

Final

Site-Specific Sampling and Analysis Plan

**Investigation of Coal Yards in the Areas of Ash Pit Nos. 1 & 3
and Powerhouse No. 2 Ash Pit
Former Plum Brook Ordnance Works, Sandusky, Ohio**

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List of Acronyms

AOC	area of concern
bgs	below ground surface
BHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DNT	dinitrotoluene
DO	dissolved oxygen
DoD	U.S. Department of Defense
EPA	U.S. Environmental Protection Agency
FADL	field activity daily log
IDW	investigation-derived waste
µg/L	micrograms per liter.
NASA	National Aeronautics and Space Administration
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyl
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RBSC	risk-based screening concentration
RI	remedial investigation
Shaw	Shaw Environmental, Inc.
SLERA	screening level ecological risk assessment
SSAP	site-specific sampling and analysis plan
SWSAP	site-wide sampling and analysis plan
SVOC	semivolatile organic compound
TNT	trinitrotoluene
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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 for Formerly Used Defense Sites. The investigation is being managed and technically overseen by the Nashville District of the U.S. Army Corps of Engineers (USACE). This 9,000-acre facility was used for the manufacture of explosives during World War II. The site is currently controlled and maintained by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station of the John H. Glenn Research Center at Lewis Field.

During a previous investigation, an overburden/shale groundwater monitoring well was installed upgradient of Ash Pit No. 1. Groundwater samples from that well indicated elevated manganese in the groundwater. Review of groundwater flow data indicated that a former powerhouse coal yard (Coal Yard No. 1) was located immediately upgradient of this well. Evaluation of site information suggests that leaching from the former coal yard may have impacted groundwater. In addition, two other powerhouse coal yards were used at PBOW.

This site-specific sampling and analysis plan (SSAP) has been prepared by Shaw Environmental, Inc. (Shaw) for the fieldwork to be conducted in support of soil remedial investigations (RI) at the coal yards in the areas of Ash Pit No. 1 (Coal Yard No. 1), Powerhouse No. 2 Ash Pit (Coal Yard No. 2), and Ash Pit No. 3 (Coal Yard No. 3). This SSAP is an addendum to the site-wide sampling and analysis plan (SWSAP) (Shaw, 2008a) and was developed in accordance with the PBOW SWSAP 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/sitewide safety and health plan (Shaw, 2008c) was also 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 the former PBOW site since 1963, and it is currently the NASA Glenn Research Center, Plum Brook Station. Figure 1-2 shows the various PBOW areas of concern (AOC), including the three coal yards.

1.2 Summary of Existing Site Data

No environmental investigations have been conducted to date for Coal Yard No. 1, Coal Yard No. 2, or Coal Yard No. 3. However, a soil and groundwater RI was conducted for Ash Pit No. 1, located north of Coal Yard No. 1 (Shaw, 2010). Overburden/shale groundwater flow in the vicinity of Coal Yard No. 1 is to the northwest. During the Ash Pit No. 1 RI, three overburden/shale monitoring wells were installed with groundwater samples analyzed for nitroaromatics, metals, volatile organic compounds, semivolatile organic compounds, and water quality parameters. One of the overburden/shale monitoring wells (AP1-MW01) was installed immediately upgradient (south) of Ash Pit No. 1 to provide information on upgradient water quality (Figure 1-3). Only chloroform and two nitroaromatics (2-nitrotoluene and 4-nitrotoluene) were detected in the upgradient well. Elevated concentrations of manganese and thallium were detected in the groundwater samples collected from this well. In May and November of 2009, manganese was detected at concentrations up to 32,300 micrograms per liter ($\mu\text{g/L}$) in this well. The detected concentrations exceeded both the risk-based screening concentration (RBSC) (88 $\mu\text{g/L}$) and the background screening concentration (656 $\mu\text{g/L}$) in all samples. Relatively low turbidity (less than 15 nephelometric turbidity units) and similar manganese concentrations present in both filtered (32,100 $\mu\text{g/L}$) and unfiltered (32,300 $\mu\text{g/L}$) samples indicate that the manganese is predominantly in dissolved form and is not the result of turbidity. Thallium was also detected at concentrations of 34.6 $\mu\text{g/L}$ in the unfiltered sample and 37.8 $\mu\text{g/L}$ in the filtered sample from AP1-MW01; similar to manganese, these results indicate that thallium was predominantly present in dissolved form. Elevated manganese was observed in a temporary piezometer (PZ05) located approximately 120 feet north of monitoring well AP1-MW01. In this piezometer, manganese was detected at similar concentrations in both the filtered sample (3,540 $\mu\text{g/L}$) and unfiltered sample (3,370 $\mu\text{g/L}$). Although turbidity was elevated in PZ05 (101 nephelometric turbidity units), the similar concentrations in the filtered/unfiltered samples again indicate that dissolved manganese is elevated in this immediate area. It is noted that thallium was not detected in PZ-05. Manganese and thallium did not exceed the background screening

concentration in any of the remaining overburden/shale monitoring wells or piezometers in the Ash Pit No. 1 area.

