Attachment I

Site-Specific Sampling and Analysis Plan
Phase 1 Remedial Investigation
Waste Water Treatment Plants 1 and 3
and Ash Pits 1 and 3
Former Plum Brook Ordnance Works, Sandusky, Ohio

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(This Site-Specific Sampling and Analysis Plan must be used in conjunction with the Site-Wide Sampling and Analysis Plan [Shaw, 2008a])

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List of Acronyms

AOC	area of concern
AP	ash pit
AP1	Ash Pit No. 1
AP3	Ash Pit No. 3
ASTM	American Society for Testing and Materials
bgs	below ground surface
BHHRA	baseline human health risk assessment
°C	degrees Celsius
CLP	Contract Laboratory Program
COC	chemical of concern
D&M	Dames and Moore, Inc.
DERP	Defense Environmental Restoration Program
DNT	dinitrotoluene
DO	dissolved oxygen
DOD	U.S. Department of Defense
DQO	data quality objective
Eh	oxygen reduction potential
EPA	U.S. Environmental Protection Agency
FFS	focused feasibility study
FADL	field activity daily log
FUDS	Formerly Used Defense Site
HTRW	hazardous, toxic, and radioactive waste
HQ	hazard quotient
ICI	International Consultants Incorporated
ID	identification
IDW	investigation-derived waste
ILCR	incremental lifetime cancer risk
IT	IT Corporation
MCL	maximum contaminant level
µg/L	micrograms per liter
ml/min	milliliters per minute
NASA	National Aeronautics and Space Administration
OD	outside diameter
OEPA	Ohio Environmental Protection Agency

List of Acronyms *(Continued)*

PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyl
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RBSC	risk-based screening concentration
RI	remedial investigation
Shaw	Shaw Environmental, Inc.
SI	site investigation
SSAP	site-specific sampling and analysis plan
SWSAP	site-wide sampling and analysis plan
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TNT	trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B
TNTC	TNT Area C
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	volatile organic compound
WARWP	West Area Red Water Pond
WWTP	waste water treatment plant
WWTP1	Waste Water Treatment Plant No. 1
WWTP2	Waste Water Treatment Plant No. 2
WWTP3	Waste Water Treatment Plant No. 3

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. The former Plum Brook Ordnance Works (PBOW) is located in Sandusky, Erie County, Ohio (Figure 1-1). The PBOW is being investigated under the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS). The investigation is being managed and technically overseen by the Nashville and Huntington Districts 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 is operated as the Plum Brook Station of the John Glenn Research Center at Lewis Field.

Shaw Environmental, Inc. (Shaw), has prepared this site-specific sampling and analysis plan (SSAP) (Shaw) for Phase 1 fieldwork to be carried out in support of continued soil and groundwater remedial investigations (RI) at two former waste water treatment plant (WWTP) areas, Waste Water Treatment Plant No. 1 (WWTP1) and Waste Water Treatment Plant No. 3 (WWTP3) and at two ash pit (AP) areas, Ash Pit No. 1 (AP1) and AP No. 3 (AP3). Phase 1 sampling activities and associated field work will begin prior to the start of Phase 2, which will be described in a subsequent Phase 2 sampling and analysis plan. This Phase 1 SSAP must be used in conjunction with the site-wide sampling and analysis plan (SWSAP) (Shaw, 2008a), to which this SSAP has been prepared as an attachment, and the quality assurance project plan (QAPP) (Shaw, 2008b) to ensure that work performed at the subject site will be of the quality required to satisfy the overall and site-specific project objectives. A site-wide accident prevention/site-wide safety and health plan (Shaw, 2008c) has also been prepared for this investigation to help provide a safe work environment.

1.1 PBOW Site History

The PBOW site was built in early 1941 and 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 by the Army during the last quarter of 1945. The property was under the supervision of the Army Ordnance Department. The War Assets Administration accepted custody of the property (3,230 acres) except for the retained area, which is known as the magazine area (2,800 acres), in 1946. The Department of the Army reacquired the 3,230 acres in 1954 and performed cleanup efforts during the 1950s

through 1963. Two property use agreements were entered into by the National Advisory Committee of Aeronautics, the predecessor of NASA, and the Army in 1956 and 1958, respectively. In 1963, accountability and custody of the entire PBOW property (6,030 acres) was transferred to NASA by the Department of the Army. NASA has operated and maintained PBOW since 1963, and it is currently the NASA Glenn Research Center, Plum Brook Station.

1.2 Summary of Existing Site Data

The only previous investigations at the WWTP1, WWTP3, AP 1, and AP3 areas were conducted by the Louisville District in June 1999. The results were reported in the *Final Report, Limited Site Investigation for the former Plum Brook Ordnance Works Waste Water Treatment Plants No. 1 and 3* (USACE, 2000a) and *Final Report, Limited Site Investigation for the former Plum Brook Ordnance Works Ash Pits No. 1 and 3* (USACE, 2000b).

The discussion of existing site soil and groundwater data will focus on the primary areas to be investigated under this RI. Although groundwater data are not subjected to risk assessment screening in this SSAP, risk-based screening concentrations (RBSC) are included as points of reference. The groundwater RBSCs are derived from U.S. Environmental Protection Agency (EPA) (2004) Region 9 preliminary remediation goal (PRG) tap water criteria. The RBSCs are based on a generalized residential drinking water scenario, assumed to be the most restrictive use of groundwater. It is emphasized that RBSCs do not infer a regulatory limit or mandated cleanup level.

1.2.1 Waste Water Treatment Plant Areas

Three waste water treatment plants (WWTP1, Waste Water Treatment Plant No. 2 (WWTP2), and WWTP3) at PBOW received waste water from TNT manufacturing operations. Figure 1-2 shows the areas of concern (AOC). WWTP1 is located nearest to TNT Area A (TNTA) and received waste water from the settling basins located at TNTA and from TNT Area B (TNTB). WWTP2 received waste water from TNTC and is located northeast of the West Area Red Water Pond (WARWP), east of Acid Area No. 2, and north of TNT Area C (TNTC). WWTP3 is located between WWTP1 and WWTP2 and northwest of TNTB (Figure 1-2). The purpose of the plants was to reduce the volume of waste water discharged from each of the manufacturing areas to the WARWP and Pentolite Road Red Water Pond waste water ponds. The waste water that was received from TNT manufacturing areas consisted of spent sulfuric and nitric acids and red water from the TNT purification process. Chemicals in the waste streams included sodium salts of sulfite, sulfate, nitrite, nitrate, sulfonates of unwanted TNT isomers, trinitrobenzoic acid, trinitrobenzaldehyde, trinitrobenzyl alcohol, nitrotoulenes, and dinitrotoluenes (Dames and Moore, Inc. [D&M], 1996).

Each of the WWTPs consisted of a neutral storage tank, an equalization tank, a condensate storage tank, an evaporator building, an incinerator, and a thick liquid storage tank. WWTP1 also included a caustic storage tank and a raw waste storage tank. The plants received waste water from the TNT manufacturing settling basins and neutralized the slurry through a chemical depuration process. The liquid was discharged to open ditches or ponds surrounding the facilities or thickened by evaporation. The thickened liquid was then incinerated. The incinerators were located to the east of the storage tanks at WWTP1 and to the north of the storage tanks at WWTP3. Ash from the incinerator was disposed of in nearby ash pits associated with the WWTPs (USACE, 2000a). Figure 1-3 shows a historic layout of WWTP1 and WWTP3, which are further discussed in the following subsections.

1.2.1.1 WWTP1

The former WWTP1 is located in the northern midsection of PBOW, approximately 200 feet northeast of the intersection of Maintenance Road and Taylor Road (Figure 1-2). It occupies approximately 2 acres of land. A former building located approximately 200 feet northeast of WWTP1 is still present and is currently used by NASA.

Limited investigation has been conducted at WWTP1. Historical drawings were reviewed by D&M (1995), and it was determined that the raw waste storage tank located at the former WWTP1 received waste from the settling basins located at manufacturing areas TNTA and TNTB.

During a field reconnaissance by Morrison-Knudsen Ferguson Corporation in March 1999, bare areas and the remains of concrete foundations were reported to have been observed where the former buildings and/or storage tanks were once present. One soil sample was collected at WWTP1, but analytical results did not show any significant contamination (USACE, 2000a).

The most recent investigation was conducted by USACE in September 1999 and presented in a limited site investigation (SI) (USACE, 2000a). Nine surface soil samples were collected with a hand auger from a depth interval of 6 to 12 inches. Each soil sample location was advanced adjacent to or within the footprint of each identified foundation. Sediment samples were also collected from an unnamed drainage ditch located approximately 300 feet northwest of the site. No water was present in the drainage ditch, so surface water samples could not be collected. The analyte list included volatile organic compounds (VOC), semivolatile organic compounds (SVOC), nitroaromatics, metals, polychlorinated biphenyls (PCB), and asbestos. Not all samples were analyzed for all compounds.

No VOCs were detected in soil or sediment samples that exceeded the PRGs for residential soil. No SVOCs were detected above PRG screening levels in soil and sediment samples. Two soil samples exhibited nitroaromatic 2,4,6-TNT above the then-current PRG screening level of 15 parts per million (ppm); one sample collected near the raw waste storage tank was at a concentration of 130 ppm and the other, a duplicate sample collected near the thick liquid storage tank, was at a concentration of 170,000 ppm (a possible field collection or laboratory error is suspected due to the significant difference between sample results and also a laboratory reanalysis test). Nitroaromatics were not detected in sediment samples. Arsenic was the only metal detected above the PRG in soil and sediment samples and concentrations ranged from 3.0 to 11.0 ppm, but results were consistent with background levels. No surface soil samples exhibited PCB concentrations above PRG limits, and no asbestos fibers were detected in any of the soil samples selected to be analyzed. Sediment samples were not analyzed for PCBs or asbestos (USACE, 2000a).

1.2.1.2 WWTP3

Former WWTP3 is located in the western midsection of PBOW, approximately 650 feet southwest of the intersection of Maintenance Road and Ransom Road and 450 feet southeast of the patrol road. It occupies approximately 2 acres of land (Figure 1-2). The neutralized waste water storage tank of former WWTP3 had been used by NASA as the K-Site Test Facility control building (USACE, 2000a). Operations at the K-Site were officially abandoned in 2007; however, it is possible that the facility may be used for test programs in the future. D&M conducted a review of records in 1995 and found that a bermed, square depression north of WWTP3 and south of Maintenance Road may have been used as an ash settling basin.

In September 1999, 16 surface soil samples were collected with a hand auger from a depth interval of 6 to 12 inches as part of the limited SI. Fourteen soil sample locations were determined by tape measured distances from the existing former neutralized storage tank, and two surface soil samples were collected within a depression north of the site. The 14 soil sample hand auger borings were advanced adjacent to or within the footprint of each identified foundation or structure. Sediment samples were also collected from an unnamed drainage ditch located approximately 300 feet west of the site. No water was present in the drainage ditch, so surface water samples were not collected. The analyte list included VOCs, SVOCs, nitroaromatics, metals, PCBs, and asbestos. Not all samples were analyzed for all compounds.

Two surface soil samples collected from the depression north of WWTP3 indicated only traces of the VOC methylene chloride, a common laboratory contaminant. Nitroaromatics were not

detected in either sample, and arsenic was detected above the PRG in both samples at concentrations of 5.80 and 6.10 milligrams per kilogram (mg/kg). One soil sample collected near the former incinerator building exhibited the SVOC compounds benzo(a)anthracene (1,200 parts per billion [ppb]), benzo(a)pyrene (1,300 ppb), benzo(b)fluoranthrene (1,200 ppb), and ideno(1,2,3-cd)pyrene (870 ppb) above the PRG screening levels. No SVOCs were detected above PRG screening levels in sediment samples. No soil or sediment samples analyzed for nitroaromatics were above screening levels. Arsenic was the only metal detected above the PRG in soil and sediment samples, and concentrations ranged from 3.6 to 6.7 ppm; results were consistent with background levels. No surface soil samples exhibited PCB concentrations above PRG limits, and no asbestos fibers were detected in any of the soil samples selected to be analyzed. Sediment samples were not analyzed for PCBs or asbestos (USACE, 2000a).

