones.



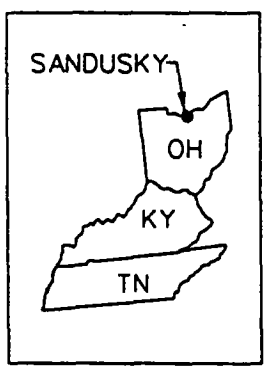


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FIGURE VII.1 –1
SITE AND HOSPITAL
LOCATION MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 5/8/97 | DATE LAST REV.: 23 JUL | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR: M. SPANGBERG | DWG NO.: \771484ES.004
DRAWN BY: R. KNIGHT | DRAWN BY: RKNIGHT | ENGR. CHCK. BY: M. SPANGBERG | PROJ. MGR. D. BURTON | PROJ. NO. 771481

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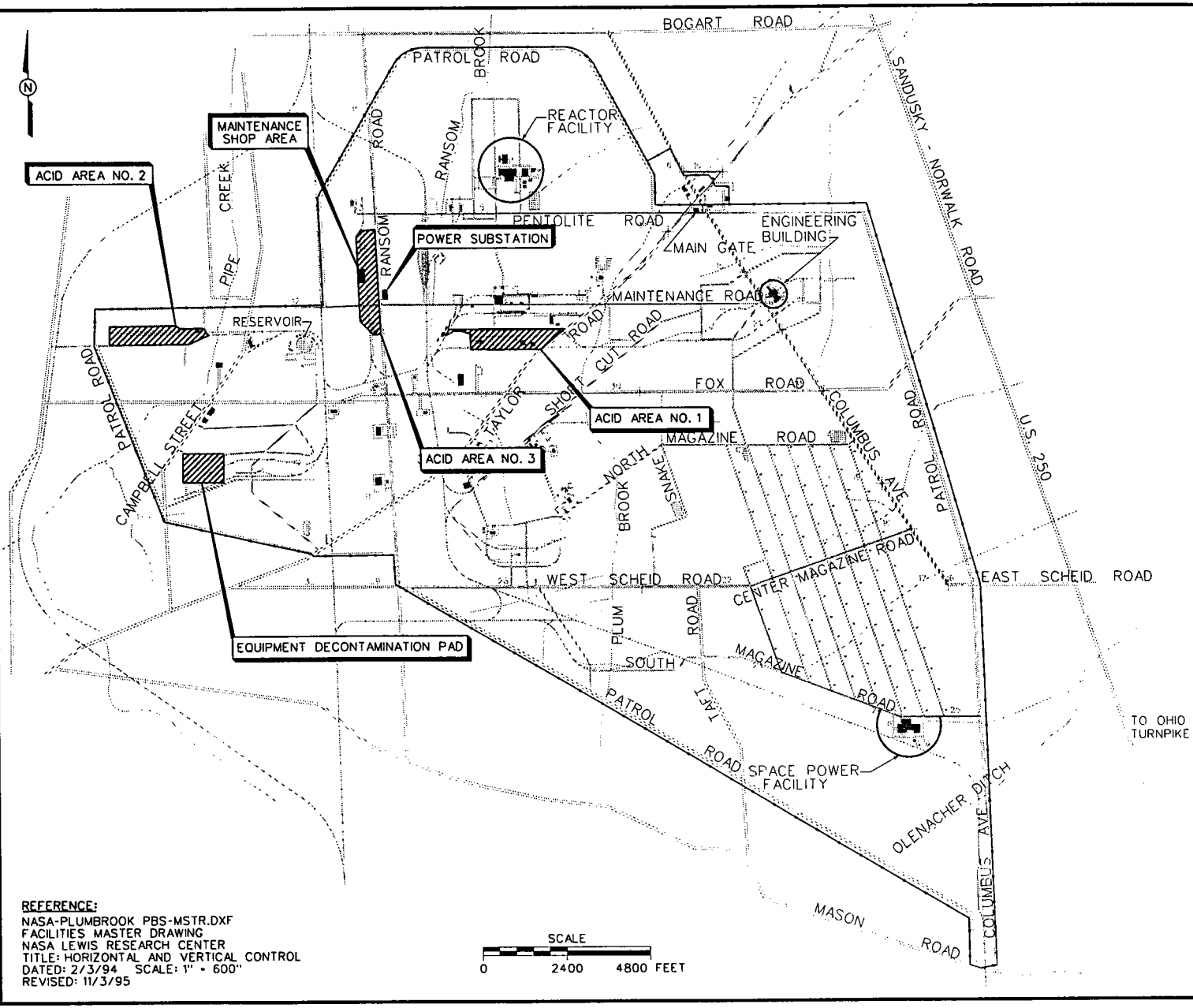

LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- INVESTIGATION AREA

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

FIGURE VII.1-2
LOCATIONS OF ACID AREAS AND OTHER INVESTIGATIVE AREAS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 03/12/98	DATE LAST REV.:	DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: M. SMITH	DWG. NO.: \773206es.007	12 MAR 98
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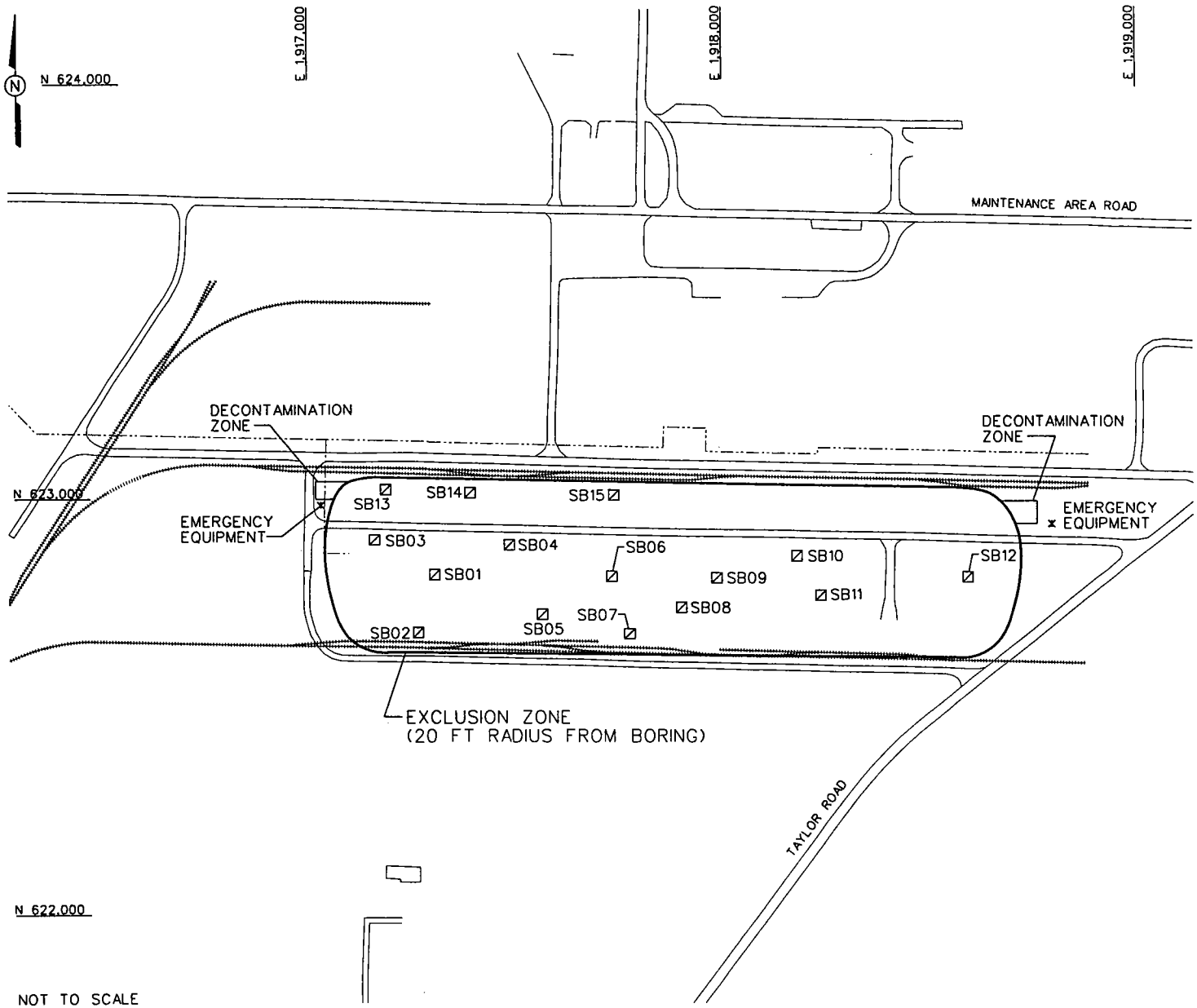

LEGEND:

- RAILROAD
- ROAD
- NATURAL GAS
- SB01 — PROPOSED SOIL BORING (PBOW-98-AA1-SB01)

FIGURE VII.1-3
ACID AREA NO. 1 SAMPLE LOCATIONS AND WORK ZONES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 03/12/98	DATE LAST REV.:	DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: M. SMITH	DWG. NO.:...\773206es.008
DRAWN BY: T. BRADSHAW	DRAWN BY:	ENGR. CHCK. BY: M. SMITH	PROJ. MGR.: SPANGBERG	PROJ. NO.: 773206

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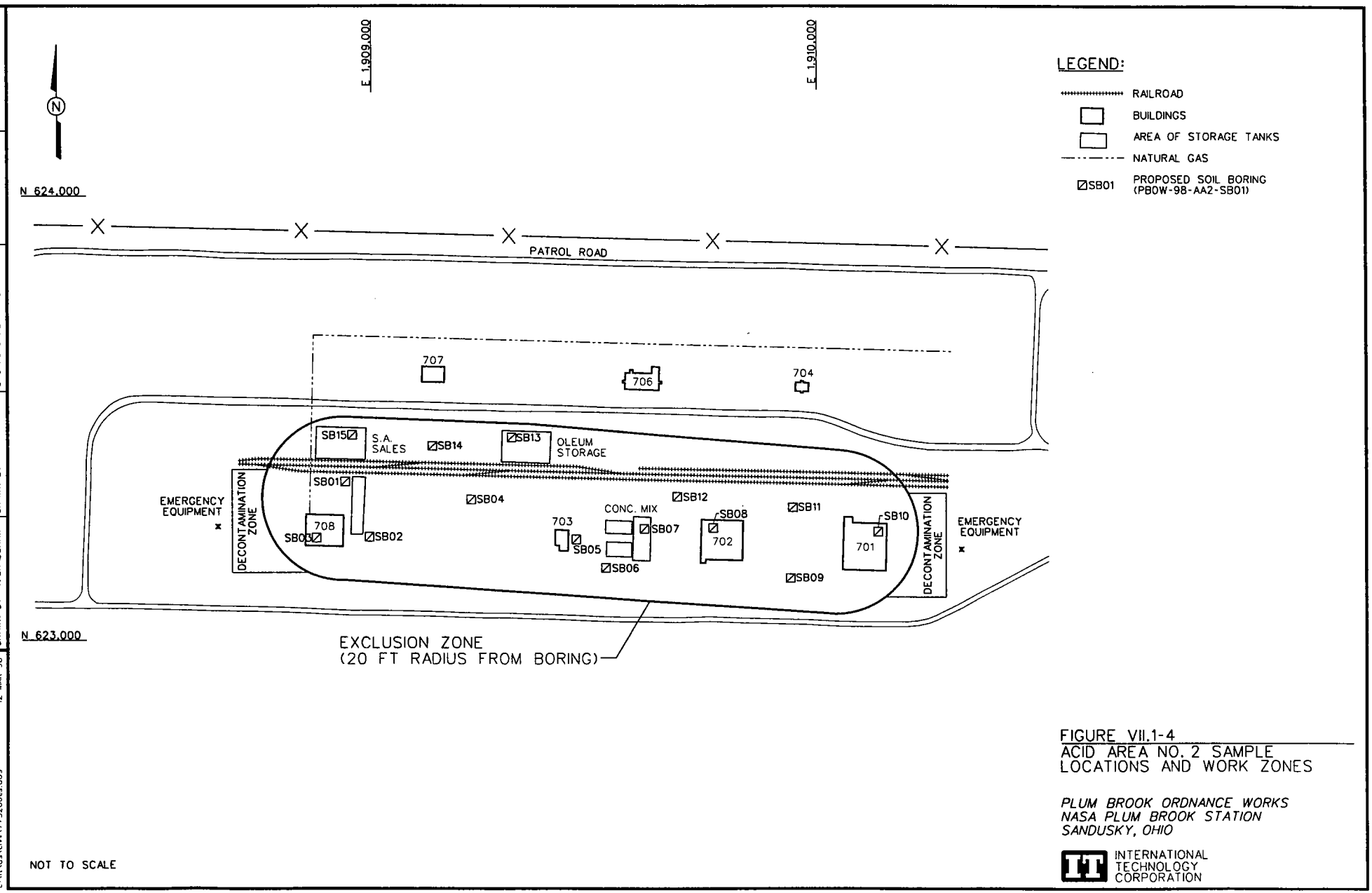

FIGURE VII.1-4
ACID AREA NO. 2 SAMPLE LOCATIONS AND WORK ZONES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 03/12/98 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: M. SMITH | DWG. NO.: ...\773206es.009
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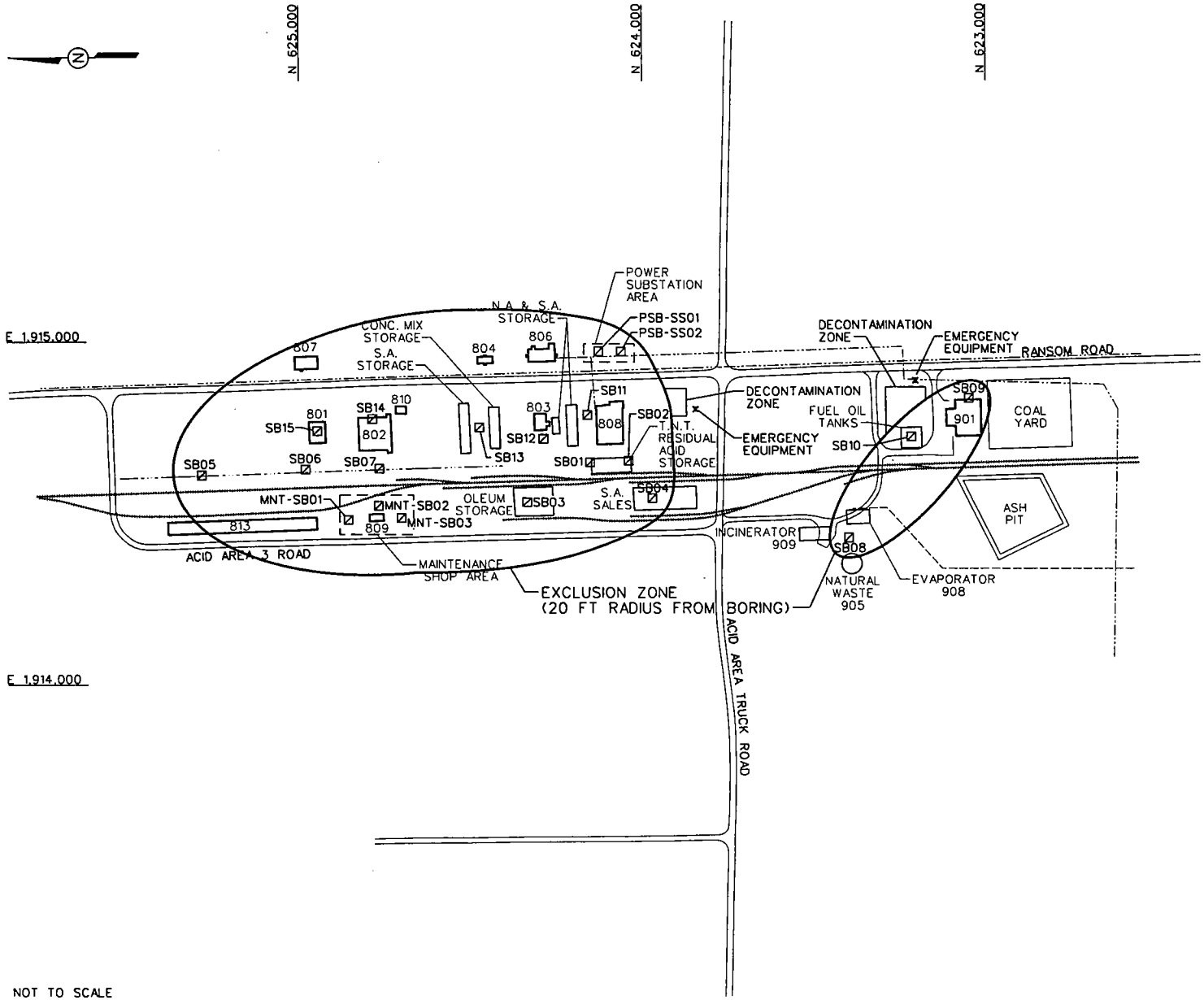

LEGEND:

- RAILROAD
- BUILDINGS
- AREA OF STORAGE TANKS
- NATURAL GAS
- RAW WATER
- EVAPORATOR LINES
- FORMER SEWER LINE
- SB01 — PROPOSED SOIL BORING (PBOW-98-AA3-SB01) (PBOW-98-MNT-SB01) (PBOW-98-PSB-SS01)

NOTE:

SB-05, -06, AND -07 ARE LOCATED ALONG THE FORMER SEWER LINE.

FIGURE VII.1-5
ACID AREA NO. 3 SAMPLE LOCATIONS AND WORK ZONES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 03/12/98 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: M. SMITH | DWG. NO.: ...\773206es.010
DRAWN BY: T. BRADSHAW | DRAWN BY: | ENGR. CHCK. BY: M. SMITH | PROJ. MGR.: SPANGBERG | PROJ. NO.: 773206

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Table VII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Physical Description	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Dinitrotoluene (DNT)	N/A	Characteristic odor	Inh Abs Ing Con	Orange-yellow solid.	Anoxia, cyanosis, anemia, jaundice; reproductive effects. Animal carcinogen.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/^{3} (skin) 0.2 mg/m^3 (skin) 1.5 mg/m^3 (skin)	- - -	PEL TLV REL	Ca [50 mg/m^3]
Gasoline [8006-61-9]	?	0.3 Characteristic odor	Inh Ing Con	Clear liquid.	Intoxication, headaches, blurred vision, dizziness, nausea; eye, nose, and throat irritation; potential kidney and other cancers. Carcinogenic.	Eye: Irrigate immediately (15 min) Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	300 ppm Ca, lowest feasible conc. (LOQ 15 ppm)	500 ppm	PEL TLV REL	?
Hydrogen chloride (hydrochloric acid) [7647-01-0]	10.16	0.255-10.06 Pungent irritating odor	Inh Ing Con	Colorless gas.	Mild irritation of the eyes, nose, and throat; drowsiness, dizziness, headache; dry, cracked skin.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention		C5 ppm C5 ppm C5 ppm	PEL TLV REL	50 ppm
Isopropyl alcohol (isopropanol) [67-63-0]	10.16	43 Rubbing alcohol odor	Inh Ing Con	Colorless liquid.	Mild irritation of the eyes, nose, and throat; drowsiness, dizziness, headache; dry, cracked skin.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	400 ppm 400 ppm 400 ppm	500 ppm 500 ppm 500 ppm	PEL TLV REL	2,000 ppm
Methanol [67-56-1]	10.85	4.2-5960 Pungent odor	Inh Abs Ing Con	Colorless liquid.	Irritated eyes, headache, drowsiness, lightheadedness, nausea, vomiting, disturbance in vision, blindness.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Fresh air Swallow: Immediate medical attention	200 ppm 200 ppm (skin) 200 ppm	250 ppm (skin) 250 ppm (skin) 250 ppm	PEL TLV REL	6,000 ppm
Nitric acid [7697-37-2]	11.95	0.3-1 Acrid suffocating odor	Inh Ing Con	Colorless, yellow, or red liquid.	Irritated eyes, mucous membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Respiratory support Swallow: Immediate medical attention	2 ppm 2 ppm 2 ppm	4 ppm 4 ppm	PEL TLV REL	25 ppm

Table VII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Physical Description	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Portland cement [65997-15-1]			Inh	Colorless to dark brown liquid.	Fine gray powder that can be irritating if inhaled or in eyes.	Eye: Irrigate immediately Skin: Soap wash flush Breath: Respiratory support Swallow: Immediate medical attention	10 mg/m^3 10 mg/m^3/total dust 5 mg/m^3 respirable fraction 10 mg/m^3		TLV PEL REL	5,000 mg/m^3
Sulfuric acid [7664-93-9]	?	0.15	Inh Ing Con	Colorless to dark brown liquid.	Irritated eyes, nose, and throat; pulmonary edema, bronchitis; emphysema; conjunctivitis; stomatitis; dental erosion; tracheobronchitis; skin and eye burns; dermatitis.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 1 mg/m^3 1 mg/m^3	3 mg/m^3	PEL TLV REL	15 mg/m^3
Trinitrotoluene (TNT) [1118-96-7]	10.59		Inh Abs Ing Con	Colorless to pale yellow solid.	Irritation of skin, mucous membranes; liver damage, jaundice, cyanosis; sneezing, cough, sore throat, muscle pain; kidney damage, cataract, sensitization; leukogytosis, anemia, cardio irregularity.	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/m^3 (skin) 0.1 mg/m^3 (skin) 0.5 mg/m^3 (skin)	3 mg/m^3	PEL TLV REL	500 mg/m^3

[a]IP = Ionization potential (electron volts).
[b]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA = Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a work day, even if the TWA is not exceeded.
[e]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
AEL = Airborne Exposure Limit.
TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value—TWA.
REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.

Table VII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works
Sandusky, Ohio

[1]IDLH (NIOSH)—Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
? = Unknown.
LEL = Lower explosive limits.
LC_{50} = Lethal concentration for 50 percent of population tested.
LD_{50} = Lethal dose for 50 percent of population tested.

VII.3.0 Personal Protective Equipment

The work activities will begin in the following levels of protection.

Task	Initial Level of PPE
Staging equipment	Level D
Surveying	Level D
Surface and subsurface soil sampling	Modified Level D*
Soil boring	Modified Level D*
Disposal of IDW	Level D

*Initial level will be raised to Level C or higher if air monitoring results in the worker's breathing zone are above action levels. Note: If unusual conditions or odors are encountered and air monitoring instruments do not detect volatile organic chemicals, turn equipment off, evacuate the work area, and contact the H&S Manager for further assistance.

A complete description of Level D, Modified Level D, and Level C follows.

Level D. The following equipment will be used for Level D protection:

- Coveralls or work clothing
- Steel-toed safety boots
- Safety glasses (with splash shield when handling liquid samples)
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Modified Level D. The following equipment will be used for Modified Level D protection:

- Permeable Tyvek, Kleenguard, or its equivalent
- Latex boot covers
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Steel-toed safety boots
- Safety glasses (with splash shield when handling liquid samples)
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level C. Level C protection will not be used unless air monitoring data indicate the need for upgrade; however, the equipment shall be readily available on site. The following equipment will be used for Level C protection:

- National Institute of Occupational Safety and Health/MSHA-approved full face, air purifying respirators equipped with organic vapor/acid gas cartridge in combination with high-efficiency particulate air filter.
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level B. Level protection will not be used unless air monitoring data indicate the need for upgrade will be used for Level B protection:

- Pressure-demand NIOSH-approved self-contained breathing apparatus
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Personnel Decontamination. All personnel working in the Exclusion Zone wearing Modified Level D or higher must undergo personnel decontamination prior to entering the support zone. Level D will require no personnel decontamination. The personnel decontamination area shall consist of the following stations.

Station 1. Personnel leaving the exclusion zone will remove the gross contamination, by physical means, from their outer clothing and boots (i.e., dislodging/displacement, rinsing, wiping: no blowing, brushing etc.).

Station 2. Equipment for this station may include plastic-lined waste receptacle, chair, clean damp cloths or paper towels, and plastic bags. At Station 2, personnel will remove their Tyvek coveralls and gloves and deposit them in the lined waste receptacles. Personnel will wipe their respirators (if used), hard hats, and boots with clean, damp cloths and then remove those items.

Those items are then hand carried to the next station.

Station 3. Equipment for this station may include a wash basin with soap and water and a respirator sanitation station. At this station, personnel will thoroughly wash their hands and face before leaving the decontamination zone. Respirators will be sanitized and then placed in a clean, plastic ziplock bag.

Donning Procedures

- Put on boots and boot covers and tape the coveralls.
- Put on gloves.
- Tape the coveralls over the gloves at the wrist.
- If Level C PPE is required, don respirator and check for secure fit.
- Put hood or head covering over the respirator.
- Put on the remaining protective equipment (i.e., hard hat, safety glasses, etc.).

VII.4.0 Site Monitoring

The environmental contaminants of concern are nitric acid, sulfuric acid and volatile and semivolatile chemicals including 2,4-DNT, 2,6-DNT, toluene and 2,4,6-trinitrotoluene.

Table VII.4-1 contains action levels for site monitoring.

Monitoring will be performed by the site safety and health officer (SSHO) initially for the location, then periodically during the performance of invasive operations. A calibrated photoionization detector will be utilized to monitor the borings and breathing zones, to determine if any organic material may be present that would necessitate upgrading of protection level.

Invasive operations include disturbing soils and collection of samples.

Noninvasive operations that do not disturb existing materials include site setup, surveying, decontamination, and miscellaneous support zone activities.

Table VII.4-1

Action Levels
Plum Brook Ordnance Works
Sandusky, Ohio

When in Level B PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 100 ppm above background in breathing zone (BZ)	Stop work, evacuate work area

When in Level C PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 50 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level B PPE.

When in Level D/Modified D PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes, if readings are sustained then upgrade to Level C PPE.

When in Support Zone

Analyte	Action Level	Required Action
Volatile organic chemicals	≥ 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.

[a]Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.
[b]Contact with the H&S manager must be made prior to continuance of work. The H&S manager may then initiate perimeter/integrated air sampling along with additional engineering controls.

No one is permitted to downgrade levels of PPE without authorization from the H&S manager.

VII.5.0 Activity Hazard Analysis

The attached activity hazard analysis (Table VII.5-1) is provided for the following activities:

- Setup of equipment and general field activities
- Surveying
- Surface and subsurface soil sampling and soil boring
- Disposal of IDW.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Staging equipment	Slip, trip, and fall hazards	• Determine best access route before transporting equipment. • Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards. • Look before you step; ensure safe and secure footing.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment.
	Falling objects	• Stay alert and clear of materials suspended overhead; wear hard hat and steel-toed boots.
	Flying debris, dirt, dust, etc.	• Wear safety glasses/goggles; ensure that eye wash is in proper working condition.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cuts/bruises	• Use cotton or leather work gloves for material handling.
	Bees, spiders, and snakes	• Inspect work area carefully and avoid placing hands and feet into concealed areas.
	Ticks	• Wear light colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear insect repellant. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after exiting the work area.
	Fire	• Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow.
	Hazard communication	• Label all containers as to contents and dispose of properly. • Ensure MSDSs are available for hazardous chemicals used on site.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Staging equipment (continued)	Noise	• Sound levels above 85 decibels (dBA) mandates hearing protection.
	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.
	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool area.
	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature) • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.
	Heat stroke	• Evaluate possibility of night work. • Perform physiological monitoring on workers during breaks. • Wear body cooling devices.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Staging equipment (continued)	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow. • Barricades shall be used on or around work areas when it is necessary to prevent the inadvertent intrusion of pedestrian traffic. • Barriers shall be used to protect workers from vehicular traffic. • Barriers shall be used to guard excavations adjacent to streets or roadways. • Flagging shall be used for the short term (less than 24 hours) to identify hazards until proper barricades or barriers are provided. • Heavy equipment shall have backup alarms.
	Forklift operations	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Portable electric tools	• Portable electric tools that are unsafe due to faulty plugs, damaged cords, or other reason, shall be tagged (do not use) and be removed from service. • Portable electric tools and all cord and plug connected equipment shall be protected by a ground fault circuit interrupter (GFCI) device. • Electrical tools shall be inspected daily prior to use.
	Extension cords	• Extension cords that have faulty plugs, damaged insulation, or are unsafe in any way shall be removed from service. • Cords shall be protected from damage from sharp edges, projections, pinch points (doorways), and vehicular traffic. • Cords shall be suspended with a nonconductive support (rope, plastic ties, etc,). • Cords shall be designed for hard duty. • Cords shall be inspected daily.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Staging equipment (continued)	Lightning strikes	• Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than laying on the ground). • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Keep all body parts in contact with the ground as close as possible. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people.
	Thunderstorms, tornados	• Listen to radio or TV announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings. • Seek shelter. Do not try to outrun a tornado.
Surveying	Slip, trip, fall	• Site workers will be required to wear hard hat, safety glasses with side shields, work gloves, and steel-toe boots when working in the field. • Flag or cover inconspicuous holes to protect against falls. • Work areas will be kept clean and orderly. • Garbage and trash will be disposed of daily in approved refuse containers. • Tools and accessories will be properly maintained and stored.
	Traffic accidents	• Place physical barrier (i.e., barricades, fencing) around work areas regularly occupied by pedestrians. • If working adjacent to roadways, have workers wear fluorescent orange vests. • Use warning signs or lights to alert oncoming traffic. • Assign flag person(s) if necessary to direct local traffic. • Set up temporary parking locations outside the immediate work area. • Motor vehicle operators shall obey all posted traffic signs, signals, and speed limits. • Pedestrians have the right-of-way. • Wear seat belts when vehicles are in motion.
	Wildlife hazards	• Workers should be cautious when driving through the site in order to avoid encounters with passing animals.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Surveying (continued)	Biological hazards	• Walking through overgrown grass areas, watch for snakes (rattlesnakes, moccasins, copperheads).
	Ticks	• Wear light colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear insect repellant. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after exiting the work area.
	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
Surface and subsurface sampling and soil boring	Overhead hazards	• Make sure no obstacles are within radius of boom. Always stay a safe distance from power lines.
	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out. • Drill rigs shall be equipped with reverse signal alarm, backup warning lights, or the vehicle is backed up only when an observer signals it is safe to do so.
	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to ensure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located and delineated or flagged prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels chocked. • Inspect brakes and tire pressure on drill rig before staging for work.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Surface and subsurface sampling and soil boring (continued)	Inexperienced operator	• Machinery and mechanized equipment shall be operated only be designated personnel. • Operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Jacks/outriggers	• Ensure proper footing and cribbing.
	Falling objects	• Remove unsecured tools and materials before raising or lowering the derrick. • Stay alert and clear of materials suspended overhead.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert at all times!
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.
	Fall hazards	• Personnel are not allowed to work off of machinery or use them as ladders. • Use fall protection when working above 6 feet.
	Noise	• Hearing protection is mandatory above 85 dBA.
	Contact with rotating or reciprocating machine parts	• Use machine guards; use long-handled shovels to remove auger cuttings. • Safe lockout procedures for maintenance work.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Surface and subsurface sampling and soil boring (continued)	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Slip, trip, and fall hazards	• Practice good housekeeping, keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards.
	Contact with potentially contaminated materials	• Real time air monitoring will take place. If necessary, proper personal protective clothing and equipment will be utilized. • Stop immediately at any sign of obstruction. • Do not breathe air surrounding boring unless necessary. • Upgrade to respirator if necessary. • Avoid skin contact with soil cuttings. Wear gloves. • Stay clear of moving parts of drill rig.
	Drum handling	• Be careful not to breathe air from around open drum any more than necessary. Monitor with photoionizaton detector/flame ionization detector (PID/FID) equipment and upgrade to respirator if necessary. • When filling a drum (with either soil or water), be careful not to make contact with the contained waste. Wear appropriate gloves. Make sure lid or bung of drum is secure. • If moving a drum unassisted, be sure to leverage properly, use proper lifting techniques, and wear safety glasses and steel-toed boots. • When using a drum dolly, make sure straps and lid catch are securely attached. Leverage properly when tilting drum. Be sure toes stay away from drum.
Disposal of IDW (Forklift Operation)	Personnel injury, property damage, and/or equipment damage	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Disposal of IDW (Forlift Operation) (continued)	Cross-contamination and contact with potentially contaminated materials	• Stop immediately at any sign of obstruction. • Sampling technicians will wear proper protective clothing and equipment to safeguard against potential contamination. • Only essential personnel will be in the work area. • Real-time air monitoring will take place before and during sampling activities. • All personnel will follow good hygiene practices. • Proper decontamination procedures will be followed. • All liquids and materials used for decontamination will be contained and disposed of in accordance with federal, state, and local regulations.
	Cut hazards	• Use care when handling glassware. • Wear adequate hand protection.
High-Pressure Water Jetting Operations	Heavy lifting	• Use proper lifting techniques. • Lifts greater than 60 pounds require assistance or mechanical equipment. • Size-up the lift.
	Slip, trip, and fall hazards	• Good housekeeping shall be implemented. • The work area shall be kept clean as feasible. • Inspect the work area for slip, trip, and fall hazards.
	Fueling	• Only approved safety cans shall be used to store fuel. • Do not refuel equipment while it is operating. • Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Faulty or damaged equipment	• Equipment shall be inspected before being placed into service and at the beginning of each shift. • Preventive maintenance procedures recommended by the manufacturer shall be followed. • A lockout/tagout procedure shall be used for equipment found to be faulty or undergoing maintenance.
	High-pressure water	• Jetting gun operator must wear appropriate PPE including hard hat, impact-resistant safety glasses with side shields, water-resistant clothing, metatarsal guards for feet and legs, and hearing protection (if appropriate). • One standby person shall be available within the vicinity of the pump during jetting operation. • The work area shall be isolated and adequate barriers will be used to warn other site personnel.

Table VII.5-1

Activity Hazard Analysis
Former Plum Brook Ordnance Works
Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
High-Pressure Water Jetting Operations (continued)	Unqualified operators	• Only qualified and trained personnel are permitted to operate machinery and mechanized equipment associated with water jet cutting and cleaning.
	Out of control equipment	• No machinery or equipment is permitted to run unattended. • Machinery or equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded.
	Noise	• Sound levels above 85 dBA mandates hearing protection by nearby site personnel.
	Activation during repairs	• All machinery or equipment will be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert and clear of materials suspended.
	Falling objects	• Hard hats are required by site personnel. • Stay alert and clear of material suspended overhead.
	Flying debris	• Impact-resistant safety glasses with side shields are required.
	Contact with potentially contaminated materials	• All site personnel will wear the appropriate PPE.

INTERNATIONAL TECHNOLOGY CORPORATION

312 Directors Drive
Knoxville, Tennessee 37923-4799
423-690-3211
Fax: 423-690-3626

April 15, 1998

Commander
U.S. Army Engineer District, Nashville
ATTN: CELRN-EP-R-M (Mrs. Linda Ingram)
Estes Kefauver Federal Building
801 Broadway
Nashville, Tennessee 37202-1070

Submittal of the Final Site-Specific Sampling and Analysis Plan (SSAP) and the Final Site-Specific Safety and Health Plan (SSHP) for the Direct Push Investigation of the Red Water Ponds Areas at the Former Plum Brook Ordnance Works, Sandusky, Ohio; Contract Number DACA62-94-D-0030; IT Project Number 773701

Dear Mrs. Ingram:

In accordance with the requirements of Delivery Order Number 0031 of Contract Number DACA62-94-D-0030, IT Corporation is pleased to submit the final SSAP and SSHP for the Direct Push Investigation of the Red Water Ponds Areas at the former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio.

Enclosed are 15 copies of the final SSAP and SSHP documents. These plans have been revised based upon technical review comments on the draft plans received from the USACE and Ohio EPA; 15 copies of responses to the technical review comments are also enclosed. Should you have any questions or require additional information regarding this submittal, please do not hesitate to call me at (423) 694-7477.

Sincerely,

Mikael L. Spangberg
Project Manager

Enclosures

INTERNATIONAL TECHNOLOGY CORPORATION

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Knoxville, Tennessee 37923-4799
423-690-3211
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Sincerely,

Mikael L. Spangberg
Project Manager

Enclosures

bcc: D. Burton
S. Muffler
G. Yu
Central Files

Attachment VIII

Site-Specific Safety And Health Plan For Tree Clearing Activities for the Direct-Push Investigation of Red Water Ponds Area Former Plum Brook Ordnance Works Sandusky, Ohio

Prepared By:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

Submitted To:

Commander
U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

IT Project No. 773701
Control Copy No. ____

Revision 2

June 1998

Reviews and Approvals

Project Manager
IT Corporation

6/5/98
Date

Health and Safety Manager
IT Corporation

6/5/98
Date

Site Coordinator
IT Corporation

Date

Site Safety and Health Officer
IT Corporation

Date

Distribution List

Control Copy Nos. 1 through 15	Mrs. Linda Ingram
Control Copy No. 16	D. Burton
Control Copy No. 17	M. Spangberg
Control Copy No. 18	S. Muffler
Control Copy No. 19	G. Yu
Control Copy No. 20	T. Smith
Control Copy No. 21	M. Smith
Control Copy No. 22	K. Napier
Control Copy No. 23	Project File
Control Copy Nos. 24 and 25	Field personnel

Plum Brook Project Emergency Contacts

Note: All field crews will be provided 2-way radios from the Plum Brook Communications Center. In the event of an emergency, contact the Plum Brook Communications Center by radio and they will contact and coordinate emergency response personnel.