Review of existing groundwater data for Ash Pit No. 1 suggests that the iron and manganese concentrations may be influenced by localized conditions in overburden/shale groundwater. Only one of the three overburden/shale monitoring wells (AP1-MW01) could be sampled using low flow sampling techniques in the two rounds of groundwater sampling conducted at the site. The use of sampling methods other than low-flow impacts water quality parameters, particularly dissolved oxygen (DO) measurements. In well AP1-MW01, which was sampled using the low-flow sampling methodology, DO concentrations were relatively low (less than 2 milligrams per liter) in both sampling events while the oxidation-reduction potential was near neutral (4.6 and -13.7 millivolts) and the pH was slightly acidic (6.56 and 6.76). As previously noted, the manganese (32,300 µg/L) and iron (4,990 µg/L) concentrations in this well were elevated. For wells AP1-MW02 and AP1-MW03, the final DO readings are considered biased high due to the fact the data were not collected from a flow-through cell. However, the redox readings in these two wells ranged from slightly reducing (-13 to -25 millivolts) in the November 2009 sampling to strongly reducing (-262 to -321 millivolts) in the May 2009 sampling. Groundwater pH in these wells varied from 6.68 to 7.28 in the two sampling events. Manganese was also detected at an elevated concentration in AP1-PZ05 (3,540 µg/L) in December 2009. Review of the field parameters indicates that the groundwater is in an oxidized state (redox value of 83 millivolts) but with a depressed pH (4.32). This may indicate that pH is the more dominant factor controlling manganese and iron concentrations. The reason for the low groundwater pH in this area is unclear, but it could be due to the oxidation of sulfide minerals (e.g., pyrite) within the coal along with subsequent leaching of acidic water and metals to groundwater. Within the pH range observed in Ash Pit No. 1 groundwater (4.32 to 7.28), theoretical solubility of manganese and of iron have been shown to vary widely (Hem, 1986). In addition, varying redox conditions also play a role in the solubility of iron.

Results of the baseline human health risk assessment (BHHRA) (Shaw, 2011) concluded that the elevated concentrations of manganese and thallium in well AP-MW01 would result in noncancer hazard quotient values for both of these analytes that would exceed the hazard index goal (i.e., ≤ 1) by more than an order of magnitude, assuming residential consumption of overburden/shale groundwater. However, use of the overburden groundwater in the Ash Pit No. 1 area is regarded as implausible because of insufficient yield, and overburden groundwater thus represents an incomplete exposure pathway. Further, the readily available municipal water supply obviates the need for use of groundwater as a potential source of tap water in the general vicinity of PBOW.

It is unclear if the manganese and thallium concentrations are due to former Ash Pit No. 1 activities, although the groundwater flow data and limited detections in one well and one piezometer indicate a potential upgradient source. The impact to overburden/shale groundwater suggests that inorganic contaminants, associated with an upgradient source (i.e., Coal Yard No. 1), may be present in surface and subsurface soil.

1.2.1 Coal Yard Areas

As noted above, PBOW was built in early 1941 and manufactured 2,4,6-TNT, DNT, and pentolite until 1945. Three power stations, Powerhouse No. 1, Powerhouse No. 2, and Powerhouse No. 3, were constructed and utilized to support the TNT manufacturing process. Each power station consisted of a main powerhouse, a coal storage area (coal yard), 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. As mentioned above, the coal yards were used as storage areas providing coal to be used in the powerhouse's boilers. The coal was brought into the yards via train. Figure 1-2 shows the location of the three coal yards on PBOW property. Figures 1-4 through 1-6 show historical photographs of each coal yard along with their associated powerhouses and ash pits.

1.2.1.1 Coal Yard No. 1

Coal Yard No. 1 was located immediately to the west of Powerhouse No. 1. The area is currently covered with grass and brush, with some exposed coal present on the ground surface.

1.2.1.2 Coal Yard No. 2

Coal Yard No. 2 was located immediately to the northeast of Powerhouse No. 2. The area is currently covered with grass and brush along with some vegetation indicative of wetlands. Recent demolition of an adjacent concrete pad by NASA resulted in some disturbance of surface soil and vegetation. Coal was observed on the ground surface in isolated areas during previous site walks.

1.2.1.3 Coal Yard No. 3

Coal Yard No. 3 was located immediately to the south of Powerhouse No. 3. The eastern portion of the Coal Yard No. 3 area is currently covered in grass that is routinely mowed. A gravel

parking area covers the western portion of Coal Yard No. 3. The gravel is approximately 6 inches thick based on recent drilling activities associated with Ash Pit No. 3. No coal has been observed at this site.

2.0 Scope of Work and Objectives

2.1 Scope of Work

As specified in the scope of work, the following RI field activities are covered by this SSAP:

- Soil RI, including soil sampling and lithologic logging
- Laboratory analysis of soil
- Management and disposal of investigation-derived waste (IDW)
- Preparation and submittal of a geographic information system deliverable.

The above activities, analytical data, and evaluation will be presented in separate site characterization report addenda (Volume 1 of the RI) for the three coal yards (three total reports). Separate BHHRA documents will be prepared as addenda referenced to the respective ash pit site BHHRA. Separate screening level ecological risk assessment (SLERA) documents will be prepared as addenda to the respective ash pit site SLERAs.

2.2 Site-Specific Data Quality Objectives

2.2.1 Overview

The data quality objectives process followed during the planning stages of the RI evaluated data requirements needed to support the decision-making process and select the best action to satisfy these requirements. Incorporated components of the data quality objectives process, described in U.S. Environmental Protection Agency (EPA) guidance (EPA, 2006), 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). The data uses and needs for this investigation are summarized in Table 2-1.