1.2.2 Ash Pit Areas

As noted above, PBOW was built in early 1941 and manufactured 2,4,6-TNT, DNT, and pentolite until 1945. Three power stations, Power House 1, Power House 2, and Power House 3, were constructed and utilized to support the TNT manufacturing process. Each power station consisted of a main powerhouse, a coal storage area, and an aboveground fuel storage tank. The fuel storage tank was surrounded by a berm to contain any potential spills or leaks. Each power house building consisted of a boiler house, compressor room, electrical room, filter room, and locker room. The buildings also contained two to four large coal-burning boilers, a turboelectric generator, a feed water treatment system, and several steam-driven or electric air compressors. The generated steam was used for space heating, driving compressors, and generating electrical power. Coal ash generated from each of the boilers in the powerhouse was collected in pits. Water was added to the ash, producing a slurry that flowed through a sluice trench to an ash sump located at the end of each power house. From the ash sump, the ash slurry traveled through a pipeline to a nearby surface water/ash impoundment (ash pit) (USACE, 2000b). Figure 1-2 shows the location of the three ash pit areas on PBOW property. Figure 1-3 shows a historic layout of the AP1 and AP3, which are discussed in Sections 1.2.2.1 and 1.2.2.2, respectively.

Based on topographical quadrangles (dated 1959 and 1969), aerial photographs, and a site survey conducted in 2008, AP3 is noted to have essentially remained unchanged. AP1 is currently overgrown with thick vegetation and, due to the basically level terrain, is thought to have been backfilled and graded. When NASA acquired PBOW property in the 1960s, the power plant facility at Power House 3 was remodeled to become the K-Site Test Facility. At the time of the 1999 USACE limited RI report, the K-Site Test Facility was in operation and supplied non-contact cooling water to the former ash pit, to the extent that it held water. The exact depth of

the water in the pit is unknown, but would not have been greater than a few feet. A pipe at the northeastern corner of the pit had supplied the cooling water. It is possible that this is the original pipe that once supplied the ash slurry to the pit. Boundaries of the pit appear to be the same as the original boundaries, with the exception of an indention to the west on the eastern boundary (USACE, 2000b). As discussed in Section 1.2.2.2, Ash Pit 3 is typically no longer ponded.

1.2.2.1 AP1

Former AP1 is located in the central part of PBOW, approximately 1,095 feet west of the intersection of Maintenance Road and Taylor Road and approximately 50 feet south of Maintenance Road (Figure 1-2).

In June 1999, the USACE conducted a limited SI of AP1 (USACE, 2000b). AP1 was noted to be overgrown with thick vegetation and a thicket of small trees ranging from 3 to 8 feet tall. Personnel were informed by NASA that an underground, high-voltage utility line bisected AP1 in a north-south direction and an underground telephone line was present approximately 5 feet south and parallel to Maintenance Road. The USACE also noted a culvert under Maintenance Road and an associated drainage ditch approximately 5 feet due north of AP1. A larger drainage ditch located northwest of AP1 contained water and was flowing in a northeast direction. During an October 2008 site visit, USACE and Shaw personnel observed water in this ditch, but it did not appear to be flowing.

The USACE collected five (0-1 foot) surface soil samples, one subsurface (4 feet) soil sample, and one collocated surface water-sediment sample. Each sample was analyzed for SVOCs and metals. Two subsurface soil samples were also analyzed for total organic carbon (TOC) and geotechnical parameters. SVOCs were not detected in any of the samples. Fourteen metals were detected in soil samples, 12 were detected in the sediment sample, and 2 were detected in the surface water sample. Several metals exceeded the PRG screening level, so further investigation was recommended (USACE, 2000b).

1.2.2.2 AP3

AP3 is located approximately 800 feet southwest of the intersection of Maintenance and Ransom Road and is west of the former NASA K-Site Test Facility research building (former Power House 3) (Figure 1-2). Operations at the K-Site were officially abandoned in 2007; however, it is possible that the facility may be used for test programs in the future. Abandoned railroad tracks running in a north-south direction are immediately east of AP3. The pit is partially surrounded by thick vegetation, with mature and smaller trees. The original surface water

impoundment had been intact as of 1999 (USACE, 2000b), holding water supplied by NASA's K-Site Test Facility. Water had been discharged from the former pond by means of an east-west-trending drainage ditch that eventually discharges into Pipe Creek (USACE, 2000b).

During a June 1999 limited SI, USACE collected three surface water and two sediment samples. Two of the surface water and sediment samples were collocated. One pair was collected near the ash pit slurry entry location, one pair near the pit discharge, and the single surface water sample was located approximately 100 feet downgradient from the ash pit discharge. Each sample was analyzed for SVOCs and metals. SVOCs were not detected in any of the samples. One metal, arsenic, was detected above the screening levels in each of the surface water samples. A total of 12 metals were detected in the sediment samples, 2 exceeding PRG screening limits. Several metals exceeded the PRG screening level, so further investigation was recommended (USACE, 2000b).

Since the K-Site ceased operations, apparently the major source of water to Ash Pit 3 has been eliminated. A review of aerial photographs indicates a lack of open water at AP3 in recent history. NASA (2008) personnel communicated that no water was present in AP3 on July 22, 2008. This was also the case during a September 2008 site visit by USACE and Shaw personnel, although a small ponded area was observed after a rain event during an October 2008 site visit.

1.3 Site-Wide Hydrogeology

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 more than 40 feet in some locations in the north. Based on data from monitoring wells installed closest to the AOC, the overburden thickness near WWTP1 is expected to be around 17 feet, with the water-bearing interval expected to be at 8 feet. At AP1, the overburden thickness is expected to be around 27 feet and the shallow water table at 9 feet. The overburden thickness at WWTP3 and AP3 is expected to be at a shallow depth of 15 feet and the overburden water at 5.5 feet below the ground surface. Overall, the water-producing capacity of the overburden materials is strongly controlled by seasonal changes and varies spatially across the PBOW facility (IT Corporation [IT], 1999). The location of all four investigation areas is initially underlain by the Plum Brook Shale followed by the Delaware Limestone. The shale bedrock is expected to be encountered at depths ranging from 15 feet at WWTP3/AP3, 17 feet at WWTP1, and possibly 27 feet at AP1. Both the Plum Brook Shale and Devonian Limestone 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 the 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.

2.0 Scope of Work and Objectives

2.1 Scope of Work

As specified in the scope of work (USACE, 2008), Phase 1 RI activities for Part 1 of the WWTP 1 and 3 and AP 1 and 3 covered by this SSAP consist of the following tasks:

- Soil RI, including direct-push soil sampling and lithologic logging
- Installation of temporary piezometers
- Groundwater sampling of piezometers
- Laboratory analysis of soil and groundwater samples
- Management and disposal of investigation-derived waste (IDW)
- Preparation and submittal of a geographic information system deliverable.

The above activities, analytical data, findings, and evaluation will be presented in an interim data summary technical memorandum.

2.2 Objectives

The primary objective of Phase 1 of the WWTP 1 and 3 and AP 1 and 3 RI is to determine the soil and overburden groundwater quality and the extent of potential chemicals of concern (COC) in soil and groundwater at the AOCs. Further investigation of overburden groundwater, limestone groundwater, surface water, and sediment will be addressed by the Phase 2 RI activities, which will be described in a subsequent sampling and analysis plan. Specific objectives of the continued RI are summarized as follows:

- Evaluate and use existing data appropriate to the AOCs
- Define site physical features and characteristics
- Determine nature and extent of DOD-related contamination in soil and groundwater at the AOCs
- Determine chemical characteristics of contamination
- Evaluate fate and transport of contamination

- Determine if overburden groundwater underlying the AOCs is in sufficient volume and quality to be defined as a potential drinking water source in the state of Ohio

- Obtain site data of quality, quantity, and distribution appropriate for site characterization, risk assessment, and feasibility study.

2.3 Site-Specific Data Quality Objectives

2.3.1 Overview

The data quality objectives (DQO) process followed during the planning stages of the RI evaluated data requirements is needed to support the decision-making process and select the best action to satisfy these requirements. Incorporated components of the DQO process, described in EPA Publication 9355.9-01, *Data Quality Objectives Process for Superfund* (EPA, 1993), are discussed in detail in Section 3.3 of the SWSAP. Determining factors for procedures necessary to satisfy investigative objectives and to establish the basis of future actions at PBOW are presented on Figure 3-1 of the SWSAP (Shaw, 2008a).

2.3.2 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 implemented. The SSAP records the rationale for the design, including the location, number, and type of samples 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.

2.3.3 Conceptual Site Model

Four factors considered in defining the conceptual model (USACE, 2008) for the RI are:

- Potential contaminant sources
- Migration pathways
- Potential receptors
- Types of contaminant of an affected medium.

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 disposal activities. The migration pathways for potential contaminants include overburden/shale groundwater and/or bedrock groundwater, soil, sediment, and surface

water runoff to creeks. Potential ecological receptors at these WWTP and AP sites are wildlife communities, plant communities, and aquatic communities associated with creeks.

Exposure of site workers to potential contaminants under current land use at PBOW is unlikely, because these four sites are remote from regular site worker activity. Although NASA does open areas of the facility during hunting season to control the deer population, WWTP1&3 and AP1&3 areas are not permitted hunting grounds. The assumption for future land use is unrestricted. Future off-site residents are assumed to be exposed to current groundwater concentrations via migration of contaminants in groundwater. Potential ecological receptors at WWTP1&3 and AP1&3 are wildlife communities, plant communities, and aquatic communities associated with creeks. Note that groundwater in the vicinity of the sites is not used as a potable source. Chemicals of potential concern, based on past use of PBOW, should primarily be nitroaromatic explosives, but may also include VOCs, SVOCs, metals, and PCBs.

2.3.4 Decision-Making Process, Data Uses, and Needs

The decision-making process, presented in detail in Section 3.3.4 of the SWSAP (Shaw, 2008), consists of a seven-step process that will be followed during the RI. Data uses and needs are summarized in Table 2-1.

2.3.5 Risk-Based Evaluation

Confirmation of contamination during the RI will be based upon a comparison of detected contaminants in samples from this investigation to the most current RBSCs. Groundwater RBSCs are derived from EPA (2004) PRG tap water criteria, and soil RBSCs are derived from residential soil PRGs. Depending on further PBOW team discussion and potential future agreements, the Regional Screening Levels (Oak Ridge National Laboratory-EPA, 2008) may be used to derive RBSCs in the future rather than PRGs. Definitive data will be used to determine whether the established guidance criteria are exceeded in the media. These definitive data will be adequate for confirming the presence of the contamination and for supporting a risk assessment and, if necessary, an FS.

2.3.6 Data Quality, Types, and Quantities

Groundwater and soil samples will be collected and analyzed to meet the objectives of the RI. Quality assurance (QA)/quality control (QC) samples will be collected for all sample types described in Chapter 3.0 of this SSAP (Table 2-2). 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 RI, data analyzed at this level of quality are appropriate for all phases of the characterization and risk assessments.

2.3.7 *Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity*

Laboratory requirements of precision, accuracy, completeness, comparability, and sensitivity (PARCCS) for all samples generated during the RI are provided in Chapter 3.0 of the QAPP (Shaw, 2008c). Tables 7-1 through 7-5 of the QAPP list the laboratory reporting limits (sensitivity). Table 9-1 of the QAPP addresses the laboratory requirements and laboratory QC parameters that effect PARCCS.