Fire Department	(419) 627-5837
Ambulance	911
Police Department	(419) 627-5863
Providence Hospital	(419) 621-7000
National Response Center	(800) 424-8802
Poison Control Center	(800) 462-0800
Ohio EPA Emergency Spill Number	(800) 282-9378
Don Burton, IT Program Manager	(423) 690-3211
Mike Spangberg, IT Project Manager	(423) 690-3211
George Yu, IT Site Manager	(423) 690-3211
Melissa Smith, IT H&S Manager	(423) 690-3211
Dr. Elaine Theriault, IT Occupational Physician	(800) 299-3674

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List of Acronyms

DNT	dinitrotoluene
H&S	Health and Safety
NIOSH	National Institute of Occupational Safety and Health
PBOW	Plum Brook Ordnance Works
PPE	personal protective equipment
PVC	polyvinyl chloride
SHP	safety and health plan
SSHO	site safety and health officer
SSHP	site-specific safety and health plan

VIII.1.0 Site Work Plan Summary

Project Objective. The objectives of this investigation at the former Plum Brook Ordnance Works (PBOW), Sandusky, Ohio, are summarized as follows:

- Determine if there are hazardous substances present at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define site physical features and characteristics (aquifer background conditions).
- Evaluate fate and transport pathways (groundwater modeling).
- Determine current and future routes of exposure.

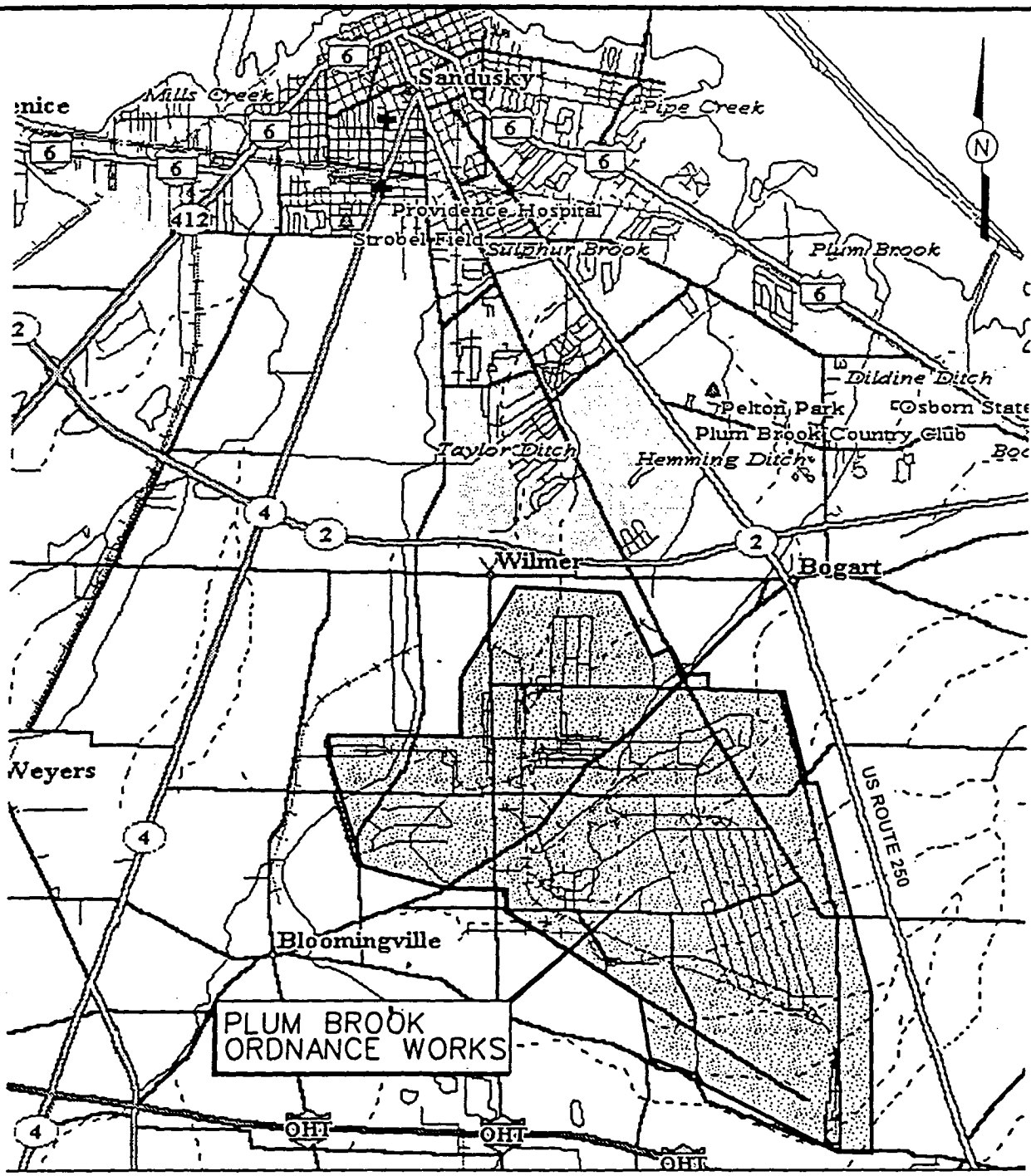
Project Tasks

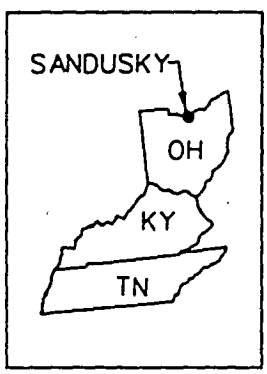
- Tree clearing and grading soil surfaces for access to sites
- Direct-push sampling
- Decontamination of equipment (high-pressure water jetting operations).

Personnel Requirements. Up to 15 employees.

Note: All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the sitewide safety and health plan (SHP) for site investigations at PBOW, and be familiar with the requirements of this site-specific SHP (SSHP). Figure VIII.1-1 presents the site and hospital location map. The Red Water Ponds and the equipment decontamination pad are presented on Figure VIII.1-2. Figures VIII.1-3 and VIII.1-4 show sample locations and work zones for the Pentolite Road and West Area Red Water Ponds.

Project Schedule. Summer 1998.





NOT TO SCALE

FIGURE VIII.1-1
SITE AND HOSPITAL
LOCATION MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 5/8/97 | DATE LAST REV.:23 JUL | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR:M. SPANGBERG | DWG. NO.: \771484ES.004
DRAWN BY: R. KNIGHT | DRAWN BY:RKNIGHT | ENGR. CHCK. BY: M. SPANGBERG | PROJ. MGR.:D. BURTON | PROJ. NO.:771481

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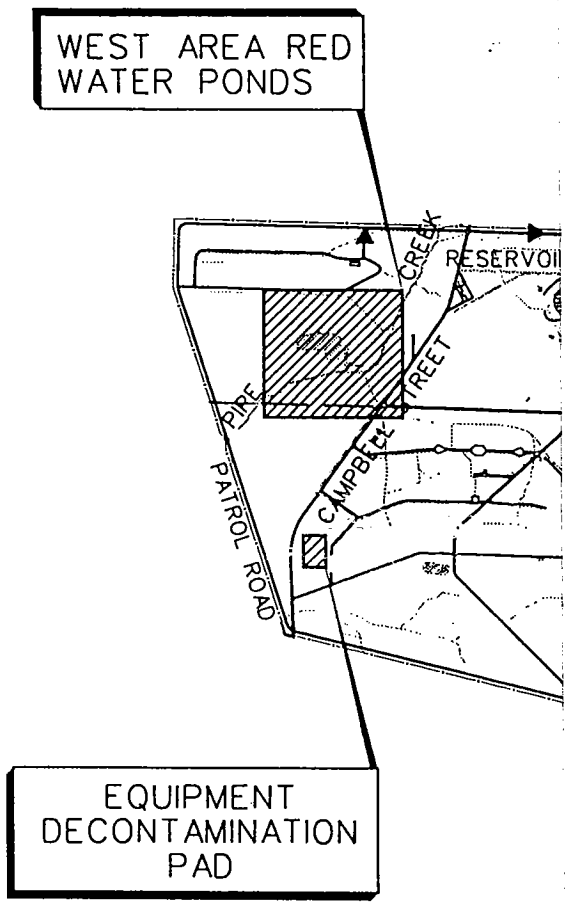


LEGEND:

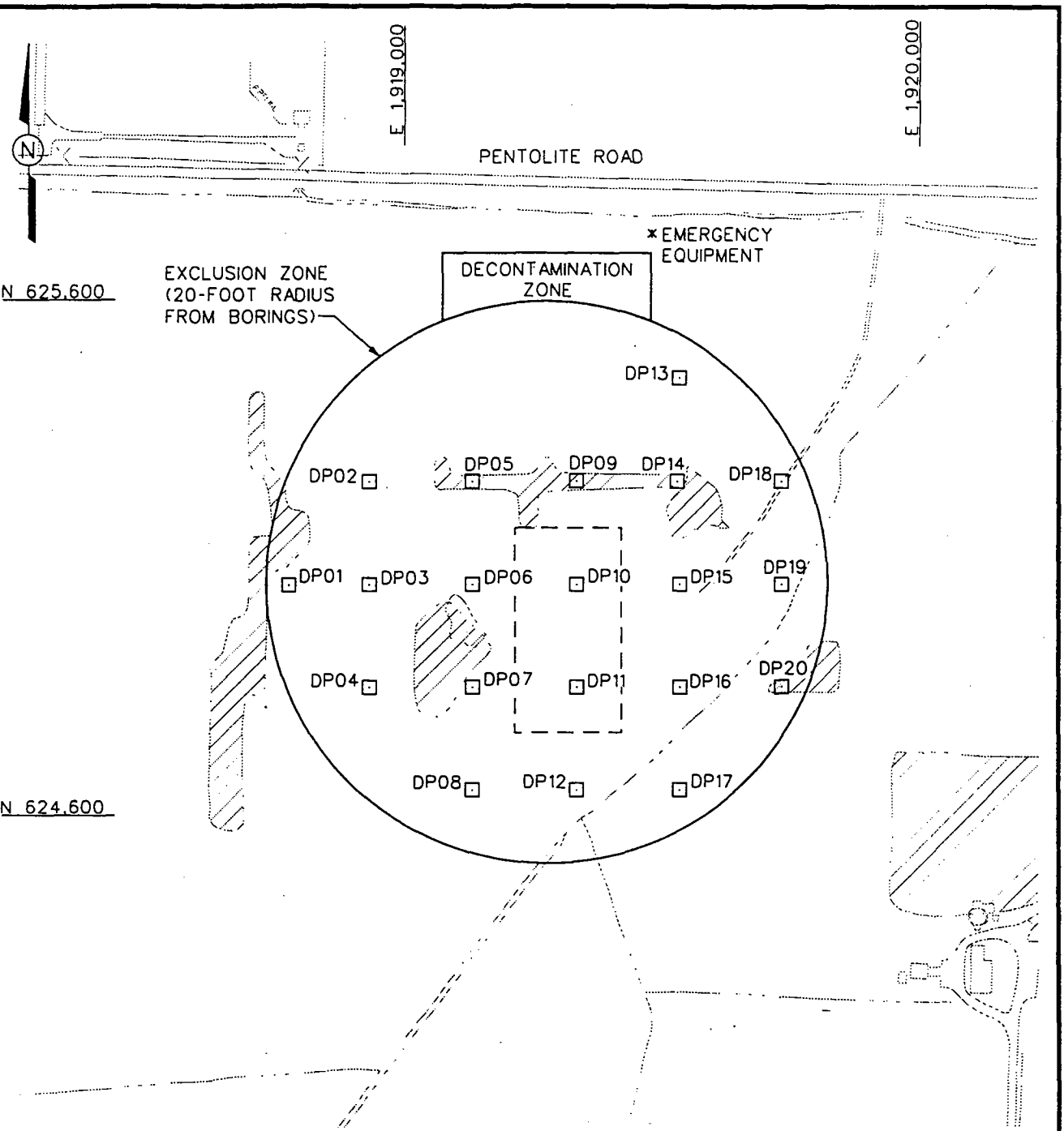
- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE WATER
- RESERVOIR
- AREA OF CONCERN
- ROUTE TO MAIN GATE

FIGURE VIII.1-2
RED WATER PONDS AND EQUIPMENT DECONTAMINATION PAD

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 02/19/98 | DATE LAST
DRAWN BY: R. VANDERGRIFF | DRAWN BY:
DRAFT. CHCK. BY: C. TUMLIN | ENGR. CHCK. BY: G. YU
INITIATOR: M. SMITH | PROJ. MGR.: M. SPANGERG
DWG. NO. | PROJ. NO.:



LEGEND:

- BUILDINGS
- SURFACE WATER
- SURFACE WATER DRAINAGE
- APPROXIMATE HISTORICAL LOCATION OF PONDS
- FENCE (PBOW BOUNDARY)
- DP01 PROPOSED SAMPLE LOCATIONS

NOT TO SCALE

FIGURE VIII.1-3
PENTOLITE ROAD RED WATER PONDS SAMPLE LOCATIONS AND WORK ZONES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 12/16/97	DATE LAST REV.:	DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: M. SMITH	DWG. NO.: \773701ES.008
DRAWN BY: D. BILLINGSLEY	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: SPANGBERG	PROJ. NO.: 773701

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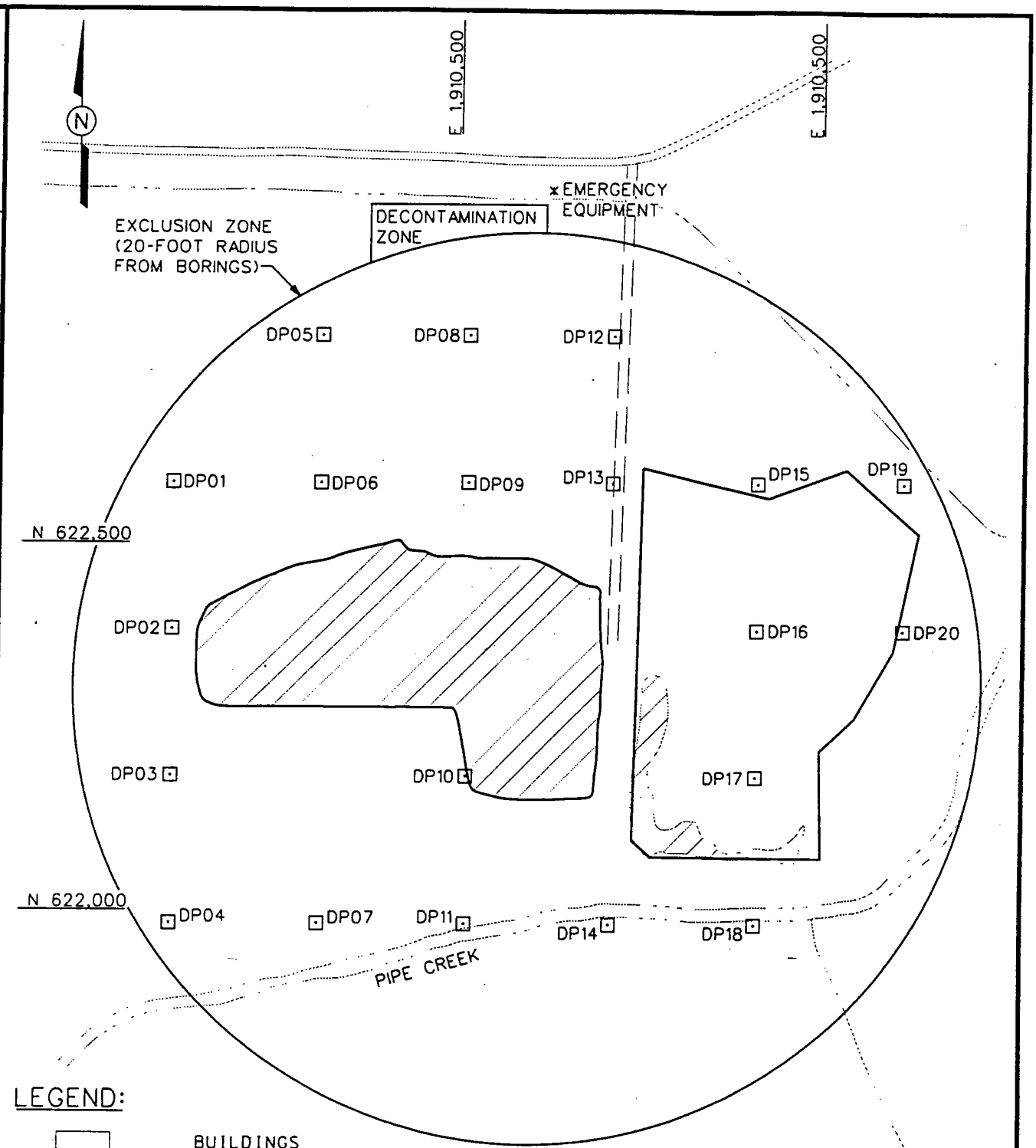

LEGEND:

- BUILDINGS
- SURFACE WATER
- SURFACE DRAINAGE
- APPROXIMATE HISTORICAL LOCATION OF PONDS
- DP01 PROPOSED SAMPLE LOCATIONS
- UNPAVED ROADS/DRIVES
- PAVED ROADS

NOT TO SCALE

FIGURE VIII.1-4
WEST AREA RED WATER PONDS SAMPLE LOCATIONS AND WORK ZONES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: \773701ES.009 | PROJ. NO.: 773701
INITIATOR: M. SMITH | PROJ. MGR.: SPANGBERG
DRAFT. CHCK. BY: C. TUMLIN | ENGR. CHCK. BY: G. YU
DATE LAST REV.: | DRAWN BY:
STARTING DATE: 02/19/98 | DRAWN BY: R. VANDERGRIFF

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VIII.2.0 Site Characterization and Analysis

VIII.2.1 Anticipated Hazards

The Activity Hazard Analysis in Chapter 5.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The Activity Hazard Analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

The potential chemical contaminants of concern include nitroaromatic compounds. The following table indicates maximum concentrations of contaminants detected during previous investigations at the Red Water Ponds Area:

Chemical	Maximum Soil Concentration (mg/kg)
2,4,6-Trinitrotoluene	12,000
1,2,5-Trinitrobenzene	58.0
2,4-Dinitrotoluene	8.9
2,6-Dinitrotoluene	3.6

Table VIII.2-1 contains chemicals anticipated and chemicals to be used during project activities.

VIII.2.2 General Site Information

A description of the site including location, site topography, and site accessibility is presented in Section 1.3 of the sitewide sampling and analysis plan prepared by IT Corporation in September 1996.

Table VIII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
1,3-Dinitrobenzene [99-65-0]	10.43		Inh Abs Ing Con	Anoxia, cyanosis, visual disturbances, central blind spot of vision, bad taste, burning of mouth, dry throat, thirsty; yellowing hair, eyes, and skin; anemia, liver damage.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 (skin) 0.15 ppm (skin) 1 mg/m^3 (skin)		PEL TLV REL	50 mg/m^3
Benzene [71-43-2]	9.24	34B119	Inh Abs Ing Con	Irritates eyes, nose, respiratory system; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude; dermatitis; bone-marrow depression. Carcinogenic.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (10 ppm) NICB0.1 skin 0.1 ppm	5 ppm C1 ppm (Ca)	PEL TLV REL	Ca [500 ppm]*
Chromium (as Cr) [7440-47-3]	NA	NA	Inh Ing Con	Irritation of eyes, skin, and upper respiratory system; fibrosis of lungs	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 0.5 mg/m^3	- -	PEL TLV	250mg/m^3 (as Cr)
Dinitrotoluene (DNT)	N/A	-	Inh Abs Ing Con	Anoxia, cyanosis, anemia, jaundice; reproductive effects. Animal carcinogen.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/^{3} (skin) NIC-0.2 mg/m^3 (skin) 1.5 mg/m^3 (skin)	- - -	PEL TLV REL	Ca [50 mg/m^3)
Ethyl benzene [100-41-4]	8.76	0.09B0.6	Inh Ing Con	Irritates eyes, mucous membranes; headache; dermatitis; narcosis, coma.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	800 ppm

Table VIII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Gasoline [8006-61-9]	?	0.3	Inh Ing Con	Intoxication, headaches, blurred vision, dizziness, nausea; eye, nose, and throat irritation; potential kidney and other cancers. Carcinogenic.	Eye: Irrigate immediately (15 min) Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	300 ppm 300 ppm Ca, lowest feasible conc. (LOQ 15 ppm)	500 ppm 500 ppm	PEL TLV REL	?
Methanol	10.85	4.2-5960	Inh Abs Ing Con	Irritated eyes, headache, drowsiness, lightheadedness, nausea, vomiting, disturbance in vision, blindness.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Fresh air Swallow: Immediate medical attention		200 ppm (skin) 200 ppm (skin) 200 ppm	PEL TLV REL	6,000 ppm
Nitric acid [7697-37-2]	11.95	0.3-1	Inh Ing Con	Irritated eyes, mucous membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Respiratory support Swallow: Immediate medical attention	2 ppm 2 ppm 2 ppm	4 ppm 4 ppm 4 ppm	PEL TLV REL	25 ppm
Nitrobenzene [98-95-3]	9.92	0.37	Inh Abs Ing Con	Irritation of eyes, skin, anoxia; dermatitis; anemia; methemoglobinemia; testicular effects.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (skin) 1 ppm (skin) 1 ppm (skin)		PEL TLV REL	200 ppm
Portland cement			Inh	Fine gray powder that can be irritating if inhaled or in eyes.	Eye: Irrigate immediately Skin: Soap wash flush Breath: Respiratory support Swallow: Immediate medical attention		10 mg/m^3 10 mg/m^3/total dust 5 mg/m^3 respirable fraction	TLV PEL/REL	
Toluene [108-88-3]	8.82	0.16B37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paralysis; dermatitis.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm 150 ppm	PEL TLV REL	500 ppm

Table VIII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
1,3,5-Trinitrobenzene	?		Inh Ing Con Abs	Irritating to the skin, mucus membranes, and eyes; nausea, vomiting, diarrhea, and abdominal pain; liver damage.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	0.1 mg/m^3 0.1 mg/m^3 0.1 mg/m^3	0.3 mg/m^3	PEL TLV REL	100 mg/m^3
Trinitrotoluene (TNT) [118-96-7]	10.59 ev		Inh Abs Ing Con	Irritation of skin, mucous membranes; liver damage, jaundice; cyanosis, sore throat; kidney damage; cardio irregularity	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/m^3 (skin) 0.1 mg/m^3 (skin) 0.5 mg/m^3 (skin)		PEL TLV REL	500 mg/m^3

[a]IP = Ionization potential (electron volts).
[b]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA = Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a work day, even if the TWA is not exceeded.
[e]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit valueCTWA.
REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[f]IDLH (NIOSH)CImmediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 97-140., 1997).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
NIC = Notice of intended change (ACGIH).

VIII.3.0 Personal Protective Equipment

The work activities will begin in the following levels of protection.

Task	Initial Level of PPE
Staging equipment	Level D
Tree Clearing (via bulldozer)	Level D
Grading Surface Soils (via bulldozer)	Level D
Direct-push sampling	Modified Level D*
Decontamination of equipment	Modified Level D*

*Initial level will be raised to Level C or higher if air monitoring results in the worker's breathing zone are above action levels. Note: If unusual conditions or odors are encountered and air monitoring instruments do not detect volatile organic chemicals or hydrogen sulfide, turn equipment off, evacuate the work area, and contact the Health and Safety (H&S) Manager for further assistance.

A complete description of Level D, Modified Level D, and Level C follows.

Level D. The following equipment will be used for Level D protection:

- Coveralls or work clothing
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working in/near/adjacent to operating equipment).

Modified Level D. The following equipment will be used for Modified Level D protection:

- Permeable Tyvek, Kleenguard, or its equivalent
- Polyvinyl chloride (PVC) boot covers
- Nitrile gloves (outer)
- Lightweight nitrile gloves (inner)
- Steel-toed safety boots

- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level C. Level C protection will not be used unless air monitoring data indicate the need for upgrade; however, the equipment shall be readily available on site. The following equipment will be used for Level C protection:

- National Institute of Occupational Safety and Health (NIOSH)-approved full face, air purifying respirators equipped with organic vapor/acid gas cartridge in combination with high-efficiency particulate air filter
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level B. Level protection will not be used unless air monitoring data indicate the need for upgrade will be used for Level B protection:

- Pressure-demand NIOSH-approved self-contained breathing apparatus
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Personnel Decontamination: All personnel working in the exclusion zone wearing Modified Level D or higher must undergo personnel decontamination prior to entering the support zone. Level D will require no personnel decontamination. The personnel decontamination area shall consist of the following stations.

Station 1. Personnel leaving the exclusion zone will remove the gross contamination, by physical means, from their outer clothing and boots (i.e., dislodging/displacement, rinsing, wiping: no blowing, brushing etc.).

Station 2. Equipment for this station may include plastic-lined waste receptacle, chair, clean damp

cloths or paper towels, and plastic bags. At Station 2, personnel will remove their Tyvek coveralls and gloves and deposit them in the lined waste receptacles. Personnel will wipe their respirators (if used), hard hats, and boots with clean, damp cloths and then remove those items. Those items are then hand-carried to the next station.

Station 3. Equipment for this station may include a wash basin with soap and water and a respirator sanitation station. At this station, personnel will thoroughly wash their hands and face before leaving the decontamination zone. Respirators will be sanitized and then placed in a clean, plastic ziplock bag.

Donning Procedures.

- Put on boots and boot covers and tape the coveralls.
- Put on gloves.
- Tape the coveralls over the gloves at the wrist.
- If Level C PPE is required, don respirator and check for secure fit.
- Put hood or head covering over the respirator.
- Put on the remaining protective equipment (i.e., hard hat, safety glasses, etc.).

VIII.4.0 Site Monitoring

The environmental contaminants of concern are volatile and semivolatile chemicals including 2,4-dinitrotoluene (DNT), 2,6-DNT, 1,3,5-trinitrobenzene, and 2,4,6-trinitrotoluene.

Table VIII.4-1 contains action levels for site monitoring.

Monitoring will be performed by the site safety and health officer (SSHO) initially for the location, then periodically during the performance of invasive operations (sampling every 5- to 10-foot soil boring depth). A calibrated photoionization detector will be utilized to monitor the wells and breathing zones, to determine if any organic material may be present that would necessitate upgrading of protection level.

Invasive operations include disturbing soils, direct-push sampling, and collection of samples.

Noninvasive operations that do not disturb existing materials include site setup, decontamination, and miscellaneous support zone activities.

Table VIII.4-1

Action Levels
Plum Brook Ordnance Works, Sandusky, Ohio

When in Level B PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	• 50 ppm above background in breathing zone (BZ)	Stop work, evacuate work area.

When in Level C PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	• 25 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained, then upgrade to Level B personal protective equipment (PPE).

When in Level D/Modified D PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	• 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes; if readings are sustained, then upgrade to Level C PPE.

When in Support Zone

Analyte	Action Level	Required Action
Volatile organic chemicals	• 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.

[a]Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.
[b]Contact with the health and safety (H&S) manager must be made prior to continuance of work. The H&S manager may then initiate perimeter/integrated air sampling along with additional engineering controls.

No one is permitted to downgrade levels of PPE without authorization from the H&S manager.

VIII.5.0 Activity Hazard Analysis

The attached activity hazard analysis (Table VIII.5-1) is provided for the following activities:

- Setup of equipment and general field activities
- Tree clearing and grading surface soils
- Direct-push sampling
- Decontamination (high-pressure water jetting operations).

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities	Slip, trip, and fall hazards	• Determine best access route before transporting equipment. • Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards. • Look before you step; ensure safe and secure footing.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment.
	Falling objects	• Stay alert and clear of materials suspended overhead; wear hard hat and steel-toed boots.
	Flying debris, dirt, dust, etc.	• Wear safety glasses/goggles; ensure that eye wash is in proper working condition.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cuts/bruises	• Use cotton or leather work gloves for material handling.
	Bees, spiders, and snakes	• Inspect work area carefully and avoid placing hands and feet into concealed areas.
	Fire	• Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Hazard communication	• Label all containers as to contents and dispose of properly. • Ensure Material Safety Data Sheets (MSDS) are available for hazardous chemicals used on site.
	Noise	• Sound levels above 85 A-weighted decibels (dBA) mandates hearing protection.
	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40EF. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Ticks	• Wear light-colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear insect repellant. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after exiting the work area.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool area.
	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Heat stroke	• Evaluate possibility of night work. • Perform physiological monitoring on workers during breaks. • Wear body cooling devices.
	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow. • Barricades shall be used on or around work areas when it is necessary to prevent the inadvertent intrusion of pedestrian traffic. • Barriers shall be used to protect workers from vehicular traffic. • Barriers shall be used to guard excavations adjacent to streets or roadways. • Flagging shall be used for the short term (less than 24 hours) to identify hazards until proper barricades or barriers are provided. • Heavy equipment shall have backup alarms.
	Forklift operations	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Portable electric tools	• Portable electric tools which are unsafe due to faulty plugs, damaged cords, or other reason, shall be tagged (do not use) and be removed from service. • Portable electric tools and all cord and plug connected equipment shall be protected by a ground-fault circuit interrupter (GFCI) device. • Electrical tools shall be inspected daily prior to use.
	Extension cords	• Extension cords that have faulty plugs, damaged insulation, or are unsafe in any way shall be removed from service. • Cords shall be protected from damage from sharp edges, projections, pinch points (doorways), and vehicular traffic. • Cords shall be suspended with a nonconductive support (rope, plastic ties, etc,). • Cords shall be designed for hard duty. • Cords shall be inspected daily.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Lightning strikes	• Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than laying on the ground). • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Keep all body parts in contact with the ground as close as possible. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people.
	Thunderstorms, tornados	• Listen to radio or TV announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings. • Seek shelter. Do not try to outrun a tornado.
Tree Clearing and Soil Grading	Heavy equipment operations	• Only qualified, trained, and authorized personnel will operate heavy equipment. • Before any machinery or mechanized equipment is placed into service, it shall be inspected and tested by a competent mechanic and certified to be in safe operating condition. • Equipment shall be inspected before being placed into service and at the beginning of each shift. • Preventive maintenance procedures recommended by the manufacturer shall be followed. • All lockout/tagout procedures shall be used for equipment found to be faulty or undergoing maintenance. • Machinery and mechanized equipment shall be operated only by designated personnel. • Getting off or on any equipment while it is in motion is prohibited. • Machinery or equipment requiring an operator shall not be permitted to run unattended. • Machinery or equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded. • All machinery or equipment will be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done. • All repairs on machinery or equipment will be made at a location that provides protection from traffic for repair persons. • Bulldozer and scraper blades, end-loader buckets, and similar equipment will be either fully lowered or blocked when being repaired or when not in use. • All self-propelled construction equipment shall be equipped with a back-up alarm.
	Fire	• Each bulldozer, backhoe, or other similar equipment will be equipped with at least one dry chemical fire extinguisher having a minimum UL rating of 5 A:B:C.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Tree Clearing and Soil Grading (continued)	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow. • Barricades shall be used on or around work areas when it is necessary to prevent the inadvertent intrusion of pedestrian traffic. Barriers shall be used to protect workers from vehicular traffic. • Barriers shall be used to guard excavations adjacent to streets or roadways. • Flagging shall be used for the short term (less than 24 hours) to identify hazards until proper barricades or barriers are provided. • Heavy equipment shall have backup alarms.
	Noise	• Hearing protection is mandatory above 85 A-weighted decibels (dBA).
	Dermatitis from poisonous plants	• Post areas that have been identified as having poisonous plants. • Avoid contact with these plants to the extent possible. • Wear clothing or coveralls with long sleeves. • Promptly wash clothing that has contacted poisonous plants. • Apply ointment to affected area.
	Rabies/bites from snakes and animals	• Keep work area clear of vegetation and small bush. • Avoid placing hands or feet into obscure areas (i.e., beneath rocks, well pads, bush piles). • Have a snakebite kit on site. • Use the buddy system. • Postpone work in areas where poisonous snakes or animals are nested.
	Ticks	• Wear light colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after existing the work area.
	Stings from bees, wasps, ants	• Identify infested areas to the site supervisor. • Workers who are allergic or capable of allergic reactions to bee, wasp, or ant stings or bites shall notify their supervisor(s). • Evaluate need for sensitive workers to have prescribed antibiotic or medicine to combat onset of symptoms.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Direct-Push Sampling	Overhead hazards	• Make sure no obstacles are within radius of boom. Always stay a safe distance from power lines.
	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out. • Drill rigs shall be equipped with reverse signal alarm, backup warning lights, or the vehicle is backed up only when an observer signals it is safe to do so.
	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to ensure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located and delineated or flagged prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels choked. • Inspect brakes and tire pressure on drill rig before staging for work.
	Inexperienced operator	• Machinery and mechanized equipment shall be operated only by designated personnel. • Operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Jacks/outriggers	• Ensure proper footing and cribbing.
	Falling objects	• Remove unsecured tools and materials before raising or lowering the derrick. • Stay alert and clear of materials suspended overhead.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert at all times!
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.
	Fall hazards	• Personnel are not allowed to work off of machinery or use machinery as ladders. • Use fall protection when working above 6 feet.
	Noise	• Hearing protection is mandatory above 85 dBA.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Direct-Push Sampling (continued)	Contact with rotating or reciprocating machine parts	• Use machine guards; use long-handled shovels to remove auger cuttings. • Use safe lockout procedures for maintenance work.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Slip, trip, and fall hazards	• Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards.
	Contact with potentially contaminated materials	• Real-time air monitoring will take place. If necessary, proper personal protective clothing and equipment will be utilized. • Stop immediately at any sign of obstruction. • Do not breathe air surrounding boring unless necessary. • Upgrade to respirator if necessary. • Avoid skin contact with soil cuttings. Wear gloves. • Stay clear of moving parts of drill rig.
	Drum handling	• Be careful not to breathe air from around open drum any more than necessary. Monitor with photoionization detector/flame ionization detector (PID/FID) equipment and upgrade to respirator if necessary. • When filling a drum (with either soil or water), be careful not to make contact with the contained waste. Wear appropriate gloves. Make sure lid or bung of drum is secure. • If moving a drum unassisted, be sure to leverage properly, use proper lifting techniques, and wear safety glasses and steel-toed boots. • When using a drum dolly, make sure straps and lid catch are securely attached. Leverage properly when tilting drum. Be sure toes stay away from drum.
High-Pressure Water Jetting Operations	Heavy lifting	• Use proper lifting techniques. • Lifts greater than 60 pounds require assistance or mechanical equipment • Size-up the lift.
	Slip, trip, and fall hazards	• Good housekeeping shall be implemented. • The work area shall be kept clean as feasible. • Inspect the work area for slip, trip, and fall hazards.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
High-Pressure Water Jetting Operations	Fueling	• Only approved safety cans shall be used to store fuel. • Do not refuel equipment while it is operating. • Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Faulty or damaged equipment	• Equipment shall be inspected before being placed into service and at the beginning of each shift. • Preventive maintenance procedures recommended by the manufacturer shall be followed. • A lockout/tagout procedure shall be used for equipment found to be faulty or undergoing maintenance.
	High-pressure water	• Jetting gun operator must wear appropriate PPE including hard hat, impact-resistant safety glasses with side shields, water-resistant clothing, metatarsal guards for feet and legs, and hearing protection (if appropriate). • One standby person shall be available within the vicinity of the pump during jetting operation. • The work area shall be isolated and adequate barriers will be used to warn other site personnel.
	Unqualified operators	• Only qualified and trained personnel are permitted to operate machinery and mechanized equipment associated with water jet cutting and cleaning.
	Out of control equipment	• No machinery or equipment is permitted to run unattended. • Machinery or equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded.
	Noise	• Sound levels above 85 dBA mandates hearing protection by nearby site personnel.
	Activation during repairs	• All machinery or equipment will be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert and clear of materials suspended
	Falling objects	• Hard hats are required by site personnel. • Stay alert and clear of material suspended overhead.
	Flying debris	• Impact-resistant safety glasses with side shields are required.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
High-Pressure Water Jetting Operations (continued)	Contact with potentially contaminated materials	• All site personnel will wear the appropriate PPE.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CELRN-EP-R-M

Project Description: Risk Assessment and Direct Push Investigation, Red Water Ponds Areas, Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract Number: DACA62-94-D-0030 Delivery Order Number: 0031

Project Number: 773701 Task / Phase Number: 02000000

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☐ Contract / Subcontract		☐ Client Furnished
☒ SAP, SSAP, CDAP, or QAPP	SSAP, Revision 1, April 1998	
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Attachment VIII

Site-Specific Sampling and Analysis Plan
Direct Push Investigation of Red Water Ponds Areas
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

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Knoxville, Tennessee 37923

Submitted To:

Commander
U.S. Army Corps of Engineers, Nashville District
Post Office Box 1070
Nashville, Tennessee 37202-1070

IT Project Number 773701
Control Copy No. 19

Revision 1

April 1998

(This SSAP must be used in conjunction with the PBOW SAP)

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List of Acronyms

bgs	below ground surface
BNA	base neutral/acid extractable compound
D&M	Dames and Moore, Inc.
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DPI	direct-push investigation
FADL	Field Activity Daily Log
FUDS	formerly used defense sites
gpm	gallons per minute
GSA	General Services Administration
GWI	groundwater investigation
ICI	International Consultants, Inc.
IDW	investigation-derived waste
IT	IT Corporation
MK	Morrison and Knudsen Corporation
msl	mean sea level
NASA	National Aeronautics and Space Administration
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
PCB	polychlorinated biphenyl
PD	project decision
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
QCP	quality control plan
RA	risk assessment
RBSC	risk-based screening concentration
SAIC	Science Application International Corporation

List of Acronyms *(continued)*

SAP	sitewide sampling and analysis plan
SMP	site management plan
SOW	scope of work
SSAP	site-specific sampling and analysis plan
SSHP	site-specific safety and health plan
SVOC	semivolatile organic compound
TAL	target analyte list
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

VIII.1.0 Project Description

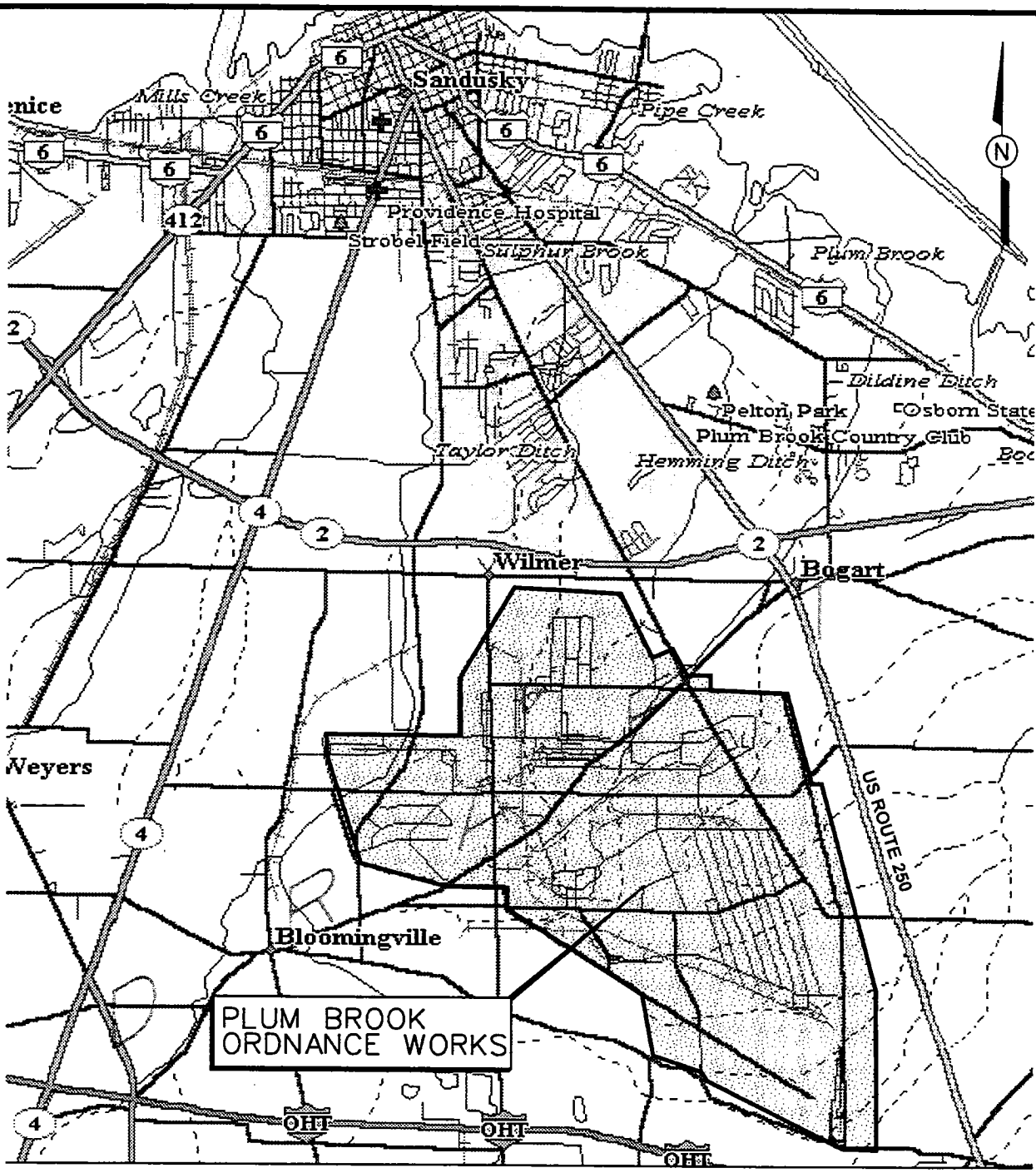
The U.S. Army is conducting studies of the environmental impact of suspected hazardous waste sites at previously owned U.S. Department of Defense (DOD) properties. This work is being pursued by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP), formerly used defense sites (FUDS) funding. The former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio (Figure VIII-1) is a DERP FUDS project currently being managed and technically overseen by the Nashville District of USACE. IT Corporation (IT) is contracted to conduct a risk assessment and direct-push investigation (RA/DPI) at the Pentolite Road and West Area Red Water Ponds Areas.