2.2.2 Problem Statements

The coal yards were outdoor storage areas for coal located next to their associated powerhouses. The coal was brought to the coal yards via railcar. Due to the coal being exposed to outdoor elements (rain and snow), the possibility exists for metals to have leached out of the coal and into the soil. In addition, there is the possibility for polycyclic aromatic hydrocarbons, a component of coal, to exist in the soil. Polychlorinated biphenyls also may be present as it is thought waste oils were used at the PBOW site for control of vegetation, and they were also a component of industrial paint used during the operational period of PBOW. Although unlikely to be present, nitroaromatics could potentially be present in the area because of the nature of the PBOW

facility. Review of available data does not suggest the potential for other contaminants (i.e., volatiles) to be present at the coal yards.

This RI is being conducted at the sites to determine if there has been a release to surface or subsurface soil. A release to soils may be indicated by elevated inorganics detected in underlying groundwater (see Section 1.2). As previously noted, groundwater use in this area is implausible due to insufficient yield; therefore, no additional groundwater investigation is planned. The RI is also being conducted to evaluate the nature of the associated threats and to eliminate from further consideration those releases that pose no significant threat to public health or the environment. Review of available information regarding historical operations has been used to develop a preliminary conceptual model for the sites, summarized in Section 2.2.3.

At this stage of the investigation, the following problem statements relate primarily to initial uncertainties regarding environmental conditions and potential risks to human and ecological receptors. Data are needed to answer the following questions:

- Have historical activities resulted in the release of contaminants to the environment?
- If contamination is identified in soil, is it present at sufficient levels to warrant further investigation?

The planned investigation for this site addresses these questions through the selection of sample locations designed to evaluate specific potential contaminant sources and release points (biased sampling).

2.2.3 Conceptual Site Model

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

- Potential contaminant sources
- Migration pathways
- Potential human health and ecological receptors
- Types of contaminant of an affected medium.

A source contamination at PBOW is past TNT manufacturing activities, including the production and storage of raw materials. The source(s) of contamination at the proposed areas of investigation results from the storage of coal. The migration pathway for potential contaminants

would primarily be associated with soil. As previously noted, the overburden/shale groundwater has been demonstrated to be of insufficient volume to be used as a potable source.

Exposure of site workers to potential contaminants under current land use at PBOW is negligible, because the coal yards are remote from regular site worker activity. PBOW is opened to deer hunting by permit; therefore, hunters may be exposed to potential contaminants in soil via direct contact (i.e., incidental ingestion or dermal contact) and potentially exposed via ingestion of venison from deer that have grazed in these areas. Exposure to hunters is expected to be limited for the following reasons: 1) hunters would be present on PBOW for a limited number of days per year because of restricted access and the duration of the season; 2) direct contact with soil would be limited because hunting season is during the cooler months, when full clothing would protect the hunter from dermal contact with soil; and 3) the area of the sites addressed by this SSAP are relatively small compared with the overall area available for hunting.

The assumption for future land use is unrestricted. Therefore, it is assumed that future site workers and residents may have direct contact with soil as well as exposure via inhalation of airborne dust and, if applicable, via inhalation of volatile contaminants. Potential ecological receptors at the coal yards are wildlife communities, plant communities, and aquatic communities associated with creeks. Chemicals of potential concern, based on past use of PBOW, should primarily be nitroaromatics, semivolatile organic compounds (SVOC), and metals.

2.2.4 Goals of the Remedial Investigation

Data collected during the planned investigation will be evaluated to meet the following goals and address the problem statements presented in Section 2.2.2.

- Evaluate and use existing data appropriate to the AOCs.
- Define the physical features and characteristics of the AOCs.
- Determine the nature and extent of the associated contamination.
- Evaluate fate and transport of contamination.
- Obtain site data of quality, quantity, and distribution appropriate for site characterization, risk assessment, and feasibility study.
- Determine the need for addition investigation.

2.2.5 Information Inputs

The locations and analytical suites for planned samples of environmental media were selected based on available historical information and existing data. Data obtained during the planned RI will be used to determine if suspected releases have occurred at the site and to evaluate the need for further investigation. Samples will be collected at locations selected in a biased manner to evaluate all discrete potential contaminant sources which have been identified.

In addition to this SSAP, the SWSAP and QAPP have been prepared to ensure that data collected during this investigation are of the appropriate type and quality to support their intended uses (Shaw, 2008a,b). Samples collected during implementation of the sampling effort will meet the recommended method guidance found in *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods* (EPA, 1996), and its subsequent updates. The subcontracted analytical laboratories will be accredited under the DoD Environmental Laboratory Accreditation Program for all analyses performed and compliant with *Quality Systems Manual for Environmental Laboratories, Version 4.2* (DoD, 2010). All other requested analyses will conform to their specified method(s). In general, this sampling plan has been developed to ensure that the data obtained satisfy the following requirements:

- Data will be of sufficient quality to be legally defensible under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- Data will have reporting limits based on the limit of detection (as defined in the DoD Quality Systems Manual, Version 4.2) that can support the preparation of future CERCLA reports for the site. Current reporting limits are presented in Appendix A.
- Data will be usable for the intended evaluations.
- Sampling locations, depths, and quantities will be sufficient to confirm/deny contaminants in soil.