3.0 Field Activities

The RI approach will be consistent with previous work (2003) conducted by Shaw at the PBOW facility and follow guidelines listed in the SWSAP (Shaw, 2008a). Field activities associated with the Phase 1 of the RI include direct-push soil sampling, temporary piezometer installation, groundwater sampling, land surveying, and IDW management. The purpose of soil sampling at the WWTPs and ash pits is to determine the nature and extent of contamination at each of these AOCs and complete other objectives, as defined in Section 2.2. The purpose of groundwater sampling is to aid in determining the appropriate locations of monitoring wells to be installed during the Phase 2 RI activities.

3.1 Soil and Groundwater Sampling Locations

Locations of soil borings and temporary piezometers have been selected using data and knowledge from the limited SI (USACE, 2000a,b). The geologist/geotechnical engineer will visually classify and log all borehole material according to the Unified Soil Classification System (USCS) and USACE engineer manual EM-1110-1-4000 (USACE, 1998).

The sampling strategy for the WWTP areas and AP areas are described in Sections 3.1.1 and 3.1.2, respectively. Details of soil sample collection methodology are described in Section 4.5 of the SWSAP (Shaw, 2008a). Although unexpected, if raw explosive material is encountered during soil (or groundwater) sampling, all activities will stop, and the USACE will be contacted to discuss procedures for disposal of the raw explosive material.

3.1.1 WWTP 1 and 3

Representative soil samples will be collected from the original land surface (soil below fill material, if encountered), 3 to 5 feet below the original ground surface (bgs), and at 8 to 10 feet below ground surface (bgs) intervals at WWTP 1 and 3 using direct-push sampling techniques. Details of soil collection methodology are described in Section 4.5 of the SWSAP (Shaw, 2008a). If fill material is encountered in any of the borings at a WWTP, the 8- to 10-foot sample will still be collected at the respective depth below the current ground surface. If bedrock is encountered at a depth of less than 10 feet bgs, then the deepest sample will be collected from bedrock to 2 feet above bedrock. If visual evidence suggests that possible soil contamination is encountered in any of the direct-push sampling sleeves, the soil sample will be collected from that interval instead of the previous or next designated sample interval.

Eight soil borings will be drilled at WWTP1 and eight drilled at WWTP3 (Figure 3-1 and 3-2). Soil borings at each WWTP will be placed around the four former tanks associated with each area. Three soil samples will be collected from each boring location from the specified depths of 0-1, 3-5, and 8-10 feet for a total of 48 soil samples (16 borings, 3 soil samples per boring). Each soil sample will be analyzed for SVOCs, nitroaromatics, and metals. In addition, PCBs will be analyzed only in the soil samples collected from 0-1 and 3-5 feet, and one surface soil (0-1 foot) sample from each WWTP area will be analyzed for TOC. Table 3-1 summarizes the analytical parameters and methods for the samples.

Temporary piezometers will be installed in a total of 12 soil borings drilled at the WWTPs (6 at WWTP1 and 6 at WWTP3) (Figures 3-1 and 3-2). Piezometer specifications are described in Section 3.2.1. Each of these borings will be advanced to refusal and a continuous lithologic log recorded. The following presents specifics for each WWTP:

- At each of the four tanks, a boring will be completed to refusal (bedrock). Continuous sampling to bedrock will be recorded.
- Once bedrock is reached, a temporary piezometer will be installed into the borehole.
- At the downgradient area, two piezometers will be installed.
- Downgradient boreholes for temporary piezometers will be drilled to bedrock, with continuous soil sampling.
- If soil boring locations around a tank have shallow bedrock (e.g., less than 5 feet) and/or appear to be dry, then an additional borehole outside of the tank locations will be made for piezometer installation.

3.1.2 Ash Pit 1 and 3

Representative soil samples will be collected from the original land surface (soil below fill material, if encountered), 3 to 5 feet below the original ground surface, and at 8- to 10-foot bgs intervals at AP1 and AP3 using direct-push sampling techniques. If fill material is encountered in any of the borings at an AP, the 8-to 10-foot sample will still be collected at the respective depth below the current ground surface. If bedrock is encountered at a depth of less than 10 feet bgs, then the deepest sample will be collected from bedrock to 2 feet above bedrock. If visual evidence suggests that possible apparent soil contamination is encountered in any of the direct-push sampling sleeves, the soil sample will be collected from that interval instead of the previous or next designated sample interval.

Eight soil borings will be drilled at AP1 and eight drilled at AP3. Figures 3-3 and 3-4 show proposed soil boring locations at AP1 and AP3, respectively. Soil borings at each AP will be spaced throughout former discharge area. Three soil samples will be collected from each boring location from the specified depths of 0-1, 3-5, and 8-10 feet, for a total of 48 soil samples (16 borings, 3 soil samples per boring). Each soil sample will be analyzed for SVOCs, nitroaromatics, and metals. In addition, PCBs will be analyzed only in the soil samples collected from 0-1 and 3-5 feet, and one surface soil (0-1 foot) sample from each AP area will be analyzed for TOC. VOCs will not be analyzed because no source was present during former manufacturing operations. Table 3-1 summarizes the analytical parameters and methods for the samples.

Temporary piezometers will be installed in a total of 12 soil borings drilled at the ash pits (6 at AP1 and 6 at AP3) (Figures 3-3 and 3-4). Each of these boring will be advanced to bedrock and a continuous lithologic log recorded. The following presents specifics for each AP:

- From eight (two at AP1 and six at AP3) selected borings, after the 8- to10-foot soil sample is collected, continuous sampling to bedrock will be recorded.
- Once bedrock is reached, a temporary piezometer will be installed into the borehole.
- If bedrock is encountered at less than 5 feet and/or the borehole appears to be dry, then an additional location will be selected for a piezometer.

3.2 Sampling Methodology and Procedures

The objective of collection of the soil and groundwater samples in the WWTP and AP areas and analyses of the soil for the selected compounds is to determine if nitroaromatic, SVOC, PCB, or metals contamination is present due to former operations. The data will be used to determine if there is any impact to bedrock groundwater or a possible risk to human health and ecological receptors.

The following sampling methods and operational procedures have been developed to ensure that the data acquired through field sampling will meet the DQOs stated in Section 2.3. All soil and groundwater samples collected by Shaw field personnel will be documented through the use of drilling borelogs (USACE Eng. Form 5056-R and 5056A-R). Soil samples that are collected for chemical analysis will be documented by sample collection logs and analysis request/chain-of-custody record forms (Figures 4-9 and 6-2 of the SWSAP [Shaw, 2008a]), following field custody procedures specified in Section 5.1 of the QAPP (Shaw, 2008b). Any changes from the

work plans will be recorded in chronological order in the variance log shown on Figure 9-1 of the SWSAP (Shaw, 2008a).

A Shaw geologist will collect the soil samples, supervise the drilling of each borehole, and will maintain a record of the drilling and soil conditions encountered. The geologist will maintain continuous, detailed subsurface logs from examining drill cuttings, recording samples/cores, and noting first-encountered and static groundwater levels for each borehole. Daily field notes will be kept on a field activity daily log (FADL) and will include sufficient information to reconstruct the progress of drilling operations, problems encountered, temporary piezometer installation procedures, etc. Figure 4-5 of the SWSAP shows a typical piezometer construction form that will be completed for all piezometers. After completion of database entry, all field forms and documents will be archived in the project files at the Shaw office in Knoxville, Tennessee. A copy of borelogs and well construction logs will be included in an appendix of the final interim report.

Upon completion of the boring, the hole will be abandoned, following procedures in Section 3.7.

3.2.1 Direct-Push Soil Sampling and Piezometer Installation

Soil samples for the WWTP and AP investigation will be collected using a direct-push drilling method. The direct-push machine is a hydraulically operated unit that uses a hydraulically powered percussion hammer to drive a decontaminated soil sampling device with retractable tip (point) to a required depth. Soil samples will be handled and packaged as described in Chapter 5.0. All sampling equipment that will come in contact with the samples will be decontaminated prior to use and between each sample collected, in accordance with Section 4.3.

Upon completion of soil sampling in selected borings advanced to bedrock at the above listed AOCs, a temporary piezometer will be installed into the direct-push borehole at locations identified in Sections 3.1.1 and 3.1.2. The temporary piezometer is typically used to measure static water levels and collect groundwater quality samples in commonly slow recharging environments. The piezometer will be made of new 1- or 2-inch outside diameter polyvinyl chloride (PVC) material and placed into the borehole through the direct-push tooling prior to removal or inserted into the borehole after the tooling is removed. The piezometer will be constructed with 5 to 10-feet of PVC screen (0.010 slot) and PVC casing. No filter pack material will be placed around the well screen. Because the sampling will occur reasonably quickly after the piezometers have been installed, semi-permanent seals are not necessary. The top 1 to 2 feet of the borehole will be sealed with bentonite to prevent precipitation water or surface runoff from infiltrating the borehole. If sealing with bentonite proves difficult, a plastic surface seal

may be used around the borehole and covered with additional soil or bentonite sloping away from the piezometer to promote runoff and prevent any surface water from entering the borehole. Once there is an adequate water column in the piezometer to permit sample collection, groundwater sampling will be conducted, as described in Section 3.3.

3.2.1.1 Lithologic Sampling

Surface and subsurface soil samples will be collected during direct-push boring operations. Soil sampling will be continuous until the bottom depth of the desired soil sample or bedrock is encountered. The geologist/geotechnical engineer will visually classify and log all borehole material according to the USCS and EM 1110-1-4000 (USACE, 1998). Soil overburden material will be sampled for the purposes of visual classification of the borehole material and samples will not be saved for geotechnical analysis. Soil cuttings will be drummed and managed for disposal as described in Chapter 6.0.

3.2.1.2 Analytical Sampling

All soil sampling will be conducted by means of a direct-push machine. Soil samples will be analyzed for target list (TCL) SVOCs, target analyte list (TAL) metals, and nitroaromatics. Selected soil samples, samples collected from 0-1 and 3-5 feet intervals, will also be analyzed for PCBs, and a total of two soil samples, 0-1-foot intervals, will be analyzed for TOC. A soil boring log will be completed at each borehole during soil sample collection. All surface soil samples will be visually inspected and logged on the hazardous, toxic, and radioactive waste (HTRW) drilling log (Figure 4-2 of the SWSAP) by the geologist/geotechnical engineer, using the USCS. After a lithologic record of the soil is made, the soil will be placed into the appropriate sample jar. If additional sample volume is required for the analysis, QA/QC requirements, or other purposes, the soil will be placed into a decontaminated stainless-steel bowl or new, gallon-size resealable plastic bag. When a second boring has been completed immediately adjacent to the original location and to the same depth as the first sample, the soil from the same interval will be combined with the previous soil, homogenized, and transferred to appropriate sample jars. Sample containers will be filled beginning with the jar(s) for nitroaromatic analysis, followed by SVOCs, metals, PCBs, and TOC. Upon filling a sample container, the jar will be placed on ice and the proper paperwork completed.

At the completion of the drilling event, a composite soil sample will be collected from the soil boring samples and analyzed for chemical parameters for disposal characterization, as described in Chapter 6.0.

3.3 Groundwater

Shallow groundwater samples will be collected (provided there is sufficient water) using temporary piezometers installed in the borings created during subsurface soil sampling. The temporary piezometer will be allowed to sit a minimum of 24 hours before being sampled to allow for settling of particles disturbed during the installation process and to allow time for the water column to reach its static level. Each location will be staked and the location surveyed for horizontal and vertical data. Where possible, each groundwater sample will be collected using the low-flow sample methodology. A peristaltic pump and Teflon® tubing, a bladder pump, an electric submersible pump, or an inertial pump will be used to discharge the groundwater through the flow-through cell. The field parameter measurements of temperature, pH, dissolved oxygen (DO), redox (Eh), turbidity, and specific conductivity will be collected throughout groundwater discharge. Additional groundwater sampling protocol is described in Section 3.3.2. The groundwater sampling equipment that contacts the water will be dedicated or cleaned between each use to prevent cross-contamination.