As an attachment to the PBOW sitewide sampling and analysis plan (SAP) (IT, 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the work to be carried out in support of the direct-push portion of the investigation at PBOW. This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP) (IT, 1996b) to ensure that work to be performed at this site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this investigation and must be used in conjunction with the sitewide safety and health plan (IT, 1996c).

VIII.1.1 Site History

The PBOW site, built in early 1941, originally consisted of 9,071 acres of primarily agricultural land that was acquired by DOD for construction of an explosives plant manufacturing 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite (Dames & Moore [D&M], 1997). Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to the Ordnance Department, and then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration (GSA).

The National Aeronautics and Space Administration (NASA) acquired PBOW 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 Township Board of Education acquired 46 acres of the



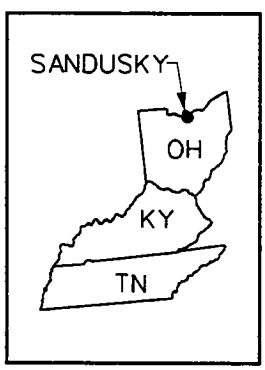


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FIGURE VIII-1
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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excess and uses this 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 approximately 6,400 acres and is using the site to conduct space research as a satellite operation of NASA's Lewis Research Center in Cleveland, Ohio. The details of these land transactions are listed in the site management plan (SMP) (International Consultants, Inc. [ICI], 1995) and can be found at the NASA Plum Brook Station (PBS).

During operation of the PBOW, process wastewater was disposed in two settling ponds, known as the West Area Red Water Ponds and the Pentolite Road Red Water Ponds. The reddish-colored wastewater contains by-products of the TNT manufacturing process, including nitroaromatic compounds. Both pond areas were identified as having potential for contamination.

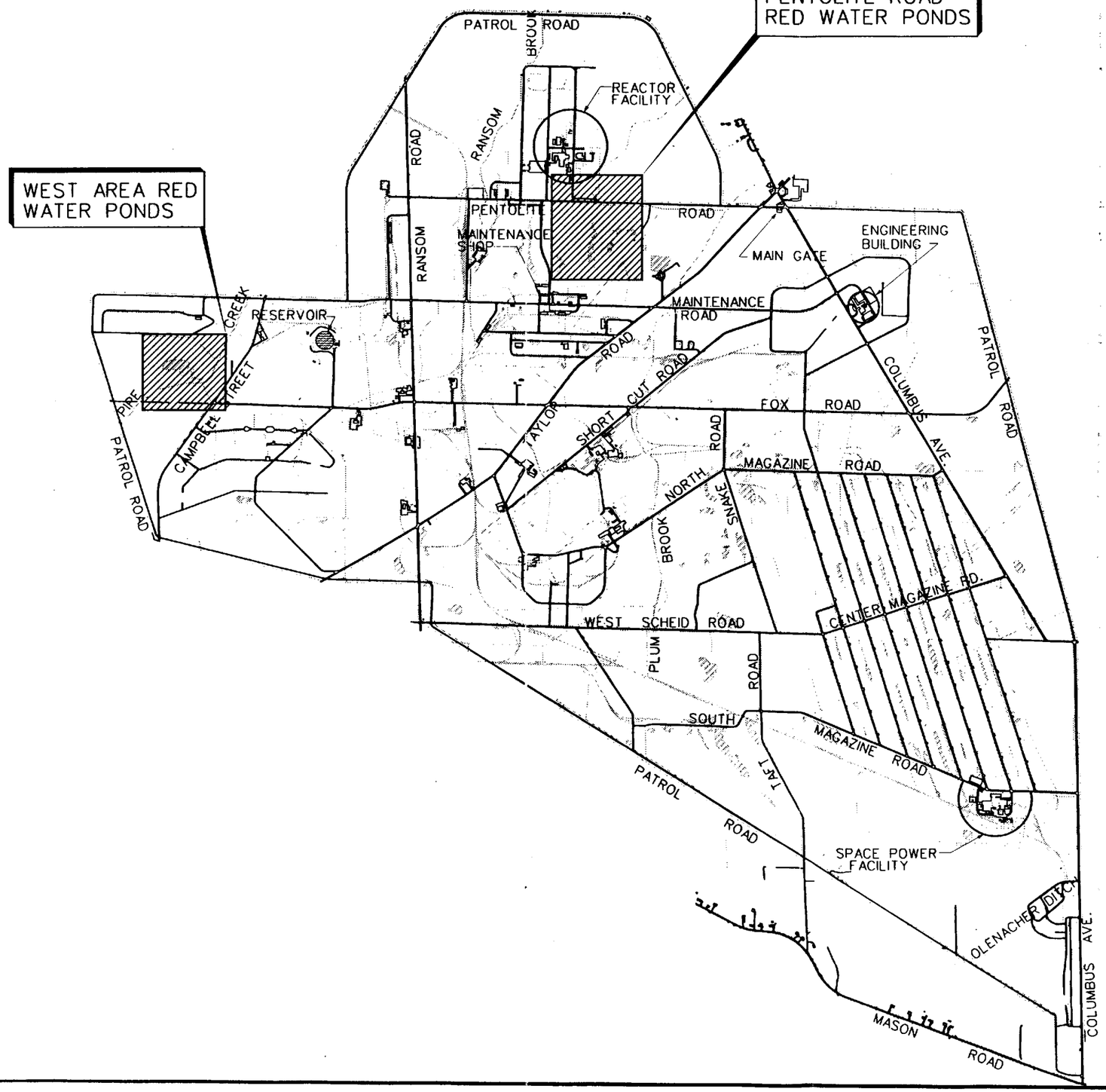
VIII.1.1.1 Pentolite Road Red Water Ponds

The Pentolite Road Red Water Ponds are located in the north-central portion of PBOW (Figures VIII-2 and VIII-3). A previous construction plan indicated that the ponds had a dimension of 200 by 400 by 3 feet and were surrounded by a 1-foot-high soil berm. The ponds had a maximum capacity of 182,000 cubic yards of wastewater (approximately 36.9 million gallons) (ICI, 1995). The Pentolite Road Red Water Ponds were backfilled in 1977 following a breach, but standing water still occurs in topographic low depressions. Surface elevations at the Pentolite Road Red Water Ponds range between 625 and 629 feet above mean sea level (msl).

VIII.1.1.2 West Area Red Water Ponds

The West Area Red Water Ponds Site consists of two irregularly shaped ponds located on the west side of PBOW (Figures VIII-2 and VIII-4). The east pond is elongated northeast to southwest adjacent to Pipe Creek. The west pond is approximately triangular in shape and is separated from the east pond by an earthen berm. Historical aerial photographs indicate that the original shapes were changed during use; they have been maintained at their approximate dimensions since the 1950s. Together, the two ponds have a maximum capacity of 120,000 cubic yards (approximately 24.3 million gallons). Elevations of the ponds range between 640 and 644 feet above msl.

Both ponds typically contain standing water; however, the east pond has been dry during several site visits. A seep was observed flowing from the east berm of the east pond into Pipe Creek in 1994 (ICI, 1995). Groundwater in the area has been encountered at approximately 10 feet below



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE WATER
- RESERVOIR
- AREA OF CONCERN

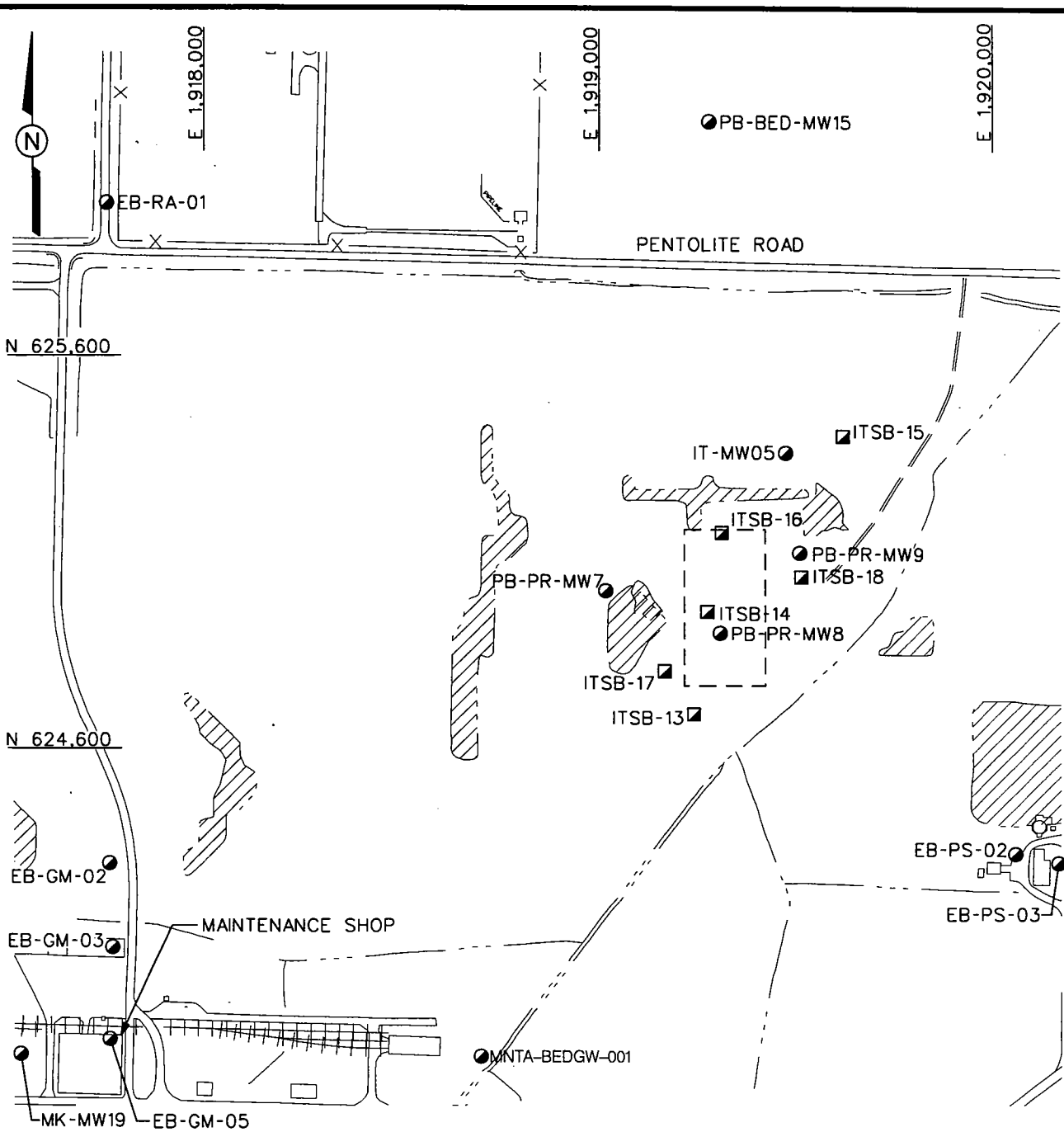
SCALE

0 2400 4800 FEET

FIGURE VIII-2
LOCATIONS OF AREA OF CONCERN

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION



LEGEND:

	BUILDINGS
	APPROXIMATE HISTORICAL LOCATION OF POND
	RAILROAD
	SURFACE WATER
	SURFACE DRAINAGE
—X—	FENCE
IT-MW02	EXISTING MONITORING WELL LOCATION
ITSB-13	EXISTING SOIL BORING LOCATION

SCALE

0 400 800 FEET

FIGURE VIII-3
PENTOLITE ROAD RED WATER PONDS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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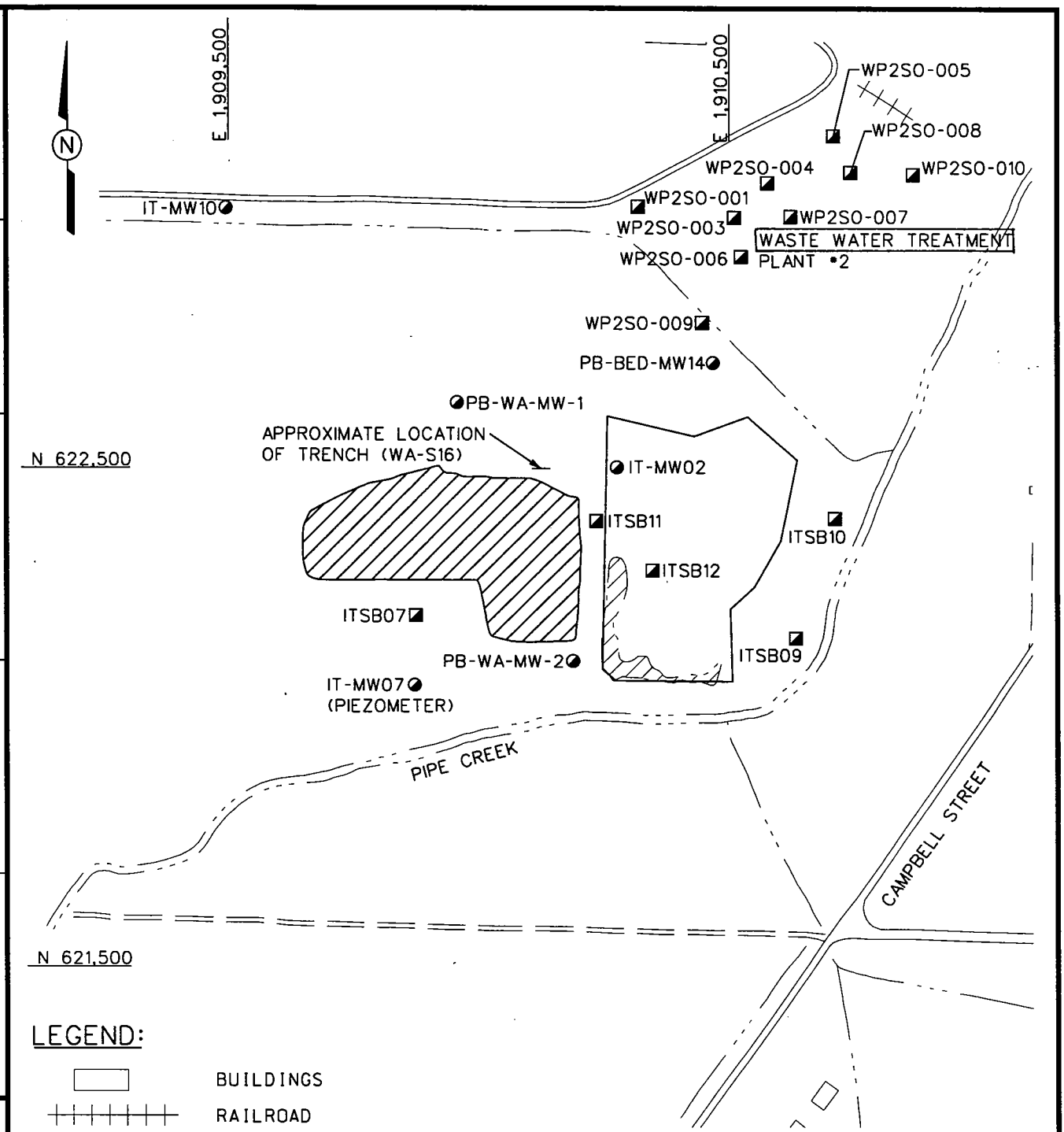

LEGEND:

	BUILDINGS
	RAILROAD
	SURFACE WATER
	SURFACE DRAINAGE
	APPROXIMATE HISTORICAL LOCATION OF PONDS
IT-MW02	EXISTING MONITORING WELL LOCATION
WP2SO-010	EXISTING SOIL BORING LOCATION
	UNPAVED ROADS/DRIVES
	PAVED ROADS

SCALE

0 300 600 FEET

FIGURE VIII-4
WEST AREA RED WATER PONDS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

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ground surface (bgs) within glacial deposits consisting of fine sand, silt, and clay. The groundwater flow direction in the vicinity of the ponds is generally to the northwest. A correlation between the pond water and the groundwater has not been established with certainty, but a trench excavated on the north bank of the west pond encountered the presence of red water at approximately 8 feet bgs (D&M, 1997).

VIII.1.2 Summary of Existing Site Conditions

The former PBOW is located approximately 4 miles south of Sandusky, Ohio and is specifically located in the Perkins, Huron, and Milan Townships. The topography of the site is relatively flat with a gentle, northward gradient slope towards Lake Erie at an average of less than 2 percent. Elevations of PBOW range from 675 feet above msl at the southeast edge of the site to approximately 625 feet above msl in the northern portion of the installation. Eleven streams exist within the site and flow toward Lake Erie. Plum Brook, Ransom Brook, and Pipe Creek are the three major streams located on the site. North-central Ohio has a continental climate with significant influence from Lake Erie. Mean annual precipitation is approximately 33.90 inches and the average monthly precipitation is approximately 1.65 inches for February, and 3.70 inches for the month of July.

Bedrock geology at PBOW is characterized by Devonian and Silurian carbonates and shales generally dipping to the southeast. The thickness of glacial till or lacustrine deposits overlying the bedrock ranges from approximately 0 to 5 feet for most of the site, to approximately 20 feet in the northern limits of the site. Exposed bedrock may be found on the ground surface. According to the PBOW preliminary assessment (Science Applications International Corporation [SAIC], 1991), some karst features are present in the carbonate rocks that form a water-bearing formation underneath the soil cover.

Two aquifers provide drinking water in the area surrounding PBOW. On the west side of Erie County, is a carbonate aquifer and on the east side is a shale aquifer. The transition between the two aquifer systems is within PBOW. Based on well usage and yields, the Ohio Department of Natural Resources has designated the groundwater in the area in three zones. The carbonate aquifer was divided into two zones based on usage and yields. Zone one occurs in the north and northwestern portion of PBOW and has yields of 100 to 500 gallons per minute (gpm). Zone two occurs in the north portion of PBOW and has yields of 15 gpm or less. Zone three consists of the shale aquifer and the overlying glacial till or lacustrine deposits. It typically has yields rarely exceeding 3 gpm (D&M, 1997).

VIII.1.3 Summary of Previous Environmental Studies

Previous investigations concerning the West Area and the Pentolite Road Red Water Ponds have been conducted and are documented in the contamination evaluation report (IT, 1991), the site inspection report (Morrison and Knudsen Corporation [MK], 1994), the sitewide groundwater investigation (GWI) draft report (D&M, 1995), the SMP (ICI, 1995), and the sitewide GWI report (IT, 1997). The following sections provide a brief synopsis of previous environmental studies.

VIII.1.3.1 Pentolite Road Red Water Ponds

In 1989, IT conducted an evaluation to confirm or deny the presence of residual chemical contamination (IT, 1991). A shallow monitoring well (IT-MW05) was installed on the northern edge of the red water ponds, in the suspected downgradient direction. Soil borings IT-SB13 through IT-SB18 were also drilled and soil samples collected. Concentrations of 2,6-DNT and 2,4-DNT in the soil were found to be greater than or equal to 0.740 parts per million (ppm) and sodium concentrations in samples from six of the borings exhibited concentrations significantly above the measured background levels (ICI, 1995).

A site inspection was conducted by MK from June through July 1993 to assess the threat posed to human health and the environment and to determine the need for any additional investigation. MK collected and analyzed surface and sediment samples from a drainage ditch along Pentolite Road north of the Pentolite Road Red Water Ponds Area. Samples were analyzed for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and nitroaromatics. No samples from the Pentolite Road ditch showed detectable levels of contaminants.

From May to June of 1994, D&M conducted a GWI to evaluate several groundwater conditions. One scope of work included the assessment of groundwater quality in the overburden and bedrock water-bearing zones at the Pentolite Road Red Water Ponds Area. Overburden monitoring wells PR-MW7, PR-MW8, and PR-MW9 and bedrock monitoring wells BED-15 and BED-16 were installed. The investigation found that the groundwater flow in the overburden exhibited a strong vertical component and the presence of groundwater in the overburden was seasonally dependent. Groundwater sample results indicated that explosive residue was present in the overburden water-bearing zone, while lower levels of explosive residue was present in the bedrock water-bearing zone (D&M, 1997).

From the sitewide GWI performed by IT in September and October of 1996, it was determined that the overburden water-bearing zone in the Pentolite Road Red Water Ponds Area had been impacted by nitroaromatic compounds. The bedrock water-bearing zone was also determined to exhibit impacts by benzene, toluene, ethyl benzene, and total xylenes, SVOCs, and nitroaromatic compounds (IT, 1997).

During the November 1997 groundwater sampling event, IT discovered that three of the overburden wells at the Pentolite Road Red Water Ponds Area (PR-MW07, PR-MW08, and PR-MW09) had red-colored water, suggesting the presence of nitroaromatics. The analytical results of these latest samples exhibited elevated concentrations of nitroaromatic compounds. The analytical results of these samples will be reported in a separate report.

VIII.1.3.2 West Area Red Water Ponds

In 1984, Battelle Laboratories collected a surface soil sample from the spoils area at the West Area Red Ponds Site. Concentrations of nitroaromatics were detected in the low-ppm range using a now obsolete analytical method (ICI, 1995).

Prior to 1985, a number of studies were conducted on the surface water and sediment from the Red Water Ponds Areas. In the western pond at the West Area Red Ponds Area, 34 bottom sediment samples were collected in a grid pattern by Ohio National Guard environmental health personnel and screened for TNT and DNT derivatives. The highest values of TNT and DNT found in the sediment were less than 1 ppm.

In 1989, IT conducted an investigation to confirm or deny the presence of residual chemical contamination from activities conducted during PBOW operations. Six subsurface soil samples were collected from 0 to 2 feet from borings IT-MW02, IT-SB07, IT-SB09, IT-SB10, IT-SB11, and IT-SB12 located at the West Area Red Water Ponds Area. No VOCs or SVOCs were detected exceeding background. Five nitroaromatic compounds were detected, with the highest concentrations detected at IT-SB12. Manganese was also detected at a concentration exceeding that of the background sample. Monitoring well IT-MW02 was installed downgradient from the West Area Red Water Ponds Area. A groundwater sample was collected for analysis of VOCs, SVOCs, nitroaromatic compounds, nitrates, sulfates, pH, and metals. Analytical results indicated some VOCs and SVOCs were detected in the parts per billion (ppb) range. Concentrations of nitroaromatics, chromium, manganese, and sulfate were detected in the ppm range.

In 1991, SAIC conducted a preliminary assessment to evaluate past waste management and hazardous material handling processes. They determined that hazardous substances had been released to the environment at the West Area Red Water Ponds Area (USACE, 1997).

In 1993, a site inspection was conducted by MK to assess the threat posed by the site on human health and the environment, and to determine the need for additional investigations. MK analyzed sediment and surface water from Pipe Creek near the West Area Red Water Ponds Area for VOCs, SVOCs, and nitroaromatics. The surface water had no detectable contaminants, but the sediment had a few VOCs and SVOCs in the low-ppb range. No nitroaromatics were detected (ICI, 1995). Four monitoring wells (MK-MW09, MK-MW10, MK-MW11, and MK-MW12) were installed in the vicinity of the West Area Red Water Ponds Area. Groundwater was collected from the four new wells and IT-MW02 for analyses of VOCs, SVOCs, nitroaromatic compounds, nitrates, sulfates, and metals. As in the IT groundwater sample collected in 1989, IT-MW02 had some VOCs and SVOCs present in the ppb range and concentrations of nitroaromatics, chromium, and sulfate in the ppm range (ICI, 1995).

In 1994, D&M conducted an investigation to evaluate groundwater occurrence and flow conditions in the overburden and bedrock water-bearing zones; assess groundwater quality in the overburden water-bearing zone; and investigate the baseline groundwater quality of the bedrock water-bearing zone to evaluate the necessity of additional work at PBOW (D&M, 1997). Two bedrock wells (BED-MW14 and BED-MW19) and two overburden wells (WA-MW01 and WA-MW02) were installed in the vicinity of the West Area Red Water Ponds Area. Hydrogeologic data indicated that groundwater flow in the overburden exhibited a strong downward vertical component and the presence of groundwater was strongly seasonally dependent. The general groundwater flow in both water-bearing zones was determined to be to the north towards Lake Erie. Groundwater samples were analyzed for VOCs, base neutral/acid extractable compounds (BNA), nitroaromatics, and metals. Significant concentrations of explosive residues were determined to be present adjacent to the ponds in both the overburden and the bedrock aquifers. VOCs and BNAs were also present in the bedrock wells. Some metals (antimony, manganese, and nickel) were also detected at concentrations exceeding their maximum contaminant levels in at least one of the sampled wells (D&M, 1997).

In 1996, IT conducted a GWI focused on the western portion of the facility, which consisted of installing three overburden monitoring wells, redeveloping existing monitoring wells, collecting groundwater samples for laboratory analysis. In addition, one monitoring well (IT-MW10) and

one temporary piezometer (IT-MW07) were installed in the vicinity of the Red Water Ponds Area. It was determined that the overburden material exhibits impacts by nitroaromatic compounds in the central portion of the West Area Red Water Ponds Area and that inorganic compounds are present at concentrations exceeding the risk-based screening concentrations (RBSC) throughout the area (IT, 1997). It was recommended that further evaluation of the metals in the groundwater be performed to determine whether they were derived from an on-site source of contamination or are related to background conditions. IT determined that the bedrock water-bearing zone was impacted by nitroaromatics and other organic compounds north of the West Area Red Water Ponds Area, but the bedrock aquifer does not exhibit impacts by any of these constituents in the central portion of the area. Inorganic compounds have also exceeded the RBSCs north of the area, but these exceedances will require further evaluation to determine the source.

During the November 1997 groundwater sampling event, IT discovered that two of the overburden wells at the West Area Red Water Ponds Area (IT-MW02 and WA-MW02) and one bedrock well (PB-BED-MW14) had red-colored water, suggesting the presence of nitroaromatics. The latest analytical results for these wells indicate elevated concentrations of nitroaromatics. The analytical results of these samples will be reported in a separate report.

VIII.2.0 Project Organization and Responsibility

The project organization for the RA/DPI consists of a project manager, a health and safety officer, a principal investigator, a human health risk assessor, an ecological risk assessor, an analytical coordinator, field geologists, and technicians. RA work plans will be issued under separate cover. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their respective responsibilities.

VIII.3.0 Scope of Work and Objectives

VIII.3.1 Scope of Work

As specified in the scope of work (SOW)(USACE, 1997), the scope for the RA/DPI at the Red Water Ponds Areas consists of preparation of a quality control plan (QCP); preparation of work plans (SSHP and SSAP); direct-push field sampling; land surveying; analytical work; human health and ecological RAs; report preparation; and geographic information system deliverables.

VIII.3.2 Objectives

The purpose of this investigation is to conduct a direct-push sampling effort at the Red Water Ponds Areas to satisfy the following project decision (PD) statement:

- Determine the nature and extent of source areas.

The following PD statements will also be satisfied, but will be addressed under the RA work plans:

- Estimate the current and future routes of exposure.
- Characterize the risk to current and future exposed human and/or biotic populations.
- Determine acceptable risk-based cleanup levels.
- Determine applicable or relevant and appropriate requirements.

In addition to the specified PD statements, the quality of the data will be such that it can be used to conduct human health and ecological RA (RA work plans will be issued under separate cover).

Specific objectives of the DPI are: (1) to delineate the vertical and lateral extent of overburden contamination in the Red Water Ponds Areas in anticipation of a future remedial action; and (2) to collect data for use in fate and transport modeling of the Red Water Ponds Areas.

VIII.4.0 Soil and Groundwater Sampling

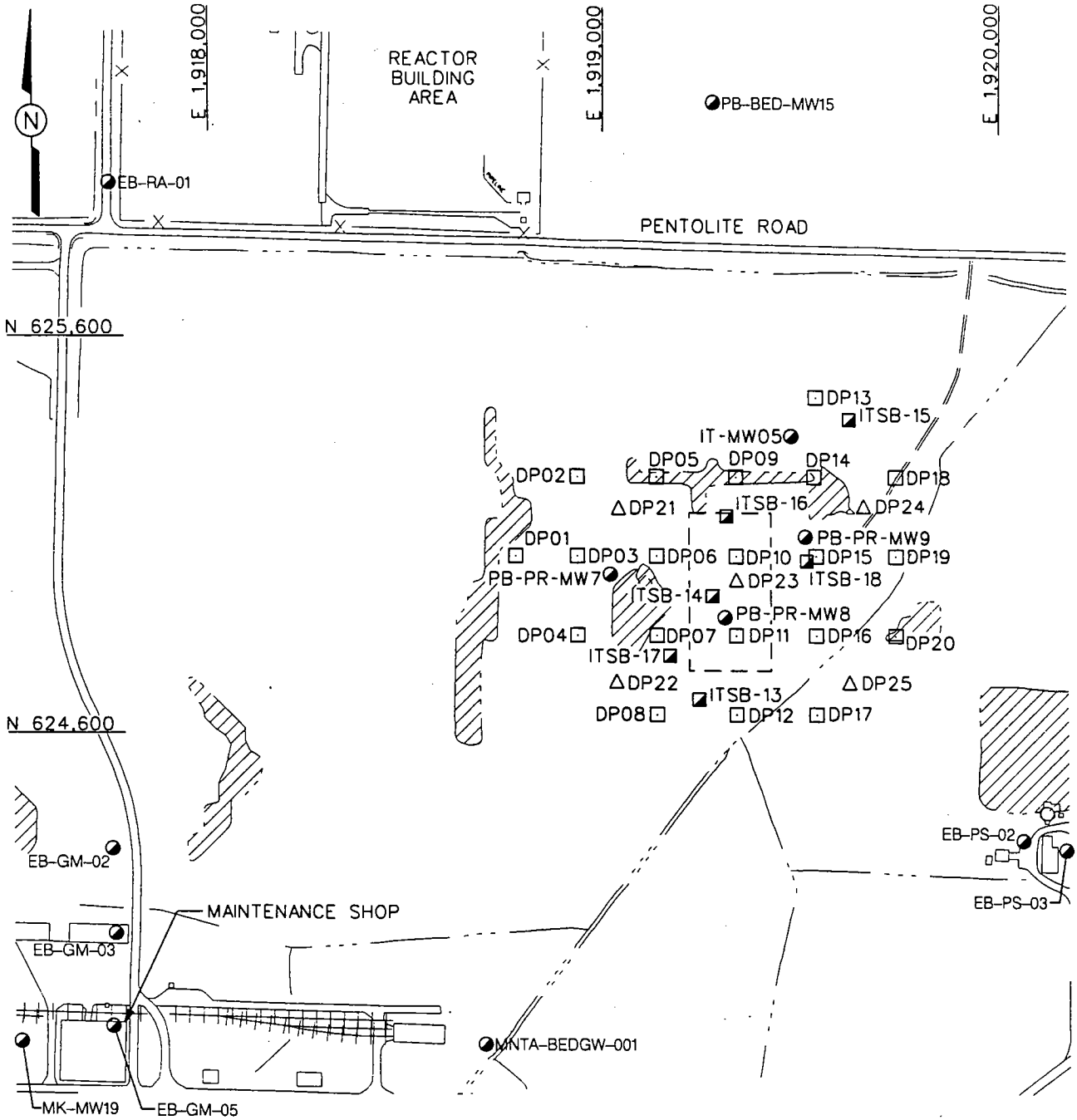
Soil and groundwater samples will be collected from 40 locations: 20 locations at each of the two Red Water Ponds Areas (Table VIII-1 and Figures VIII-5 and -6). One surface and two subsurface soil samples will be collected from each of the 40 locations, for a total of 120 soil samples. One groundwater sample will also be collected from each of the 40 locations. Temporary well screens and casings will be installed in up to 20 boreholes where groundwater is not encountered in the overburden during drilling to allow groundwater to flow into the new borehole. An attempt will be made to collect a sample at a later date from the initially dry locations. Geotechnical soil samples will be collected from ten additional direct-push soil borings, five from locations at each red water pond area. Three geotechnical samples will be collected from each geotechnical direct-push soil boring location, for a total of 30 geotechnical soil samples. Specific procedures for soil and groundwater sampling are presented in Sections VIII.4.1 and VIII.4.2. Tables VIII-2 and VIII-3 summarize the soil and groundwater designations

Table VIII-1

Summary of Sample Collection Quantities, Direct-Push Investigation
Red Water Ponds Areas
Former Plum Brook Ordnance Works,Sandusky, Ohio

Area of Concern	Media	Number of Surface Soil Samples	Number of Direct Push Borings	Number of Samples			
				Primary Samples	Duplicate Samples	Split Samples	Matrix Spike/ Matrix Spike Duplicates
Pentolite Road Red Water Ponds	Surface Soil	20	0	20	1	1	1
	Subsurface Soil	0	20	40	2	2	2
	Geotechnical	0	5	15	0	0	0
	Groundwater	0	20	20	1	1	1
West Area Red Water Ponds	Surface Soil	20	0	20	1	1	1
	Subsurface Soil	0	20	40	2	2	2
	Geotechnical	0	5	15	0	0	0
	Groundwater	0	20	20	1	1	1
Column Totals	**Surface Soil**	**40**	**0**	**40**	**2**	**2**	**2**
	Subsurface Soil	**0**	**40**	**80**	**4**	**4**	**4**
	Geotechnical	**0**	**10**	**30**	**0**	**0**	**0**
	Groundwater	**0**	**40**	**40**	**2**	**2**	**2**

Notes: 1. From each direct-push boring location, except those for geotechnical analysis, one surface soil sample, two subsurface soil samples, and one groundwater sample will be collected.
2. Field duplicates, splits, and matrix spike/matrix spike duplicate samples will be collected at a rate of 5 percent of primary samples collected.