Data will be sufficient to support human health and ecological risk assessments needed to determine whether any future action is necessary at the site, and to help guide such actions.

The following inputs will be required to make informed decisions regarding the questions listed above:

- Soil samples will be collected from the three coal yards for laboratory analysis which include the following: nitroaromatics, polychlorinated biphenyls (PCB), SVOCs, and target analyte list metals.

- Laboratory data packages will include signed chain-of-custody forms, Form I documents, method blanks, laboratory control sample/laboratory control sample duplicate forms, matrix spike/matrix spike duplicate forms, initial and continuing calibrations, prep logs, analysis logs, all chromatograms and quantitation reports, standard preparation logs, and any other raw data as applicable.
- The laboratory will provide a Staged Electronic Data Deliverable in Hypertext Markup Language format along with a ShawView™ electronic deliverable.
- Digital geospatial will conform to Federal Geographic Data Committee Standard STD-001-1998.

Data collection methods and analytical procedures are intended to provide results of sufficient quality to satisfactorily determine the spatial distribution of contaminations at the site. The detection limits achieved using the specified methods are generally less than screening levels used for risk assessments. However, in cases where these methods exceed the screening levels, the uncertainty will be addressed in the human health and ecological risk assessment reports.

2.2.6 Boundaries of the Sites

The site boundaries for Coal Yard No. 1, Coal Yard No. 2, and Coal Yard No. 3 are shown on Figures 1-4, 1-5, and 1-6, respectively. These boundaries are based on review of historical photographs. Should this RI determine that any soil contamination associated with a specific AOC extends beyond these boundaries, the investigation boundaries will be modified as needed.

2.2.7 Decision Rules

Analytical results from the planned sampling efforts will be evaluated to determine if there had been a release and to determine where contaminant sources are located. Confirmation of contamination during the RI will be based upon a comparison of detected contaminants in samples from this investigation to the most current RSBCs. Soil RBSCs are derived from residential soils RSLs (EPA, 2011, www.epa.gov/req3hwmd/risk/human/rb-concentration-table/Generic_Table/index.htm). Inorganics in soil will also be screened against background screening concentrations. Note that no background data sets exist for naturally occurring organic compounds. Background contributions associated with these organic compounds will be qualitatively evaluated in the risk assessments, *as appropriate, based on relevant site-specific information that may exist for the chemicals in question*. Definitive data will be used to determine whether the established guidance criteria are exceeded in the soil. These definitive data will be adequate for confirming the presence of the contamination and for supporting a risk assessment and a feasibility study.

The following decision rules apply to the complete RI effort:

- If after completion of the sampling activities, results indicate that contamination is not encountered at concentrations that *may* pose a significant threat to public health or the environment, then additional evaluation will not be recommended *prior to the risk assessments*. Results will be reported in an RI report.
- If after completion of the sampling activities, results indicate that contamination is encountered at concentrations that *may* pose a significant threat to public health or the environment, then *Shaw and USACE risk assessors and/or health and safety personnel will be consulted*. Additional evaluation *may* be recommended *prior to the risk assessments, which would be documented in an RI report*.

2.2.8 Performance or Acceptance Criteria (Decision Errors)

The primary sources of decision errors, errors that might lead to a wrong decision, include sample density and sampling and analytical methods.

Sample Density. Sample locations, the spacing between the individual samples, and sample depths are important in obtaining data which represent the true distribution of contaminants with sufficient accuracy to achieve project objectives. Potential errors have been minimized by 1) identifying historical and environmental data and 2) selecting additional sample locations which are biased toward suspected contaminant sources.

Sampling and Analytical Methods. Sampling and/or analytical methods may be sources of error if proper sample collection procedures are not followed, if the analytical reporting limits exceed target goals, or if the analytical methods have an unacceptably high margin of error. To limit errors in sample collection, procedures for sample collection have been provided in the SWSAP (Shaw, 2008a).

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, as described in Chapter 3.0 of this SSAP. All samples will be analyzed by EPA-approved methods and will comply with EPA definitive data requirements. In addition to meeting the quality needs of the RI, data analyzed at this level of quality are appropriate for all phases of the RI and risk assessments.

3.0 Field Activities

Field activities associated with the RI include minimal site clearing/grubbing, restoration, surface and subsurface soil sampling, land surveying, and IDW management. The purpose of soil sampling at the AOCs is to determine if appreciable contamination is present at the site and determine the nature and extent of contamination (if present) at each of the AOCs and complete other objectives, as defined in Section 2.2.

3.1 Soil Remedial Investigation

The following sections summarize the proposed soil investigation. Table 3-1 summarizes the samples and analytical parameters.

Soil Sampling Methodology. The purpose of the surface and subsurface soil sampling is to determine the presence/absence of contamination at each coal yard. A qualified geologist or geotechnical engineer will be on site for all drilling and sampling operations. The geologist/geotechnical engineer will visually classify and log all borehole material according to the Unified Soil Classification System, EM 1110-1-4000 (USACE, 1998) on the Hazardous, Toxic and Radioactive Waste drilling log (USACE Eng. Forms 5056-R and 5056A-R).