3.3.1 Water Level Monitoring

After the piezometers of WWTP1, WWTP3, AP1, or AP3 have been installed for a minimum of 24 hours and prior to any groundwater sampling, groundwater levels from all piezometers within the AOC will be measured and recorded. This will provide a "snapshot" of local groundwater conditions, aid in regional groundwater flow interpretations, and provide information for the upcoming groundwater sampling. In addition, during the groundwater sampling and prior to groundwater collection, the water level will again be measured and recorded. The depth to water will be measured to the nearest 0.01 foot from the highest point on the riser (inner casing) or from a marking on the riser from which the elevation has been surveyed.

3.3.2 Groundwater Sampling

Proposed temporary piezometer locations of each AOC are shown on Figures 3-1 through 3-4. All sampling and purging equipment (pumps, tapes, discharge piping) will be decontaminated prior to use and after each successive use. As noted in Section 3.3, the selected choice for groundwater sample collection is the low-flow sampling methodology. If the water column in a piezometer is not large enough to permit low-flow purging and sampling, less than 24 inches, then USACE will be notified and the following alternative sampling options discussed:

- Groundwater collected for analysis without any purging
- Groundwater purged and sample collected using a disposable Teflon bailer
- Groundwater in piezometer not purged or sampled.

Groundwater samples will be analyzed at a laboratory for TCL semivolatiles, TAL metals (filtered and unfiltered), nitroaromatics, and water quality parameters (Table 3-1). Also, ferrous iron will be analyzed in the field using a test kit.

3.3.3 Groundwater Sampling Schedule

Following installation of all the temporary piezometers at WWTP1, WWTP3, AP1, and AP3, groundwater sampling will begin. For time and production efficiency, all piezometers of a given AOC will be sampled before beginning groundwater sampling at another AOC; if necessary to permit groundwater recharge or if piezometers of AOCs are in nearby proximity, groundwater sampling from multiple piezometers of varying AOCs may be conducted.

Following groundwater level measurement, sample collection, and permission from the USACE, all temporary piezometers will be removed and the borehole filled to ground surface with granular bentonite. Piezometer material (PVC screen and casing) will be cleaned, cut into 5-foot manageable lengths, and discarded into the local sanitary trash.

3.3.4 Groundwater Sampling Equipment

The equipment required for groundwater sampling includes:

- Water level indicator
- Low-flow (peristaltic, submersible, inertial, or bladder) pump with Teflon-lined tubing
- Teflon or stainless-steel bailer of appropriate size for the monitoring well fitted with a bottom-emptying device
- Nylon rope
- Eh, DO, pH, temperature, turbidity, and specific conductance meters
- Appropriate sample bottles and temperature-controlled container
- Plastic sheeting
- Five-gallon buckets with lids
- Photoionization detector/lower explosive limit meter
- Mason jar for calculating purge rate

- Well construction diagrams.

3.3.5 Groundwater Sampling Procedures

Sampling of the temporary piezometers will take place no sooner than 24 hours after piezometer installation. All equipment used to purge or sample the groundwater will be protected from ground surface contact and contamination by use of clean plastic sheeting. Two procedures are available for purging and sampling wells. Low-flow (minimal drawdown) is the preferred purging and sampling method in piezometers where adequate recharge exists. If piezometers do not recharge adequately to use low-flow (minimal drawdown) sampling, an alternative method will be used depending on the static water level in the piezometer relative to the screen. Both of these methods are described in the following procedures:

- The piezometer will be checked for proper identification and structural integrity.

- After unlocking the piezometer and removing the well cap, a photoionization detector/lower explosive limit meter 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 are above background, safety precautions outlined in the site-wide safety and health plan will be followed (Shaw, 2008c).

- The depth to water will be measured using a decontaminated water level indicator, then the volume of water in the casing and screen will be calculated.

- Where recharge rates permit, the well will be purged and sampled using a modified low-flow (minimal drawdown) sampling methodology. An electric submersible pump, a bladder pump, inertial pump, or peristaltic pump (not sampling for any VOC compounds in this field event) will be used to complete the sampling. The pump (or tubing) will be inserted into the midportion of the well screen and the well pumped at a rate that minimizes drawdown. Typically, purging rates are on the order of 200 milliliters per minute (ml/min) to 500 ml/min. It is critical that the purge rate be set such that drawdown in the well is never greater than 0.5 feet. Water chemistry parameters (pH, Eh, conductivity, temperature, DO, and turbidity) will be monitored for stability.

- If the pre-pumping (static) water level is above the top of the well screen and drawdown exceeds 0.5 feet even at the lowest setting of the pump, low-flow sampling cannot be conducted. In this situation, iterative pumping and recovery cycles will be required to remove at least one volume of the standing water in the well casing and saturated annulus. In this instance, the water level must not be allowed to drop below the top of the well screen. It is, however, acceptable to pump out the stagnant water in the well casing at a higher purge rate but pumping must be stopped when the water level in the well reaches the top of the well screen. Once at least one well volume is removed, the well may be sampled. It

should be noted, however, that attempts will be made to remove more than one well volume of water.

- If the pre-pumping (static) water level is below the top of the well screen and drawdown exceeds 0.5 feet even at the lowest setting of the pump, low-flow sampling cannot be conducted. In this situation, iterative pumping and recovery cycles will be required to remove at least one volume of the standing water in the well casing and saturated annulus. However, in some wells, recharge may be so low that adequate purging of the well may not be achieved even over a period of days. In this case, the well may be sampled without purging, after consultation with the USACE.

- During purging, field measurement of pH, Eh, temperature, turbidity, DO, and conductivity will be performed. When using low-flow sampling, once these parameters are stable, the well may be sampled. If stability is not achieved after 4 hours of purging, Shaw will notify the USACE and discuss a plan for sampling the well or piezometer. Stability is defined as follows:

  - pH +/- 0.1 standard units

  - Eh +/- 10 mV

  - Temperature +/- 3% degrees Celsius (^{o}C)

  - Turbidity (three consecutive readings less than 100 nephelometric turbidity units)

  - DO +/-1%

  - Conductivity +/-3% of reading.

- The order in which groundwater samples will be collected will be:
  1) nitroaromatics, 2) SVOCs, 3) dissolved metals, 4) total metals, 5) turbidity, alkalinity, total dissolved solids, total suspended solids, chloride, sulfate, 6) nitrate, 7) cyanide, 8) hardness, and 9) ferrous iron.

- Where possible, groundwater samples will be collected using a submersible pump or peristaltic sampling pump and in-line sampling. Where the use of in-line sampling is not possible, a bottom-emptying Teflon bailer will be used.

- Sample containers will be labeled with appropriate identifying information (location, date, time, condition, added preservatives, etc.). The preprinted labels will be provided by the field sampling crew leader. 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 samples will be collected so as to minimize aeration as water enters the bottle. Pumping rates will not exceed 500 ml/min.

- Samples for metals and/or nitroaromatics 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:

  - The water sample will be filtered at the well site with an in-line filter.

  - A Millipore filtration apparatus (or comparable equipment) equipped with a 0.45-micron filter will be used. An in-line filter will be used for each well.

- All sample containers will be transferred to a cooler chest (kept at 4 degrees °C) and delivered to the laboratory in sufficient time so that specified holding times are not exceeded. Details of the sample preservation, packing, and shipping are provided in Chapter 5.0.

3.4 Land Surveying

Following completion of soil sampling and temporary piezometer installation, Shaw will secure the services of an Ohio-registered professional land surveyor to determine the coordinates and elevations of confirmation soil borings and monitoring well locations. The horizontal coordinates will be to the closest 0.1 foot and referenced to the State Plane Coordinate System. Vertical coordinates (ground elevation and well riser, if applicable) will be to the nearest 0.01 foot and referenced to the 1929 National Geodetic Vertical Datum. If the 1929 datum is not readily available, the existing local vertical datum will be used. All survey data will be tabulated. Loop closure for survey accuracy will be within the horizontal and vertical limits given above. Once sample survey information is available, it will be entered on approved Shaw boring logs. Critical reference points, landmarks, and sample locations will be plotted on appropriate map figures with a scale large enough to show their locations relative to other structures at the site.

3.5 Utility Clearances

Prior to beginning any intrusive investigation (i.e., soil boring, temporary piezometer installation), to fulfill Shaw standard operating procedures and USACE requirements, all sites will be marked for underground utilities by personnel from NASA, Plum Brook Station Health and Safety Division, or other appropriate department. Even after NASA has located underground utilities that may be present in the AOC, all direct-push locations will be hand dug, probed with an air knife, or screened with geophysical instrumentation to a depth of 5 feet before drilling begins.

3.6 Site Access

All Shaw personnel and subcontractors will meet each morning at the NASA/Plum Brook Station, white/red barn area, or other "headquarters" type area for the morning tailgate safety/ job safety analysis meeting, equipment calibration, gathering of needed material, and replenishing of water. At the end of each day, IDW generated during fieldwork will also be moved by the subcontractor back onto the Shaw IDW storage area located in the secured, NASA staging area. Names of Shaw personnel and Shaw subcontractors will be provided by Shaw to Mr. Robert Lallier, NASA Environmental Coordinator, at least 72 hours in advance so that site access can be arranged. All personnel entering the NASA (former PBOW) facility will be appropriately trained and instructed by Plum Brook Station concerning site safety issues. All Shaw personnel and any subcontracted personnel involved must be a U.S. citizen.

3.7 Abandonment

Upon completion of soil borings at the WWTPs and APs, the boreholes will be abandoned by pressure grouting from the bottom to the top of the borehole using a tremie pipe. Neat cement grout, which uses a ratio of one 94-lb bag of Portland cement to no more than 6 gallons of water and 2 to 8 % bentonite powder will be used as the sealant. For boreholes in which a temporary piezometer was installed, after permission from the USACE has been received informing Shaw that no further action will be conducted with the groundwater, the temporary screen and casing will be removed prior to grouting, and the abandonment of the piezometers will be in accordance with Ohio Department of Natural Resources (ODNR) requirements, following OEPA (2005) guidance. Abandonment will be performed as follows:

- Groundwater will be bailed or pumped from the piezometer, contained, and disposed of as IDW.
- Piezometer PVC screen and casing will be removed and cut into approximately 5-foot lengths and decontaminated using the approach described in Section 5.1 of the SWSAP.
- A concrete/grout mixture will be tremied from the bottom of the boring until undiluted grout flows from the borehole/well at the ground surface.
- After 24 hours, the borehole/well will be checked for settlement and additional grout added, if necessary.

4.0 Sample Analysis and Decontamination Procedures

4.1 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 sample media and numbering system are described as follows.

Project Code	Year	Sample Type[a]	Site Identification[b]	Location (Well ID)	Sample Number	Depth[c]
PBOW	08	XX	XXXX	XXXX	XXXX	(XXXX)

[a]Sample type:

SO – soil sample
GW – groundwater sample
MS – matrix spike
MD – matrix spike duplicate
SB – subsurface soil
SS – surface soil sample

[b]Site:

WWTP 1 – Waste Water Treatment Plant 1
WWTP 3 – Waste Water Treatment Plant 3
Ash Pit 1 – Ash Pit 1
Ash Pit 3 – Ash Pit 3

[c]Depth: Only required for soil samples.

The complete sample number will be recorded by the Shaw field geologist in the FADL and/or in the boring log, and in the sample collection log as appropriate. PBOW-00-SB-WWTP1-SO001-AB0001-08-10 signifies that this soil sample was collected from a depth of 8 to 10 feet at soil location SO001 in WWTP1 with a sample number of AB0001 (Shaw, 2008a).

4.2 Analytical Program

The analytical program has been designed to acquire sufficient and defensible data to determine the extent of contamination in the investigated areas. Table 3-1 summarizes the analytical parameters required and associated laboratory methods to be used during this investigation.