LEGEND:

▭	BUILDINGS
++++++++	RAILROAD
▨	SURFACE WATER
——— - - -	SURFACE WATER DRAINAGE
▭	APPROXIMATE HISTORICAL LOCATION OF PONDS
——— X ———	FENCE (PBOW BOUNDARY)
◐IT-MW02	EXISTING MONITORING WELL LOCATION
◪ITSB-13	EXISTING SOIL BORING LOCAITON
⊡DP01	PROPOSED SAMPLE LOCATIONS
△DP21	PROPOSED GEOTECHNICAL LOCATIONS

SCALE

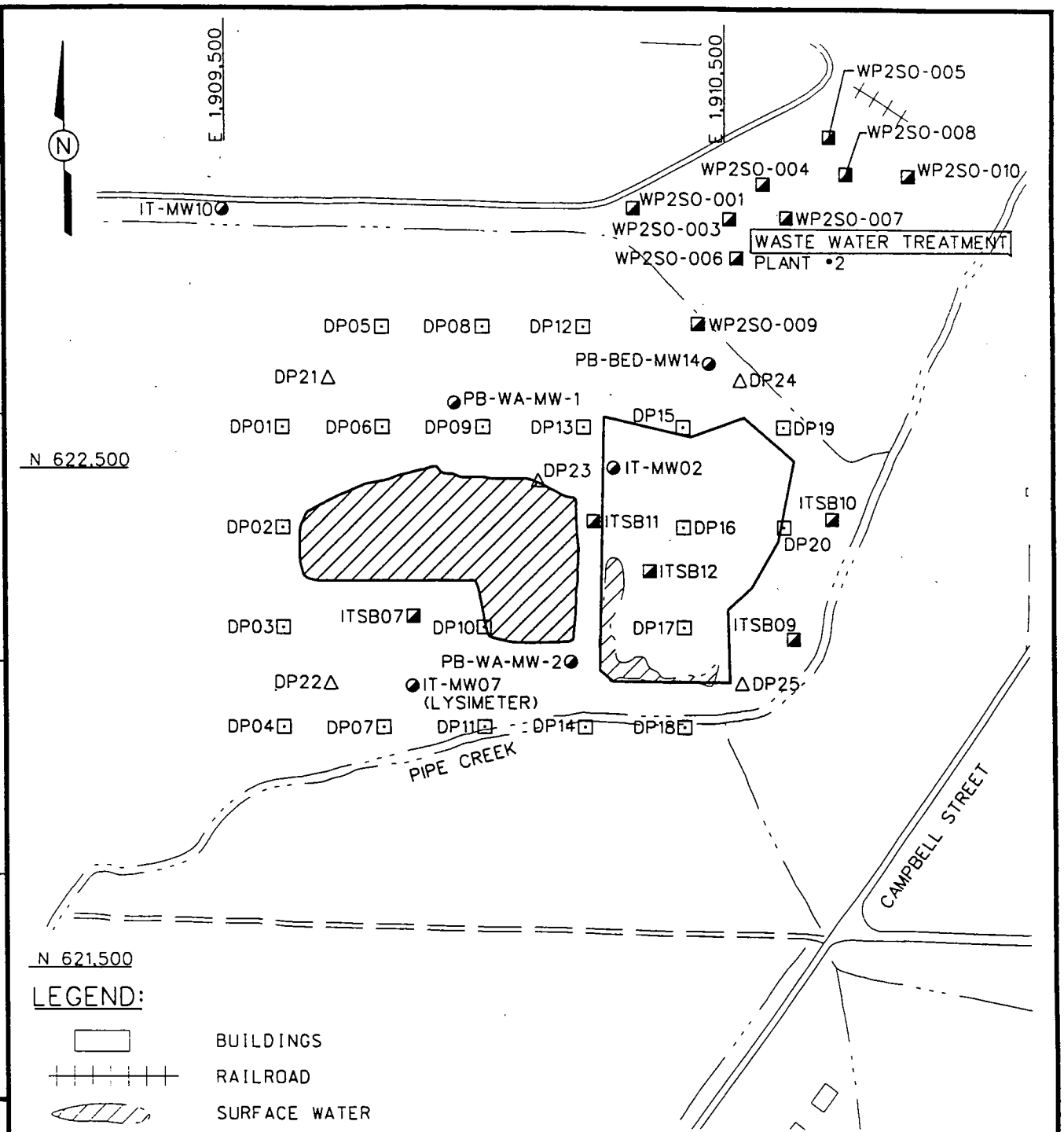
0 400 800 FEET

FIGURE VIII-5
PENTOLITE ROAD RED WATER PONDS SAMPLE LOCATIONS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: \773701ES.005
PROJ. NO.: 773701
INITIATOR: D. KESSLER
PROJ. MGR.: SPANGBERG
DRAFT. CHCK. BY: C. TUMLIN
ENGR. CHCK. BY: R. ELLIS
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 12/16/97
DRAWN BY: D. BILLINGSLEY
12:08:06
06 MAR 98
RVANDERG
C:\IT\OS\CIVIL\773701ES.005



LEGEND:

▭	BUILDINGS
┼┼┼┼┼┼	RAILROAD
▨	SURFACE WATER
——— - - -	SURFACE DRAINAGE
▭	APPROXIMATE HISTORICAL LOCATION OF PONDS
◐ IT-MW02	EXISTING MONITORING WELL LOCATION
◪ WP2SO-010	EXISTING SOIL BORING LOCATION
⊡ DP01	PROPOSED SAMPLE LOCATIONS
△ DP21	PROPOSED GEOTECHNICAL LOCATIONS
═ ═ ═	UNPAVED ROADS/DRIVES
═══	PAVED ROADS

SCALE

0 300 600 FEET

FIGURE VIII-6
WEST AREA RED WATER PONDS SAMPLE LOCATIONS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: \773701ES.006 | INITIATOR: D. KESSLER | DRAFT. CHCK. BY: C. TUMLIN | DATE LAST REV.: | STARTING DATE: 12/16/97
PROJ. NO.: 773701 | PROJ. MGR.: SPANGBERG | ENGR. CHCK. BY: R. ELLIS | DRAWN BY: | DRAWN BY: D. BILLINGSLEY
06 MAR '18 15:14:12
RVANDERG C:\ITNDS\CIVIL\773701ES.006

Table VIII-2

Summary of Soil and Groundwater Sample Designation and QA/QC Samples
Direct-Push Investigation at Pentolite Road Red Water Ponds Area
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Designation	Direct Push Boring Designation	Sample Matrix	Sampling Depth Interval (feet, bgs)	QA/QC Samples			
				FD/FS	MS/MD	FB	ER
PBOW-98-SO-PRRP-DP01-7200-(0001)	DP01	Soil	0 - 1	X	X		
PBOW-98-SO-PRRP-DP01-7210-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP01-7220-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP01-7230		Groundwater	NA	X	X		
PBOW-98-SO-PRRP-DP02-7240-(0001)	DP02	Soil	0 - 1				
PBOW-98-SO-PRRP-DP02-7250-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP02-7260-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP02-7270		Groundwater	NA				
PBOW-98-SO-PRRP-DP03-7280-(0001)	DP03	Soil	0 - 1				
PBOW-98-SO-PRRP-DP03-7290-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP03-7300-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP03-7310		Groundwater	NA				
PBOW-98-SO-PRRP-DP04-7320-(0001)	DP04	Soil	0 - 1				
PBOW-98-SO-PRRP-DP04-7330-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP04-7340-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP04-7350		Groundwater	NA				
PBOW-98-SO-PRRP-DP05-7360-(0001)	DP05	Soil	0 - 1				
PBOW-98-SO-PRRP-DP05-7370-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP05-7380-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP05-7390		Groundwater	NA				
PBOW-98-SO-PRRP-DP06-7400-(0001)	DP06	Soil	0 - 1				
PBOW-98-SO-PRRP-DP06-7410-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP06-7420-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP06-7430		Groundwater	NA				
PBOW-98-SO-PRRP-DP07-7440-(0001)	DP07	Soil	0 - 1				
PBOW-98-SO-PRRP-DP07-7450-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP07-7460-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP07-7470		Groundwater	NA				

Table VIII-2

Summary of Soil and Groundwater Sample Designation and QA/QC Samples
Direct-Push Investigation at Pentolite Road Red Water Ponds Area
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Designation	Direct Push Boring Designation	Sample Matrix	Sampling Depth Interval (feet, bgs)	QA/QC Samples			
				FD/FS	MS/MD	FB	ER
PBOW-98-SO-PRRP-DP08-7480-(0001)	DP08	Soil	0 - 1				
PBOW-98-SO-PRRP-DP08-7490-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP08-7500-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP08-7510		Groundwater	NA				
PBOW-98-SO-PRRP-DP09-7520-(0001)	DP09	Soil	0 - 1				
PBOW-98-SO-PRRP-DP09-7530-(0405)			4 - 5	X	X		
PBOW-98-SO-PRRP-DP09-7540-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP09-7550		Groundwater	NA				
PBOW-98-SO-PRRP-DP10-7560-(0001)	DP10	Soil	0 - 1				
PBOW-98-SO-PRRP-DP10-7570-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP10-7580-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP10-7590		Groundwater	NA				
PBOW-98-SO-PRRP-DP11-7600-(0001)	DP11	Soil	0 - 1				
PBOW-98-SO-PRRP-DP11-7610-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP11-7620-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP11-7630		Groundwater	NA				
PBOW-98-SO-PRRP-DP12-7640-(0001)	DP12	Soil	0 - 1				
PBOW-98-SO-PRRP-DP12-7650-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP12-7660-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP12-7670		Groundwater	NA				
PBOW-98-SO-PRRP-DP13-7680-(0001)	DP13	Soil	0 - 1				
PBOW-98-SO-PRRP-DP13-7690-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP13-7700-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP13-7710		Groundwater	NA				
PBOW-98-SO-PRRP-DP14-7720-(0001)	DP14	Soil	0 - 1				
PBOW-98-SO-PRRP-DP14-7730-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP14-7740-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP14-7750		Groundwater	NA				

Table VIII-2

Summary of Soil and Groundwater Sample Designation and QA/QC Samples
Direct-Push Investigation at Pentolite Road Red Water Ponds Area
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Designation	Direct Push Boring Designation	Sample Matrix	Sampling Depth Interval (feet, bgs)	QA/QC Samples			
				FD/FS	MS/MD	FB	ER
PBOW-98-SO-PRRP-DP15-7760-(0001)	DP15	Soil	0 - 1				
PBOW-98-SO-PRRP-DP15-7770-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP15-7780-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP15-7790		Groundwater	NA				
PBOW-98-SO-PRRP-DP16-7800-(0001)	DP16	Soil	0 - 1				
PBOW-98-SO-PRRP-DP16-7810-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP16-7820-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP16-7830		Groundwater	NA				
PBOW-98-SO-PRRP-DP17-7840-(0001)	DP17	Soil	0 - 1				
PBOW-98-SO-PRRP-DP17-7850-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP17-7860-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP17-7870		Groundwater	NA				
PBOW-98-SO-PRRP-DP18-7880-(0001)	DP18	Soil	0 - 1	X	X		
PBOW-98-SO-PRRP-DP18-7890-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP18-7900-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP18-7910		Groundwater	NA				
PBOW-98-SO-PRRP-DP19-7920-(0001)	DP19	Soil	0 - 1				
PBOW-98-SO-PRRP-DP19-7930-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP19-7940-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP19-7950		Groundwater	NA				
PBOW-98-SO-PRRP-DP20-7960-(0001)	DP20	Soil	0 - 1				
PBOW-98-SO-PRRP-DP20-7970-(0405)			4 - 5				
PBOW-98-SO-PRRP-DP20-7980-(0910)			9 - 10				
PBOW-98-GW-PRRP-DP20-7990		Groundwater	NA				
PBOW-98-FB-PRRP-8000	NA		NA			X	
PBOW-98-FB-PRRP-8010	NA		NA			X	
PBOW-98-ER-PRRP-8020	NA		NA				X
PBOW-98-ER-PRRP-8030	NA		NA				X
PBOW-98-ER-PRRP-8040	NA		NA				X
PBOW-98-ER-PRRP-8050	NA		NA				X

FD/FS - Field duplicate/field split sample.
MS/MD - Matrix spike/matrix spike duplicate.
FB - Field blank sample.
QA/QC - Quality assurance/quality control.
NA - Not applicable.
bgs - Below ground surface.
ER - Equipment rinsate sample.

Table VIII-3

Summary of Soil and Groundwater Sample Designation and QA/QC Samples
Direct-Push Investigation at West Area Red Water Ponds Area
Former Plum Brook Ordnance Works, Sandusky, Ohio

Soil Sample Designation	Direct Push Boring Designation	Sample Matrix	Sampling Depth Interval (feet, bgs)	QA/QC Samples			
				FD/FS	MS/MD	FB	ER
PBOW-98-SO-WARP-DP01-8100-(0001)	DP01	Soil	0 - 1	X	X		
PBOW-98-SO-WARP-DP01-8110-(0405)			4 - 5				
PBOW-98-SO-WARP-DP01-8120-(0910)			9 - 10				
PBOW-98-GW-WARP-DP01-8130		Groundwater	NA	X	X		
PBOW-98-SO-WARP-DP02-8140-(0001)	DP02	Soil	0 - 1				
PBOW-98-SO-WARP-DP02-8150-(0405)			4 - 5				
PBOW-98-SO-WARP-DP02-8160--(0910)			9 - 10				
PBOW-98-GW-WARP-DP02-8170		Groundwater	NA				
PBOW-98-SO-WARP-DP03-8180-(0001)	DP03	Soil	0 - 1				
PBOW-98-SO-WARP-DP03-8190-(0405)			4 - 5				
PBOW-98-SO-WARP-DP03-8200-(0910)			9 - 10				
PBOW-98-GW-WARP-DP03-8210		Groundwater	NA				
PBOW-98-SO-WARP-DP04-8220-(0001)	DP04	Soil	0 - 1				
PBOW-98-SO-WARP-DP04-8230-(0405)			4 - 5				
PBOW-98-SO-WARP-DP04-8240-(0910)			9 - 10				
PBOW-98-GW-WARP-DP04-8250		Groundwater	NA				
PBOW-98-SO-WARP-DP05-8260-(0001)	DP05	Soil	0 - 1				
PBOW-98-SO-WARP-DP05-8270-(0405)			4 - 5				
PBOW-98-SO-WARP-DP05-8280-(0910)			9 - 10				
PBOW-98-GW-WARP-DP05-8290		Groundwater	NA				
PBOW-98-SO-WARP-DP06-8300-(0001)	DP06	Soil	0 - 1				
PBOW-98-SO-WARP-DP06-8310-(0405)			4 - 5				
PBOW-98-SO-WARP-DP06-8320-(0910)			9 - 10				
PBOW-98-GW-WARP-DP06-8330		Groundwater	NA				
PBOW-98-SO-WARP-DP07-8340-(0001)	DP07	Soil	0 - 1				
PBOW-98-SO-WARP-DP07-8350-(0405)			4 - 5				
PBOW-98-SO-WARP-DP07-8360-(0910)			9 - 10				
PBOW-98-GW-WARP-DP07-8370		Groundwater	NA				

Table VIII-3

Summary of Soil and Groundwater Sample Designation and QA/QC Samples
Direct-Push Investigation at West Area Red Water Ponds Area
Former Plum Brook Ordnance Works, Sandusky, Ohio

Soil Sample Designation	Direct Push Boring Designation	Sample Matrix	Sampling Depth Interval (feet, bgs)	QA/QC Samples			
				FD/FS	MS/MD	FB	ER
PBOW-98-SO-WARP-DP08-8380-(0001)	DP08	Soil	0 - 1				
PBOW-98-SO-WARP-DP07-8390-(0405)			4 - 5				
PBOW-98-SO-WARP-DP07-8400-(0910)			9 - 10				
PBOW-98-GW-WARP-DP08-8410		Groundwater	NA				
PBOW-98-SO-WARP-DP09-8420-(0001)	DP09	Soil	0 - 1				
PBOW-98-SO-WARP-DP09-8430-(0405)			4 - 5	X	X		
PBOW-98-SO-WARP-DP09-8440-(0910)			9 - 10				
PBOW-98-GW-WARP-DP09-8450		Groundwater	NA				
PBOW-98-SO-WARP-DP10-8460-(0001)	DP10	Soil	0 - 1				
PBOW-98-SO-WARP-DP10-8470-(0405)			4 - 5				
PBOW-98-SO-WARP-DP10-8480-(0910)			9 - 10				
PBOW-98-GW-WARP-DP10-8490		Groundwater	NA				
PBOW-98-SO-WARP-DP11-8500-(0001)	DP11	Soil	0 - 1				
PBOW-98-SO-WARP-DP11-8510-(0405)			4 - 5				
PBOW-98-SO-WARP-DP11-8520-(0910)			9 - 10				
PBOW-98-GW-WARP-DP11-8530		Groundwater	NA				
PBOW-98-SO-WARP-DP12-8540-(0001)	DP12	Soil	0 - 1				
PBOW-98-SO-WARP-DP12-8550-(0405)			4 - 5				
PBOW-98-SO-WARP-DP12-8560-(0910)			9 - 10				
PBOW-98-GW-WARP-DP12-8570		Groundwater	NA				
PBOW-98-SO-WARP-DP13-8580-(0001)	DP13	Soil	0 - 1				
PBOW-98-SO-WARP-DP13-8590-(0405)			4 - 5				
PBOW-98-SO-WARP-DP13-8600-(0910)			9 - 10				
PBOW-98-GW-WARP-DP13-8610		Groundwater	NA				
PBOW-98-SO-WARP-DP14-8620-(0001)	DP14	Soil	0 - 1				
PBOW-98-SO-WARP-DP14-8630-(0405)			4 - 5				
PBOW-98-SO-WARP-DP14-8640-(0910)			9 - 10				
PBOW-98-GW-WARP-DP14-8650		Groundwater	NA				

Table VIII-3

Summary of Soil and Groundwater Sample Designation and QA/QC Samples
Direct-Push Investigation at West Area Red Water Ponds Area
Former Plum Brook Ordnance Works, Sandusky, Ohio

Soil Sample Designation	Direct Push Boring Designation	Sample Matrix	Sampling Depth Interval (feet, bgs)	QA/QC Samples			
				FD/FS	MS/MD	FB	ER
PBOW-98-SO-WARP-DP15-8660-(0001)	DP15	Soil	0 - 1				
PBOW-98-SO-WARP-DP15-8670-(0405)			4 - 5				
PBOW-98-SO-WARP-DP15-8680-(0910)			9 - 10				
PBOW-98-GW-WARP-DP15-8690		Groundwater	NA				
PBOW-98-SO-WARP-DP16-8700-(0001)	DP16	Soil	0 - 1				
PBOW-98-SO-WARP-DP16-8710-(0405)			4 - 5				
PBOW-98-SO-WARP-DP16-8720-(0910)			9 - 10				
PBOW-98-GW-WARP-DP16-8730		Groundwater	NA				
PBOW-98-SO-WARP-DP17-8740-(0001)	DP17	Soil	0 - 1				
PBOW-98-SO-WARP-DP17-8750-(0405)			4 - 5				
PBOW-98-SO-WARP-DP17-8760-(0910)			9 - 10				
PBOW-98-GW-WARP-DP17-8770		Groundwater	NA				
PBOW-98-SO-WARP-DP18-8780-(0001)	DP18	Soil	0 - 1	X	X		
PBOW-98-SO-WARP-DP18-8790-(0405)			4 - 5				
PBOW-98-SO-WARP-DP18-8800-(0910)			9 - 10				
PBOW-98-GW-WARP-DP18-8810		Groundwater	NA				
PBOW-98-SO-WARP-DP19-8820-(0001)	DP19	Soil	0 - 1				
PBOW-98-SO-WARP-DP19-8830-(0405)			4 - 5				
PBOW-98-SO-WARP-DP19-8840-(0910)			9 - 10				
PBOW-98-GW-WARP-DP19-8850		Groundwater	NA				
PBOW-98-SO-WARP-DP20-8860-(0001)	DP20	Soil	0 - 1				
PBOW-98-SO-WARP-DP20-8870-(0405)			4 - 5				
PBOW-98-SO-WARP-DP20-8880-(0910)			9 - 10				
PBOW-98-GW-WARP-DP20-8890		Groundwater	NA				
PBOW-98-FB-WARP-8900	NA		NA			X	
PBOW-98-FB-WARP-8910	NA		NA			X	
PBOW-98-ER-WARP-8920	NA		NA				X
PBOW-98-ER-WARP-8930	NA		NA				X
PBOW-98-ER-WARP-8940	NA		NA				X
PBOW-98-ER-WARP-8950	NA		NA				X

FD/FS - Field duplicate/field split sample.
MS/MD - Matrix spike/matrix spike duplicate.
FB - Field blank sample.
QA/QC - Quality assurance/quality control.
NA - Not applicable.
bgs - below ground surface.
ER - Equipment rinsate sample.

and sample quantities at the Pentolite Road Red Water Ponds and West Area Red Water Ponds Areas, respectively. Table VIII-4 summarizes the geotechnical designations and sample quantities for samples from both the Pentolite Road and West Area Red Water Pond Areas. Table VIII-5 summarizes the analytical parameters and methods for the soil and groundwater samples at both Red Water Ponds Areas.

Duplicate samples will be submitted to the contract laboratory at the rate of 5 percent of regular soil and groundwater samples collected for chemical analysis. Split samples will be submitted to the quality assurance (QA) laboratory at the rate of 5 percent of regular soil and groundwater samples collected for chemical analysis. Matrix spike and matrix spike duplicate samples will also be submitted to the laboratory at the rate of 5 percent of regular soil and groundwater samples. Tables VIII-2 and VIII-3 show the quality assurance/quality control (QA/QC) samples to be collected at Pentolite Road Red Water Ponds and West Area Red Water Ponds Areas, respectively. QA/QC samples will be collected in accordance with the procedures specified in the SAP (IT, 1996a) and QAPP (IT, 1996b).

VIII.4.1 Surface Soil Sampling

One surficial soil sample (0 to 1 foot) will be collected from each of the 40 direct-push borings according to the method described in Section 4.0 of the sitewide SAP (IT, 1996a). All 40 surface soil samples will be analyzed for metals and nitroaromatics. To provide a more comprehensive suite of potential contaminants in support of the RA, approximately 20 of these surface soil samples (10 from each of the Red Water Ponds Areas) will also be analyzed for VOCs, SVOCs, and PCBs. Specific soil samples to be analyzed for the extended parameter list will be selected in the field by the IT geologist based on evidence of ground scarring, stressed vegetation, standing water, staining, etc. In the event that these features are not evident, then specific locations will be selected by picking every other boring location.

VIII.4.2 Direct-Push Drilling and Sampling

Direct-push drilling and sampling procedures will be used for collection of subsurface soil at 50 locations (40 soil sample locations for chemical analysis and 10 soil sample locations for geotechnical testing) and groundwater at 40 locations. All direct-push techniques typically consist of a hydraulic drive unit, stainless-steel sampling point, and sampling rods. The hydraulic drive unit will first be positioned at the selected boring location. A hydraulically powered percussion hammer will drive a 2.0-inch outside diameter core barrel, steel preprobe, or groundwater sampler to the required depth. If a sample tube is extruded and there is insufficient

Table VIII-4

Geotechnical Soil Sample Designations
Direct-Push Investigation at Red Water Ponds Areas
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Identification[a]	Soil Boring Identification	Sample Depth (feet bgs)[b]
Pentolite Road Red Water Ponds Area		
PBOW-98-PRRP-DP21-Geot-(depth)	DP21	TBD
PBOW-98-PRRP-DP21-Geot-(depth)		TBD
PBOW-98-PRRP-DP21-Geot-(depth)		TBD
PBOW-98-PRRP-DP22-Geot-(depth)	DP22	TBD
PBOW-98-PRRP-DP22-Geot-(depth)		TBD
PBOW-98-PRRP-DP22-Geot-(depth)		TBD
PBOW-98-PRRP-DP23-Geot-(depth)	DP23	TBD
PBOW-98-PRRP-DP23-Geot-(depth)		TBD
PBOW-98-PRRP-DP23-Geot-(depth)		TBD
PBOW-98-PRRP-DP24-Geot-(depth)	DP24	TBD
PBOW-98-PRRP-DP24-Geot-(depth)		TBD
PBOW-98-PRRP-DP24-Geot-(depth)		TBD
PBOW-98-PRRP-DP25-Geot-(depth)	DP25	TBD
PBOW-98-PRRP-DP25-Geot-(depth)		TBD
PBOW-98-PRRP-DP25-Geot-(depth)		TBD
West Area Red Water Ponds Area		
PBOW-98-WARP-DP21-Geot-(depth)	DP21	TBD
PBOW-98-WARP-DP21-Geot-(depth)		TBD
PBOW-98-WARP-DP21-Geot-(depth)		TBD
PBOW-98-WARP-DP22-Geot-(depth)	DP22	TBD
PBOW-98-WARP-DP22-Geot-(depth)		TBD
PBOW-98-WARP-DP22-Geot-(depth)		TBD
PBOW-98-WARP-DP23-Geot-(depth)	DP23	TBD
PBOW-98-WARP-DP23-Geot-(depth)		TBD
PBOW-98-WARP-DP23-Geot-(depth)		TBD
PBOW-98-WARP-DP24-Geot-(depth)	DP24	TBD
PBOW-98-WARP-DP24-Geot-(depth)		TBD
PBOW-98-WARP-DP24-Geot-(depth)		TBD
PBOW-98-WARP-DP25-Geot-(depth)	DP25	TBD
PBOW-98-WARP-DP25-Geot-(depth)		TBD
PBOW-98-WARP-DP25-Geot-(depth)		TBD

[a]Geotechnical sample identifications are independent from the sample numbering system for primary samples.

[b]TBD. Geotechnical sampling depths will be determined in the field based on lithology changes.

and sample quantities at the Pentolite Road Red Water Ponds and West Area Red Water Ponds Areas, respectively. Table VIII-4 summarizes the geotechnical designations and sample quantities for samples from both the Pentolite Road and West Area Red Water Pond Areas. Table VIII-5 summarizes the analytical parameters and methods for the soil and groundwater samples at both Red Water Ponds Areas.

Duplicate samples will be submitted to the contract laboratory at the rate of 5 percent of regular soil and groundwater samples collected for chemical analysis. Split samples will be submitted to the quality assurance (QA) laboratory at the rate of 5 percent of regular soil and groundwater samples collected for chemical analysis. Matrix spike and matrix spike duplicate samples will also be submitted to the laboratory at the rate of 5 percent of regular soil and groundwater samples. Tables VIII-2 and VIII-3 show the quality assurance/quality control (QA/QC) samples to be collected at Pentolite Road Red Water Ponds and West Area Red Water Ponds Areas, respectively. QA/QC samples will be collected in accordance with the procedures specified in the SAP (IT, 1996a) and QAPP (IT, 1996b).

VIII.4.1 Surface Soil Sampling

One surficial soil sample (0 to 1 foot) will be collected from each of the 40 direct-push borings according to the method described in Section 4.0 of the sitewide SAP (IT, 1996a). All 40 surface soil samples will be analyzed for metals and nitroaromatics. To provide a more comprehensive suite of potential contaminants in support of the RA, approximately 20 of these surface soil samples (10 from each of the Red Water Ponds Areas) will also be analyzed for VOCs, SVOCs, and PCBs. Specific soil samples to be analyzed for the extended parameter list will be selected in the field by the IT geologist based on evidence of ground scarring, stressed vegetation, standing water, staining, etc. In the event that these features are not evident, then specific locations will be selected by picking every other boring location.

VIII.4.2 Direct-Push Drilling and Sampling

Direct-push drilling and sampling procedures will be used for collection of subsurface soil at 50 locations (40 soil sample locations for chemical analysis and 10 soil sample locations for geotechnical testing) and groundwater at 40 locations. All direct-push techniques typically consist of a hydraulic drive unit, stainless-steel sampling point, and sampling rods. The hydraulic drive unit will first be positioned at the selected boring location. A hydraulically powered percussion hammer will drive a 2.0-inch outside diameter core barrel, steel preprobe, or groundwater sampler to the required depth. If a sample tube is extruded and there is insufficient

recovery, the sample will be collected from another borehole immediately adjacent (not more than 1 foot to either side) of the original location. The distance will be noted along with the general direction on the Sample Collection Log and the Field Activity Daily Log (FADL).

After the samples have been collected, the hole will be abandoned by grouting to the surface. The grout to be used will contain approximately 94 pounds Portland Type II cement and no more than 3 pounds powdered bentonite and 7 gallons of potable water. Any soil remaining from probe activities will be disposed of on the ground adjacent to the borehole location.

At each of the 40 soil borings, two subsurface soil samples will be collected and analyzed for metals and nitroaromatics. To provide a more comprehensive suite of potential contaminants in support of the RA, approximately 20 of these samples (10 from each of the Red Water Ponds Areas) will also be analyzed for VOCs, SVOCs, and polychlorinated biphenyls (PCB); these locations will be selected as previously specified in Section VIII.4.1. At ten of the soil borings (five in each Red Water Ponds Area) soil will be analyzed for geotechnical parameters only.

VIII.4.2.1 Direct-Push Soil Sampling Procedures

When the probe has reached the desired depth, the point will be retracted, the soil sampler driven forward, and a liner will be filled. The core barrel will be a stainless-steel tube with an inner liner made of Teflon™.

The direct-push crew will extrude the liner from the sample tube and place Teflon tape and vinyl end caps (red cap on the top, black cap on the bottom) on each end of the liner. The direct-push crew will then bring the sample to the field geologist for description and headspace screening if pertinent. The center portion of the liner will be selected for laboratory analysis. Teflon tape will be placed on each end and covered by vinyl end caps. The sample location identification (see Chapter VIII.5.0) and depth will be written on the upper (red) vinyl end cap. Where there is any variation in the section of sample that is collected, this shall be noted in the FADL and Sample Collection Log.

VIII.4.2.1.1 Collection of Subsurface Soil Samples For Chemical Analysis

Each direct-push hole for chemical analysis will be advanced to the top of the water table or to refusal, whichever is reached first. Two subsurface soil samples from each hole will be collected for chemical analysis of nitroaromatics and metals. The center portion of each sample interval will be cut, sealed as previously discussed, and placed in a gallon-sized ziplock bag, and then

into a properly chilled sample cooler for submission to the laboratory. Next, the top 6-inch section of the liner will be placed into a ziplock bag to obtain a headspace reading. The soil in the ziplock bag will be allowed to volatilize; a photoionization detection and/or flame ionization detection reading will then be obtained. If the surface soil sample from a given boring is not analyzed for VOCs, SVOCs, and PCBs, then one of the two subsurface sample intervals selected for analysis will be analyzed for these parameters based on the headspace readings obtained from the upper 6 inches of each liner and or on visual characteristics indicative of contamination.

VIII.4.2.1.2 Collection of Subsurface Soil Samples For Geotechnical Analysis

Samples collected for geotechnical analysis will be obtained from a total of ten soil borings, which includes five boring locations from each Red Water Ponds Area. An acetate liner will be used with each of these samples. Samples will be analyzed for moisture content, Atterberg limits, sieve analysis, and soil density. If possible, a total of three samples will be obtained from each geotechnical borehole. The samples will be collected from a depth to be determined in the field with the intent to collect one from the soil/groundwater interface, one from within the water-bearing material, and one from the overburden/bedrock interface of the samples. Because no samples are to be submitted for chemical analysis from these borings, no headspace readings of the soil will be required; however, soil descriptions will be performed for each borehole.

VIII.4.2.2 Direct-Push Groundwater Sampling Procedures

Groundwater will be collected, if possible, from all the borings in which soil has been collected for chemical analysis. If the groundwater is encountered before the bedrock is reached and the field geologist believes a sufficient quantity of water can be obtained, a groundwater sampler or a rod with an expendable tip will be pushed into the formation. If an insufficient quantity of water is present for the collection of the appropriate samples, a screen will be placed in the borehole and a temporary piezometer will be constructed. The collection method will be either through a peristaltic pump using Teflon tubing or a stainless-steel mini bailer. In place of a peristaltic pump, a Teflon tube equipped with a bottom check ball may also be used. An appropriate number of bottles will be filled for laboratory analysis. All groundwater samples will be analyzed for: VOCs; SVOCs; target analyte list (TAL) metals; dissolved TAL metals; nitroaromatics; PCBs; hardness; alkalinity; total organic carbon; total dissolved solids; total suspended solids; chloride; cyanide (total); nitrate; and sulfate.

Filtration of groundwater samples for dissolved metal analysis will be performed in the field using a 0.45 μm in-line filter. If an in-line filter is not possible due to use of tubing with a

bottom check ball, the water samples will be filtered in the field office using a vacuum 0.45 μm filter paper and a vacuum pump.

Piezometer installation may be necessary if the direct-push borehole fails to produce enough water for sampling. Piezometer construction will consist of 5-foot-long and 1-inch inside-diameter Schedule 40 PVC screen with factory slot (0.010-inch) and appropriate length of riser to extend the piezometer 2 feet above ground surface. Filter sand (No. 20 to No. 30 U.S. sieve) will be slowly poured into the annular space between the piezometer and the borehole from the bottom to 2 feet above the piezometer screen. Bentonite pellets will then be placed from the top of the filter pack to the ground surface and will be hydrated for at least 24 hours prior to sampling. If after 48 hours, the piezometer does not contain enough water for sample collection, USACE-Nashville District will be contacted for further instruction. Piezometers will be abandoned when sampling is completed, following appropriate federal and state regulations.

VIII.4.3 Sampling Locations at Pentolite Road Red Water Ponds

At the Pentolite Road Red Water Ponds Area, 20 locations will be sampled for chemical analysis of the surface soil, subsurface soil, and groundwater, and 5 locations will be sampled for geotechnical analysis. Figure VIII-5 shows the tentative boring locations. The placement of these soil borings will be based on a systematic grid pattern to provide thorough coverage with a limited number of samples and to minimize sampling bias. The exact location of these borings are subject to change if visual and/or site conditions warrant (i.e., standing water, stressed or no vegetation, visual surface staining). The borehole locations should achieve complete coverage around the perimeter of the former pond area to determine the vertical and lateral extent of surface and subsurface soil and groundwater contamination.

VIII.4.4 Sampling Locations at West Area Red Water Ponds

At the West Area Red Water Ponds Area, 20 locations will be sampled for chemical analysis of the surface soil, subsurface soil, and groundwater, and 5 locations will be sampled for geotechnical analysis. Figure VIII-6 shows the proposed sampling locations. Except adjacent to the west pond, the soil borings will be placed in a grid pattern to provide maximum coverage with a limited number of samples and to minimize sampling bias. The exact location of these borings are subject to change if visual and/or site conditions warrant (ie. standing water, stressed or no vegetation, visible surface staining). The borehole locations should achieve adequate coverage around the perimeter of the former pond area to determine the vertical and lateral extent of surface and subsurface soil and groundwater contamination.

VIII.5.0 Sample Numbering System

The sample numbering system to be used during this investigation will conform to USACE-Nashville District's numbering convention and will be used in each of the site-specific investigations. Specifically, each sample will be assigned a unique sample identification number that describes where the sample is collected. Each sample number consists of a group of letters and numbers separated by hyphens. The sample media and numbering system used for the Red Water Ponds Areas is described as follows:

Project Code	Year	Sample Type	Site Identification	Sample Location Number	Laboratory Identification Number	Depth
PBOW	98	XX	XXXX	XXXX	XXXX	(XXXX)

Sample types:

SO - Soil sample
GW - Groundwater
FS - Field split sample
FD - Field duplicate
MS - Matrix spike sample
MD - Matrix spike duplicate sample
ER - Equipment rinsate sample
FB - Field blank sample.

Site Identification Names:

Pentolite Road Red Water Ponds Area - PRRP
West Area Red Water Ponds Area – WARP.

"PBOW-98-SO-PRRP-DP08-7490-0405" signifies that this soil sample was collected in 1998 from Pentolite Road Red Water Pond Area at direct-push soil boring number DP08 from 4 to 5 feet bgs and was given a unique laboratory number 7490. The sample identification number will be recorded by the IT field geologist on the FADL, the Sample Collection Log, and the Boring Log (if appropriate). Examples of these forms can be found in Section 4.0 of the SAP (IT, 1996a).

The sample numbering system applies to all primary and QA/QC samples collected for chemical analysis purpose. Separate identifications have been assigned to geotechnical samples (Table VIII-4).

VIII.5.1 Analytical Program

Requirements of the analytical program are presented in the SAP (IT, 1996a) and the QAPP (IT, 1996b). Primary samples will be sent to Quanterra Environmental Services located in Knoxville, Tennessee. Split samples will be sent to the USACE Northwest Division Laboratory in Omaha, Nebraska.

VIII.5.2 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SAP (IT, 1996a) and will be followed during the direct-push investigation. The IT field coordinator will contact PBS for access to a potable water source and a location at which to perform decontamination activities.

VIII.6.0 Sample Preservation, Packaging, and Shipping

Sample containers and caps will be new, certified as precleaned containers from I-CHEM, and made of materials recommended by the U.S. Environmental Protection Agency in Title 40 Code of Federal Regulations Part 136 and SW-846 (3rd Edition). Sample containers and preservative/preservation methods are summarized in Table VIII-6, modified from Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be placed in a ziplock bag before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that the sample is received by the laboratory.

Samples will be placed in coolers as soon as possible after collection and will be packed so as to minimize the possibility of container breakage by using vermiculite or styrofoam peanuts to fill void space. Samples will be cooled as promptly as feasible to a temperature of approximately 4 degrees Celsius and maintained at that temperature by means of blue ice or double-packaged ice from the time the shipping container is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by next-day-delivery service.