Borings will be advanced and soil samples will be collected using hand augers or alternatively, using direct-push drilling technology. The limited field sampling does not warrant the mobilization costs of a direct-push drilling rig; however, a direct-push unit may be used if the work is completed in conjunction with other ongoing field efforts at PBOW. The direct-push unit uses a hydraulically powered percussion hammer to drive a decontaminated soil sampling device with retractable tip (point) to a required depth. Soil samples for chemical analysis will be handled and packaged as described in Chapter 5.0. All hand augers or direct-push 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.

Soil samples collected for chemical analysis will be documented by sample collection logs and analysis request/chain-of-custody record forms (Figures 4-7 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 this SSAP or the SWSAP will be recorded in chronological order on a variance log for this project similar to that shown as Figure 9-1 of the SWSAP (Shaw, 2008a).

All soil samples collected by Shaw field personnel will be documented through the use of drilling borelogs (USACE Eng. Forms 5056-R and 5056A-R).

Continuous logging performed by the geologist/geotechnical engineer will include detailed subsurface information from examining drill cuttings, recording samples/cores, and noting first-encountered and static groundwater levels for each borehole. Daily field notes will be recorded on a field activity daily log (FADL) and will include sufficient information to reconstruct the progress of excavation, drilling operations, problems encountered, etc. 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 will be included in an appendix to the final RI report.

The equipment required for soil sampling includes the following:

- Hazardous, toxic, and radioactive waste borelog, sample collection log, and chain of custody
- Appropriate sample jars
- Clean, stainless-steel bowl and mixing device or new resealable plastic bag
- Plastic sheeting
- Photoionization detector/lower explosive limit meter
- Cooler packed with ice for sample storage.

For soil intervals that are collected for analytical sample analysis, the samples will be collected in the appropriate jars prior to lithologic logging. 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. In the case of direct-push samples, a second boring will be completed immediately adjacent to the original location. The surface soil sample (0 to 1 foot below ground surface [bgs] interval) from the adjacent boring will be combined with the original surface soil sample, homogenized, and transferred to appropriate sample jars. Once full, the jar will be placed on ice and the proper paperwork completed.

Ash Pit Nos. 1 and 3 and Powerhouse No. 2 Ash Pit Coal Yards. Preliminary lithologic borings will be completed at each area to verify the extent of the former coal yards. Investigations at other ordnance plant coal yards (i.e., West Virginia Ordnance Works) found

residual seams of coal present in the near-surface soils. Residual coal is still present at Coal Yard No. 1 and Coal Yard No. 2. The location of the preliminary borings will initially be placed at locations based on the aerial photographs of the former coal yards (Figures 1-4, 1-5, and 1-6). A total of 12 borings (4 per AOC) will be advanced, with three samples collected from each soil boring for chemical analysis. Figures 3-1 through 3-3 show the proposed soil boring locations. Note that these locations may be changed in the field based on lithologic borings completed at the site. The sampling intervals for the soil samples will be as follows: one from 0 to 1 foot bgs (soil below fill material, if encountered), one from 3 to 5 feet bgs, and one from 8 to 10 feet bgs, for a total of 36 samples. Should coal be encountered in any soil boring, the sampling depths will be adjusted to collect the soil immediately below the coal itself. Care will be taken not to entrain any coal into the analytical sample.

At many PBOW sites, following closure and removal of the manufacturing structures, tanks, and equipment, a local fill sand was brought to the areas to cover the remaining concrete building foundations and demolition scars and to provide a natural landscape appearance. However, fill material is not thought to be present at either Coal Yard No. 1 or Coal Yard No. 2, as residual coal has been observed on the ground surface. At Coal Yard No. 3, the area has been regraded by NASA, with approximately half of the area covered in grass and the remainder covered with approximately 6 inches of gravel. Because this area potentially has been impacted by NASA activities, samples will focus on the grass-covered area on the east side of the site.

The 36 samples will be analyzed for nitroaromatics, target analyte list metals, and SVOCs. The 0- to 1-foot and 3- to 5-foot bgs soil samples will also be analyzed for PCBs. One surface soil (0- to 1-foot) sample will be analyzed for total organic carbon for each of the three AOCs. Volatile organic compounds (VOC) will not be analyzed because no source was present during former manufacturing operations. Table 3-1 summarizes the samples and analytical parameters.

3.2 Borehole Abandonment

Upon completion of soil borings at each AOC, soil boreholes will be abandoned in accordance with Ohio Department of Natural Resources requirements, following Ohio Environmental Protection Agency (2005) guidance. Abandonment for soil borings will be performed as follows:

- All boreholes will be abandoned by pouring bentonite chips in the borehole. Boreholes that are abandoned immediately after sampling are “open” due to the cohesive nature of the site soils and do not require tamping.

- After 24 hours, the borehole will be checked for settlement and additional bentonite added, if necessary.

3.3 Surveying

Prior to site clearing, Shaw will secure the services of an Ohio-registered professional land surveyor to determine the coordinates and elevations of both existing and new locations. All sampling locations will be surveyed by an Ohio-registered surveyor prior to sampling.

In addition, upon completion of the field soil sampling, each soil boring location will be surveyed.

For each soil boring location, the coordinates and elevations will be established according to EM 1110-1-4000. The horizontal coordinates will be to the closest 0.1 foot and referenced to the North American Datum of 1983, Ohio State Plane North. Vertical coordinates (ground elevation) will be to the nearest 0.01 foot and referenced to the 1929 National Geodetic Vertical Datum. U.S. feet will be used for all measurements. All survey data will be tabulated. Loop closure for survey accuracy will be within the horizontal and vertical limits given above.