A contract laboratory will analyze samples for nitroaromatics, TCL SVOCs, TAL metals, PCBs, and TOC. All applicable analyses will meet the recommended method guidance found in *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods*, SW-846, Third Edition

Update (EPA, 1996) and its subsequent updates. They will meet the QA/QC requirements outlined in the EM-200-1-6 *Chemical Quality Assurance for Hazardous, Toxic and Radioactive Waste (HTRW) Projects* (USACE, 1997). The analytical laboratory must comply with *Quality Systems Manual for Environmental Laboratories* (DOD, 2006). All other requested analyses must conform to their specified method(s).

4.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 5.0 of the SWSAP (Shaw, 2008a) and will be followed during the current RI. The Shaw field coordinator must contact Plum Brook Station 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 (direct-push rods, augers, drill rods, 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.

Equipment that may come in contact with samples for chemical analysis (stainless steel homogenization bowls, mixing spoons, drill bit shoes, drill sleeves, etc.):

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

Decontamination wash water and rinse water will be managed for disposal as described in Section 6.2.

5.0 Sample Preservation, Packing, and Shipping

Sample containers and caps will be new, certified as precleaned, and made of materials recommended by the EPA in Title 40, Code of Federal Regulations, Part 136 and SW-846 (EPA, 1996). Sample containers and preservatives/preservation methods are summarized in Table 5-1. 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.

Samples for chemical analysis will be placed in coolers as soon as possible after collection and will be packed to minimize container breakage by using vermiculite, Styrofoam peanuts, or bubble wrap to fill void spaces in the cooler. Coolers will be taped, marked, and sealed, and custody maintained, as described in Chapter 6.0 of the SWSAP. Samples will be cooled to a temperature of approximately 4°C and maintained at that temperature by means of double-bagged ice until the cooler is received at the laboratory. Coolers will be shipped to the laboratory by a next-day delivery service. The temperature of each cooler will be taken with an infrared thermometer upon receipt. Notification of shipment, including air bill number, will be telephoned or faxed to the laboratory on the day of sample collection. If this is not possible, the laboratory will be notified the following morning.

Completed analytical request/chain-of-custody records will be secured and included with each shipment of coolers to:

Analytical Management Labs, Inc.
ATTN: Melania Harris
15130 South Keeler
Olathe, Kansas 66062
Phone: (913) 829 0101 Ext. 23
Fax: (913) 829 1181
Email: mharris@amllabinc.com

6.0 Investigation-Derived Waste Management Plan

Anticipated IDW during field activities includes soil (drill cuttings), purge/development water, decontamination fluid, and disposable personal protective equipment (PPE). Detailed procedures for IDW management are provided in Chapter 8.0 of the SWSAP (Shaw, 2008a). The following is a brief summary of the procedures for handling IDW.

6.1 Soil and Groundwater

Residual subsurface soil will be placed in 55-gallon drums upon completion of field sampling. IDW drums will be labeled to indicate project name and date collected.

6.2 Decontamination Fluid

Limited quantities 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 isopropanol, methanol, and hexane will be collected in metal pans for evaporation.

6.3 Sampling Equipment and Personal Protective Equipment

Limited quantities of PPE and sampling equipment, including Tyvek suits, latex/nitrile gloves, plastic, and disposable tubing used for groundwater sampling, will be generated during sampling. All sampling equipment and PPE will be double-bagged and disposed of in on-site dumpsters. If any of the sampling equipment and PPE appears to be grossly contaminated, it will be decontaminated prior to disposal.

6.4 Investigation-Derived Waste Sampling

All soil and water IDW will be sampled at the completion of field work. For soils, one composite soil sample will be collected from drummed soil for each AOC. The composite sample will then be submitted to the identified laboratory for a full toxicity characteristic leaching procedure analysis and nitroaromatics. Seven-day turnaround time will be used, unless otherwise directed by the project manager.

When the analytical results are received, Shaw personnel will evaluate the results and make a determination of off-site disposal methods. Possible disposal facilities will be identified by Shaw; however, selection of the facility or facilities to receive the IDW will be the responsibility of the USACE.

7.0 References

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TABLES

Table 2-1

Summary of Data Quality Objectives
Phase I Remedial Investigation
Waste Water Treatment Plants 1 and 3/Ash Pits 1 and 3
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
EPA OEPA DOD USACE NASA Shaw Other Contractors Possible Future Land Users	Previous environmental investigations show varying degrees of contamination in the groundwater and soil.	Contaminant Source Production of TNT, DNT, and pentolite. Past DOD operations. Migration Pathways Soil, sediment, surface water, and groundwater. Potential receptors Wildlife, human. Potential Contaminants of Concern SVOCs, metals, PCBs, and explosives.	Groundwater Surface Water Sediments Soil	Determine if there are hazardous substances present that constitute an unacceptable risk to human health and the environment. Define site physical features and characteristics. Evaluate fate and transport pathways. Determine the nature and extent of source areas. Define current and future routes of exposure. Determine whether contaminant distribution is consistent with DOD activities.	Groundwater Metals Explosives SVOCs Water quality parameters[a] Soil Metals Explosives PCBs SVOCs TOC	Field screen Definitive

DNT - Dinitrotoluene.
DOD - U.S. Department of Defense.
EPA - U.S. Environmental Protection Agency.
OEPA - Ohio Environmental Protection Agency.
USACE - U.S. Army Corps of Engineers.
NASA - National Aeronautics and Space Administration.
SVOC - Semivolatile organic compound.
TNT - Trinitrotoluene.
Shaw - Shaw Environmental, Inc.
TOC - Total organic carbon.
PCB - Polychlorinated biphenyls.

[a] Refer to Table 3-1 for identification of water quality parameters.

Table 2-2

Summary of Soil and Groundwater Analytical Samples
Phase I Remedial Investigation
Waste Water Treatment Plants 1 and 3/Ash Pits 1 and 3
Former Plum Brook Ordnance Works, Sandusky, Ohio

Direct-Push Soil Samples						
Parameters	**Field Samples**	**QA/QC Samples**	**Rinsates**	**Source Water**	**Trip Blanks**	**Matrix Spike/Duplicates**
Nitroaromatics	96	10	4	1	NA	4/4
TCL SVOCs	96	10	4	1	NA	4/4
PCBs	64	10	4	1	NA	4/4
TAL Metals	96	10	4	1	NA	4/4
Total Organic Carbon	4	NA	NA	NA	NA	4/4
Piezometer Groundwater Samples						
Parameters	**Field Samples**	**QA/QC Samples**	**Rinsates**	**Source Water**	**Trip Blanks**	**Matrix Spike/Duplicates**
Nitroaromatics	24	2	4	1	NA	2/2
TCL SVOCs	24	2	4	1	NA	2/2
Metals (Filtered)	24	2	4	1	NA	2/2
Metals (Total)	24	2	4	1	NA	2/2
Water Quality Parameters [a]	24	NA	NA	NA	NA	2/2

[a] Refer to Table 3-1 for identification of water quality parameters.

PCB - Polychlorinated biphenyl.
QA - Quality assurance.
QC - Quality control.
SVOC - Semivolatile organic compound.
TAL - Target analyte list.
TCL - Target compound list.

Table 3-1

Summary of Soil and Groundwater Analytical Parameters and Methods
Phase I Remedial Investigation
Waste Water Treatment Plants 1 and 3/Ash Pits 1 and 3
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Matrix	Analytical Parameters[a]	Analytical Method[b]
Groundwater	TCL Semivolatile Organic Compounds	SW-846 3510C/8270C
	Nitroaromatic Compounds	SW-846 3535/8330
	Total TAL Metals	SW-846 3005A/6010B/7470A
	Dissolved TAL Metals	SW-846 3005A/6010B/7470A
	Turbidity[c]	MCAWW 180.1
	Alkalinity[c]	MCAWW 310.1
	Hardness[c]	MCAWW 130.2
	Total Dissolved Solids[c]	MCAWW 160.1
	Total Suspended Solids[c]	MCAWW 160.2
	Chloride[c]	MCAWW 325.3
	Cyanide, total[c]	SW-846 9010A/9012
	Nitrate[c]	MCAWW 352.1
	Oxidative-reduction potential (ORP)[c]	ASTM D-1498-08
	Ferrous iron[c]	Field test kit[c]
	Sulfate[c]	MCAWW 375.3
Soil	TCL SVOCs	SW-846 3541/8270C
	Nitroaromatic Compounds	SW-846 8330
	PCBs	SW-846 3541/8082
	TAL Metals	SW-846 3050B/6010B/7471A
	TOC	Lloyd-Kahn
Groundwater IDW	TCL VOCs	SW-846 5030B/8260B
	TCL SVOCs	SW-846 3510C/8270C
	Nitroaromatics	SW-846 3535/8330
	TAL Metals	SW-846 3005A/6010B/7470A
	Ignitability	SW-846 1010
	pH	SW-846 9045B
	Corrosivity	SW-846 1110
	Reactive Cyanide	7.3.3/7.3.4
	Reactive Sulfide	7.3.3/7.3.4
Soil IDW	TCLP VOCs	SW-846 1311/5030B/8260B
	TCLP SVOCs	SW-846 1311/3510C/8270C
	TCLP Metals	SW-846 1311/3010A/6010B/7470A
	Ignitability	SW-846 1010
	Corrosivity	SW-846 1110
	Reactivity	7.3.3.2/7.3.4.2

[a]TAL and TCL are used to designate parameter lists with no requirements for Contract Laboratory Program method quality control or data reporting packages

[b]Analyses found in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* USEPA Publication, Third Edition, and *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, March 1983 and subsequent revisions, except as noted.

[c]Water quality parameter.

[d]Field testing will use an appropriate field test kit or method according to EPA 600/4-79-020: Method for Chemical Analysis of Water and Wastes in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, USEPA Publication, Third Edition.

IDW - Investigation-derived waste.
PBC - Polychlorinated biphenyl.
SVOC - Semivolatile organic compound.
TAL - Target analyte list.
TCL - Target compound list.
TCLP - Toxicity characteristic leaching procedure.
VOC - Volatile organic compound.

Table 5-1

Analyses, Containers, Preservatives, and Holding Times
Phase I Remedial Investigation
Waste Water Treatment Plants 1 and 3/Ash Pits 1 and 3
Former Plum Brook Ordnance Works, Sandusky, Ohio

Matrix	Parameter	Analytical Method	Sample Container*	Preservation Requirements	Holding Time
Groundwater	TCL VOCs	SW-846 5030B/8260B	(3) 40 ml VOA vial	Cool to 4°C, HCL to pH <2	14 days
	TCL SVOCs	SW-846 3520C/8270C	(2) 1 L amber glass	Cool to 4°C	7 days extraction/40 days
	Nitroaromatics	SW-846 3535/8330	(2) 1 L amber glass	Cool to 4°C	7 days extraction/40 days
	PCBs	SW-846 3520C/8082	(2) 1 L amber glass	Cool to 4°C	7 days extraction/40 days
	TAL Metals (Total/Dissolved)	SW-846 3005A/6010B/7470A	(2) 500 mL HDPE	Cool to 4°C, HNO_3 to pH <2	6 months (28 days for Hg)
	Turbidity	MCAWW 180.1		Cool to 4°C	48 Hours
	Alkalinity	MCAWW 310.1		Cool to 4°C	14 days
	Total Disolved Solids	MCAWW 160.1	(1) 1 L amber glass	Cool to 4°C	7 days
	Total Suspended Solids	MCAWW 160.2		Cool to 4°C	7 days
	Sulfate	MCAWW 375.3		Cool to 4°C	28 days
	Chloride	MCAWW 325.3		Cool to 4°C	28 days
	Hardness	MCAWW 130.2	(1) 125 mL HDPE	Cool to 4°C, HNO_3 to pH <2	6 months
	Cyanide, Total	SW-846 9010A/9012	(1) 125 mL HDPE	Cool to 4°C, NaOH to pH >12	14 days
	Nitrate	MCAWW 352.1	(1) 125 mL HDPE	Cool to 4°C	48 Hours
Soil	TCL SVOCs	SW-846 3541/8270C	(1) 8 oz CWM glass with Teflon-lined lid	Cool to 4°C	14 days extraction/40 days
	Nitroaromatics	SW-846 8330			14 days extraction/40 days
	PCBs	SW-846 3541/8082			14 days extraction/40 days
	TAL Metals	SW-846 3050B/6010B/7471A			6 months (28 days for Hg)
	TOC	Lloyd-Kahn			28 days
Groundwater IDW	TCL VOCs	SW-846 5030B/8260B	(3) 40 ml VOA vial	Cool to 4°C, HCL to pH <2	14 days
	TCL SVOCs	SW-846 3510C/8270C	(2) 1 L amber glass	Cool to 4°C	7 days extraction/40 days
	Nitroaromatics	SW-846 3535/8330	(1) 1 L amber glass	Cool to 4°C	7 days extraction/40 days
	TAL Metals	SW-846 3005A/6010B/7470A	(1) 250 mL HDPE	Cool to 4°C, HNO_3 to pH <2	6 months (28 days for Hg)
	Ignitability	SW-846 1010	(1) 1 L Amber	Cool to 4°C	ASAP
	pH	SW-846 9045B			
	Corrosivity	SW-846 1110			
	Reactive Cyanide	7.3.3/7.3.4			
	Reactive Sulfide	7.3.3/7.3.4			