Table VIII-5

Summary of Chemical and Geotechnical Analytical Parameters, Risk Assessment and Direct-Push Investigation at Red Water Ponds Areas Former Plum Brook Ordnance Works, Sandusky, Ohio

Parameter Name	Surface and Subsurface Soil Method Number	Groundwater Method Number
TCL Volatile Organic Compounds	8260A	8260A
TCL Semivolatile Organic Compounds	3540B/8270B	3520B/8270B
Nitroaromatics	8330	Modified 8330
Total TAL Metals	3050A/6010A/7471A	3005A/6010A/7470
Dissolved TAL Metals	NA	3005A/6010A/7470
Polychlorinated Biphenyls	3540B/8081	3520B/8081
Hardness	NA	EPA 130.2
Alkalinity	NA	EPA 310.1
Total Organic Carbons	NA	SW-846 9060
Total Dissolved Solids	NA	EPA 160.1
Total Suspended Solids	NA	EPA 160.2
Chloride	NA	EPA 325.3
Cyanide (Total)	NA	9010A
Nitrate	NA	EPA 352.2
Sulfate	NA	EPA 375.4
Geotechnical Parameters		
Moisture Content	ASTM D2216	NA
Atterberg Limits	ASTM D4318	NA
Sieve Analysis	ASTM D422	NA
Soil Density	To Be Determined	NA

References:

The analytical methods above are found in the following references:

Test Method for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, update II September 1994.

Test Method for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, update I July 1992.

Test Method for Evaluating Solid Waste, Physical/Chemical Methods, 3rd Edition, update II December 1990.

Notes:

- Three samples from each of 40 direct-push borings will be analyzed for nitroaromatics and TAL metals.
- One soil sample from each of the 40 direct-push borings will be analyzed for VOCs, SVOCs, and PCBs; the sampling interval will be determined in the field by the IT geologist based on visual observations and/or organic vapor readings.
- Three samples from each of ten separate direct-push borings will be analyzed for geotechnical parameters.

PCB - Polychlorinated biphenyls.

TCL - Target compound list.

TAL - Target analyte list. Metals include Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Ti, V, As, Hg, Se, and Zn.

Table VIII-6

Laboratory Sample Containers, Preservatives, and Holding Times
Direct-Push Investigation of Red Water Ponds Area
Former Plum Brook Ordnance Works
Sandusky, Ohio

Matrix	Analytical Parameter	Analytical Method	Container Type & Quantity	Preservative	Holding Time
Water	Volatile Organics	8260A	3 x 40-mL Glass w/ Teflon® -Lined Septum	HCl to pH < 2, Cool to 4°C	14 days from collection
	Explosives	8330	2 x IL Amber Glass w/Teflon	Cool to 4°C	Extract 7 days from collection, analyze 40 days from extraction
	Semivolatile Organics	3520B/8270B	2 x 1-L Amber Glass w/Teflon-Lined Cap	Cool to 4°C	Extract 7 days from collection, analyze 40 days from extraction
	Pesticides/PCBs	3520B/8081	2 x 1-L Amber Glass w/Teflon-Lined Cap	Cool to 4°C	Extract 7 days from collection, analyze 40 days from extraction
	Metals (Filtered)	3010A/6010A 7060A/7470A 7740	1 x 1-L HDPE[a] w/White Poly Cap	HNO_3 to pH < 2 Cool to 4°C preserve following field filtration	180 days from collection (Hg - 28 days) from collection
	Metals (Unfiltered)	3010A/6010A 7060A/7470A 7740	1 x 1-L HDPE w/White Poly Cap	HNO_3 to pH < 2, Cool to 4°C	180 days from collection (Hg - 28 days) from collection
	Total cyanide	9010A	1 x 500 ml HDPE w/White Poly Cap	NaOH to pH < 12, Cool to 4°C	14 days
Soils	Volatile Organics	8260A	2 x 120 mL Wide-Mouth Glass w/ Teflon-Lined Cap or Teflon Liner Tube with Cap	Cool to 4°C	14 days from collection
	Explosives	8330	1 x 250 mL Wide-Mouth Clear Glass w/ Teflon-Lined Cap or Teflon Liner Tube with Cap	Cool to 4°C	Extract 14 days from collection, analyze 40 days from extraction
	Semivolatile Organics	3540B/8270B	1 x 250-mL Wide-Mouth Clear Glass w/Teflon-Lined Cap or Teflon Liner Tube with Cap	Cool to 4°C	Extract 14 days from collection, analyze 40 days from extraction

Table VIII-6

Laboratory Sample Containers, Preservatives, and Holding Times
Direct-Push Investigation of Red Water Ponds Area
Former Plum Brook Ordnance Works
Sandusky, Ohio

Matrix	Analytical Parameter	Analytical Method	Container Type & Quantity	Preservative	Holding Time
Soils (continued)	Pesticides/PCBs	3540B/8081	1 x 250-mL Wide-Couth Clean Glass w/Teflon-Lined Cap or Teflon Liner Tube with Cap	Cool to 4°C	Extraact 14 days from collection, analyze 40 days from extraction
	Total Cyanide	9013/9010A	1 x 120-mL Wide-Mouth Claer Glass w/Teflon-Lined Cap or Teflon Liner Tube with Cap	Cool to 4°C	14 days
	Metals	3050A/6010A 7060A/7471A 7740	1 x 120-mL Wide-Mouth Clear Glass w/Teflon-Lined Cap or Teflon Liner Tube with Cap	Cool to 4°C	180 days from collection (Hg - 28 days) from collection
	Grain Size and Moisture	ASTM D2216, D421, D422	1 x 500-mL Wide-Mouth Glass w/ Teflon-Lined Cap or Teflon Liner Tube with Cap	---	---
	TCLP[c] VOC	1311/8240	2 x 120-mL Wide-Mouth	Cool to 4°C	14 days TCLP extraction, 14 days analysis
	TCLP SVOC	1311/8270	1 x 500-mL Wide-Mouth	Cool to 4°C	14 days TCLP extraction, 7 days to leachate extraction, 40 days to analysis
	TCLP TAL[d] Metals	1311/6010/7000	1 x 250-mL Wide-Mouth Glass Out of SVOC container	Cool to 4°C	180 days TCLP extraction, 180 days analysis Hg - 28 days TCLP extraction, 28 days analysis

[a]HDPE - High Density Polyethylene
[b]PCB - polychlorinated biphenyls
[c]TCLP - Toxicity Characteristic Leaching Procedure
[d]TAL - Total dissolved metals include Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Fe, K, Mg, Na, Pb, Cu, Ni, Mn, Tl, V, Zn, As, Hg, and Se.

Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of shipment. If this is not possible, the laboratory will be notified the following morning. Field split samples will be sent to the USACE-designated QA/QC laboratory following the same procedures as for other primary laboratory samples.

Completed analysis request/chain-of-custody records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or, for split samples:

U.S. Army Corps of Engineers
Northwest Division Laboratory
CENWO-LB
Attention: Mr. Douglas Taggart
420 South 18th Street
Omaha, Nebraska 68102-2586
Phone: (402) 444-4300

VIII.7.0 Investigation-Derived Waste Management Plan

Anticipated investigation-derived waste (IDW) during the investigation includes excess soil samples/cuttings, decontamination fluid, and disposable personal protective equipment. Residual surface soil will be used as backfill or spread out on the surface at the point of origin. Decontamination water will be collected and stored in 55-gallon drums and transported to the designated on-site staging area for later disposal, while decontamination chemicals (methanol) will be kept in a stainless-steel pan and allowed to evaporate. Disposable personal protective equipment will be double-bagged and disposed of in the on-site dumpster. More detailed procedures of IDW management are provided in Chapter 8.0 of the SAP (IT, 1996a).

VIII.8.0 Human Health and Ecological Risk Assessment

IT will prepare human health and ecological RA work plans as specified in the revised SOW (USACE, 1997) as a separate document. These will be submitted for review prior to completion of field activities.

VIII.9.0 Schedule

The project schedule is presented in Table VIII-7. The schedule is tentative and is subject to revision and approval from USACE Nashville District.

VIII.10.0 References

Dames and Moore, Inc., (D&M), 1995, ***Records Review Report, Plum Brook Ordnance Works, Sandusky, Ohio,*** April, 1995.

Dames and Moore, Inc., (D&M), 1997, ***Red Water Ponds Focused Remedial Investigation Final Report, Plum Brook Station/NASA, Sandusky, Ohio,*** April 1997.

International Consultants, Inc., (ICI), 1995, ***Site Management Plan, Plum Brook Ordnance Works, Sandusky, Ohio,*** Part B, Areas of Concern, September 1995.

IT Corporation (IT), 1997, ***Sitewide Groundwater Investigation, Former Plum Brook Ordnance Works, Sandusky, Ohio***, September 1997.

IT Corporation (IT), 1996a, ***Sitewide Sampling and Analysis Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

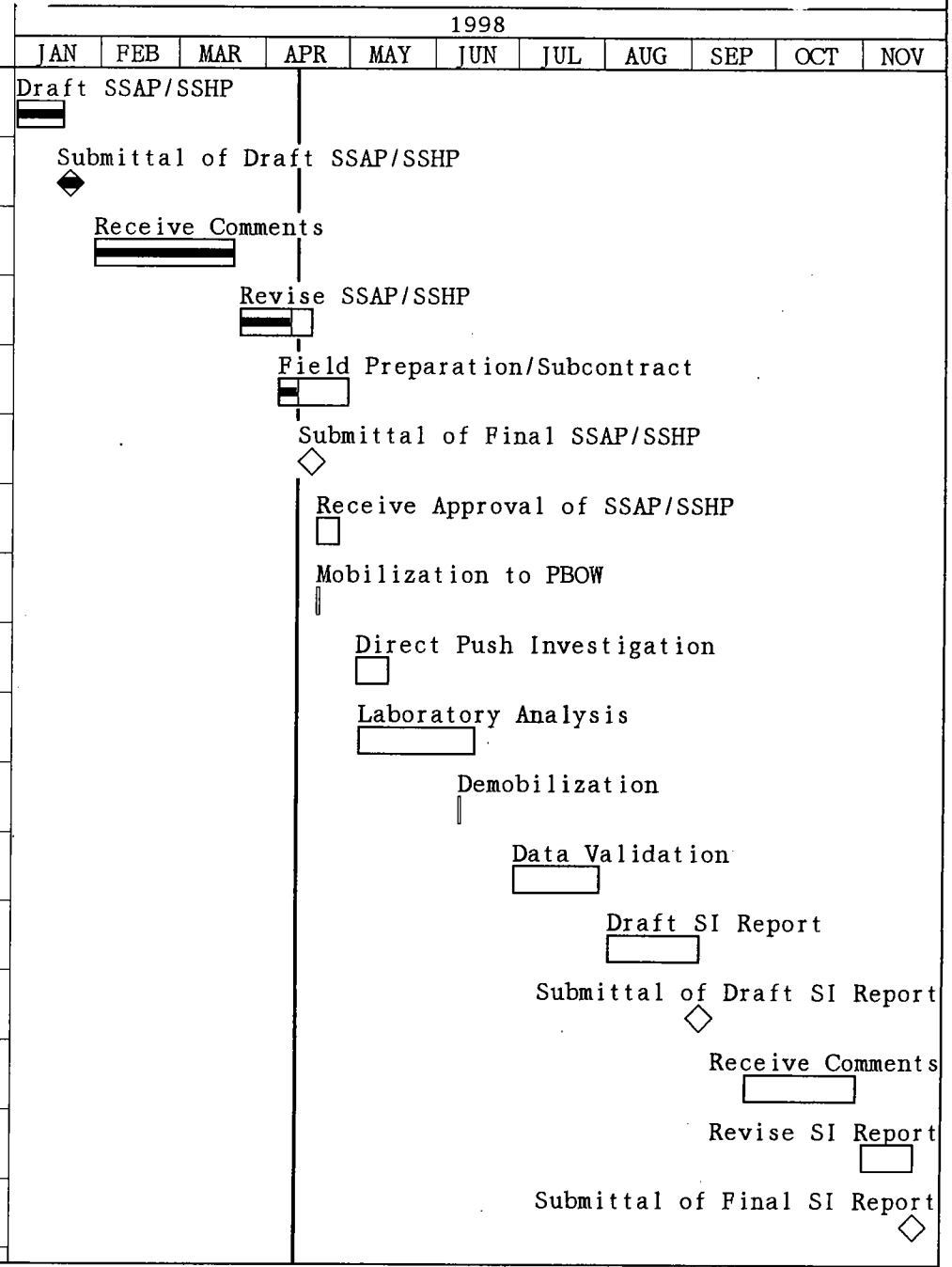
IT Corporation (IT), 1996b, ***Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio,*** July 1996.

IT Corporation (IT), 1996c, ***Sitewide Safety and Health Plan, Plum Brook Ordnance Works, Sandusky, Ohio***, July 1996.

IT Corporation (IT), 1991, ***Engineering Report for the Contamination Evaluation for the Former Plum Brook Ordnance Works, Sandusky, Ohio***, January 1991.

Morrison and Knudsen Corporation (MK), 1994, ***Site Inspection Report, Plum Brook Station, Sandusky, Ohio,*** volume 1 (prepared for NASA), January 1994.

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
Draft SSAP/SSHP	2JAN98A	18JAN98A	22
Submittal of Draft SSAP/SSHP		20JAN98A	0
Receive Comments	30JAN98A	20MAR98A	39
Revise SSAP/SSHP	23MAR98A	17APR98	17
Field Preparation/Subcontract	6APR98A	30APR98	25
Submittal of Final SSAP/SSHP		17APR98	0
Receive Approval of SSAP/SSHP	20APR98	27APR98	8
Mobilization to PBOW	20APR98	20APR98	1
Direct Push Investigation	4MAY98	15MAY98	12
Laboratory Analysis	5MAY98	15JUN98	42
Demobilization	10JUN98	10JUN98	1
Data Validation	30JUN98	30JUL98	31
Draft SI Report	3AUG98	4SEP98	33
Submittal of Draft SI Report		4SEP98	0
Receive Comments	21SEP98	30OCT98	40
Revise SI Report	2NOV98	20NOV98	19
Submittal of Final SI Report		20NOV98	0



Plot Date 13APR98
Data Date 13APR98
Project Start 16SEP97
Project Finish 20NOV98

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

NCOB PBRW

Sheet 1 of 1

USACE - NASHVILLE DISTRICT
Red Water Ponds Area, Plum Brook Ord
Risk Assessment & Direct Push Investigation

Proposed Project Schedule

Date	Revision	Checked	Approved

Table VIII-7

Science Applications International Corporation (SAIC), 1991, ***Plum Brook Station Preliminary Assessment Report***.

U.S. Army Corps of Engineers (USACE), 1997, ***Scope of Work for Risk Assessment and Direct Push Investigation, Red Water Ponds Area, Former Plum Brook Ordnance Works***, September 1997.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CELRN-EP-R-M

Project Description: Risk Assessment and Direct Push Investigation, Red Water Ponds Areas, Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract Number: DACA62-94-D-00030 Delivery Order Number: 0031

Project Number: 773701 Task / Phase Number: 02000000

Document Type	Identify specific section or segment covered by this checkprint	Document Origin
☐ Technical / Cost Proposal		☐ Originator Developed
☐ RFP		☒ Edited Standard
☐ Contract / Subcontract		☐ Client Furnished
☐ SAP, SSAP, CDAP, or QAPP		
☒ SHP or SSHP	SSHP, Revision 1, April 1998	**Document Status**
☐ _____ Report		☐ Preliminary
☐ Risk Assessment / Evaluation		☐ Internal Draft
☐ Specifications & Plans		☐ Draft
☐ Design Calculations		☐ Draft Final
☐ Tables		☒ Final
☐ Drawings / Figures		☐ Other: _____
☐ Other: _____		

	Required Person	Signature	Date
Originator	M. Smith	Melissa G Smith	4/15/98
Checker			
Backchecker			
Updater			
Rechecker			
Technical Reviewer	H. Pullum	Harry A. Pullum	4/15/98
Technical Reviewer			
Technical Reviewer			
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Attachment VIII

Site-Specific Safety And Health Plan
Direct-Push Investigation of Red Water Ponds Area
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared By:

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Submitted To:

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IT Project No. 773701
Control Copy No. 19

Revision 1

April 1998

This Site-Specific Safety and Health Plan Attachment must be used in conjunction with the Sitewide Safety and Health Plan for Site Investigations and Groundwater Investigations at the former Plum Brook Ordnance Works, dated July 1997.

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4/15/98
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4/15/98
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Site Coordinator
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4/15/98
Date

Site Safety and Health Officer
IT Corporation

Date

This Site-Specific Safety and Health Plan Attachment must be used in conjunction with the Sitewide Safety and Health Plan for Site Investigations and Groundwater Investigations at the former Plum Brook Ordnance Works, dated July 1997.

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Control Copy No. 21	M. Smith
Control Copy No. 22	K. Napier
Control Copy No. 23	Project File
Control Copy Nos. 24 and 25	Field personnel

Plum Brook Project Emergency Contacts

Note: All field crews will be provided 2-way radios from the Plum Brook Communications Center. In the event of an emergency, contact the Plum Brook Communications Center by radio and they will contact and coordinate emergency response personnel.

Fire Department	(419) 627-5837
Ambulance	911
Police Department	(419) 627-5863
Providence Hospital	(419) 621-7000
National Response Center	(800) 424-8802
Poison Control Center	(800) 462-0800
Ohio EPA Emergency Spill Number	(800) 282-9378
Don Burton, IT Program Manager	(423) 690-3211
Mike Spangberg, IT Project Manager	(423) 690-3211
George Yu, IT Site Manager	(423) 690-3211
Melissa Smith, IT H&S Manager	(423) 690-3211
Dr. Elaine Theriault, IT Occupational Physician	(800) 299-3674

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List of Acronyms

DNT	dinitrotoluene
H&S	Health and Safety
NIOSH	National Institute of Occupational Safety and Health
PBOW	Plum Brook Ordnance Works
PPE	personal protective equipment
PVC	polyvinyl chloride
SHP	safety and health plan
SSHO	site safety and health officer
SSHP	site-specific safety and health plan

VIII.1.0 Site Work Plan Summary

Project Objective. The objectives of this investigation at the former Plum Brook Ordnance Works (PBOW), Sandusky, Ohio, are summarized as follows:

- Determine if there are hazardous substances present at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define site physical features and characteristics (aquifer background conditions).
- Evaluate fate and transport pathways (groundwater modeling).
- Determine current and future routes of exposure.

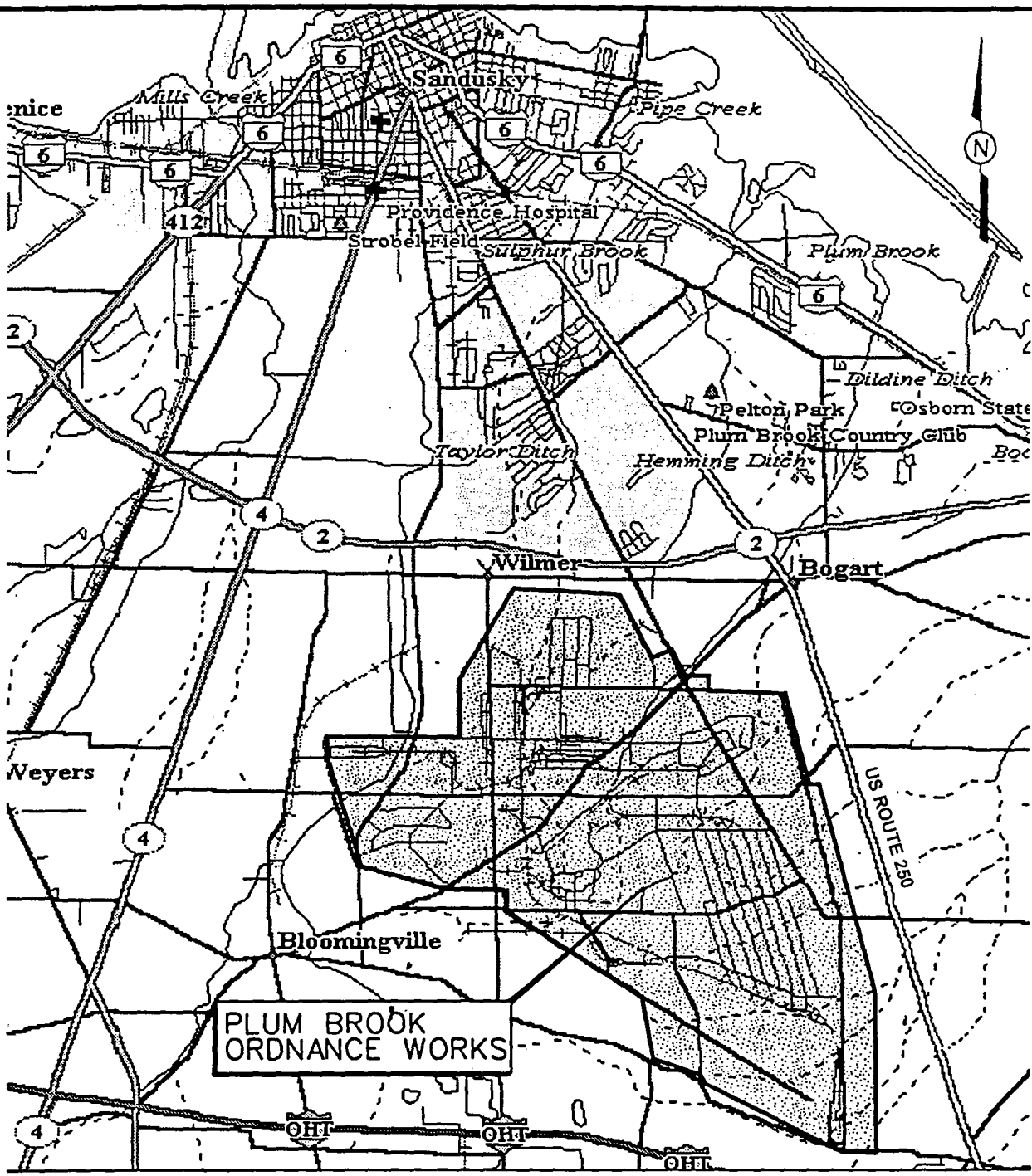
Project Tasks

- Direct-push sampling
- Decontamination of equipment (high-pressure water jetting operations).

Personnel Requirements. Up to 15 employees.

Note: All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the sitewide safety and health plan (SHP) for site investigations at PBOW, and be familiar with the requirements of this site-specific SHP (SSHP). Figure VIII.1-1 presents the site and hospital location map. The Red Water Ponds and the equipment decontamination pad are presented on Figure VIII.1-2. Figures VIII.1-3 and VIII.1-4 show sample locations and work zones for the Pentolite Road and West Area Red Water Ponds.

Project Schedule. Late spring 1998.



NOT TO SCALE

FIGURE VIII.1-1
SITE AND HOSPITAL
LOCATION MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 5/8/97 | DATE LAST REV.:23 JUL | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR:M. SPANGBERG | DWG. NO.: \771484ES.004
DRAWN BY: R. KNIGHT | DRAWN BY:RKNIGHT | ENGR. CHCK. BY: M. SPANGBERG | PROJ. MGR.:D. BURTON | PROJ. NO.:771481

771481ES.004 11:33:19 JULY 23, 1997 RMK

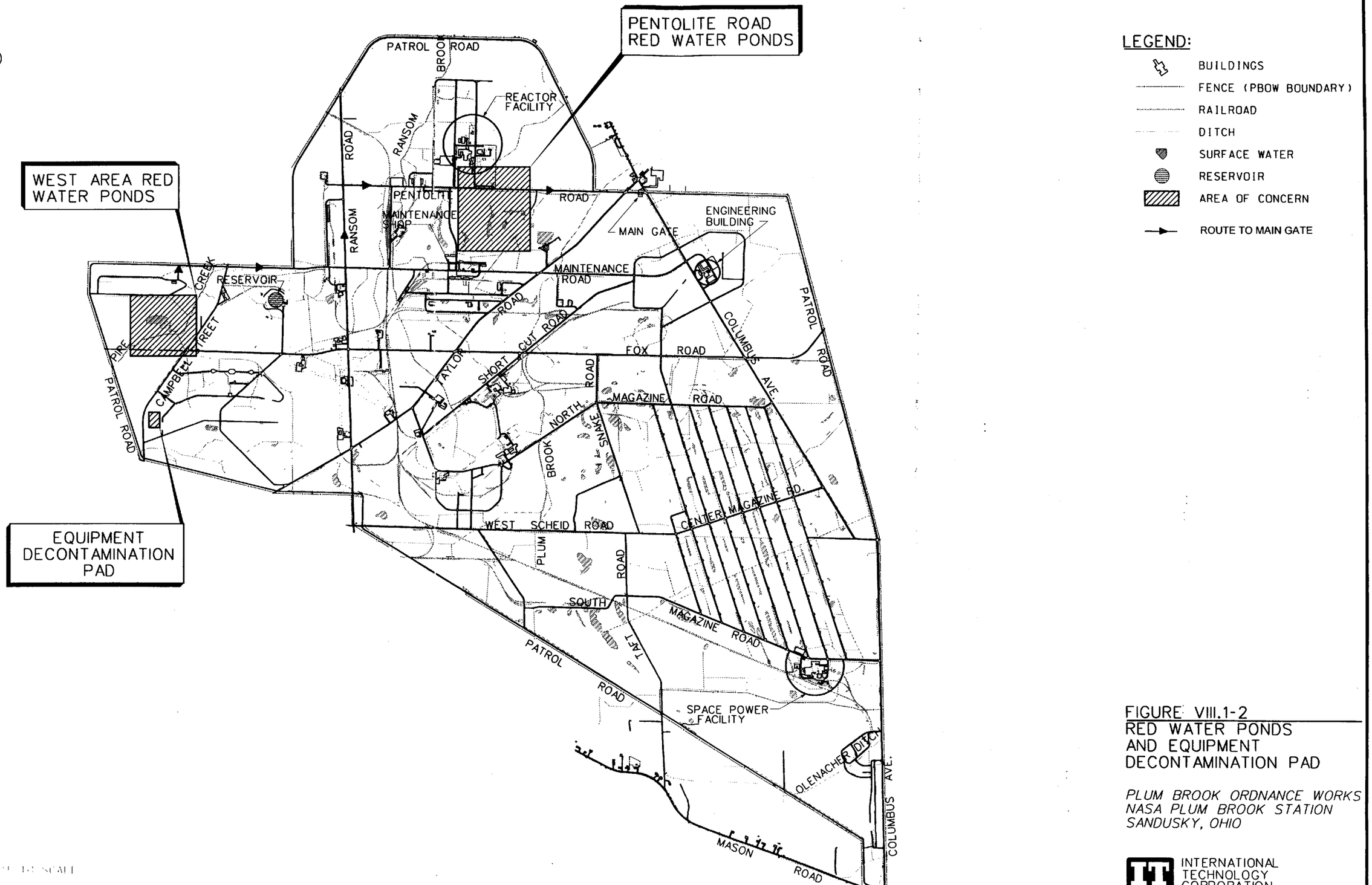


FIGURE VIII.1-2
RED WATER PONDS
AND EQUIPMENT
DECONTAMINATION PAD

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL
TECHNOLOGY
CORPORATION

NOT TO SCALE

STARTING DATE: 02/19/98	DATE LAST	DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: M. SMITH	DWG. NO.:
DRAWN BY: R. VANDERGRIFF	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: M. SPANGBERG	PROJ. NO.:

'6 16 48
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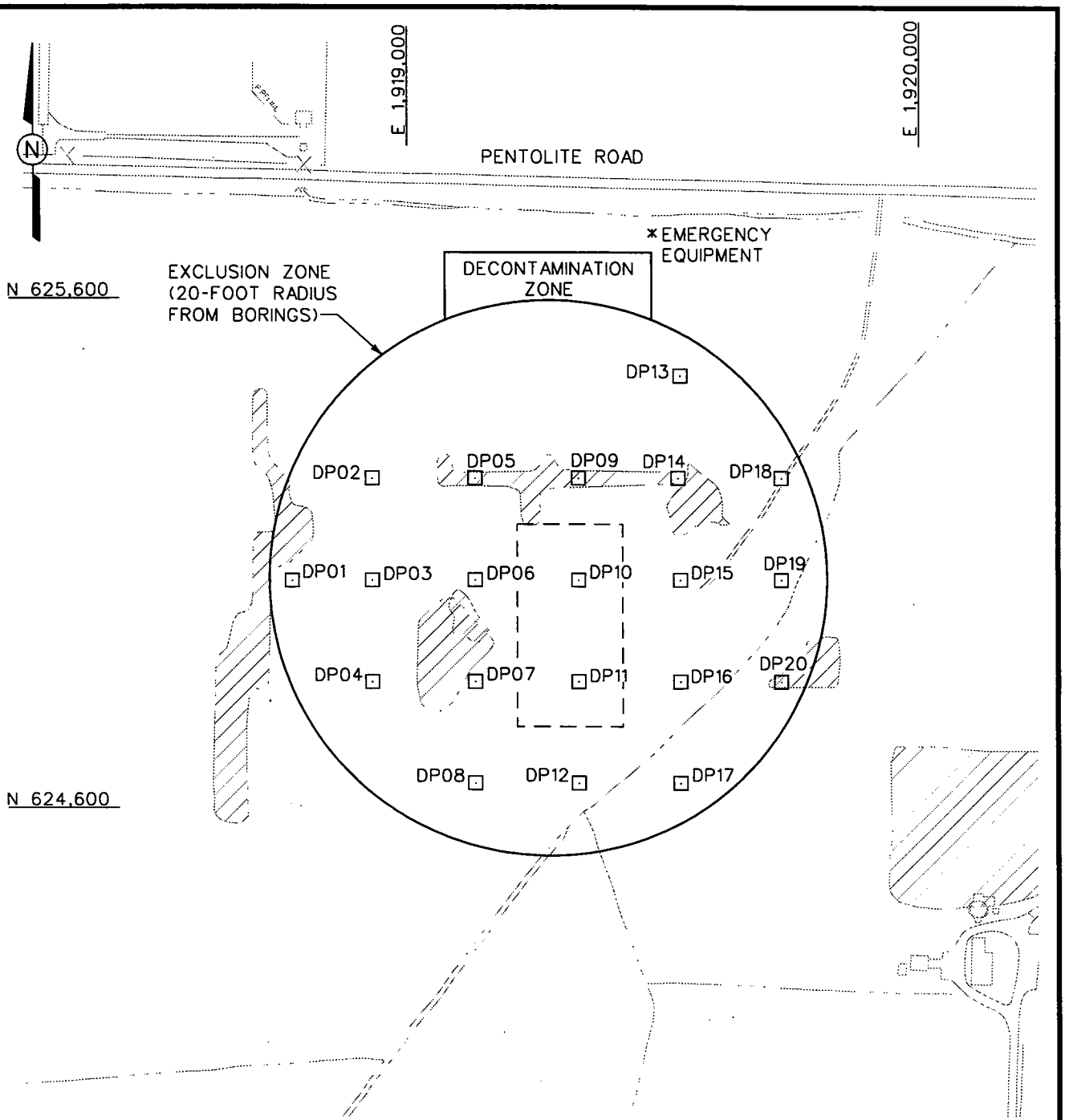

LEGEND:

- BUILDINGS
- SURFACE WATER
- SURFACE WATER DRAINAGE
- APPROXIMATE HISTORICAL LOCATION OF PONDS
- FENCE (PBOW BOUNDARY)
- DP01 PROPOSED SAMPLE LOCATIONS

NOT TO SCALE

FIGURE VIII.1-3
PENTOLITE ROAD RED WATER PONDS SAMPLE LOCATIONS AND WORK ZONES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: \773701ES.008
PROJ. NO.: 773701
INITIATOR: M. SMITH
PROJ. MGR.: SPANGBERG
DRAFT. CHCK. BY: C. TUMLIN
ENGR. CHCK. BY: G. YU
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 12/16/97
DRAWN BY: D. BILLINGSLEY
16:18:07
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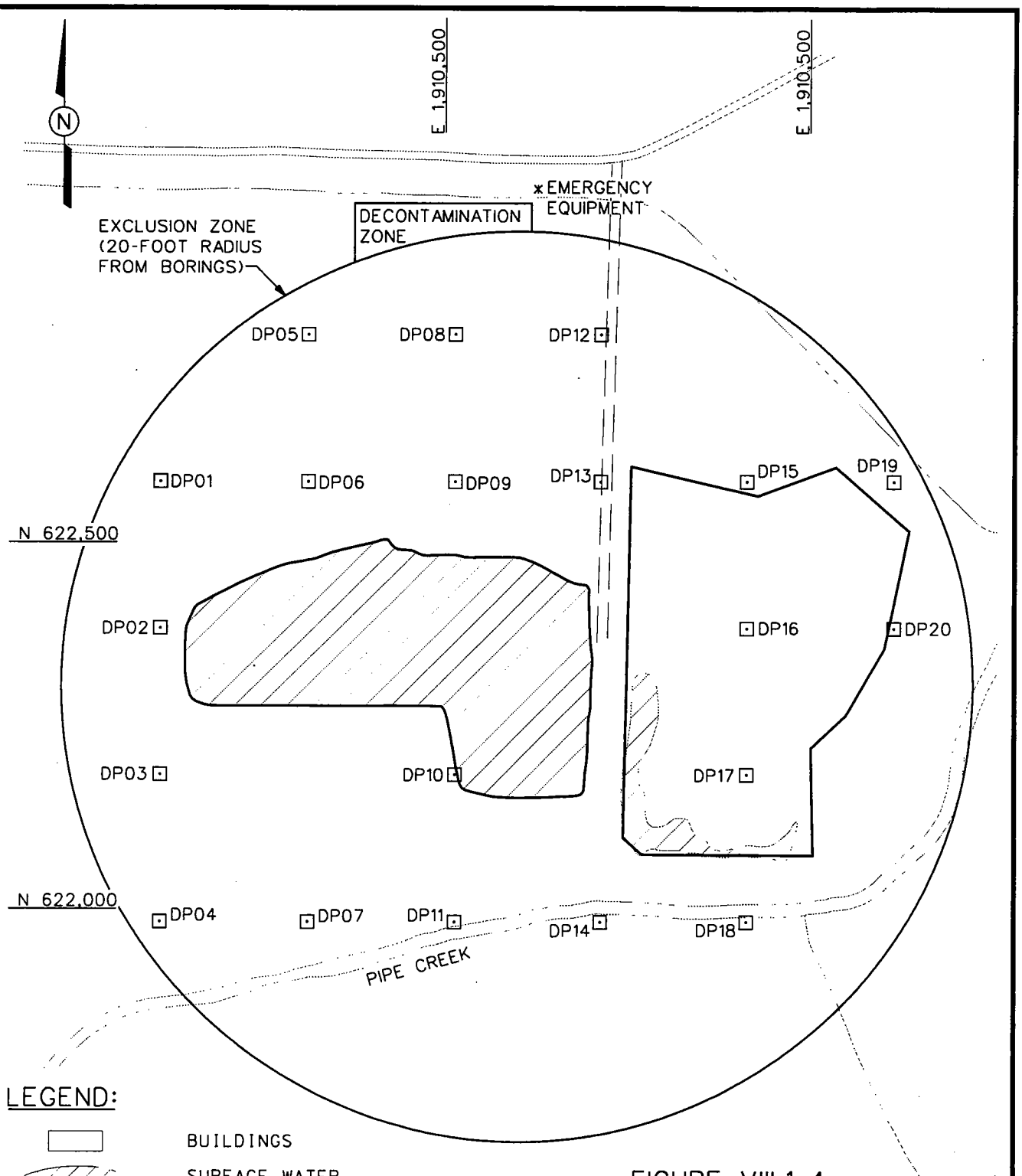

LEGEND:

- BUILDINGS
- SURFACE WATER
- SURFACE DRAINAGE
- APPROXIMATE HISTORICAL LOCATION OF PONDS
- DP01 PROPOSED SAMPLE LOCATIONS
- UNPAVED ROADS/DRIVES
- PAVED ROADS

NOT TO SCALE

FIGURE VIII.1-4
WEST AREA RED WATER PONDS SAMPLE LOCATIONS AND WORK ZONES

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: \773701ES.009 | PROJ. NO.: 773701
INITIATOR: M. SMITH | PROJ. MGR.: SPANGBERG
DRAFT. CHCK. BY: C. TUMLIN | ENGR. CHCK. BY: G. YU
DATE LAST REV.: | DRAWN BY:
STARTING DATE: 02/19/98 | DRAWN BY: R. VANDERGRIFF
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VIII.2.0 Site Characterization and Analysis

VIII.2.1 Anticipated Hazards

The Activity Hazard Analysis in Chapter 5.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The Activity Hazard Analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

The potential chemical contaminants of concern include nitroaromatic compounds. The following table indicates maximum concentrations of contaminants detected during previous investigations at the Red Water Ponds Area:

Chemical	Maximum Soil Concentration (mg/kg)
2,4,6-Trinitrotoluene	12,000
1,2,5-Trinitrobenzene	58.0
2,4-Dinitrotoluene	8.9
2,6-Dinitrotoluene	3.6

Table VIII.2-1 contains chemicals anticipated and chemicals to be used during project activities.

VIII.2.2 General Site Information

A description of the site including location, site topography, and site accessibility is presented in Section 1.3 of the sitewide sampling and analysis plan prepared by IT Corporation in September 1996.