3.4 Utility Clearances

Prior to beginning any intrusive investigation (i.e., soil boring), 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 sampling locations will be hand dug to a depth of 5 feet before drilling begins (assuming sampling is completed using direct-push sampling).

3.5 Site Clearing and Restoration

Brush clearing may be required for equipment access to the sampling locations. The necessary clearing will be proposed to and coordinated with NASA. Clearing activities will be kept to a minimum.

Shaw and its subcontractors will restore the area to pre-investigation conditions. Shaw and its subcontractors will regrade any ruts, depressions, and earthen piles that may cause a walking and driving hazard. Any pavement/concrete destroyed or removed will be replaced. The site will be restored to the satisfaction of on-site USACE personnel.

3.6 Site Access

All Shaw personnel and subcontractors will meet each morning at the NASA/Plum Brook Station, Shaw office trailer, 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 U.S. citizens.

4.0 Sample Analysis and Decontamination Procedures

4.1 Sample Number System

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

Project Code	Year	Sample Type ^a	Site Identification ^b	Location (Boring ID)	Sample Number	Depth ^c
PBOW	11	XX	XXXX	XXXX	XXXX	(XXXX)

^aSample type:

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

^bSite:

AP1 – Ash Pit No. 1
AP2 – Powerhouse No. 2 Ash Pit
AP3 – Ash Pit No. 3
CY - Coal Yard

^cDepth: Only required for soil samples.

In addition, field QC is identified by the sample purpose; field duplicates and field splits use the sample numbering convention shown above. The sample purpose is recorded on the sample collection log and in ShawView PBOW database. The sample purpose is suppressed when creating chain-of-custody and bottle labels. Thus, field QC remains blind to the subcontract laboratories. See the site-wide QAPP (Shaw, 2008b) for a detailed discussion of field QC.

The complete sample number will be recorded by the Shaw field geologist/geotechnical engineer in the FADL and/or in the boring log, and in the sample collection log as appropriate.

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 4-1 summarizes the analytical parameters required and associated laboratory methods to be used during this investigation.

All applicable analyses will meet all project specific requirements; DoD Quality Systems Manual, Version 4.2, requirements; and the recommended method guidance found in *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods* (EPA, 1996) and its subsequent updates. The analytical laboratory will be accredited under the DoD *Quality Systems Manual for Environmental Laboratories*, Version 4.2 (DoD, 2010). All other requested analyses must conform to their specified method(s).

The following types of field QA/QC samples will be collected: field duplicates, field splits, equipment rinsates, trip blanks, and source water samples. Definitions of both field and laboratory QA/QC can be found in the QAPP (Shaw, 2008b).

4.3 Decontamination Procedures

Decontamination requirements and procedures are specified in detail in Chapter 6.0 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 do 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.):

- Pre-wash and scrub using a brush in potable water.
- Wash and scrub using a brush with nonphosphate detergent.
- Rinse with potable water.
- Rinse with ASTM International Type II water.
- Rinse with a rinse agent containing 10 percent hydrochloric acid (when sampling for metals).
- Rinse with methanol when sampling for organics.

- Rinse with ASTM International Type II water.
- Rinse with hexane (when sampling for PCBs).
- Final rinse with ASTM International 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.

Pre-wash, wash, and rinse waters will be changed at least daily and as they become excessively dirty.

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 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 and time the sample is collected, prepared, and analyzed.

Samples for chemical analysis will be placed in coolers filled with ice immediately after collection and will be packed to minimize container breakage by using 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±2 degrees Celsius 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:

ATTN: Sue Bell
Accutest Southeast Laboratory
4405 Vineland Road, Suite C-15
Orlando, Florida 32811
Phone: (813) 741-3338
Fax: (813) 741-9137
Email: SueB@accutest.com

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

ATTN: Denise Pohl
Test America
4101 Shuffel Street NW
North Canton, OH 44270
Phone: (330) 966-9789
Fax: (330) 497-0772
Email: Denise.Pohl@testamerica.com

6.0 Investigation-Derived Waste Management Plan

Anticipated IDW during field activities includes soil (drill cuttings), decontamination fluid, and disposable personal protective equipment (PPE). Detailed procedures for IDW management are provided in Chapter 8.0 of the SWSAP (Shaw, 2008a) and will be managed consistent with regulatory guidance (EPA, 1992). The following is a brief summary of the procedures for handling IDW.

6.1 Soil

Excess soil from the soil borings will be placed in 55-gallon drums upon completion of field sampling. As noted in Section 3.2, the boreholes will be abandoned by filling with bentonite chips. IDW drums will be labeled to indicate project name and date collected. Upon completion of the sampling, the drummed soil will be sampled and properly disposed of as discussed in Section 6.4.

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, and plastic, will be generated during sampling. All sampling equipment and PPE will be double-bagged and disposed of in on-site Shaw contract 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 and Disposal

All soil and water IDW will be sampled at the completion of fieldwork. Table 4-1 summarizes the analytical parameters and methods for the IDW samples. Soil and water composite samples will be collected from the IDW. The composite samples will then be submitted to the identified laboratory for a full toxicity characteristic leaching procedure analysis for VOCs, SVOCs, and metals. In addition, water composite samples will be analyzed for nitroaromatics and pH. Hazardous waste characteristic parameters (ignitability, corrosivity, and reactivity) will also be

analyzed. 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 USACE.