Table 5-1

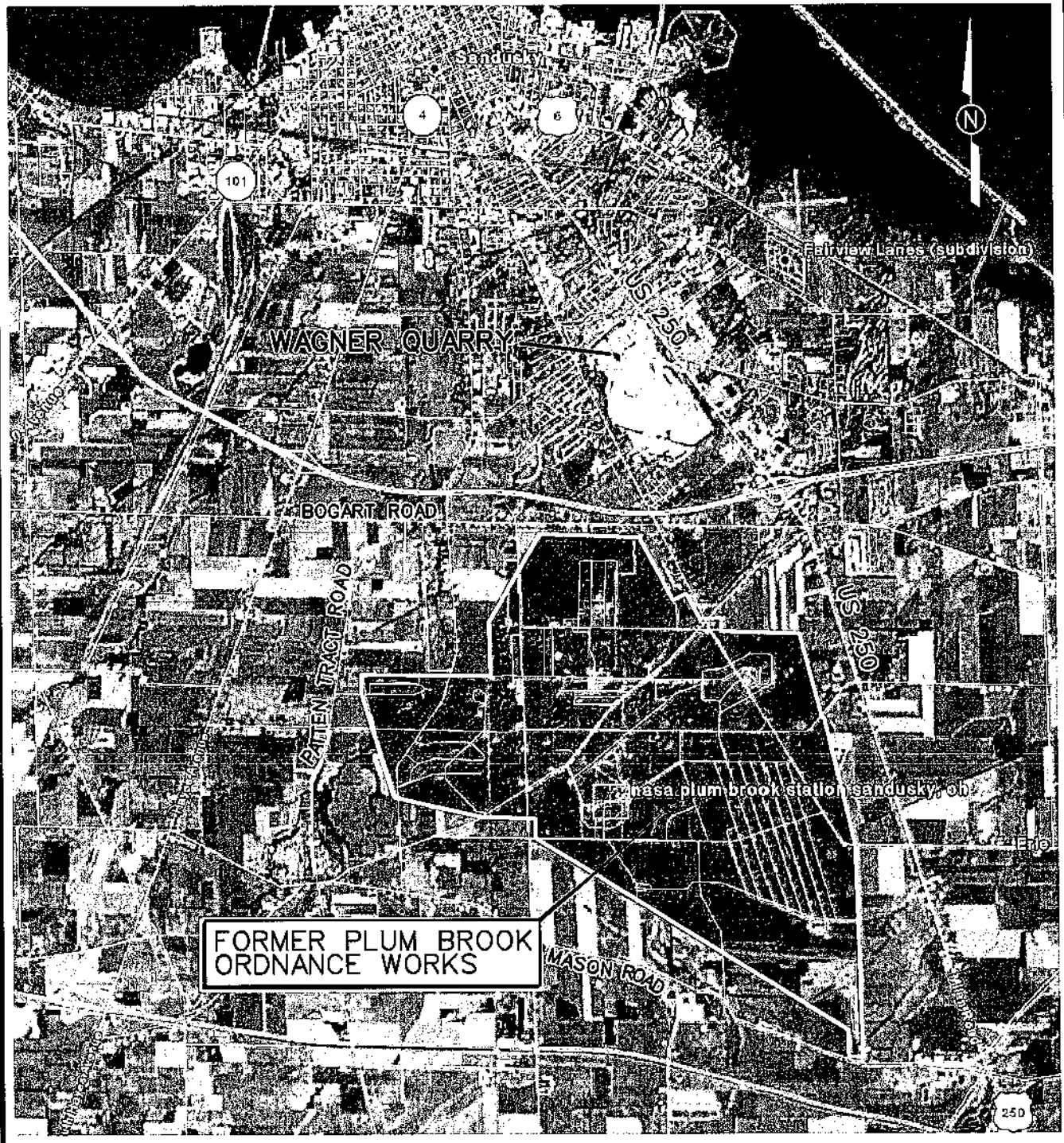
Analyses, Containers, Preservatives, and Holding Times
Phase I Remedial Investigation
Waste Water Treatment Plants 1 and 3/Ash Pits 1 and 3
Former Plum Brook Ordnance Works, Sandusky, Ohio

Matrix	Parameter	Analytical Method	Sample Container*	Preservation Requirements	Holding Time
Soil IDW	TCLP VOCs	SW-846 1311/5030B/8260B	(1) 8 oz CWM glass with Teflon-lined lid	Cool to 4°C	14 days extraction
	TCLP SVOCs	SW-846 1311/3510C/8270C			14 days extraction/40 days
	TCLP Metals	SW-846 1311/3010A/6010B/7470A			14 days /ext./6 months (28 days for Hg)
	Ignitability	SW-846 1010			ASAP
	Corrosivity	SW-846 1110			ASAP
	Reactivity	7.3.3.2/7.3.4.2			ASAP

°C - Degrees Celsius.
CWM - Clear wide mouth.
H_2SO_4 - Sulfuric acid.
HCl - Hydrochloric acid.
HDPE - High-density polyethylene.
Hg - Mercury.
HNO_3 - Nitric acid.
L - Liter.
mL - Milliliter.
NaOH - Sodium hydroxide.
PAH - Polynuclear aromatic hydrocarbon.
SVOC - Semivolatile organic compound.
TAL - Target analyte list.
TCL - Target compound list.
TOC - Total organic compound.
VOC - Volatile organic compound.
IDW - Investigative-derived waste.
EPA - U.S. Environmental Protection Agency.
VOA - Volatile organic analysis.
OZ - Ounces.
Ext. - Extraction
ASAP - As soon as possible.

*Number of containers required in ( ).

FIGURES



NOT TO SCALE

FIGURE 1-1
PBOW VICINITY MAP

PHASE 1 WWTP1 &3 AND AP1 &3 SSAP
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

STARTING DATE: 07/30/08	DATE LAST REV.:	DRAFT. CHCK. BY:	INITIATOR: D. KESSLER
DRAWN BY: C. BENTLEY	DRAWN BY:	ENGR. CHCK. BY:	PROJ. MGR.: S. DOWNEY

132288_ssap_001.dgn
PROJ. NO.: 132288

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cbentley
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RESPONSE TO COMMENTS

Draft Site-Specific Sampling and Analysis Plan
and Site-Specific Safety and Health Plan
Waste Water Treatment Plants 1 and 3 and Ash Pits 1 and 3
Phase 1 Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Review comments from J. Byczkowski, Ohio Environmental Protection Agency, DERR.

Comment 1: **Section 1.2.1.1, page 1-3. This Document states: "*...2,4,6-TNT above the PRG screening level of 15 parts per million...*" Please correct screening level of 2,4,6-TNT to 16 parts per million.**

Response 1: We recognize that 16 mg/kg is the current screening value, based on 2004 EPA Region 9 Preliminary Remediation Goals (PRG). This text summarizes the findings of the 2000 Site Investigation (SI) report, which is assumed to have used screening values appropriate for the date of the investigation. The text will be revised to, "*...2,4,6-TNT above the **then-current** PRG screening level of 15 parts per million...*"

Comment 2: **Section 1.2.1.2, page 1-4. This Document states: *...dibenz(ah)anthracene, 56 ppb, was above the screening level...*" The OEPA-DERR recommended screening level for dibenz(ah)anthracene is 0.062 mg/kg soil, which is more than 56 ppb. Please modify, delete or correct this sentence to say: "...dibenz(ah)anthracene, 56 ppb, was below the screening level..."**

Response 2: Dibenz(a,h)anthracene was not detected in WWTP3 samples. This statement will be deleted.

Comment 3: **Section 2.3.5, page, 2-3. Currently, the U.S. EPA Region 5 does not promote the "*Regional Screening Levels*" (RSLs), adopted by Regions 3, 6 and 9. The Ohio EPA-DERR still recommends the Region 9 PRG Table (2004) for deriving risk-based screening levels (10% PRG for non-carcinogens and 100% PRG for carcinogens).**

Reference: OEPA – DERR (2004) Use of U.S. EPA Region 9 PRGs as screening Values in Human Health Risk Assessments. Technical Decision Compendium, 28 April 2004. On-line: http://www.epa.state.oh.us/derr/rules/screening.pdf.

Response 3: The text states that PRGs will be used, but allows that further team discussion may result in the use of Regional Screening Levels (RSLs). EPA and the Oak Ridge National Laboratory have jointly developed the RSL as an update to the Region 9, PRGs, Region 3 RBCs, and Region 6 MSSLs. The various regions have been involved in the development of the RSLs and that these updated values should be used rather than the older region-specific values. The USACE also agrees with EPA

concerning the use of these screening values and would like to discuss their adoption at a future team meeting. This text is included to express the potential for discussion of using the RSLs are PBOW.

Review comments from J. Weatherington-Rice, Bennett & Williams, Inc., (TAPP Contractor)

General Comments

Comment 1: **1.2.1.1 WWTP1, page 1-4 & 1.2.1.2 WWTP3, page 1-5. Again review documents reference elevated "background levels" of arsenic at the PBOW site. While there are historically higher levels of arsenic in Ohio contaminated by natural events, this setting is NOT a typical location expected to be affected by arsenic enhanced Canadian materials and/or heavy metals bio-accumulation in coal measures. Naturally occurring arsenic levels at this site should NOT be above the PRG levels in soil and sediment. It is expected that the locally elevated "background levels" of arsenic may be attributed to the burning of coal with less than modern smokestack scrubbers. If arsenic is going to continue to be an issue for "clean-up" standards at the site, the community surrounding PBOW would be better served to have an "off-site" arsenic background established to insure that local clean-up standards are not being skewed by historical land-use patterns.**

Response 1: The statement that concentrations are consistent with background levels were made within the approved Site Investigation (SI) report (USACE, 2000); this section represents a summary of that document. There is no statement in the document that background concentrations are elevated. Perhaps the reviewer defines "elevated" as those concentrations that exceed PRG levels. If that is the case, then it must be considered that PRGs are calculated strictly based on exposure assumptions and toxicological data (EPA, 2004); PRGs do not consider background concentrations or analytical capabilities of detecting concentrations at the PRGs. Therefore, it would be incorrect to assume that if the concentration of a chemical constituent exceeds the respective PRG then its concentration is elevated. Arsenic provides an excellent example to illustrate this.

The residential soil PRGs were used as risk-based screening values in the SI report. The PRG for arsenic at the time of the SI time was 0.38 mg/kg (it is currently 0.39 mg/kg), which approximates the currently attainable quantitation limits. In the 1990's it would not have been possible to quantify concentrations of arsenic below 1 mg/kg; as mentioned, in the derivation of PRGs, EPA does not consider the ability of analytical methods to attain a specific value.