Table VIII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
1,3-Dinitrobenzene [99-65-0]	10.43		Inh Abs Ing Con	Anoxia, cyanosis, visual disturbances, central blind spot of vision, bad taste, burning of mouth, dry throat, thirsty; yellowing hair, eyes, and skin; anemia, liver damage.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m³ (skin) 0.15 ppm (skin) 1 mg/m³ (skin)		PEL TLV REL	50 mg/m³
Benzene [71-43-2]	9.24	34–119	Inh Abs Ing Con	Irritates eyes, nose, respiratory system; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude; dermatitis; bone-marrow depression. Carcinogenic.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (10 ppm) NIC–0.1 skin 0.1 ppm	5 ppm C1 ppm (Ca)	PEL TLV REL	Ca [1,000 ppm]* *OSHA
Chromium (as Cr) [7440-47-3]	NA	NA	Inh Ing Con	Irritation of eyes, skin, and upper respiratory system; fibrosis of lungs	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m³ 0.5 mg/m³	- -	PEL TLV	250mg/m³ (as Cr)
Dinitrotoluene (DNT)	N/A	-	Inh Abs Ing Con	Anoxia, cyanosis, anemia, jaundice; reproductive effects. Animal carcinogen.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/³ (skin) NIC-0.2 mg/m³ (skin) 1.5 mg/m³ (skin)	- - -	PEL TLV REL	Ca [50 mg/m³)
Ethyl benzene [100-41-4]	8.76	0.09–0.6	Inh Ing Con	Irritates eyes, mucous membranes; headache; dermatitis; narcosis, coma.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	800 ppm

Table VIII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Gasoline [8006-61-9]	?	0.3	Inh Ing Con	Intoxication, headaches, blurred vision, dizziness, nausea; eye, nose, and throat irritation; potential kidney and other cancers. Carcinogenic.	Eye: Irrigate immediately (15 min) Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	300 ppm 300 ppm Ca, lowest feasible conc. (LOQ 15 ppm)	500 ppm 500 ppm	PEL TLV REL	?
Methanol	10.85	4.2-5960	Inh Abs Ing Con	Irritated eyes, headache, drowsiness, lightheadedness, nausea, vomiting, disturbance in vision, blindness.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Fresh air Swallow: Immediate medical attention		200 ppm (skin) 200 ppm (skin) 200 ppm	PEL TLV REL	6,000 ppm
Nitric acid [7697-37-2]	11.95	0.3-1	Inh Ing Con	Irritated eyes, mucous membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Respiratory support Swallow: Immediate medical attention	2 ppm 2 ppm 2 ppm	4 ppm 4 ppm 4 ppm	PEL TLV REL	25 ppm
Nitrobenzene [98-95-3]	9.92	0.37	Inh Abs Ing Con	Irritation of eyes, skin, anoxia; dermatitis; anemia; methemoglobinemia; testicular effects.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (skin) 1 ppm (skin) 1 ppm (skin)		PEL TLV REL	200 ppm
Portland cement			Inh	Fine gray powder that can be irritating if inhaled or in eyes.	Eye: Irrigate immediately Skin: Soap wash flush Breath: Respiratory support Swallow: Immediate medical attention		10 mg/m^3 10 mg/m^3/total dust 5 mg/m^3 respirable fraction	TLV PEL/REL	
Toluene [108-88-3]	8.82	0.16–37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paralysis; dermatitis.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm 150 ppm	PEL TLV REL	500 ppm

Table VIII.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
1,3,5-Trinitrobenzene	?		Inh Ing Con Abs	Irritating to the skin, mucus membranes, and eyes; nausea, vomiting, diarrhea, and abdominal pain; liver damage.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	0.1 mg/m^3 0.1 mg/m^3 0.1 mg/m^3	0.3 mg/m^3	PEL TLV REL	100 mg/m^3
Trinitrotoluene (TNT) [118-96-7]	10.59 ev		Inh Abs Ing Con	Irritation of skin, mucous membranes; liver damage, jaundice; cyanosis, sore throat; kidney damage; cardio irregularity	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/m^3 (skin) 0.1 mg/m^3 (skin) 0.5 mg/m^3 (skin)		PEL TLV REL	500 mg/m^3

[a]IP = Ionization potential (electron volts).
[b]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA = Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a work day, even if the TWA is not exceeded.
[e]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value—TWA.
REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[f]IDLH (NIOSH)—Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
NIC = Notice of intended change (ACGIH).

VIII.3.0 Personal Protective Equipment

The work activities will begin in the following levels of protection.

Task	Initial Level of PPE
Staging equipment	Level D
Direct-push sampling	Modified Level D*
Decontamination of equipment	Modified Level D*

*Initial level will be raised to Level C or higher if air monitoring results in the worker's breathing zone are above action levels. Note: If unusual conditions or odors are encountered and air monitoring instruments do not detect volatile organic chemicals or hydrogen sulfide, turn equipment off, evacuate the work area, and contact the Health and Safety (H&S) Manager for further assistance.

A complete description of Level D, Modified Level D, and Level C follows.

Level D. The following equipment will be used for Level D protection:

- Coveralls or work clothing
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Modified Level D. The following equipment will be used for Modified Level D protection:

- Permeable Tyvek, Kleenguard, or its equivalent
- Polyvinyl chloride (PVC) boot covers
- Nitrile gloves (outer)
- Lightweight nitrile gloves (inner)
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level C. Level C protection will not be used unless air monitoring data indicate the need for upgrade; however, the equipment shall be readily available on site. The following equipment will be used for Level C protection:

- National Institute of Occupational Safety and Health (NIOSH)-approved full face, air purifying respirators equipped with organic vapor/acid gas cartridge in combination with high-efficiency particulate air filter
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level B. Level protection will not be used unless air monitoring data indicate the need for upgrade will be used for Level B protection:

- Pressure-demand NIOSH-approved self-contained breathing apparatus
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Personnel Decontamination: All personnel working in the exclusion zone wearing Modified Level D or higher must undergo personnel decontamination prior to entering the support zone. Level D will require no personnel decontamination. The personnel decontamination area shall consist of the following stations.

Station 1. Personnel leaving the exclusion zone will remove the gross contamination, by physical means, from their outer clothing and boots (i.e., dislodging/displacement, rinsing, wiping: no blowing, brushing etc.).

Station 2. Equipment for this station may include plastic-lined waste receptacle, chair, clean damp cloths or paper towels, and plastic bags. At Station 2, personnel will remove their Tyvek coveralls and gloves and deposit them in the lined waste receptacles. Personnel will wipe their respirators (if used), hard hats, and boots with clean, damp cloths and then remove those items. Those items are then hand-carried to the next station.

Station 3. Equipment for this station may include a wash basin with soap and water and a respirator sanitation station. At this station, personnel will thoroughly wash their hands and face before leaving the decontamination zone. Respirators will be sanitized and then placed in a clean, plastic ziplock bag.

Donning Procedures.

- Put on boots and boot covers and tape the coveralls.
- Put on gloves.
- Tape the coveralls over the gloves at the wrist.
- If Level C PPE is required, don respirator and check for secure fit.
- Put hood or head covering over the respirator.
- Put on the remaining protective equipment (i.e., hard hat, safety glasses, etc.).

VIII.4.0 Site Monitoring

The environmental contaminants of concern are volatile and semivolatile chemicals including 2,4-dinitrotoluene (DNT), 2,6-DNT, 1,3,5-trinitrobenzene, and 2,4,6-trinitrotoluene.

Table VIII.4-1 contains action levels for site monitoring.

Monitoring will be performed by the site safety and health officer (SSHO) initially for the location, then periodically during the performance of invasive operations (sampling every 5- to 10-foot soil boring depth). A calibrated photoionization detector will be utilized to monitor the wells and breathing zones, to determine if any organic material may be present that would necessitate upgrading of protection level.

Invasive operations include disturbing soils, direct-push sampling, and collection of samples.

Noninvasive operations that do not disturb existing materials include site setup, decontamination, and miscellaneous support zone activities.

Table VIII.4-1

Action Levels
Plum Brook Ordnance Works, Sandusky, Ohio

When in Level B PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 50 ppm above background in breathing zone (BZ)	Stop work, evacuate work area.

When in Level C PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 25 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained, then upgrade to Level B personal protectivie equipment (PPE).

When in Level D/Modified D PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	≥ 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes; if readings are sustained, then upgrade to Level C PPE.

When in Support Zone

Analyte	Action Level	Required Action
Volatile organic chemicals	≥ 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.

[a]Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.
[b]Contact with the health and safety (H&S) manager must be made prior to continuance of work. The H&S manager may then initiate perimeter/integrated air sampling along with additional engineering controls.

No one is permitted to downgrade levels of PPE without authorization from the H&S manager.

VIII.5.0 Activity Hazard Analysis

The attached activity hazard analysis (Table VIII.5-1) is provided for the following activities:

- Setup of equipment and general field activities
- Direct-push sampling
- Decontamination (high-pressure water jetting operations).

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities	Slip, trip, and fall hazards	• Determine best access route before transporting equipment. • Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards. • Look before you step; ensure safe and secure footing.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment.
	Falling objects	• Stay alert and clear of materials suspended overhead; wear hard hat and steel-toed boots.
	Flying debris, dirt, dust, etc.	• Wear safety glasses/goggles; ensure that eye wash is in proper working condition.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cuts/bruises	• Use cotton or leather work gloves for material handling.
	Bees, spiders, and snakes	• Inspect work area carefully and avoid placing hands and feet into concealed areas.
	Fire	• Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Hazard communication	• Label all containers as to contents and dispose of properly. • Ensure Material Safety Data Sheets (MSDS) are available for hazardous chemicals used on site.
	Noise	• Sound levels above 85 A-weighted decibels (dBA) mandates hearing protection.
	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Ticks	• Wear light-colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear insect repellant. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after exiting the work area.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool area.
	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.
	Heat stroke	• Evaluate possibility of night work. • Perform physiological monitoring on workers during breaks. • Wear body cooling devices.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow. • Barricades shall be used on or around work areas when it is necessary to prevent the inadvertent intrusion of pedestrian traffic. • Barriers shall be used to protect workers from vehicular traffic. • Barriers shall be used to guard excavations adjacent to streets or roadways. • Flagging shall be used for the short term (less than 24 hours) to identify hazards until proper barricades or barriers are provided. • Heavy equipment shall have backup alarms.
	Forklift operations	• Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Portable electric tools	• Portable electric tools which are unsafe due to faulty plugs, damaged cords, or other reason, shall be tagged (do not use) and be removed from service. • Portable electric tools and all cord and plug connected equipment shall be protected by a ground-fault circuit interrupter (GFCI) device. • Electrical tools shall be inspected daily prior to use.
	Extension cords	• Extension cords that have faulty plugs, damaged insulation, or are unsafe in any way shall be removed from service. • Cords shall be protected from damage from sharp edges, projections, pinch points (doorways), and vehicular traffic. • Cords shall be suspended with a nonconductive support (rope, plastic ties, etc,). • Cords shall be designed for hard duty. • Cords shall be inspected daily.
	Lightning strikes	• Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than laying on the ground). • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Keep all body parts in contact with the ground as close as possible. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Thunderstorms, tornados	• Listen to radio or TV announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings. • Seek shelter. Do not try to outrun a tornado.
Direct-Push Sampling	Overhead hazards	• Make sure no obstacles are within radius of boom. Always stay a safe distance from power lines.
	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out. • Drill rigs shall be equipped with reverse signal alarm, backup warning lights, or the vehicle is backed up only when an observer signals it is safe to do so.
	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to ensure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located and delineated or flagged prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels choked. • Inspect brakes and tire pressure on drill rig before staging for work.
	Inexperienced operator	• Machinery and mechanized equipment shall be operated only by designated personnel. • Operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Jacks/outriggers	• Ensure proper footing and cribbing.
	Falling objects	• Remove unsecured tools and materials before raising or lowering the derrick. • Stay alert and clear of materials suspended overhead.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert at all times!
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Direct-Push Sampling (continued)	Fall hazards	• Personnel are not allowed to work off of machinery or use machinery as ladders. • Use fall protection when working above 6 feet.
	Noise	• Hearing protection is mandatory above 85 dBA.
	Contact with rotating or reciprocating machine parts	• Use machine guards; use long-handled shovels to remove auger cuttings. • Use safe lockout procedures for maintenance work.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Slip, trip, and fall hazards	• Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards.
	Contact with potentially contaminated materials	• Real-time air monitoring will take place. If necessary, proper personal protective clothing and equipment will be utilized. • Stop immediately at any sign of obstruction. • Do not breathe air surrounding boring unless necessary. • Upgrade to respirator if necessary. • Avoid skin contact with soil cuttings. Wear gloves. • Stay clear of moving parts of drill rig.
	Drum handling	• Be careful not to breathe air from around open drum any more than necessary. Monitor with photoionization detector/flame ionization detector (PID/FID) equipment and upgrade to respirator if necessary. • When filling a drum (with either soil or water), be careful not to make contact with the contained waste. Wear appropriate gloves. Make sure lid or bung of drum is secure. • If moving a drum unassisted, be sure to leverage properly, use proper lifting techniques, and wear safety glasses and steel-toed boots. • When using a drum dolly, make sure straps and lid catch are securely attached. Leverage properly when tilting drum. Be sure toes stay away from drum.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
High-Pressure Water Jetting Operations	Heavy lifting	• Use proper lifting techniques. • Lifts greater than 60 pounds require assistance or mechanical equipment • Size-up the lift.
	Slip, trip, and fall hazards	• Good housekeeping shall be implemented. • The work area shall be kept clean as feasible. • Inspect the work area for slip, trip, and fall hazards.
	Fueling	• Only approved safety cans shall be used to store fuel. • Do not refuel equipment while it is operating. • Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Faulty or damaged equipment	• Equipment shall be inspected before being placed into service and at the beginning of each shift. • Preventive maintenance procedures recommended by the manufacturer shall be followed. • A lockout/tagout procedure shall be used for equipment found to be faulty or undergoing maintenance.
	High-pressure water	• Jetting gun operator must wear appropriate PPE including hard hat, impact-resistant safety glasses with side shields, water-resistant clothing, metatarsal guards for feet and legs, and hearing protection (if appropriate). • One standby person shall be available within the vicinity of the pump during jetting operation. • The work area shall be isolated and adequate barriers will be used to warn other site personnel.
	Unqualified operators	• Only qualified and trained personnel are permitted to operate machinery and mechanized equipment associated with water jet cutting and cleaning.
	Out of control equipment	• No machinery or equipment is permitted to run unattended. • Machinery or equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded.
	Noise	• Sound levels above 85 dBA mandates hearing protection by nearby site personnel.

Table VIII.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
High-Pressure Water Jetting Operations (continued)	Activation during repairs	• All machinery or equipment will be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert and clear of materials suspended
	Falling objects	• Hard hats are required by site personnel. • Stay alert and clear of material suspended overhead.
	Flying debris	• Impact-resistant safety glasses with side shields are required.
	Contact with potentially contaminated materials	• All site personnel will wear the appropriate PPE.

INTERNATIONAL TECHNOLOGY CORPORATION

DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CELRN-EP-R-M

Project Description: RI/FS of TNT Area B, Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract Number: DACA62-94-D-0030 Delivery Order Number: 0034

Project Number: 775616 Task / Phase Number: 02000000

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☐ RFP		☒ Edited Standard
☐ Contract / Subcontract		☐ Client Furnished
☐ SAP, SSAP, CDAP, or QAPP		
☒ SHP or SSHP	SSHP, Revision 0, September 1998	**Document Status**
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☐ Risk Assessment / Evaluation		☐ Internal Draft
☐ Specifications & Plans		☒ Draft
☐ Design Calculations		☐ Draft Final
☐ Tables		☐ Final
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Program Manager			

NOTICE: By signature above, parties certify that the subject document has been prepared by and/or reviewed by them (as appropriate), that all review comments have been resolved, and that the document is ready for submittal.

Attachment IX

Site-Specific Safety and Health Plan
Remedial Investigation of TNT Area B
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared by:

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Knoxville, Tennessee 37923

Submitted to:

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U.S. Army Engineer District, Nashville
Post Office Box 1070
Nashville, Tennessee 37202-1070

IT Project No. 775616
Control Copy No. 21

September 1998

This Site-Specific Safety and Health Plan Attachment must be used in conjunction with the Sitewide Safety and Health Plan for Site Investigations and Groundwater Investigations at the former Plum Brook Ordnance Works, dated July 1997.

Reviews and Approvals

Project Manager
IT Corporation

Date

Health and Safety Manager
IT Corporation

Date

Site Coordinator
IT Corporation

Date

Site Safety and Health Officer
IT Corporation

Date

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This Site-Specific Safety and Health Plan Attachment must be used in conjunction with the Sitewide Safety and Health Plan for Site Investigations and Groundwater Investigations at the former Plum Brook Ordnance Works, dated July 1997.

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Control Copy No. 21	M. Gunderson
Control Copy No. 22	Project File
Control Copy Nos. 23 and 24	Field personnel

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Plum Brook Project Emergency Contacts

Note: All field crews will be provided 2-way radios from the Plum Brook Communications Center. In the event of an emergency, contact the Plum Brook Communications Center by radio and they will contact and coordinate emergency response personnel.

Fire Department	(419) 627-5837
Ambulance	911
Police Department	(419) 627-5863
Providence Hospital	(419) 621-7000
National Response Center	(800) 424-8802
Poison Control Center	(800) 462-0800
Ohio EPA Emergency Spill Number	(800) 282-9378
Don Burton, IT Program Manager	(423) 690-3211
Mike Spangberg, IT Project Manager	(423) 690-3211
George Yu, IT Site Manager	(423) 690-3211
Melissa Smith, IT H&S Manager	(423) 690-3211
Dr. Elaine Theriault, IT Occupational Physician	(800) 299-3674

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List of Acronyms

DNT	dinitrotoluene
NIOSH	National Institute of Occupational Safety and Health
PBOW	Plum Brook Ordnance Works
PPE	personal protective equipment
SHP	safety and health plan
SSHP	site safety and health plan

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IX.1.0 Site Work Plan Summary

Project Objective. The objectives of this investigation at the former Plum Brook Ordnance Works (PBOW), Sandusky, Ohio, are summarized as follows:

- Determine if there are hazardous substances present at the site in a manner that constitutes unacceptable risk to human health and the environment.
- Define site physical features and characteristics (aquifer background conditions).
- Evaluate fate and transport pathways (groundwater modeling).
- Determine current and future routes of exposure.

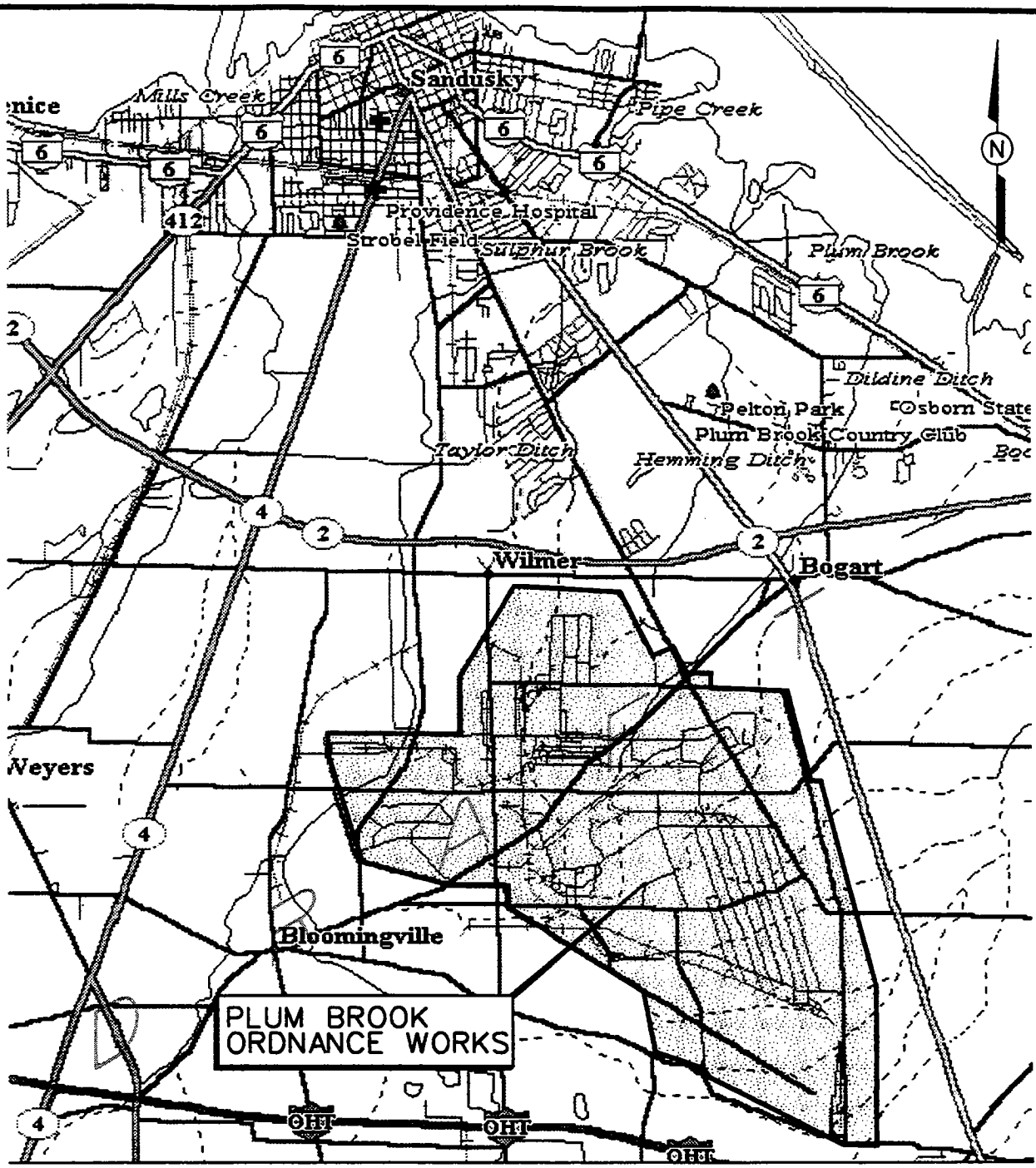
Project Tasks

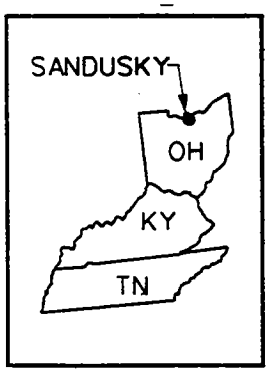
- Surveying
- Soil boring and sampling
- Decontamination of equipment (high-pressure water jetting operations)
- Sediment/seep and surface water sampling.

Personnel Requirements. Up to 15 employees.

Note: All personnel on this site shall have received training, informational programs, and medical surveillance as outlined in the sitewide safety and health plan (SHP) for site investigations at PBOW, and be familiar with the requirements of this site-specific SHP (SSHP). Figure IX.1-1 presents the site and hospital location map. The TNT Area B work zones will change daily due to the large area to be sampled. Based on the sampling, sufficient work zones boundaries will be established at least 10 feet from surface sampling locations and 30 feet from all boring locations.

Project Schedule. Late fall 1998.





NOT TO SCALE

FIGURE IX-1

SITE AND HOSPITAL
LOCATION MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL
TECHNOLOGY
CORPORATION

STARTING DATE: 12/16/97	DATE LAST REV 02 SEP 98	DRAFT. CHCK. BY:		INITIATOR: D. KESSLER	DWG. NO.: \775616ES.003
DRAWN BY: D. BILLINGSLEY	DRAWN BY: RVANDERG	ENGR. CHCK. BY: D. KESSLER		PROJ. MGR.: M.SPANGBERG	PROJ. NO.: 775616

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IX.2.0 Site Characterization and Analysis

IX.2.1 Anticipated Hazards

The activity hazard analysis in Chapter 5.0 contains project-specific practices utilized to reduce or eliminate anticipated site hazards. The activity hazard analysis indicates specific chemical and physical hazards that may be present and encountered during each task from on-site operations. Below each task is a list of hazards and specific actions that will be taken to control the respective hazards. These control measures may include work practice controls, engineering controls, and/or use of appropriate personal protective equipment (PPE).

The potential contaminants of concern include nitroaromatic compounds. The following table indicates maximum concentrations of contaminants detected during previous investigations at TNT Area B:

Chemical	Maximum Soil Concentration (mg/kg)
2,4,6-Trinitrotoluene	20,000
1,3,5-Trinitrobenzene	25
2,4-Dinitrotoluene	11,000
2,6-Dinitrotoluene	12,000

Table IX.2-1 contains chemicals anticipated and chemicals to be used during project activities.

IX.2.2 General Site Information

A description of the site including location, site topography, and site accessibility is presented in Section 1.3 of the site-wide sampling and analysis plan prepared by IT Corporation in September 1996.

Table IX.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
1,3-Dinitrobenzene [99-65-0]	10.43		Inh Abs Ing Con	Anoxia, cyanosis, visual disturbances, central blind spot of vision, bad taste, burning of mouth, dry throat, thirsty; yellowing hair, eyes, and skin; anemia, liver damage.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 (skin) 0.15 ppm (skin) 1 mg/m^3 (skin)		PEL TLV REL	50 mg/m^3
Benzene [71-43-2]	9.24	34-119	Inh Abs Ing Con	Irritates eyes, nose, respiratory system; giddiness; headache, nausea, staggered gait; fatigue, anorexia, lassitude; dermatitis; bone-marrow depression. Carcinogenic.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (10 ppm) NIC-0.1 skin 0.1 ppm	5 ppm C1 ppm (Ca)	PEL TLV REL	Ca [1,000 ppm]* *OSHA
Chromium (as Cr) [7440-47-3]	NA	NA	Inh Ing Con	Irritation of eyes, skin, and upper respiratory system; fibrosis of lungs.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 0.5 mg/m^3	- -	PEL TLV	250mg/m^3 (as Cr)
Dinitrotoluene (DNT)	N/A	-	Inh Abs Ing Con	Anoxia, cyanosis, anemia, jaundice; reproductive effects. Animal carcinogen.	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/^{3} (skin) NIC-0.2 mg/m^3 (skin) 1.5 mg/m^3 (skin)	- - -	PEL TLV REL	Ca [50 mg/m^3)
Ethyl benzene [100-41-4]	8.76	0.09-0.6	Inh Ing Con	Irritates eyes, mucous membranes; headache; dermatitis; narcosis, coma.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	125 ppm 125 ppm 125 ppm	PEL TLV REL	800 ppm

Table IX.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
Gasoline [8006-61-9]	?	0.3	Inh Ing Con	Intoxication, headaches, blurred vision, dizziness; nausea; eye, nose, and throat irritation; potential kidney and other cancers. Carcinogenic.	Eye: Irrigate immediately (15 min) Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	300 ppm 300 ppm Ca, lowest feasible conc. (LOQ 15 ppm)	500 ppm 500 ppm	PEL TLV REL	?
Methanol	10.85	4.2-5960	Inh Abs Ing Con	Irritated eyes, headache, drowsiness, lightheadedness, nausea, vomiting, disturbance in vision, blindness.	Eye: Irrigate immediately Skin: Water flush promptly Breath: Fresh air Swallow: Immediate medical attention		200 ppm (skin) 200 ppm (skin) 200 ppm	PEL TLV REL	6,000 ppm
Nitric acid [7697-37-2]	11.95	0.3-1	Inh Ing Con	Irritated eyes, mucous membranes, and skin; delayed pulmonary edema, pneumonitis, bronchitis; dental erosion.	Eye: Irrigate immediately Skin: Wash flush promptly Breath: Respiratory support Swallow: Immediate medical attention	2 ppm 2 ppm 2 ppm	4 ppm 4 ppm 4 ppm	PEL TLV REL	25 ppm
Nitrobenzene [98-95-3]	9.92	0.37	Inh Abs Ing Con	Irritation of eyes, skin, anoxia; dermatitis; anemia; methemoglobinemia; testicular effects.	Eye: Irrigate immediately Skin: Wash flush Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (skin) 1 ppm (skin) 1 ppm (skin)		PEL TLV REL	200 ppm
Portland cement			Inh	Fine gray powder that can be irritating if inhaled or in eyes.	Eye: Irrigate immediately Skin: Soap wash flush Breath: Respiratory support Swallow: Immediate medical attention		10 mg/m^3 10 mg/m^3/total dust 5 mg/m^3 respirable fraction	TLV PEL/REL	
Toluene [108-88-3]	8.82	0.16-37	Inh Abs Ing Con	Fatigue, weakness; confusion, euphoria, dizziness, headache; dilated pupils, lacrimation; nervousness, muscular fatigue, insomnia; paralysis; dermatitis.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 50 ppm (skin) 100 ppm	150 ppm 150 ppm	PEL TLV REL	500 ppm

Table IX.2-1

Toxicological and Physical Properties of Chemicals
Plum Brook Ordnance Works, Sandusky, Ohio

Substance [CAS]	IP[a] (eV)	Odor Threshold (ppm)	Route[b]	Symptoms of Exposure	Treatment	TWA[c]	STEL[d]	Source[e]	IDLH (NIOSH)[f]
1,3,5-Trinitrobenzene	?		Inh Ing Con Abs	Irritating to the skin, mucus membranes, and eyes; nausea, vomiting, diarrhea, and abdominal pain; liver damage.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	0.1 mg/m^3 0.1 mg/m^3 0.1 mg/m^3	0.3 mg/m^3	PEL TLV REL	100 mg/m^3
Trinitrotoluene (TNT) [118-96-7]	10.59 ev		Inh Abs Ing Con	Irritation of skin, mucous membranes; liver damage, jaundice; cyanosis, sore throat; kidney damage; cardio irregularity.	Eye: Irrigate immediately Skin: Soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	1.5 mg/m^3 (skin) 0.1 mg/m^3 (skin) 0.5 mg/m^3 (skin)		PEL TLV REL	500 mg/m^3

[a]IP = Ionization potential (electron volts).
[b]Route = Inh, Inhalation; Abs, Skin absorption; Ing, Ingestion; Con, Skin and/or eye contact.
[c]TWA = Time-weighted average. The TWA concentration for a normal work day (usually 8 or 10 hours) and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day without adverse effect.
[d]STEL = Short-term exposure limit. A 15-minute TWA exposure that should not be exceeded at any time during a work day, even if the TWA is not exceeded.
[e]PEL = Occupational Safety and Health Administration (OSHA) permissible exposure limit (29 CFR 1910.1000, Table Z).
TLV = American Conference of Governmental Industrial Hygiene (ACGIH) threshold limit value—TWA.
REL = National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit.
[f]IDLH (NIOSH)—Immediately dangerous to life or health (NIOSH). Represents the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
NE = No evidence could be found for the existence of an IDLH (NIOSH Pocket Guide to Chemical Hazards, Pub. No. 90-117, 1990).
C = Ceiling limit value which should not be exceeded at any time.
Ca = Carcinogen.
NA = Not applicable.
NIC = Notice of intended change (ACGIH).

IX.3.0 Personal Protective Equipment

The work activities will begin in the following levels of protection.

Task	Initial Level of PPE
Staging equipment	Level D
Surveying	Level D
Soil boring and sampling	Modified Level D*
Decontamination of equipment	Modified Level D*
Sediment/seep/surface water sampling	Level D

*Initial level will be raised to Level C or higher if air monitoring results in the worker's breathing zone are above action levels. Note: If unusual conditions or odors are encountered and air monitoring instruments do not detect volatile organic chemicals or hydrogen sulfide, turn equipment off, evacuate the work area, and contact the Health and Safety Manager for further assistance.

A complete description of Level D, Modified Level D, and Level C follows.

Level D. The following equipment will be used for Level D protection:

- Coveralls or work clothing
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment)
- U.S. Coast Guard-approved personal flotation device (where potential for drowning exists).

Modified Level D. The following equipment will be used for Modified Level D protection:

- Permeable Tyvek, Kleenguard, or its equivalent
- Polyvinyl chloride boot covers
- Nitrile gloves (outer)
- Lightweight nitrile gloves (inner)
- Steel-toed safety boots
- Safety glasses
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level C. Level C protection will not be used unless air monitoring data indicate the need for upgrade; however, the equipment shall be readily available on site. The following equipment will be used for Level C protection:

- National Institute of Occupational Safety and Health (NIOSH)-approved full face, air purifying respirators equipped with organic vapor/acid gas cartridge in combination with high-efficiency particulate air filter
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Level B. Level protection will not be used unless air monitoring data indicate the need for upgrade will be used for Level B protection:

- Pressure-demand NIOSH-approved self-contained breathing apparatus
- Hooded, saran-coated Tyvek, taped at gloves, boots, and respirator
- Nitrile gloves (outer)
- Latex or lightweight nitrile gloves (inner)
- Neoprene steel-toed boots or polyvinyl chloride overbooties/steel-toed safety boots
- Hard hat
- Hearing protection (when working near/adjacent to operating equipment).

Personnel Decontamination: All personnel working in the exclusion zone wearing modified Level D or higher must undergo personnel decontamination prior to entering the support zone. Level D will require no personnel decontamination. The personnel decontamination area shall consist of the following stations.

Station 1. Personnel leaving the exclusion zone will remove the gross contamination, by physical means, from their outer clothing and boots (i.e., dislodging/displacement, rinsing, wiping: no blowing, brushing etc.).

Station 2. Equipment for this station may include plastic-lined waste receptacle, chair, clean damp cloths or paper towels, and plastic bags. At Station 2, personnel will remove their Tyvek coveralls and gloves and deposit them in the lined waste receptacles. Personnel will wipe their respirators (if used), hard hats, and boots with clean, damp cloths and then remove those items. Those items are then hand-carried to the next station.

Station 3. Equipment for this station may include a wash basin with soap and water and a respirator sanitation station. At this station, personnel will thoroughly wash their hands and face before leaving the decontamination zone. Respirators will be sanitized and then placed in a clean, plastic ziplock bag.

Donning Procedures.

- Put on boots and boot covers and tape the coveralls.
- Put on gloves.
- Tape the coveralls over the gloves at the wrist.
- If Level C PPE is required, don respirator and check for secure fit.
- Put hood or head covering over the respirator.
- Put on the remaining protective equipment (i.e., hard hat, safety glasses, etc.).

IX.4.0 Site Monitoring

The environmental contaminants of concern are volatile and semivolatile chemicals including 2,4-dinitrotoluene (DNT), 2,6-DNT, 1,3,5-trinitrobenzene, and 2,4,6-trinitrotoluene.

Table IX.4-1 contains action levels for site monitoring.

Monitoring will be performed by the site safety and health officer initially for the location, then periodically during the performance of boring operations (sampling every 5- to 10-foot soil boring depth). A calibrated photoionization detector will be utilized to monitor the wells and breathing zones, to determine if any organic material may be present that would necessitate upgrading of protection level.

No air monitoring is required for operations that do not disturb existing materials (i.e., site setup, surveying, decontamination, and miscellaneous support zone activities).

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Table IX.4-1

Action Levels
Plum Brook Ordnance Works, Sandusky, Ohio

When in Level B PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	• 50 ppm above background in breathing zone (BZ)	Stop work, evacuate work area.

When in Level C PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	• 25 ppm above background in BZ	Stop work, suspend work activities for 15 to 30 minutes, if readings are sustained, then upgrade to Level B personal protectivie equipment (PPE).

When in Level D/Modified D PPE

Analyte	Action Level	Required Action[a,b]
Volatile organic chemicals	• 5 ppm above background in BZ	Stop activities, suspend work activities for 15 to 30 minutes; if readings are sustained, then upgrade to Level C PPE.

When in Support Zone

Analyte	Action Level	Required Action
Volatile organic chemicals	• 1 ppm above background in BZ	Evacuate support zone and re-establish perimeter of EZ.

[a]Four instantaneous peaks in any 15-minute period or a sustained reading for 5 minutes in excess of the action level will trigger a response.
[b]Contact with the health and safety (H&S) manager must be made prior to continuance of work. The H&S manager may then initiate perimeter/integrated air sampling along with additional engineering controls.

No one is permitted to downgrade levels of PPE without authorization from the H&S manager.

IX.5.0 Activity Hazard Analysis

The attached activity hazard analysis (Table IX.5-1) is provided for the following activities:

- Setup of equipment and general field activities
- Surveying
- Soil boring and sampling
- Decontamination (high-pressure water jetting operations)
- Sediment/seep and surface water sampling.

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Table IX.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities	Slip, trip, and fall hazards	• Determine best access route before transporting equipment. • Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards. • Look before you step; ensure safe and secure footing.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment.
	Falling objects	• Stay alert and clear of materials suspended overhead; wear hard hat and steel-toed boots.
	Flying debris, dirt, dust, etc.	• Wear safety glasses/goggles; ensure that eye wash is in proper working condition.
	Pinch points	• Keep hands, fingers, and feet clear of moving/suspended materials and equipment. • Beware of contact points. • Stay alert at all times!
	Cuts/bruises	• Use cotton or leather work gloves for material handling.
	Bees, spiders, and snakes	• Inspect work area carefully and avoid placing hands and feet into concealed areas.
	Fire	• Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Hazard communication	• Label all containers as to contents and dispose of properly. • Ensure Material Safety Data Sheets (MSDS) are available for hazardous chemicals used on site.
	Noise	• Sound levels above 85 A-weighted decibels (dBA) mandates hearing protection.
	Lighting	• Adequate lighting will be provided to ensure a safe working environment.
	Cold stress	• Workers should wear insulated clothing when temperatures drop below 40°F. • Drink warm beverages on breaks. Refrain from drinking caffeinated beverages. • Remove wet clothing promptly. • Take breaks in warm areas. • Reduce work periods as necessary. • Layer work clothing.