For each AOC, the following will be collected:

- One composite sample from boring soils IDW
- One composite sample from decontamination water IDW.

The samples will be composite samples of the IDW generated except those IDW aliquots to be sampled for VOCs. The IDW sample aliquots collected for VOCs will be grab samples.

7.0 References

- Hem, John D., 1986, *Study and Interpretation of the Chemical Characteristics of Natural Water*. U.S. Geological Survey, Water Supply Paper 2254.
- Ohio Environmental Protection Agency, 2005, *Technical Guidance for Ground Water Investigations, Chapter 9, Sealing Abandoned Monitoring Wells and Boreholes*, Revision 1, Division of Drinking and Ground Waters, Columbus, Ohio, February.
- Shaw Environmental, Inc. (Shaw), 2011, *Baseline Human Health Risk Assessment, Ash Pit 1 Plum Brook Ordnance Works, Sandusky, Ohio*, Final, August.
- Shaw Environmental, Inc. (Shaw), 2010, *Ash Pit 1 and Ash Pit 3 Site Characterization Report, Plum Brook Ordnance Works, Sandusky, Ohio*, November.
- Shaw Environmental, Inc. (Shaw), 2008a, *Site-Wide Sampling and Analysis Plan, Plum Brook Ordnance Works, Sandusky, Ohio*, July.
- Shaw Environmental, Inc. (Shaw), 2008b, *Site-Wide Quality Assurance Project Plan, Plum Brook Ordnance Works, Sandusky, Ohio*, July.
- Shaw Environmental, Inc. (Shaw), 2008c, *Site-Wide Health and Safety Plan, Plum Brook Ordnance Works, Sandusky, Ohio*, July.
- U.S. Army Corps of Engineers (USACE), 2008, *Scope of Work Remedial Investigation Part 1, Waste Water Treatment Plants 1 and 3, Ash Pits 1 and 3, and Nitroaromatics Treatability Study, Former Plum Brook Ordnance Works (PBOW), Sandusky, Ohio*, May.
- U.S. Army Corps of Engineers (USACE), 1998, *Monitoring Well Design, Installation, and Documentation of Hazardous and/or Toxic Waste Sites*, USACE Engineering Manual, EM-1110-1-4000, November.
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- U.S. Environmental Protection Agency (EPA), 2011, *Regional Screening Level Table*, 2011.
- U.S. Environmental Protection Agency (EPA), 2006, *Guidance on Systematic Planning Using the Data Quality Objective Process*, EPA 240-B-06-001, Office of Environmental Information, Washington, D.C., February.
- U.S. Environmental Protection Agency (EPA), 1996, *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods*, EPA Publications SW-0846, Third Edition, Update III, (<http://www.epa.gov/sw-846/sw846.htm>).

U.S. Environmental Protection Agency (EPA), 1992, *Guide to Management of Investigative-Derived Wastes*, EPA Publications 9345.3-03FS, January.

TABLES

Table 2-1

**Summary of Data Quality Objectives
Investigation of Coal Yards in the Areas of Ash Pits 1 and 3 and Powerhouse 2 Ash Pit
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	Coal Yards: Groundwater data from Ash Pit No. 1 indicate potential leaching from Coal Yard No. 1.	<u>Contaminant Source</u> Storage of coal in the coal yards <u>Migration Pathways</u> Soil to groundwater <u>Potential receptors</u> Wildlife, human <u>Potential Contaminants of Concern</u> Explosives, PCBs, SVOCs, and metals	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	<u>Soil</u> Metals Explosives SVOCs PCBs TOC	Definitive Laboratory Definitive ^a

DNT - Dinitrotoluene.

DOD - U.S. Department of Defense.

EPA - U.S. Environmental Protection Agency.

NASA - National Aeronautics and Space Administration.

OEPA - Ohio Environmental Protection Agency.

PCB - Polychlorinated biphenyl.

Shaw - Shaw Environmental, Inc.

SVOC - Semivolatile organic compound.

TNT - Trinitrotoluene.

TOC - Total organic carbon.

USACE - U.S. Army Corps of Engineers

VOC - Volatile organic compound.

^a The laboratory will provide data packages consisting of all laboratory receipt documentation, sample prep and run log documentation, calibrations forms, quality control forms, Form I's, and all raw data generated in support of the analysis of PBOW samples.

Table 3-1

**Summary of Soil Analytical Samples
Investigation of Coal Yards in the Areas of Ash Pits 1 and 3 and Powerhouse 2 Ash Pit
Former Plum Brook Ordnance Works, Sandusky, Ohio**