With respect to concentrations of arsenic typically found in background soils, there are numerous references to indicate that the concentration range described in the SI report (3.0 to 11 mg/kg) is well within background ranges. For example,

- Shacklette and Boerngen (1984) estimated an arithmetic mean arsenic concentration of 7.4 mg/kg in background soils found in the eastern half of the U.S. This approximates the midpoint in the SI report range.

- One of the Ohio soil samples collected by Shacklette and Boerngen (1984) appears to have been collected in Sandusky County or Erie County. Although Shacklette and Boergen do not provide individual analytical results for the hundreds of samples collected in their report, based on a figure in their document, this sample had an arsenic concentration within the range of 6.5 to 10 mg/kg.

- The Agency for Toxic Substances and Disease Registry reports that typical soil arsenic concentrations are between 1 and 40 mg/kg (ATSDR, 2000).

- The State of Ohio (OEPA, 2008) calculated a mean background arsenic concentration of 5.6 mg/kg from 569 soil samples and recognizes that all soil arsenic concentrations or 13 mg/kg or less can be regarded as "normal occurrence." Note that the even the maximum concentration detected in the SI report is less than this value.

The PBOW background data set was established in 1998 for naturally occurring inorganic constituents, including arsenic (IT, 1998). Based on this data set, USACE and OEPA recognize that elevated arsenic has not been observed in PBOW facility soil.

Comment 2: **<u>1.2.2 Ash Pit Areas, page 1-5</u>. Are the ash pits lined? If so, with what? Should we be expecting additional leaching of contaminants out of the bottom and sides of the Ash Pit 3 because of the additional cooling water?**

Response 2: The Ash Pits are not known to have been lined. The analytical results of the piezometer samples should capture additional contamination that might have occurred via leaching. Incidentally, the K-Site is no longer operational, although it is possible that the facility could be used by NASA in the future. The report will be revised to reflect this.

Comment 3: **<u>2.3.3 Conceptual Site Model, beginning page 2-2</u>. Why have hunters been excluded from the list of people possibly impacted by these sites? Are these areas "off limits" to hunters who come on to the facility? How do we know that they will not be exposed to contamination in the soil, sediment and surface water runoff? What about the drainage to**

Pipe Creek? If it is currently or has been contaminated in the past, is this an "off site" risk to the greater community? Clarification should be added here.

Response 3: Hunting is permitted in some areas of PBOW, but NASA confirmed that hunting is not permitted at any of these four areas, likely due to the presence of nearby buildings and other structures. Surface water and sediment will be evaluated as appropriate in a second phase of the investigation.

Comment 4: **<u>3.1.1 WWPT 1 and 3 beginning page 3-1</u>. How will the drillers/samplers determine "original land surface below fill"? A USDA soils description process would help with that delineation. This is a different classification than the USCS classification system required by EPA but has been used in tandem with the USCS system at other sites around Ohio to help with just this type of a determination.**

The natural questions to ask at this point are "What kind of drilling?" as some systems work better than others. "What are the specifications on the piezometers?" While these issues are later discussed in the report, it would be extremely helpful to note that fact here and reference the locations of those discussions later in the report. By not including the later citation, the reader is left hanging with unanswered questions.

Response 4: Shaw will utilize both the USCS and USDA soils descriptions to aid in determining if fill is present. To date, Shaw has conducted investigations at other sites (i.e., the TNT areas) where fill material was encountered. The fill material consisted of locally derived sandy soil used to cover building foundations. It is likely that any fill present at the new areas to be investigated would be similar since the closeout activities at these sites occurred in the same time period. Direct-push drilling technology will be used as mentioned in the first sentence of Section 3.1.1, and the cores will be continuously logged. The following sentence will be added as the second sentence of the first full paragraph (preceding the bullet list) on page 3-2: "Piezometer specifications are described in Section 3.2.1." All of the field activities are described in Chapter 3.0 in what is intended to be a logical format.

Comment 5: **<u>3.2.1 Direct-Push Soil Sampling, beginning on page 3-4</u>. In discussing the installation and completion process for the piezometers, the follow statements are made; "No filter pack material will be placed around the well screen. The top 1-2 feet of the borehole will be sealed with bentonite or other noncontaminated material to prevent surface water from infiltration into the borehole". Given the nature of the natural materials expected to be intersected by the direct-push soil sampler**

and into which the piezometers are to be set, we SHOULD NOT expect the formation to collapse around the outside of the well screen creating a "natural pack" well. Therefore, since at least some annulus space is expected to be preserved between the inside of the bore hole and the outside of the well screen, how will the installers prevent the bentonite from moving down the boring annulus and clogging the PVC screen? Are they going to install some kind of packer or seal around the PVC to prevent migration downward? More explanation of installation and completion technique is needed here.

Response 5: The referenced text in the second paragraph of Section 3.2.1 will be revised as follows: "... placed around the well screen. No filter pack material will be placed around the well screen. *Because the sampling will occur reasonably quickly after the piezometers have been installed, semi-permanent seals are not necessary.* The top 1 to 2 feet of the borehole will be sealed with bentonite to prevent precipitation water or surface runoff from infiltrating the borehole. *If sealing with bentonite proves difficult, a plastic surface seal may be used around the borehole and covered with additional soil or bentonite sloping away from the piezometer to promote runoff and prevent any surface water from entering the borehole.* Figure 4-5 of the ..."

Comment 6: **<u>3.2.1.1 Lithologic Sampling, page 3-5</u>. A natural question arises from the reading of this section. Are the cuttings going to be drummed in case of contamination for later disposal? This issue is addressed later in the report but it would help to have a link to that section included here.**

Response 6: The following sentence will be added to the end of this section: "Soil cuttings will be drummed and managed for disposal as described in Chapter 6.0.

Comment 7: **<u>3.3.5 Groundwater Sampling Procedures, beginning on page 3-7</u>. At what level below the top of the screen will the sampling be conducted? Will that location be adjusted depending on the type of sampling undertaken? Where 10-foot screens are used, will the wells be sampled both high on the well screen and also at the bottom? More clarification as to the "location" of the sampling efforts would help here.**

Response 7: As stated in the fourth bullet of Section 3.3.5 (Page 3-8), the pump will be inserted into the midportion of the screened interval or suspected water-producing interval. If low flow sampling cannot be achieved and the static water level is above the screen, then the pump intake will be placed at the top of the screen and pumped iteratively until one piezometer volume has been removed. The water level will not be allowed to drop below the top of the screen. If the static water level is below the top of the screen, the

pump will be lowered to the mid point between the static water level and the bottom of the piezometer screen. Only a single sample will be collected from the pizometer; there is no intent to sample multiple zones within the well screen.

Comment 8: **<u>3.7 Abandonment, beginning on page 3-10</u>. Will the materials be tremie piped to the bottom of the hole for abandonment or will some other process be used? If so, what process? What is the cement/bentonite/water mix ratio used for the abandonment mix? If granulated bentonite is used, will it be turned into slurry (at what ratio) and how will it be emplaced in the boring?**

Response 8: The Section 3.7 text will be revised as shown: Upon completion of soil borings at the WWTPs and APs, *the boreholes will be abandoned by pressure grouting from the bottom to the top of the borehole using a tremie pipe. Neat cement grout, which uses a ratio of one 94-lb bag of Portland cement to no more than 6 gallons of water and 2 to 8 % bentonite powder will be used as the sealant.* For boreholes in which a temporary piezometer was installed, after permission from the USACE has been received informing Shaw that no further action will be conducted with the groundwater, the temporary screen and casing will be removed *prior to grouting, and the abandonment of the piezometers will be in accordance with Ohio Department of Natural Resources (ODNR) requirements, following OEPA (2005) guidance.*

Comment 9: **<u>4.3 Decontamination Procedures, beginning on page 4-2</u>. Will wash and rinse water be drummed for later testing and disposal? That issue is discussed later but the question from the reader comes here so a reference to this topic at this point would be helpful.**

Response 9: The following sentence will be added to the end of this section: "Water and rinse water will be managed for disposal as described in Section 6.2."

<u>Specific Comments</u>

Comment 1: **<u>1-2 Summary of Existing Site Data, page 1-2</u>. "It is emphasized that RBSCs do not infer a regulatory limit or mandated cleanup level." This sentence stipulates that the ground water cleanup levels at the sites could be set at higher contamination levels than those which have been mandated by US EPA for Region 9's preliminary remediation goal (PRG) tap water criteria. If this concept is held for the clean-up effort and the ground water is later used as a potable water supply, this situation may create conflicts. Why is this phrase added to the text?**

Response 1: PRGs are risk-based values that were developed for screening purposes only. If the maximum concentration does not exceed the PRG (or the

RBSCs which are derived from the PRGs), then the groundwater concentrations are definitely regarded—without further evaluation—to pose no unacceptable risk. However, the exceedance of an RBSC does not necessarily connote that an unacceptable risk exists. The exceedance simply means that further evaluation is required, based on risk, exposure, and site management goals. This statement is left in the text because it has been our collective experience at numerous facilities that some individuals do not understand the concept that exceedance of a screening value does not necessarily mean requirement for cleanup.

Comment 2: **<u>1.2.1.1. WWTP1 page 1-3</u>. What is the status of the transmission lines from settling basins TNTA and TNTB to WWTP1? Will the bedding of those lines be investigated for leaks in this remediation project or at a later period of time? If later, what project will undertake this potential contamination site review?**

Response 2: An investigation of the sewer lines is outside of the scope of this current investigation. An SSAP for the lines extending from TNTA to the WWTP1 has been submitted. The status of the lines extending from TNTB to WWTP1 is uncertain. It is possible that these have been remediated, but documentation to this effect has not been identified.

Comment 3: **<u>Figure 1-2</u>. The associated waste water sewer lines shown don't have any mention of when/if they will be investigated as part of the remedial investigation process. If they are to be included at a later point in time, perhaps a notation or color coding could be included on this figure.**

Response 3: Figure 1-2 is intended to show where the four sites described in this SSAP are at PBOW. These areas are color-coded in red. The other sites are included for perspective, and are coded in black. It is not the intent of this figure to convey the investigative status of each area.

<u>References for Responses</u>

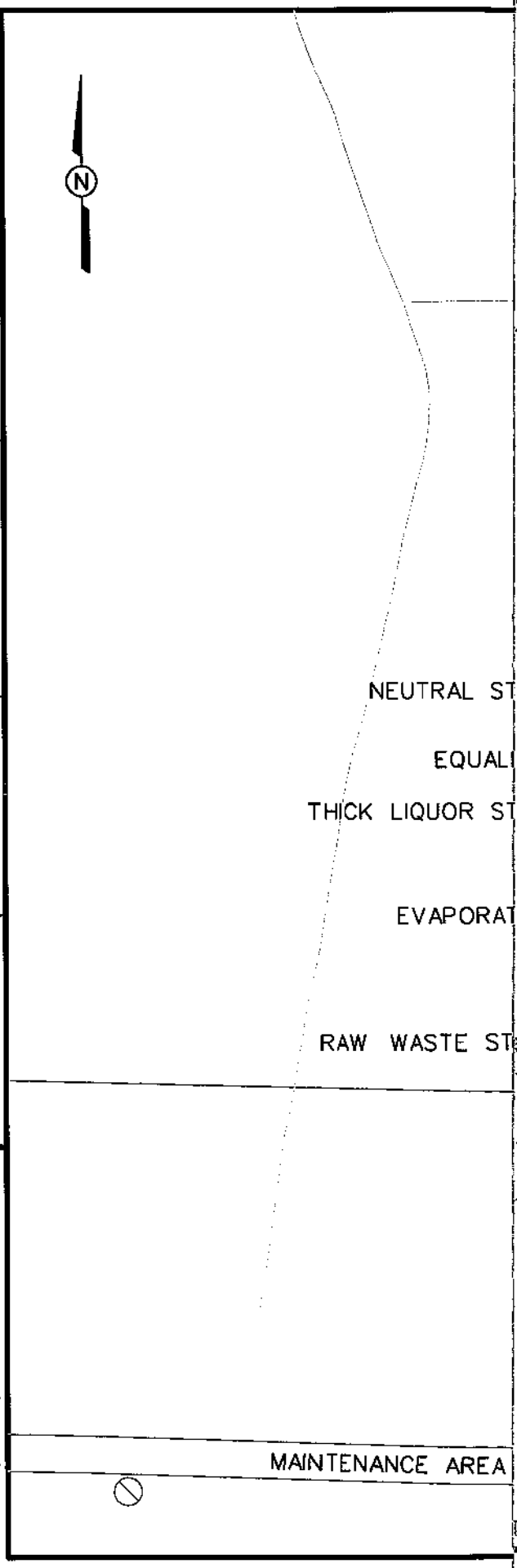
Agency for Toxic Substances and Disease Registry, (ATSDR), 2000, ***Update Toxicological Profile for Arsenic***, Draft for Public Comment, U.S. Public Health Service, Atlanta, Georgia, September, on line.