Table IX.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Poison ivy/oak/sumac	• Avoid plant areas if possible. • Wear long sleeves and long pants. • Promptly wash clothing that has contacted poisonous plants. • Wash affected areas immediately with soap and water.
	Ticks	• Wear light-colored clothing (can see ticks better). • Mow vegetated and small brush areas. • Wear insect repellant. • Wear long sleeves and long pants. • Visually check oneself promptly and frequently after exiting the work area.
	Heat rash	• Keep the skin clean and dry. • Change perspiration-soaked clothing, as necessary. • Bathe at end of work shift or day. • Apply powder to affected area.
	Heat cramps	• Drink plenty of cool fluids even when not thirsty. • Provide cool fluid for work crews. • Move victim to shaded, cool area.
	Heat exhaustion	• Conduct physiological worker monitoring as needed (i.e., heart rate, oral temperature). • Set up work/rest periods. • Use the buddy system. • Allow workers time to acclimate. • Have ice packs available for use. • Take frequent breaks.
	Heat stroke	• Evaluate possibility of night work. • Perform physiological monitoring on workers during breaks. • Wear body cooling devices.

Table IX.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Contact with moving equipment/vehicles	• Work area will be barricaded/demarcated. • Equipment will be laid out in an area free of traffic flow. • Barricades shall be used on or around work areas when it is necessary to prevent the inadvertent intrusion of pedestrian traffic. • Barriers shall be used to protect workers from vehicular traffic. • Barriers shall be used to guard excavations adjacent to streets or roadways. • Flagging shall be used for the short term (less than 24 hours) to identify hazards until proper barricades or barriers are provided. • Heavy equipment shall have backup alarms.
	Forklift operations	• • Use qualified and trained forklift operators. • The operator shall not exceed the load capacity rating for the forklift. • The load capacity shall be clearly visible on the forklift. • Forklift operators shall inform their supervisor of any prescribed medication that they are taking that would impair their judgement.
	Portable electric tools	• Portable electric tools which are unsafe due to faulty plugs, damaged cords, or other reason, shall be tagged (do not use) and be removed from service. • Portable electric tools and all cord and plug connected equipment shall be protected by a ground-fault circuit interrupter (GFCI) device. • Electrical tools shall be inspected daily prior to use.
	Extension cords	• Extension cords that have faulty plugs, damaged insulation, or are unsafe in any way shall be removed from service. • Cords shall be protected from damage from sharp edges, projections, pinch points (doorways), and vehicular traffic. • Cords shall be suspended with a nonconductive support (rope, plastic ties, etc.). • Cords shall be designed for hard duty. • Cords shall be inspected daily.

Table IX.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Setup of equipment and general field activities (continued)	Lightning strikes	• Whenever possible, halt activities and take cover. • If outdoors, stay low to the ground. • Limit the body surface area that is in contact with the ground (i.e., kneeling on one knee is better than laying on the ground). • Seek shelter in a building if possible. • Stay away from windows. • If available, crouch under a group of trees instead of one single tree. • Keep all body parts in contact with the ground as close as possible. • Remain 6 feet away from tree trunk if seeking shelter beneath tree(s). • If in a group, keep 6 feet of distance between people.
	Thunderstorms, tornadoes	• Listen to radio or TV announcements for pending weather information. • Cease field activities during thunderstorm or tornado warnings. • Seek shelter. Do not try to outrun a tornado.
Surveying	Slip, trip, fall	• Site workers will be required to wear hard hat, safety glasses with side shields, work gloves, and steel-toe boots when working in the field. • Provide adequate lighting in all work areas. • Whenever possible, avoid routing cords and hoses across walking pathways. • Flag or cover inconspicuous holes to protect against falls. • Work areas will be kept clean and orderly. • Garbage and trash will be disposed of daily in approved refuse containers. • Tools and accessories will be properly maintained and stored. • Work areas and floors will be kept free of dirt, grease, and slippery materials.
	Traffic accidents	• Place physical barrier (i.e., barricades, fencing) around work areas regularly occupied by pedestrians. • If working adjacent to roadways, have workers wear fluorescent orange vests. • Use warning signs or lights to alert oncoming traffic. • Assign flag person(s) if necessary to direct local traffic. • Set up temporary parking locations outside the immediate work area. • Motor vehicle operators shall obey all posted traffic signs, signals, and speed limits. • Pedestrians have the right-of-way. • Wear seat belts when vehicles are in motion.
	Wildlife hazards	• Workers should be cautious when driving through the site in order to avoid encounters with passing animals.

Table IX.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Soil Boring and Sampling	Overhead hazards	• Make sure no obstacles are within radius of boom. Always stay a safe distance from power lines.
	Faulty or damaged equipment being utilized to perform work	• All machinery or mechanized equipment will be inspected by a competent mechanic and be certified to be in safe operating condition. • Equipment will be inspected before being put to use and at the beginning of each shift. • Faulty/unsafe equipment will be tagged and if possible locked out. • Drill rigs shall be equipped with reverse signal alarm, backup warning lights, or the vehicle is backed up only when an observer signals it is safe to do so.
	Uneven terrain, poor ground support, inadequate clearances, contact with utilities	• Inspections or determinations of road conditions and structures shall be made in advance to ensure that clearances and load capacities are safe for the passage or placing of any machinery or equipment. • All mobile equipment and areas in which they are operated shall be adequately illuminated. • Aboveground and belowground utilities will be located and delineated or flagged prior to staging equipment. • Whenever the equipment is parked, the parking brake shall be set. • Equipment parked on inclines will have the wheels choked. • Inspect brakes and tire pressure on drill rig before staging for work.
	Inexperienced operator	• Machinery and mechanized equipment shall be operated only by designated personnel. • Operators shall inform their supervisor(s) of any prescribed medication that they are taking that would impair their judgment.
	Jacks/outriggers	• Ensure proper footing and cribbing.
	Falling objects	• Remove unsecured tools and materials before raising or lowering the derrick. • Stay alert and clear of materials suspended overhead.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert at all times!
	Fire	• Mechanized equipment shall be shut down prior to and during fueling operations. • Have fire extinguishers inspected and readily available.
	Fall hazards	• Personnel are not allowed to work off of machinery or use machinery as ladders. • Use fall protection when working above 6 feet.

Table IX.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
Direct-Push Sampling (continued)	Noise	• Hearing protection is mandatory above 85 dBA.
	Contact with rotating or reciprocating machine parts	• Use machine guards; use long-handled shovels to remove auger cuttings. • Use safe lockout procedures for maintenance work.
	Heavy lifting	• Use proper lifting techniques. Lifts greater than 60 pounds require assistance or mechanical equipment; size-up the lift.
	Slip, trip, and fall hazards	• Practice good housekeeping; keep work area picked up and clean as feasible. • Continually inspect the work area for slip, trip, and fall hazards.
	Contact with potentially contaminated materials	• Real-time air monitoring will take place. If necessary, proper personal protective clothing and equipment will be utilized. • Stop immediately at any sign of obstruction. • Do not breathe air surrounding boring unless necessary. • Upgrade to respirator if necessary. • Avoid skin contact with soil cuttings. Wear gloves. • Stay clear of moving parts of drill rig.
	Drum handling	• Be careful not to breathe air from around open drum any more than necessary. Monitor with photoionization detector/flame ionization detector (PID/FID) equipment and upgrade to respirator if necessary. • When filling a drum (with either soil or water), be careful not to make contact with the contained waste. Wear appropriate gloves. Make sure lid or bung of drum is secure. • If moving a drum unassisted, be sure to leverage properly, use proper lifting techniques, and wear safety glasses and steel-toed boots. • When using a drum dolly, make sure straps and lid catch are securely attached. Leverage properly when tilting drum. Be sure toes stay away from drum.
High-Pressure Water Jetting Operations	Heavy lifting	• Use proper lifting techniques. • Lifts greater than 60 pounds require assistance or mechanical equipment • Size-up the lift.
	Slip, trip, and fall hazards	• Good housekeeping shall be implemented. • The work area shall be kept clean as feasible. • Inspect the work area for slip, trip, and fall hazards.

Table IX.5-1

Activity Hazard Analysis
Plum Brook Ordnance Works, Sandusky, Ohio

Activity	Potential Hazards	Recommended Controls
High-Pressure Water Jetting Operations (continued)	Fueling	• Only approved safety cans shall be used to store fuel. • Do not refuel equipment while it is operating. • Fire extinguishers shall be suitably placed, distinctly marked, readily accessible, and maintained in a fully charged and operable condition.
	Faulty or damaged equipment	• Equipment shall be inspected before being placed into service and at the beginning of each shift. • Preventive maintenance procedures recommended by the manufacturer shall be followed. • A lockout/tagout procedure shall be used for equipment found to be faulty or undergoing maintenance.
	High-pressure water	• Jetting gun operator must wear appropriate PPE including hard hat, impact-resistant safety glasses with side shields, water-resistant clothing, metatarsal guards for feet and legs, and hearing protection (if appropriate). • One standby person shall be available within the vicinity of the pump during jetting operation. • The work area shall be isolated and adequate barriers will be used to warn other site personnel.
	Unqualified operators	• Only qualified and trained personnel are permitted to operate machinery and mechanized equipment associated with water jet cutting and cleaning.
	Out of control equipment	• No machinery or equipment is permitted to run unattended. • Machinery or equipment will not be operated in a manner that will endanger persons or property nor will the safe operating speeds or loads be exceeded.
	Noise	• Sound levels above 85 dBA mandates hearing protection by nearby site personnel.
	Activation during repairs	• All machinery or equipment will be shut down and positive means taken to prevent its operation while repairs or manual lubrications are being done.
	Pinch points	• Keep feet and hands clear of moving/suspended materials and equipment. • Stay alert and clear of materials suspended
	Falling objects	• Hard hats are required by site personnel. • Stay alert and clear of material suspended overhead.
	Flying debris	• Impact-resistant safety glasses with side shields are required.
	Contact with potentially contaminated materials	• All site personnel will wear the appropriate PPE.

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DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CELRN-EP-R-M

Project Description: RI/FS of TNT Area B, Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract Number: DACA62-94-D-0030 Delivery Order Number: 0034

Project Number: 775616 Task / Phase Number: 02000000

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☐ Risk Assessment / Evaluation		☐ Internal Draft
☐ Specifications & Plans		☒ Draft
☐ Design Calculations		☐ Draft Final
☐ Tables		☐ Final
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Program Manager			

NOTICE: By signature above, parties certify that the subject document has been prepared by and/or reviewed by them (as appropriate), that all review comments have been resolved, and that the document is ready for submittal.

Attachment IX

Site-Specific Sampling and Analysis Plan
Remedial Investigation at TNT Area B
Former Plum Brook Ordnance Works
Sandusky, Ohio

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IT Project Number 775616
Control Copy No. 15 21

Revision 0

September 1998

(This SSAP must be used in conjunction with the PBOW SAP)

Reviews and Approvals

Project Manager IT Corporation	Date
Site Coordinator IT Corporation	Date
QA/QC Officer IT Corporation	Date

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List of Acronyms

AR/COC	Analysis Request/Chain of Custody (Record)
COPC	chemical(s) of potential concern
D&M	Dames and Moore
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FUDS	Formerly Used Defense Sites
GIS	geographic information system
IDW	investigation-derived waste
IMS	Ion Mobility Spectroscopy
IT	IT Corporation
mg/kg	milligrams per kilogram
MK	Morrison-Knudsen Ferguson Corporation
NASA	National Aeronautic and Space Administration
NGVD	National Geodetic Vertical Datum
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
PCB	polychlorinated biphenyl
PLS	professional land surveyor
PRG	preliminary remediation goals
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RBC	risk-based concentration
RI	remedial investigation
SAP	sampling and analysis plan
SHP	safety and health plan
SOW	statement of work
SPCS	State Plane Coordinate System
SSAP	site-specific sampling and analysis plan

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List of Acronyms *(Continued)*

SSHP	site-specific safety and health plan
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TNT	trinitrotoluene
TNTB	TNT Area B
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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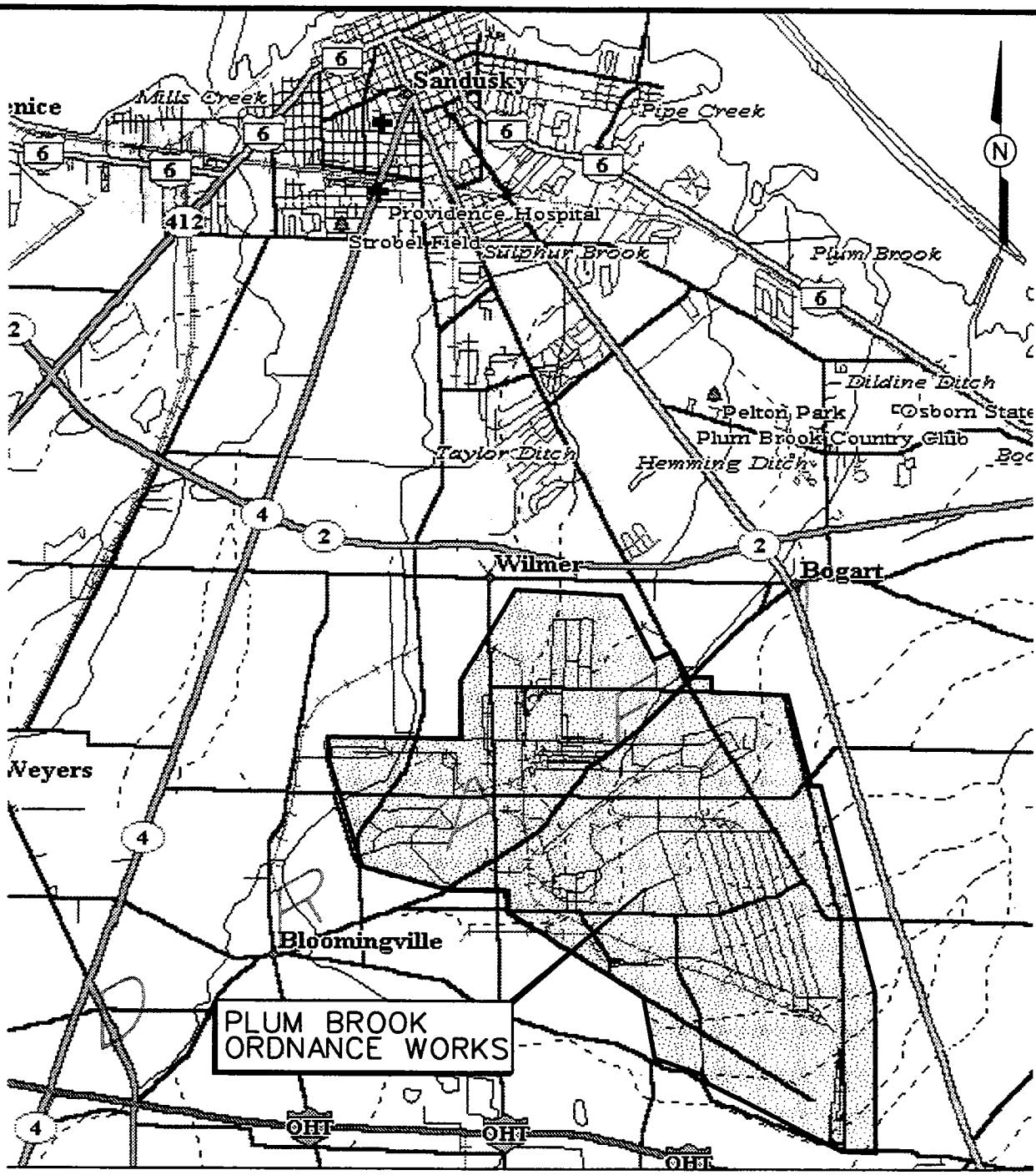
IX.1.0 Project Description

The U.S. Army is conducting studies of environmental impact of suspected hazardous waste sites at previously owned U.S. Department of Defense (DOD) properties. The former Plum Brook Ordnance Works (PBOW) is located in Sandusky, Erie County, Ohio (Figure IX-1). It is being investigated under the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS) and is being managed and technically overseen by the Nashville District of the U.S. Army Corps of Engineers (USACE). This 9,000-acre facility was used for the manufacture of explosives during World War II. The site is currently owned by the National Aeronautics and Space Administration (NASA) and operated as the Plum Brook Station (PBS) by the NASA Lewis Research Center based in Cleveland, Ohio.

As an attachment to the PBOW site-wide sampling and analysis plan (SAP) (IT Corporation [IT], 1996a), this site-specific sampling and analysis plan (SSAP) has been prepared for the field work to be carried out in support of the remedial investigation (RI) at Trinitrotoluene Area B (TNTB). This SSAP must be used in conjunction with the SAP and the quality assurance project plan (QAPP) (IT, 1996b) to ensure that work to be performed at the subject site will be of the quality required to satisfy the overall and site-specific project objectives. A site-specific safety and health plan (SSHP) has also been prepared separately for this investigation and must be used in conjunction with the site-wide safety and health plan (SHP) (IT, 1996c).

IX.1.1 Site History

The PBOW site, built in early 1941, manufactured 2,4,6-trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began; decontamination was completed during the last quarter of 1945. The property was initially transferred to Ordnance Department, then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration. NASA acquired PBOW in 1963 and is presently utilizing the site.



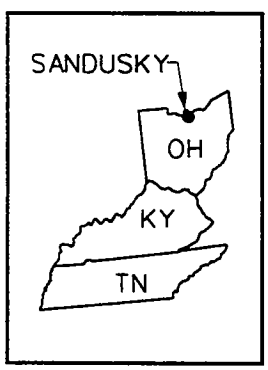


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FIGURE IX-1
VICINITY MAP

PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 12/16/97	DATE LAST REV 02 SEP 98	DRAFT. CHCK. BY:	INITIATOR: D. KESSLER	DWG. NO.: \775616ES.003
DRAWN BY: D. BILLINGSLEY	DRAWN BY: RVANDERG	ENGR. CHCK. BY: D. KESSLER	PROJ. MGR.: M.SPANGBERG	PROJ. NO.: 775616

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IX.1.2 Summary of Existing Site Data

The former TNTB is located in the southern part of PBOW and occupies approximately 48 acres of land as shown in Figure IX-2. The NASA Hypersonic Tunnel Facility is located on the northwest side of the area and the B2 facility is located immediately northeast of the site. TNTB was used during World War II as a manufacturing facility for TNT and DNT. During PBOW operations, TNTB contained three TNT lines consisting of six buildings each and one DNT line consisting of one building. Wastewater from TNTB was routed to the Pentolite Road Red Water Ponds through underground flume and sewer lines. Some modifications to the northwest portion of the site were apparently made during NASA construction activities. However, roads, building foundations, and remnants of utilities are still recognizable. According to the Records Review Report (Dames and Moore [D&M], 1995), TNTB was decontaminated along with two other TNT areas in 1955 and again in 1966. However, the decontamination at TNTB was reportedly not as thorough as that in TNT Area A and significant subsurface contamination associated with underground flumes and sewer lines is probably still present. Previous environmental investigations in this area included a 1993 Site Inspection by Morrison Knudsen Ferguson Corporation (MK, 1994) and a 1994 TNT Areas Site Investigation by D&M (D&M, 1997). The MK inspection of the TNTB site included one surface soil sample, two subsurface soil samples, one co-located sample pair of surface water and sediment, and two groundwater samples. Organic compounds were not detected in the surface water sample collected from Ransom Brook, but the co-located sediment sample exhibited detectable organic constituents including 2,4,6-TNT at 25 milligrams per kilogram (mg/kg). One subsurface soil sample also contained 12 mg/kg of 2,4,6-TNT. In addition, one groundwater sample from a downgradient overburden well (MK-MW-17) showed the presence of bis(2-ethylhexyl)phthalate at a concentration of 12 micrograms per liter.

A total of 34 soil samples were collected from 26 borings within the TNTB site during the 1994 D&M investigation (Figure IX-3). Boring locations were placed in and around former buildings that were associated with the TNT production lines. A wide range of nitroaromatic compounds were detected, including TNT at concentrations up to 20,000 mg/kg (near Bi-Tri House) and 2,6-DNT up to 12,000 mg/kg (near DNT Sweating/Graining House).

IT conducted a site-wide groundwater investigation at PBOW in 1996 (IT, 1997) and again in 1997 (IT, 1998); both investigations included collection of groundwater samples from wells in TNTB. There are four existing monitoring wells in TNTB. Two wells MK-MW16 and TNTB-BED-GW002 are located along the south perimeter of TNTB, hydraulically upgradient of the

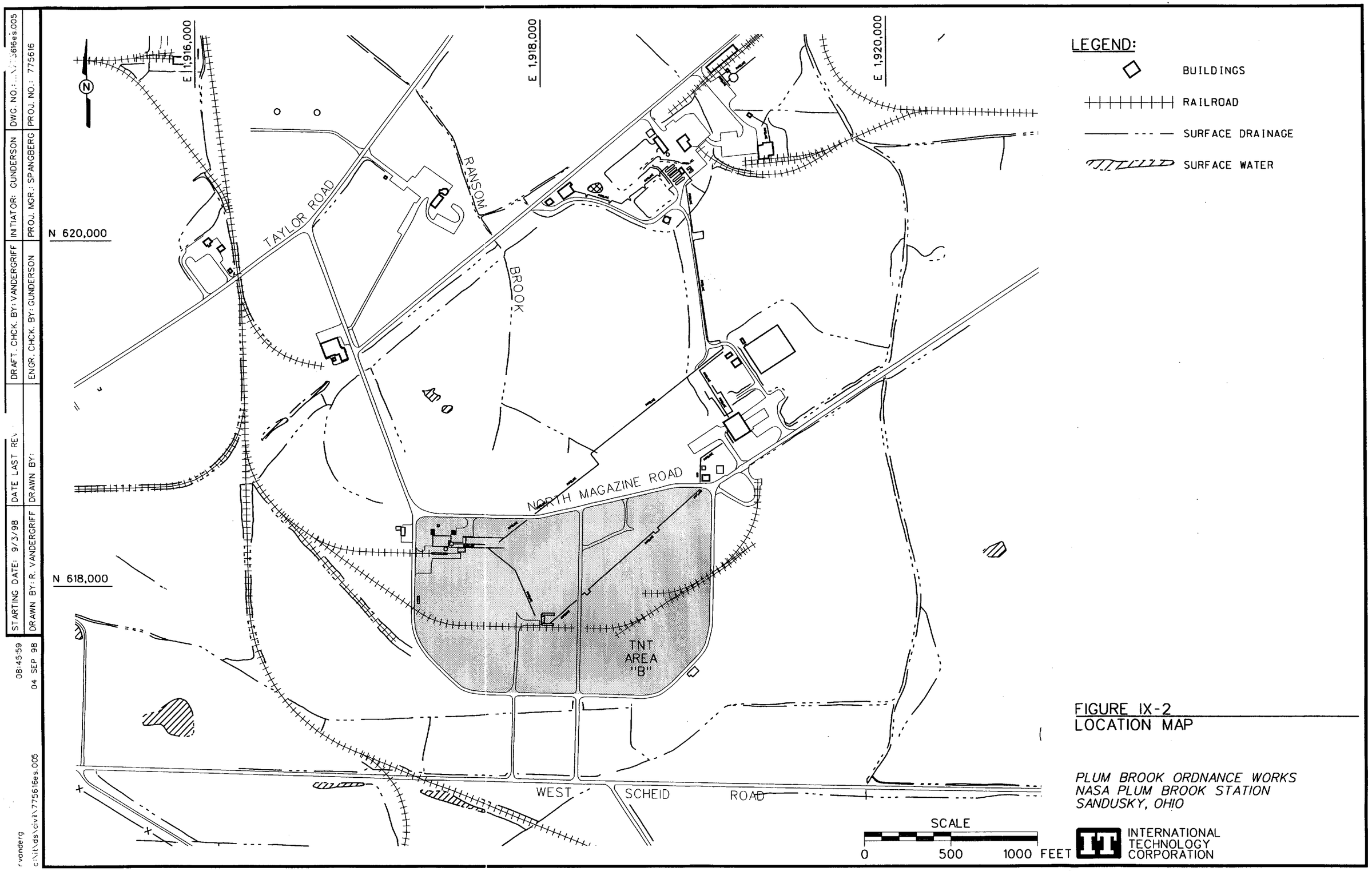

FIGURE IX-2
LOCATION MAP

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

MAP POCKET

Fig IX-3

Proposed Surface Soil

Boring Locations

Drawing # 775616ES.002

Job # 775616

site. Two other wells (MK-MW17 and TNTB-BED-GW001) are located along the north perimeter of TNTB, downgradient of the site. Organic compounds have been detected in MK-MW17 (4-amino-2,6-DNT) and in TNTB-BED-GW002 (benzene) at concentrations above their respective screening levels (IT, 1998).

Two hydrolithologic units are known to exist at PBOW. The overburden unit, composed of glacial outwash materials, has a thickness ranging from a few feet in the south to greater than 40 feet in some locations in the north. The water producing capacity of the overburden materials is strongly controlled by seasonal changes and the overburden water-bearing zone is therefore not considered to be a primary source of water. The bedrock unit consists of Devonian limestone and shale that dip to the southeast at approximately 35 feet per mile. Based on previously collected data, the overburden thickness within the TNTB site is generally less than 5 feet.

In general, groundwater flows in a northerly direction, towards Lake Erie, in both the unconsolidated overburden material and consolidated bedrock. However, on the western side of the installation groundwater in the overburden water-bearing zone flows to the northwest while groundwater in the bedrock aquifer flows to the northeast. The groundwater flow regime in the overburden unit shows a strong seasonal variation.

IX.2.0 Project Organization and Responsibility

The project organization for this RI consists of a project manager, a health and safety officer, a principal investigator, an analytical coordinator, field geologists, and technicians. Chapter 2.0 of the SAP (IT, 1996a) presents names of key IT personnel and their responsibilities.

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IX.3.0 Scope of Work and Objectives

IX.3.1 Scope of Work

As specified in the scope of work (SOW) (USACE, 1998), the RI activities at TNTB will consist of preparation of site-specific addenda to the site-wide SAP and SHP; completion of field activities, including installation of soil borings and collection of soil samples from selected locations for chemical analysis; evaluation of analytical results; report preparation; and a geographic information system (GIS) deliverable.

IX.3.2 Objectives

The primary objective of the RI is to determine the presence of chemical(s) of potential concern (COPC) in soils at TNTB. Specific objectives of the RI are summarized as follows:

- Define site physical features and characteristics
- Determine the nature and extent of source areas
- Determine whether contaminant distribution is consistent with DOD activities.

Sufficient surface and subsurface soil data will be collected so that a feasibility study (FS) can be conducted to select the most effective remediation technology. Additionally, the collected data will be used to conduct human health and ecological risk assessments for the site.

IX.3.3 Site-Specific Data Quality Objectives

Overview. The data quality objectives (DQO) process followed during the planning stages of the RI evaluated data requirements needed to support the decision-making process and selected the best action to satisfy these requirements. Incorporated components of the DQO process, described in the U.S. Environmental Protection Agency (EPA) publication 9355.9-01 *Data Quality Objectives Process for Superfund* (EPA, 1993), are discussed in detail in Section 3.3 of the SAP. Determining factors for procedures necessary to satisfy investigative objectives and to establish the basis of future actions at PBOW are presented in Figure 3-2 of the SAP (IT, 1996a).

Data Users and Available Data. A site-specific conceptual model developed using existing data, helped to identify data gaps. During the project planning process effective methodologies for filling the data gaps were designed and reviewed by the data users with the most efficient data collection design being implemented. The SSAP records the rationale for the design, including

the location, number, and type of sampling necessary to fill the data gaps and to satisfy the DQOs. The SSAP, along with companion documents, provides the regulatory agencies with sufficient detail so that they can conclude whether the investigative effort is adequate to satisfy the study objectives.

Conceptual Site Model. Four factors considered in defining the conceptual model for the RI are:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Contaminants of concern.

A source of contamination at PBOW is past TNT manufacturing activities, including the production and storage of raw materials. Sources at the proposed areas of investigation result from TNT and DNT production and associated activities. The migration pathways for potential contaminants include groundwater, soil, sediment, and surface water runoff to creeks. Likely receptors at PBOW are limited to aquatic organisms in creeks and wildlife. Exposure of humans to potential contaminants under current land use at PBOW is unlikely since the site is a secure NASA research station. Potential receptors near the facility include off-site water users. COPC based on past use of the site should primarily be nitroaromatic explosives, but may also include volatile organic compounds (VOC), semivolatile organic compounds (SVOC), metals, pesticides/ polychlorinated biphenyls (PCB), and cyanide.

Decision-Making Process, Data Uses, and Needs. The decision-making process, presented in detail in Section 3.3.3 of the SAP (IT, 1996a), consists of a seven-step process that will be followed during the RI. Data uses and needs are summarized in Table 3-1 of the SAP (IT, 1996a).

Risk Evaluation. Confirmation of contamination during the RI will be based upon a comparison of detected contaminants in confirmation soil samples from this investigation to risk-based screening concentrations adapted from the most current risk-based concentrations (RBC) developed by EPA Region 3. Specifically, RBCs used will reflect a cancer risk of 10^{-6} or a hazard index of 0.1. EPA definitive data will be used to determine whether or not the established guidance criteria are exceeded in the media. Definitive data will be adequate for confirming the

presence of the contamination and for supporting a risk assessment and feasibility study, if necessary.

Data Quality, Types, and Quantities. Soil, surface water, and sediment samples will be collected and analyzed to meet the objectives of the RI. Quality assurance/quality control (QA/QC) samples will be collected for all sample types as described in Section IX.4.3 of this SSAP. All samples, except the screening samples, will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the RI, data analyzed at this level of quality are appropriate for all phases of the characterization and risk assessment. All soil screening samples will be analyzed in the field using Ion Mobility Spectroscopy (IMS) field screening methods and the data will be used to determine the nature and extent of the nitroaromatic contamination. The repeatability of the IMS results will be checked in the field using immunoassay or wet chemistry field test procedures.

Precision, Accuracy, and Completeness. Laboratory requirements of precision, accuracy, and completeness for confirmation samples generated during the RI are provided in Chapter 12.0 of the QAPP (IT, 1996b).

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IX.4.0 Field Activities

Field activities associated with the RI at TNTB will include surface and subsurface soil sampling, field screening for explosives, land surveying, and investigation-derived waste (IDW) management.

IX.4.1 Rationale for Soil Sample Placement

A total of 360 surface soil samples will be collected within the TNTB area for field screening. From these locations, one composited surface soil sample (0 to 1 foot) will be collected for a total of 360 surface soil screening samples to be analyzed using the IMS technology. In addition, up to 40 composite subsurface soil samples will be collected from "hot spots" that are identified from surface soil screening results. Two-foot composites will be collected from 2 to 10 feet below ground surface (or to the top of bedrock if bedrock occurs shallower than 10 feet. An additional 10 subsurface soil samples will be collected along the underground red water sewer lines to determine if they may be contributing subsurface explosives contamination. Subsurface soil samples will also be analyzed using the IMS method. The hot spots will be those locations where nitroaromatic explosives concentrations exceed the EPA Region 9 Preliminary Remediation Goals (PRG) for explosives (Table IX-1). If less than 40 locations are identified where surface soil contains explosives exceeding the PRG, subsurface samples will be collected in areas that exhibited the highest total concentrations of nitroaromatics. If more than 40 locations are identified where surface soil contains explosives exceeding the PRG, the first 40 locations with the highest concentrations will be selected for subsurface sampling. However, if two or more of these surface samples are adjacent to one another and are interpreted to define a contiguous area of surface soil contamination, only one subsurface soil sample may be collected at the location of highest contamination among adjacent sampling locations. The intent of this sampling approach is to best use the limited number of subsurface samples to determine the depth of contamination at as many individual areas of contamination as possible. This will ultimately lead to better volume estimates for the subsequent FS. A summary of soil sample designations and QA/QC samples to be collected is provided in Table IX-2.

Considering the size of the sampling area (48 acres or 0.25 square miles), a hot spot sampling strategy will be utilized to delineate the extent of known hot spots based on previous sampling results (D&M, 1997) and to provide coverage of suspected source areas within the TNT B area. There are 19 buildings associated with 3 TNT production lines and one DNT line as summarized

Table IX-1

Summary of Explosives Preliminary Remediation Goals
Remedial Investigation at TNT Area B
Former Plum Brook Ordnance Works, Sandusky, Ohio

Compound	Preliminary Remediation Goals[a]	
	Residential (mg/kg)	Industrial (mg/kg)
1,3-Dintrobenzene	5.5E+00	1.1E+02
Nitrobenzene	1.6E+01	1.0E+02
2,4-Dinitrotoluene	1.1E+02	2.1E+03
2,6-Dinitrotoluene	5.5E+01	1.1E+03
1,3,5-Trinitrobenzene	1.6E+03	3.2E+04
2,4,6-Trinitrotoluene	1.5E+01	1.0E+02

[a] From EPA Region 9, Preliminary Remediation Goals for Planning Purposes, 1998.

mg/kg - Milligrams per kilogram.

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Table IX-2

Summary of Environmental Samples and QA/QC Samples to be Collected
Remedial Investigation at TNT Area B
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Type	Required Analysis	Sample Quantity	QA/QC Samples[a]	
			Contract Laboratory (QC)	USACE Laboratory (QA)
Soil Screening	IMS field screening for nitroaromatics	360 (surface soil) 40 (subsurface soil)	2/day[b]	--
Soil Confirmation[c]	Nitroaromatics	40	4	4
	TCL VOCs	40	4	4
	TCL SVOCs	40	4	4
	TAL Metals	40	4	4
	PCBs	40	4	4
Surface Water	Nitroaromatics	10	1	1
	TCL VOCs	10	1	1
	TCL SVOCs	10	1	1
	TAL Metals	10	1	1
	PCBs	10	1	1
Sediment	Nitroaromatics	10	1	1
	TCL VOCs	10	1	1
	TCL SVOCs	10	1	1
	TAL Metals	10	1	1
	PCBs	10	1	1

[a] Ten percent of the total number of the confirmation soil samples and surface water/sediment samples will be collected for QA and QC analysis. The sample that is taken for confirmation purpose will also be field screened by IMS.

[b] Two composite samples per day will be collected and analyzed by a wet chemistry field test or immunoassay kit to check the repeatability of the ion mobility spectroscopy (IMS) results.

[c] From the same location a confirmation sample is taken, another sample will also be collected for analysis by IMS techniques.

PCB - Polychlorinated biphenyl.
QA/QC - Quality assurance/quality control.
TAL - Target analyte list.
TCL - Target compound list.
USACE - U.S. Army Corps of Engineers.

in Table IX-3 and as shown on Figure IX-3. In addition, a wastewater settling tank area (Building 417) is located in the northern part of the site and connected to the production lines via underground red water sewers. Seven of the 19 buildings and the settling tanks were sampled during the 1994 D&M investigation; explosives were detected in selected locations. Surface soil screening samples will be placed in and around each building area (including the settling tank area) (Table IX-2 and Figure IX-3). The sampling locations were chosen to provide adequate coverage adjacent to the building, to incorporate previous sampling results reported by D&M (1997), and to cover suspected source areas identified during investigations at similar TNT production facilities (West Virginia Ordnance Works and Volunteer Army Ammunition Plant). Screening data will be reviewed daily to determine if there are discernable patterns in soil contamination and to place subsequent delineation samples. Selection of new, alternate, or delineation sampling locations will be completed in consultation with the USACE-Nashville District on-site representative. Figure IX-3 presents the design of the initial soil sampling locations. These data are expected to provide an estimate of contaminated soil volume for use in the subsequent FS.

Locations of screening samples will be determined based upon the surveyed (baselines) screening sample grids, where measurements to grid nodes and other known site features will be used to locate each sample point.

IX.4.2 Sampling Methodology and Procedures

The following sampling methods and operational procedures have been developed to ensure that the data acquired through field sampling will meet the data quality objectives stated in Section IX.3.3. All soil samples collected by IT field personnel will be documented through the use of Analysis Request/Chain of Custody Record forms (AR/COC, Figure 6-2 of the SAP [IT, 1996a]) following field custody procedures specified in Section 5.1 of the QAPP (IT, 1996b). Any changes from the work plans will be recorded in chronological order in the variance log shown in Figure 9-1 of the SAP (IT, 1996a).

IX.4.2.1 Screening Soil Samples

Either a hand auger, a portable gas-powered drill rig, hydropunch, or a truck-mounted drill rig will be used to drill borings to the specific depth. Soil samples for field screening will be collected using stainless-steel split spoons or hand augers; undisturbed samples will be collected for VOC analysis using a drive sampler. If a drive sampler cannot be used effectively due to the

Table IX-3

Major TNT Production Buildings at TNT Area B
Former Plum Brook Ordnance Works, Sandusky, Ohio

Former Building Name	Building Number	Building Sampled	Previous Data[a]
Mono House	451, 461, 471	451	TNT, 2,4-DNT, 2,6-DNT
Bi-fortifier House	453, 463, 473	453	TNT, 4-amino-DNT,
Tri House	452, 462, 472	452	TNT, 2,4-DNT, 2,6-DNT
Wash House	456, 466, 476	456, 466	TNT, 2-amino-DNT
Nail House	458, 468	--	Not sampled
Recovery House	459, 469, 479	--	Not sampled
DNT Nitrator House	415	--	Not sampled
Setting Tanks	417	417	TNT, 2,4-DNT, 2-amino-DNT
DNT Sweating/Graining House	412	412	2,4-DNT, 2,6-DNT, 3,4-DNT

[a] Data from D&M TNT Areas Site Investigation Report (D&M, 1997).

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proximity of bedrock or weathered bedrock, then care will be used to collect a minimally disturbed sample and place it in the appropriate container. If the quantity of soil in the split spoon is not sufficient, then an additional boring will be advanced immediately adjacent to the original boring, and samples will be collected at the same interval as the original sample. Upon completion of sampling, soil borings will be backfilled with soil cuttings removed from the borehole during drilling and grouted, as needed. Each screening location will be referenced to the surveyed grid.