IT Corporation (IT), 1998, ***Site Investigation of Acids Areas, Plum Brook Ordnance Works, Sandusky, Ohio***, Prepared for U.S. Army Corps of Engineers, Nashville District, Sandusky, Ohio, August.

Ohio Environmental Protection Agency (OEPA), 2008, ***Closure Plan Review Guidance for RCRA Facilities***, 2008, Division of Hazardous Waste management, online at www.epa.state.oh.us/dhwm.

Shacklette, H.T., and J.G. Boerngen, 1984, ***Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States***, U.S. Geological Survey, Alexandria, Virginia, Professional Paper 1270.

U.S. Army Corps of Engineers (USACE), 2000, ***Final Report, Limited Site Investigation for the former Plum Brook Ordnance Works, Waste Water Treatment Plants No. 1 and 3,*** July.



LEGEND:

- PREVIOUS SURFACE SOIL SAMPLE (USACE, 2000)
- PROPOSED SOIL BORING
- PROPOSED PIEZOMETER

NOTES:

1. SOIL SAMPLED PREVIOUSLY IN 1999 (U.S. ARMY CORPS OF ENGINEERS [USACE], 2000 LIMITED SITE INVESTIGATION, FINAL REPORT, FOR THE FORMER PLUM BROOK ORDNANCE WORKS WASTE WATER TREATMENT PLANTS NO. 1 AND 3, SANDUSKY, OHIO, JULY).
2. PROPOSED LOCATIONS MAY BE MOVED BASED ON FIELD OBSERVATIONS.
3. ADDITIONAL PIEZOMETERS WILL BE COMPLETED AT 4 OF THE PROPOSED SOIL BORING LOCATIONS BASED ON FIELD OBSERVATIONS.

FIGURE 3-1

WWTP1 - PROPOSED SOIL BORING AND TEMPORARY PIEZOMETER LOCATIONS

PHASE 1 WWTP1&3 AND AP1&3 SSAP
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

STARTING DATE: 08/06/08	DATE LAST REV.:	DRAFT. CHCK. BY: C. BENTLEY	INITIATOR: D. KESSLER	132288_ssap_005.dgn
DRAWN BY: C. BENTLEY	DRAWN BY:	ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY	PROJ. NO.: 132288

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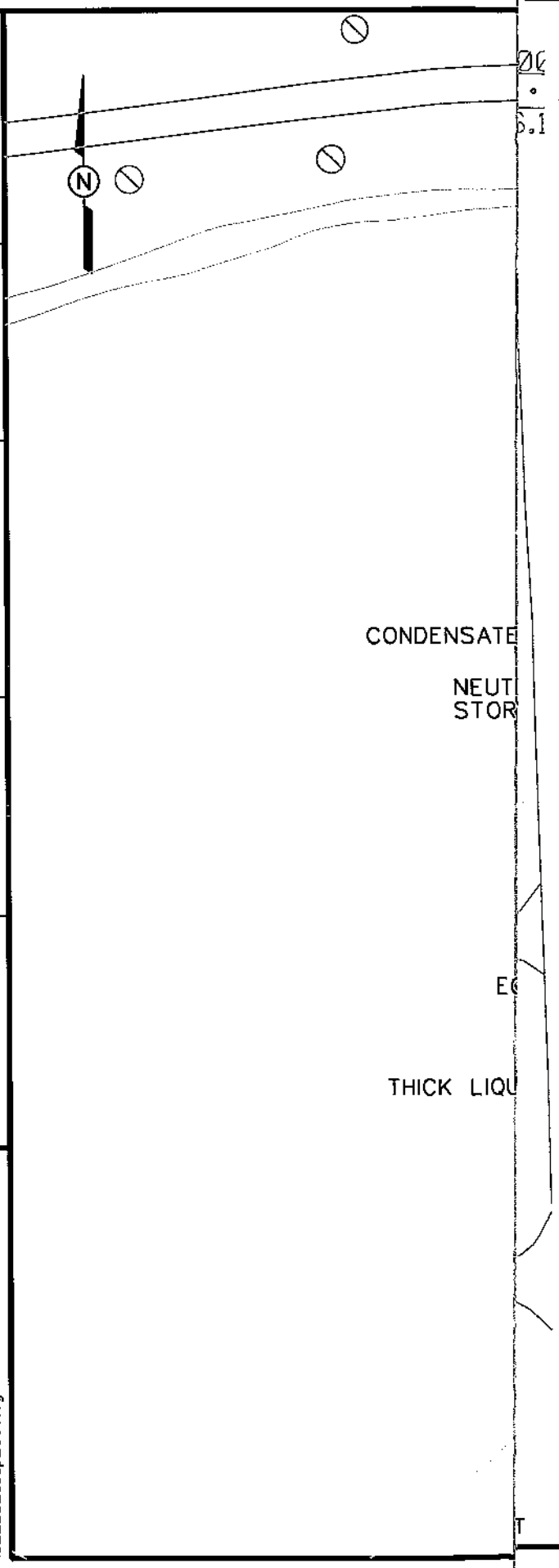

LEGEND:

- PREVIOUS SURFACE SOIL SAMPLE (APPROXIMATE) (USACE, 2000)
- PROPOSED SOIL BORING
- PROPOSED PIEZOMETER

NOTES:

1. SOIL SAMPLED PREVIOUSLY IN 1999 (U.S. ARMY CORPS OF ENGINEERS [USACE], 2000 LIMITED SITE INVESTIGATION, FINAL REPORT, FOR THE FORMER PLUM BROOK ORDNANCE WORKS WASTE WATER TREATMENT PLANTS NO. 1 AND 3, SANDUSKY, OHIO, JULY).
2. PROPOSED LOCATIONS MAY BE MOVED BASED ON FIELD OBSERVATIONS.
3. ONE ADDITIONAL SOIL BORING WILL BE COMPLETED BASED ON FIELD OBSERVATIONS.
4. ADDITIONAL PIEZOMETERS WILL BE COMPLETED AT 4 OF THE PROPOSED SOIL BORING LOCATIONS BASED ON FIELD OBSERVATIONS.

FIGURE 3-2

WWTP3 - PROPOSED SOIL BORING AND TEMPORARY PIEZOMETER LOCATIONS

PHASE 1 WWTP1&3 AND AP1&3 SSAP
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

STARTING DATE: 08/06/08	DATE LAST REV.:	DRAFT. CHCK. BY: C. BENTLEY	INITIATOR: D. KESSLER	132288_ssap_006.dgn
DRAWN BY: C. BENTLEY	DRAWN BY:	ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY	PROJ. NO.: 132288

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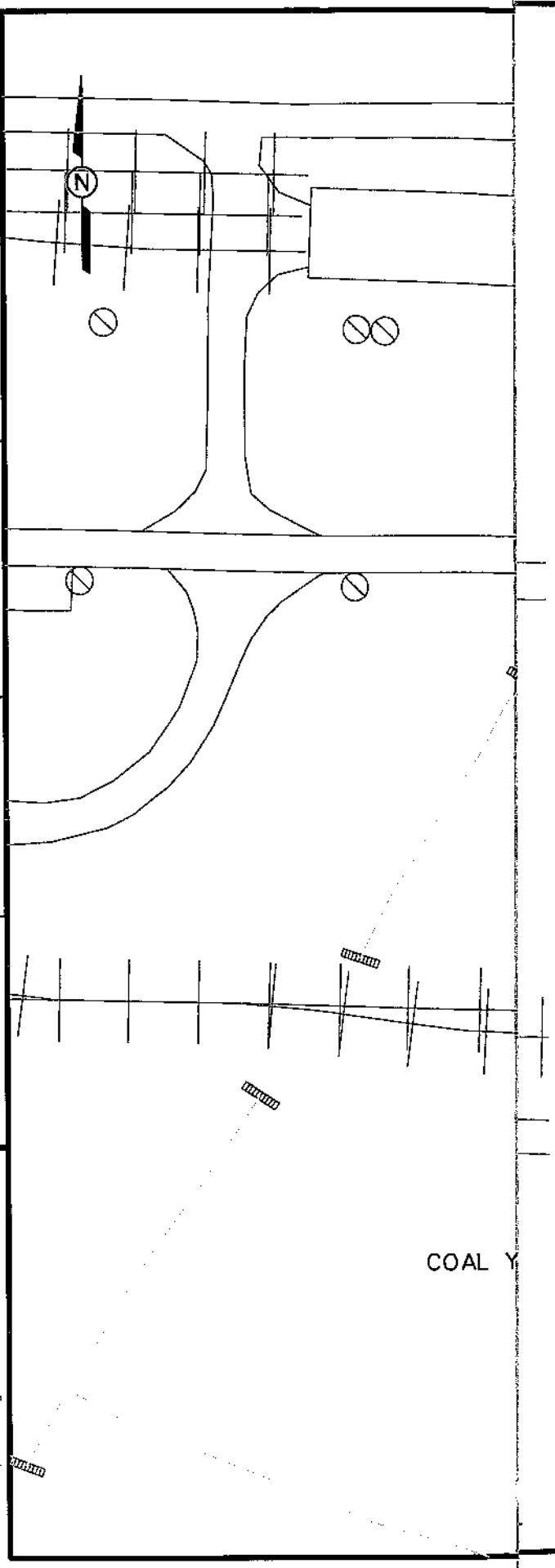

LEGEND:

- PREVIOUS SOIL BORING (USACE, 2000)
- PREVIOUS SURFACE SOIL SAMPLE (USACE, 2000)
- PROPOSED SOIL BORING
- PROPOSED SOIL BORING/PIEZOMETER
- PROPOSED PIEZOMETER

NOTES:

1. PROPOSED LOCATIONS MAY BE MOVED BASED ON FIELD OBSERVATIONS.
2. PREVIOUS SOIL SAMPLES COLLECTED IN 1999 (USACE, 2000, LIMITED SITE INVESTIGATION, FINAL REPORT, FOR THE FORMER PLUM BROOK ORDNANCE WORKS ASH PITS NO. 1 AND 3, SANDUSKY, OHIO, JULY).
3. SOIL BORING PLACEMENT IN ASH PIT BASED ON HISTORIC PHOTOGRAPH.

FIGURE 3-3

ASH PIT NO.1 - PROPOSED SOIL BORING AND TEMPORARY PIEZOMETER LOCATIONS

PHASE 1 WWTP1&3 AND AP1&3 SSAP
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

STARTING DATE: 08/06/08	DATE LAST REV.:
DRAWN BY: C. BENTLEY	DRAWN BY:
DRAFT. CHCK. BY: C. BENTLEY	INITIATOR: D. KESSLER
ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY
132288_ssap_007.dgn	PROJ. NO.: 132288

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