All soil samples will be visually inspected and logged on the hazardous, toxic, radiologic waste drilling log (Figure 4-11 of the SAP) by an IT field geologist using the Unified Soil Classification System; however, continuous sampling for lithologic descriptions will not be performed for screening locations. A summary of screening soil sample designations is provided in Table IX-4.

IX.4.2.2 Confirmation Soil Samples

A total of 40 confirmation soil samples will be collected and analyzed off-site (Table IX-5). Of these, up to 25 will be collected as surface samples and at least 15 will be subsurface samples. These samples will be of definitive data quality to be used in risk assessment of TNTB. Confirmation sample locations will be selected based on the screening results and will consist of both surface and subsurface samples. Confirmation samples will be collected to confirm either positive detection (hot spot) or negative detection (non-detect) from field screening. Therefore, up to 5 confirmation samples shall be selected from screening locations exhibiting non-detect in field analysis. Confirmation samples will be collected following the same procedures as for screening samples. The selection of boring locations for confirmation samples will be determined in consultation with the USACE-Nashville District on-site representative. Each confirmation borehole will be staked, labeled, and surveyed.

IX.4.2.3 Surface Water and Sediment Samples

Five surface water samples (including possible seeps) and five collocated sediment samples will be collected from pre-marked locations along Ransom Brook between Taylor Road and TNTB. The SOW called for 10 samples to be collected. However, upon further review of site conditions it was determined that 5 samples would be sufficient to characterize any contamination that may be present in Ransom Brook, primarily due to the short distance between the head waters of the brook and Taylor Road. Ransom Brook initiates in a general area immediately north of TNTB

Table IX-4

Soil Screening Samples to be Collected
Remedial Investigation at TNT Area B
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Type	Sample Identification	Number of Samples	Sampling Depth (feet)
Screening Surface Soil	TNTB-SS001-0010-(00-01)	360	0 - 1.0'
	TNTB-SS002-0020-(00-01)		0 - 1.0'
	:		:
	:		:
	TNTB-SS100-0100-(00-01)		:
	TNTB-SS101-1010-(00-01)		:
	:		:
	:		:
	TNTB-SS200-0200-(00-01)		:
	TNTB-SS201-2010-(00-01)		:
	:		:
	:		:
	TNTB-SS359-3590-(00-01)		0 - 1.0'
	TNTB-SS360-3600-(00-01)		0 - 1.0'
Screening [a] Subsurface Soil	TNTB-SSxxx-xxxx-(depth)	40	2' - 10'
Confirmation Samples to be Screened[b]	PBOW-98-SO-TNTB-SOxx-xxxx-(depth)	40	To be determined based on screening results

[a] Screening subsurface soil samples will be collected from selected surface screening locations exhibiting highest detections of nitroaromatic compound(s).

[b] From the same location a confirmation sample is taken, another sample will also be collected for analysis by ion mobility spectroscopy (IMS) technique.

Table IX-5

Confirmation Soil Samples and QA/QC Samples to be Collected
Remedial Investigation at TNT Area B
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Identification	QA/QC Samples		
	Field Duplicate	MS/MSD	Field split
PBOW-98-SO-TNTB-SO01-5010-(depth)			
PBOW-98-SO-TNTB-SO02-5020-(depth)			
PBOW-98-SO-TNTB-SO03-5030-(depth)			
PBOW-98-SO-TNTB-SO04-5040-(depth)			
PBOW-98-SO-TNTB-SO05-5050-(depth)			
PBOW-98-SO-TNTB-SO06-5060-(depth)	x		x
PBOW-98-SO-TNTB-SO07-5070-(depth)			
PBOW-98-SO-TNTB-SO08-5080-(depth)			
PBOW-98-SO-TNTB-SO09-5090-(depth)			
PBOW-98-SO-TNTB-SO10-5100-(depth)			
PBOW-98-SO-TNTB-SO11-5110-(depth)			
PBOW-98-SO-TNTB-SO12-5120-(depth)			
PBOW-98-SO-TNTB-SO13-5130-(depth)			
PBOW-98-SO-TNTB-SO14-5140-(depth)	x		x
PBOW-98-SO-TNTB-SO15-5150-(depth)		x	
PBOW-98-SO-TNTB-SO16-5160-(depth)			
PBOW-98-SO-TNTB-SO17-5170-(depth)			
PBOW-98-SO-TNTB-SO18-5180-(depth)			
PBOW-98-SO-TNTB-SO19-5190-(depth)			
PBOW-98-SO-TNTB-SO20-5200-(depth)			
PBOW-98-SO-TNTB-SO21-5210-(depth)			
PBOW-98-SO-TNTB-SO22-5220-(depth)			
PBOW-98-SO-TNTB-SO23-5230-(depth)			
PBOW-98-SO-TNTB-SO24-5240-(depth)			
PBOW-98-SO-TNTB-SO25-5250-(depth)		x	
PBOW-98-SO-TNTB-SO26-5260-(depth)	x		x
PBOW-98-SO-TNTB-SO27-5270-(depth)			
PBOW-98-SO-TNTB-SO28-5280-(depth)			
PBOW-98-SO-TNTB-SO29-5290-(depth)			
PBOW-98-SO-TNTB-SO30-5300-(depth)			
PBOW-98-SO-TNTB-SO31-5310-(depth)			
PBOW-98-SO-TNTB-SO32-5320-(depth)			
PBOW-98-SO-TNTB-SO33-5330-(depth)			
PBOW-98-SO-TNTB-SO34-5340-(depth)			
PBOW-98-SO-TNTB-SO35-5350-(depth)	x		x
PBOW-98-SO-TNTB-SO36-5360-(depth)			
PBOW-98-SO-TNTB-SO37-5370-(depth)			
PBOW-98-SO-TNTB-SO38-5380-(depth)			
PBOW-98-SO-TNTB-SO39-5390-(depth)			
PBOW-98-SO-TNTB-SO40-5400-(depth)			

Note: Confirmation samples will be collected at the same location as an ion mobility spectroscopy (IMS) screening sample. Actual sample locations will be determined based on IMS screening results.

MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.

(Table IX-6 and Figure IX-4). It is likely that the Ransom Brook contains minimal flow or even dry during certain time of the year, most likely in the summer. Sampling of surface water from Ransom Brook must be conducted when there is sufficient flow in the channel. Although shown in the attached schedule to occur at the end of the field sampling effort, this sampling will be completed as soon as possible. The USACE-Nashville District on-site representative will be notified prior to any schedule changes in field sampling.

Surface Water Sampling. The equipment required for surface water sampling includes a stainless-steel pitcher, a 100-foot measuring tape, proper sampling containers, and required health and safety device.

The following procedure will be followed for the collection of surface water samples:

- Refer to the health and safety plan before proceeding with sampling.
- Surface water shall be collected first, prior to any sediment sampling.
- Surface water sampling shall occur from downstream to upstream with VOCs being collected first followed by SVOCs, explosives and other required samples.
- Two persons will perform the sampling. One person will carefully adopt an optimal sampling position and remain in that position until all sampling at that locality is completed in order to minimize the agitation of the sediment and water. The other person will be positioned within arms length of the sampler on dry ground, to aid in field measurements, filling of sample bottles, and to fill out sample collection log.
- At each sampling location, a decontaminated stainless-steel pitcher will be triple rinsed with water from the creek. Alternatively, the samples bottles may be directly immersed in the surface water body, unless split samples are required. At end of sampling, field parameters including Eh, pH, specific conductance, temperature, and dissolved oxygen will be measured and recorded in sample collection log.
- Surface water sample locations will be flagged and shown in the collection log for use during land survey.
- For seeps, the construction of temporary collection boxes may be required.

Table IX-6

Surface Water and Sediment Samples and QA/QC Samples to be Collected
Remedial Investigation at TNT Area B
Former Plum Brook Ordnance Works, Sandusky, Ohio

	Sample Identification[a]	QA/QC Samples		
		Field Duplicate	MS/MSD	Field Split
Surface Water	PBOW-98-SW-TNTB-SW01-5510-0000			
	PBOW-98-SW-TNTB-SW02-5520-0000			
	PBOW-98-SW-TNTB-SW03-5530-0000			
	PBOW-98-SW-TNTB-SW04-5540-0000			
	PBOW-98-SW-TNTB-SW05-5550-0000			
	PBOW-98-SW-TNTB-SW06-5560-0000	x	x	x
	PBOW-98-SW-TNTB-SW07-5570-0000			
	PBOW-98-SW-TNTB-SW08-5580-0000			
	PBOW-98-SW-TNTB-SW09-5590-0000			
	PBOW-98-SW-TNTB-SW10-5600-0000			
Sediment	PBOW-98-SD-TNTB-SD01-5610-0000			
	PBOW-98-SD-TNTB-SD02-5620-0000			
	PBOW-98-SD-TNTB-SD03-5630-0000			
	PBOW-98-SD-TNTB-SD04-5640-0000	x	x	x
	PBOW-98-SD-TNTB-SD05-5650-0000			
	PBOW-98-SD-TNTB-SD06-5660-0000			
	PBOW-98-SD-TNTB-SD07-5670-0000			
	PBOW-98-SD-TNTB-SD08-5680-0000			
	PBOW-98-SD-TNTB-SD09-5690-0000			
	PBOW-98-SD-TNTB-SD10-5700-0000			

[a] Surface water and sediment samples are co-located (i.e., SW01 and SD01 are from the same location).

MS/MSD - Matrix spike/matrix spike duplicate.
QA/QC - Quality assurance/quality control.

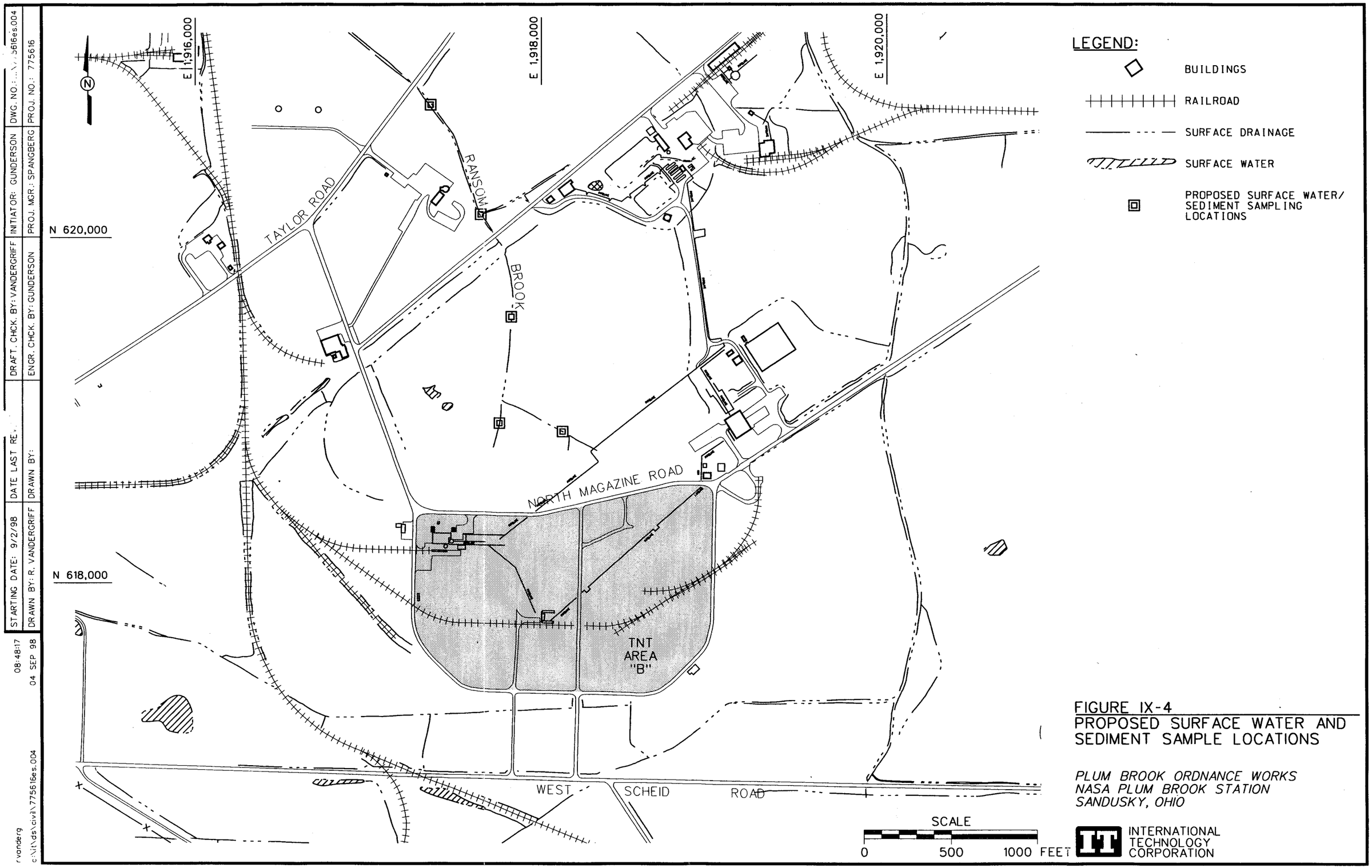

FIGURE IX-4
PROPOSED SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Sediment Sampling. The equipment required for sediment sampling includes an Ekman dredge or similar device, stainless-steel bowls, wood stakes, hammer, a 100-foot tape, proper sample container, and required health and safety device.

The following procedure will be followed for the collection of surface water samples:

- Refer to the health and safety plan before proceeding with sampling.
- The collection of sediment samples from Ransom Brook shall be conducted using a decontaminated Ekman dredge or similar device. In flowing water, the sample shall be taken at the location upstream of the sampler.
- Sediment sampling should occur in areas of low flow with sediment consisting of fine sand or smaller grain size.
- Fill the sample containers with sediment from the bowl, packing the VOC samples as soon as possible. Samples collected for VOC analysis will be placed in the container with no headspace. Sample containers will be labeled and placed on ice in a cooler. When all required samples are collected, the sampling location will be staked and flagged for use in land survey.

IX.4.3 Boring Abandonment

Upon completion of soil sampling, soil borings will be abandoned by backfilling with soils removed during sampling. Any remaining space will be grouted to the surface. The type of grout to be used will be bentonite-cement slurry grout with approximately 5 percent bentonite powder and 95 percent Type 1 portland cement, mixed with 5 to 6 gallons of clean water. The IT field geologist will check the abandoned boring after 24 hours for any grout settlement or depression and add more grout if necessary. Due to the shallow boring depth, use of a tremie pipe is optional.

IX.4.4 Land Surveying

Prior to commencing soil screening sampling activities, IT will secure the services of an Ohio-registered PLS to establish up to eight baselines for screening sampling grids. These baselines will be placed to establish sampling grids based on the historical site layout and previous analytical results. Each baseline will be up to 1,600 feet in length with nodes spaced at 100-foot intervals.

Following completion of confirmation soil sampling and surface/water sediment sampling activities, the PLS will determine the coordinates and elevations of confirmation soil borings and surface water/sediment samples. The horizontal coordinates will be surveyed to the closest 0.1 foot and referenced to the SPCS. Vertical elevations will be surveyed to the nearest 0.01 foot and referenced to the 1929 National Geodetic Vertical Datum (NGVD).

Locations of screening samples will be determined based upon the surveyed (baselines) screening sample grids, where measurements to grid nodes and other known site features will be used to locate each sample point.

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IX.5.0 Sample Analysis and Decontamination Procedures

IX.5.1 Sample Number System

The sample numbering system to be used during this investigation will conform to the USACE-Nashville District's numbering convention. Specifically, each sample will be assigned a unique sample identification number that describes where the sample was collected. Each number consists of a group of letters and numbers, separated by hyphens. The numbering system to be used for the RI is described as follows:

Project Code	Year	Sample Type[a]	Site Identification	Boring Number	Sample Number	Sample Depth (ft)
PBOW	1998	XX	TNTB	XXXX	XXXX	XX-XX

[a]Sample types:

ER - Equipment rinsate sample
FB - Field blank
FD - Field duplicate sample
FS - Field split sample
MD - Matrix spike duplicate sample
MS - Matrix spike sample
SO - Soil sample
SD - Sediment sample
SW - Surface water sample.

PBOW-98-SO-TNTB-SB01-0560- (0406) signifies that this soil sample is collected from depth soil boring SB01 in TNTB with a sample number of 0560. The sample identification number will be recorded by the IT field geologist in the field activity daily log, boring log, and sample collection log as shown respectively in Figures 4-1, 4-11, and 4-16 of the SAP (IT, 1996a).

IX.5.2 Analytical Program

The analytical program has been designed to acquire sufficient and defensible data to determine the extent of soils in the investigated areas that has been impacted by nitroaromatic compounds. Table IX-7 summarizes the analytical parameters required and associated laboratory methodologies to be utilized during this investigation.

Table IX-7

Summary of Analytical Parameters and Methods
Remedial Investigation at TNT Area B
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Media	Analytical Parameters[a]	Methods[b]
Screening Soils	Nitroaromatic Compounds	IMS (on-site laboratory)
Confirmation Soils	Nitroaromatic Compounds	EPA SW-846 8330
	TCL VOCs	EPA SW-846 8260A
	TCL SVOCs	EPA SW-846 3540B/8270B
	TAL Metals[c]	EPA SW-846 3050A/6010/7471A
	PCB	EPA SW-846 3540B/8081
Surface Water	Nitroaromatic Compounds	EPA SW-846 8330 (modified)
	TCL VOCs	EPA SW-846 8260A
	TCL SVOCs	EPA SW-846 3540B/8270B
	TAL Metals	EPA SW-846 3050A/6010/7471A
	PCB	EPA SW-846 3540B/8081
Sediment	Nitroaromatic Compounds	EPA SW-846 8330
	TCL VOCs	EPA SW-846 8260A
	TCL SVOCs	EPA SW-846 3540C/8270C
	TAL Metals	EPA SW-846 3050B/6010B/7000
	PCB	EPA SW-846 3540B/8081

[a] The analytical methods, except ion mobility spectroscopy (IMS), are found in the following references:

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. Environmental Protection Agency (EPA) Publication SW-846, Third edition, update II, September 1994.
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA Publication SW-846, Third edition, Update I, July 1992.
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA Publication SW-846, Third edition, Update II, December 1990.

[b] Target analyte list (TAL) and target compound list (TCL) are used to only designate analyte lists, with no requirements for Contract Laboratory Program (CLP) method quality control (QC) or data reporting packages.

[c] TAL metals include Ag, Al, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Ti, V, As, Hg, Se, and Zn.

PCB - Polychlorinated biphenyl.
SVOC - Semivolatile organic compound.
VOC - Volatile organic compound.

A total of 360 surface and 40 subsurface soil samples will be analyzed using IMS technique for screening nitroaromatic constituents. Table IX-4 presents the screening sample identifications for tracking purpose. The analysis will be performed in a on-site laboratory equipped with self-sustained IMS unit capable of carrying out analyses using all explosive standards and generating hardcopies. IMS field screening will be performed by an experienced chemist following procedures established in the IMS field screening SOP. Note that the IMS field screening SOP will be submitted under separate cover.

At least 40 confirmation soil samples will be analyzed by a off-site contract laboratory for nitroaromatics, target compound list (TCL) VOCs, TCL SVOCs, target analyte list (TAL) metals, and PCBs. Laboratory QC procedures and data quality requirements are specified in and referenced to appropriate sections of the QAPP (IT, 1996b). Confirmation sample locations will be selected based on the screening results and will consist of both surface and subsurface samples.

In addition to soil samples, five surface water and five sediment samples will be analyzed for nitroaromatics, TCL VOCs, TCL SVOCs, TAL metals, and PCBs.

IX.5.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SAP (IT, 1996a) and will be followed during the current investigation at TNTB. IT field coordinator must contact PBS for access to a potable water source for decontamination use. The following summarizes decontamination procedures for equipment before site entry, between borings, and before site departure:

Nonsampling equipment (augers, drill rod, etc that does not contact analytical samples):

- Steam-rinse with potable water, or wash and scrub using a brush with nonphosphate detergent, and then rinse with potable water.

Sampling equipment (split spoons, spoons, bowls, etc that contacts analytical samples):

- Wash and scrub using a brush with nonphosphate detergent.
- Rinse with potable water.

- Rinse with deionized water (American Society for Testing and Materials Type II water).
- Rinse with methanol.
- Final rinse with deionized water. The volume of water used will be at least five times greater than the volume of methanol used.
- Air dry.
- Wrap in aluminum foil.

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IX.6.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned containers from I-CHEM, made of materials recommended by the EPA in Title 40, Code of Federal Regulations, Part 136 and SW-846 (3rd Edition). Sample containers and preservatives/preservation methods are summarized in Table 5-1 of the QAPP (IT, 1996b). Sample containers will be supplied and shipped to the job site by the designated primary laboratory.

Each sample container will be bagged before placement in the cooler. Sample holding times will be calculated from the date the sample is collected, not the date that it is received by the laboratory.

Samples for chemical analysis will be placed in coolers as soon as possible after collection and will be packed so as to minimize the possibility of container breakage by using Vermiculite or styrofoam peanuts to fill void spaces in the cooler. Samples will be cooled as promptly as feasible to a temperature of approximately 4 degrees Celsius and maintained at that temperature by means of blue ice or double-bagged ice from the time the shipping carton is sealed using tape and custody tape until it is received at the laboratory. Coolers will be shipped to the laboratory by a next-day-delivery service. Notification of shipment, including airbill number, will be telephoned or faxed to the laboratory the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

Completed AR/COC records will be secured and included with each shipment of coolers to:

Sample Receiving
Quanterra Environmental Services
5815 Middlebrook Pike
Knoxville, Tennessee 37921
Telephone: (423)-588-6401

or (for QA samples)

USACE Northwest Division Laboratory
CENWO-LB
Attention: Mr. Douglas Taggart
420 South 18th Street
Omaha, Nebraska 68102-2586
Telephone: (402) 444-4300.

IX.7.0 Investigation-Derived Waste Management Plan

Anticipated IDW during field activities includes excess soil samples, decontamination fluid, and disposable personal protective equipment. Detailed procedures of IDW management is provided in Chapter 8.0 of the SAP (IT, 1996a). The following is a brief summary of the procedures for handling IDW.

IX.7.1 Surface Soil

Residual surface soil will be used as backfill or spread out on the surface at the point of origin. Therefore, no IDW will be generated during surface soil sampling.

IX.7.2 Drill Cuttings From Borings

Soil cuttings from soil borings and excess soil samples will be returned immediately after sample collection to the point of origin (backfill). Therefore, no IDW will be generated during soil boring for subsurface soil sampling.

IX.7.3 Excess Soils and Laboratory Wastes from Field Screening

Excess soils generated during on-site field screening analyses will be placed in 55-gallon drums for later disposal. Other laboratory wastes will be placed in separate drums for later off-site disposal.

IX.7.4 Decontamination Fluid

Limited quantity of decontamination fluid, including wash water, nonphosphate soapy water, and final rinse water, will be kept in plastic tubs during the decontamination process, and will be placed in 55-gallon drums upon completion of field sampling. Decontamination fluid containing small quantities of solvents such as methanol or hexane will be collected in metal pans for evaporation. IDW drums will be labeled to indicate project name, date collected, and contents and stored on pallets in the staging area located east of the Building 9201 on Pentolite Road.

IX.8.0 Project Schedule

The project schedule is presented in Figure IX-5.

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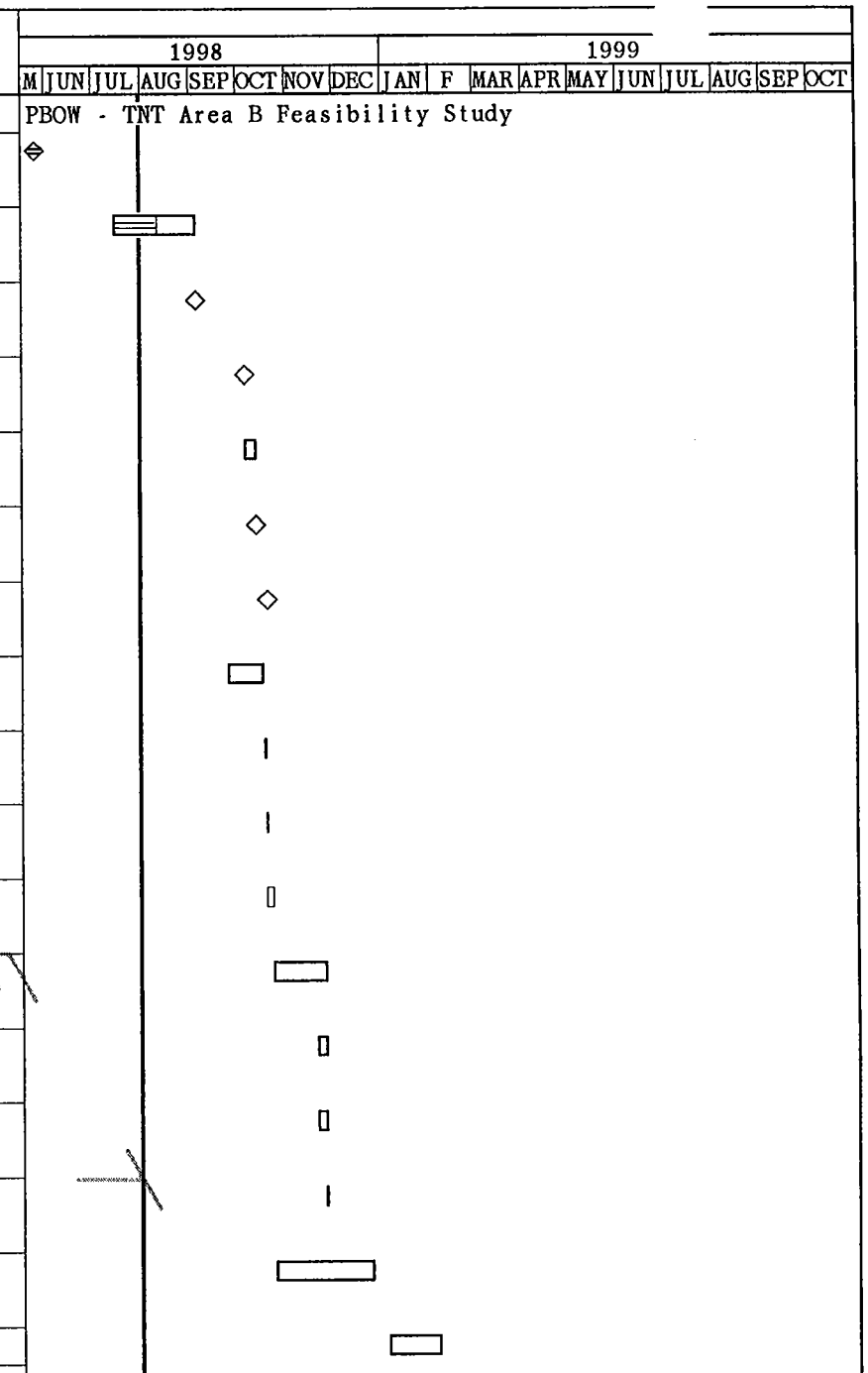
ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
Notice to Proceed	26MAY98A	
Prepare & Submit SSAP & SSHP	15JUL98A	4SEP98
Submit SSAP & SSHP		4SEP98
Receive Comments		5OCT98
Revise SSAP/SSHP	6OCT98	12OCT98
Submit Revised SSAP/SSHP		12OCT98
Receive Approval of Final SSAP/SSHP		19OCT98
Field Preparation/Subcontracting	25SEP98	16OCT98
Mobilization to PBOW	18OCT98	18OCT98
Kickoff Meeting	19OCT98	19OCT98
Site Clearing/Surveying	19OCT98	22OCT98
Soil Sampling & Fiel Screening	23OCT98	25NOV98
Sediment & Surface Water Sampling	20NOV98	25NOV98
Final Surveying	20NOV98	25NOV98
Demob	25NOV98	25NOV98
Lab Analysis	24OCT98	24DEC98
Data Validation	4JAN99	5FEB99



Plot Date 3SEP98
Data Date 31JUL98
Project Start 26MAY98
Project Finish 15OCT99

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

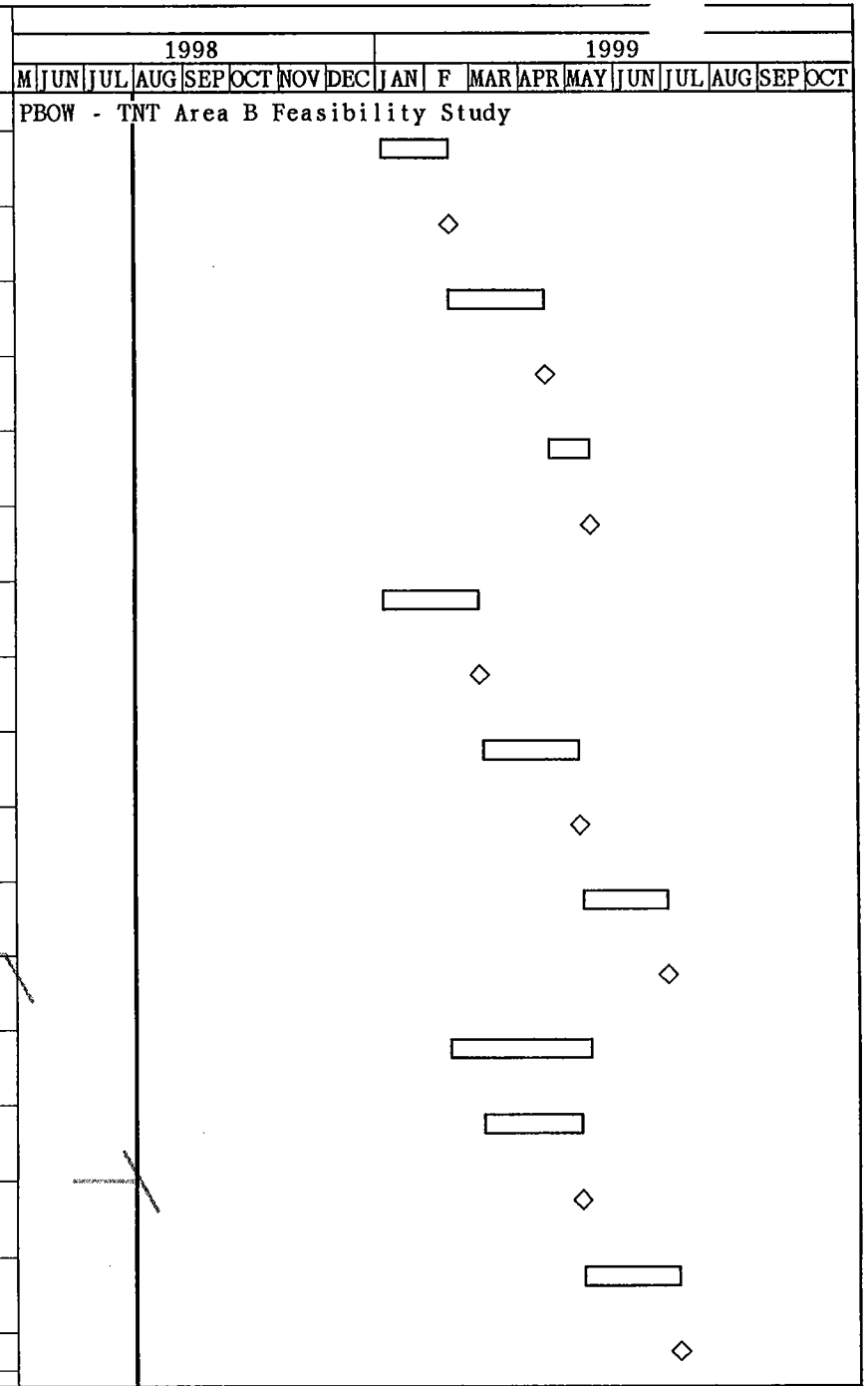
NCOB PBPS

USACE - NASHVILLE DISTRICT
PBOW SCHEDULE
TNT AREA B INVESTIGATION

SCHEDULE REVISIONS

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
Volume I Report	4JAN99	15FEB99
Submit Draft Volume I Report		15FEB99
Review Draft Volume I Report	15FEB99	16APR99
Receive Comments Draft Volume I Report		16APR99
Revise Draft Volume I Report	19APR99	14MAY99
Submit Final Volume I Report		14MAY99
Volumes II & III Draft Reports	4JAN99	5MAR99
Submit Draft Volumes II & III Reports		5MAR99
Review Draft Volumes II & III Reports	8MAR99	7MAY99
Receive Comments Draft Volumes II & III Reports		7MAY99
Revise Draft Volumes II & III Reports	10MAY99	2JUL99
Submit Final Volumes II & III Reports		2JUL99
Prepare Final Database Deliverable	15FEB99	14MAY99
Draft Volume IV Report	8MAR99	8MAY99
Submit Draft Volume IV Report		8MAY99
Review Draft Volume IV Report	10MAY99	9JUL99
Receive Comments on Draft Volume IV Report		9JUL99



Plot Date 3SEP98
Data Date 31JUL98
Project Start 26MAY98
Project Finish 15OCT99

(c) Primavera Systems, Inc.

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

NCOB PBFS

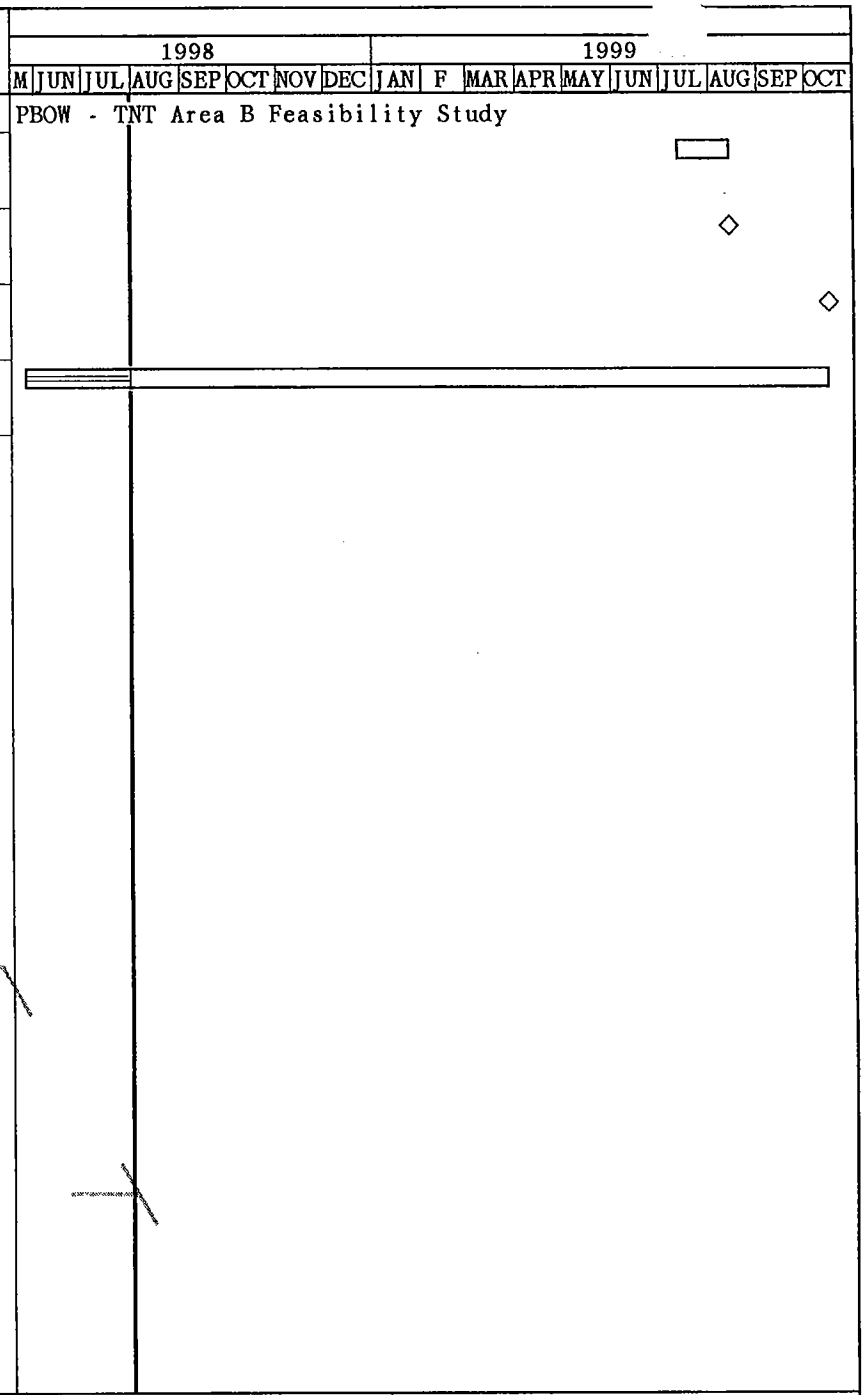
Sheet 2 of 3

USACE - NASHVILLE DISTRICT
PBOW SCHEDULE
TNT AREA B INVESTIGATION

SCHEDULE REVISIONS

Date	Revision	Checked	Approved

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
Revise Draft Volume IV Report	12JUL99	13AUG99
Submit Final Volume IV Report		13AUG99
Final Volumes I, II, III, & IV Approval		15OCT99
Project Management and Quality Control Plan	26MAY98A	15OCT99



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Plot Date 3SEP98
Data Date 31JUL98
Project Start 26MAY98
Project Finish 15OCT99

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Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

NCOE PBFS

Sheet 3 of 3

USACE - NASHVILLE DISTRICT
PBOW SCHEDULE
TNT AREA B INVESTIGATION

SCHEDULE REVISIONS

Date	Revision	Checked	Approved

IX.9.0 References

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