Coal Yards Soil Borings						
Parameters	Field Samples	QA/QC Samples	Rinsates	Source Water ^a	Trip Blanks	Matrix Spike/Duplicates
Nitroaromatics	36	4	1	1	NA	2/2
TCL SVOCs	36	4	1	1	NA	2/2
TAL Metals	36	4	1	1	NA	2/2
PCBs	24	3	1	1	NA	2/2
TOC	3	0	0	0	NA	0/0
Soil IDW Samples						
Parameters	Field Samples	QA/QC Samples	Rinsates	Source Water ^a	Trip Blanks	Matrix Spike/Duplicates
Nitroaromatics	3	NA	NA	NA	NA	NA
TCLP VOCs	3	NA	NA	NA	NA	NA
TCLP SVOCs	3	NA	NA	NA	NA	NA
TCLP Metals	3	NA	NA	NA	NA	NA
RCI	3	NA	NA	NA	NA	NA
Water IDW Samples						
Parameters	Field Samples	QA/QC Samples	Rinsates	Source Water ^a	Trip Blanks	Matrix Spike/Duplicates
Nitroaromatics	4	NA	NA	NA	NA	NA
TCL VOCs	4	NA	NA	NA	NA	NA
TCL SVOCs	4	NA	NA	NA	NA	NA
TAL Metals	4	NA	NA	NA	NA	NA
RCI	4	NA	NA	NA	NA	NA
pH	4	NA	NA	NA	NA	NA

TCL - Target compound list.

SVOC - Semivolatile organic compound.

TAL - Target analyte list.

PCB - Polychlorinated biphenyl.

VOC - Volatile organic compound.

TOC - Total organic compound.

RCI - Reactivity, corrosivity, and ignitability.

Quality control (QC) samples are field duplicates submitted blind to primary contract laboratory.

Quality assurance (QA) samples are field splits sent blind to secondary Department of Defense Environmental Laboratory Accreditation Program approved laboratory.

^a Source Water - Clean water used in decontamination procedures.

Table 4-1

**Summary of Soil and Groundwater Analytical Parameters and Methods
Investigation of Coal Yards in the Areas of Ash Pits 1 and 3 and Powerhouse 2 Ash Pit
Former Plum Brook Ordnance Works, Sandusky, Ohio**

Sample Matrix	Analytical Parameters ^a	Analytical Method ^d
Soil	TCL Semivolatile Organic Compounds Nitroaromatic Compounds Polychlorinated Biphenyls TAL Metals Total Organic Carbon	SW-846 3550C/8270D SW-846 8330A SW-846 3550C/8082A SW-846 3050B/6010C/7471B Walkley-Black
Liquid IDW	Target Compound List Volatile Organic Compound Target Compound List Semivolatile Organic Compound Nitroaromatics TAL Metals Ignitability pH Corrosivity Reactive Cyanide Reactive Sulfide	SW-846 8260B SW-846 3510C/8270D SW-846 8330A SW-846 3010A/6010C/7470A SW-846 1010A SW-846 9040C SW-846 1110A 7.3.3/7.3.4 7.3.3/7.3.4
Soil IDW	TCLP Volatile Organic Compounds TCLP Semivolatile Organic Compounds TCLP Metals Ignitability Corrosivity Reactivity	SW-846 1311/8260B SW-846 1311/3510C/8270C SW-846 1311/3010A/6010C/7470A SW-846 1010A SW-846 1110A 7.3.3.2/7.3.4.2

^aTarget analyte list (TAL) and target compound list (TCL) are used to designate parameter lists with no requirements for Contract Laboratory Program method quality control or data reporting packages.

^bAnalyses 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.

^cWater quality parameter.

^dField 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*, EPA Publication, Third Edition.

IDW - Investigation-derived waste.

TCLP - Toxicity characteristic leaching procedure.

TOC - Total organic compound.

Table 5-1

**Analytical Methods, Containers, Preservatives, and Holding Times
Investigation of Coal Yards in the Areas of Ash Pits 1 and 3 and Powerhouse 2 Ash Pit
Former Plum Brook Ordnance Works, Sandusky, Ohio**

Matrix	Parameter	Analytical Method	Sample Container*	Preservation Requirements	Holding Time
Soil	TCL SVOCs Nitroaromatics PCBs TAL Metals TOC	SW-846 3550C/8270D SW-846 8330A SW-846 3550C/8082A SW-846 3050B/6010C/7471B Walkley-Black	(1) 8 oz CWM glass with Teflon-lined lid	Cool to 4°C	14 days extraction/40 days 14 days extraction/40 days 14 days extraction/40 days 6 months (28 days for Hg) 28 days
Liquid IDW	TCL VOCs TCL SVOCs Nitroaromatics TAL Metals Ignitability pH Corrosivity Reactive Cyanide Reactive Sulfide	SW-846 8260B SW-846 3510C/8270D SW-846 8330A SW-846 3050C/6010C/7470A SW-846 1010A SW-846 9045D SW-846 1110A 7.3.3/7.3.4 7.3.3/7.3.4	(3) 40 ml VOA vial (2) 1 L amber glass (1) 1 L amber glass (1) 250 mL HDPE	Cool to 4°C, HCL to pH <2 Cool to 4°C Cool to 4°C Cool to 4°C, HNO ₃ to pH <2	14 days 7 days extraction/40 days 7 days extraction/40 days 6 months (28 days for Hg)
			(1) 1 L Amber	Cool to 4°C	ASAP
Soil IDW	TCLP VOCs TCLP SVOCs TCLP Metals Ignitability Corrosivity Reactivity	SW-846 1311/8260B SW-846 1311/3510C/8270D SW-846 1311/3010A/6010C/7470A SW-846 1010A SW-846 1110A 7.3.3.2/7.3.4.2	(1) 8 oz CWM glass with Teflon-lined lid	Cool to 4°C	14 days extraction 14 days extraction/40 days 14 days /ext./6 months (28 days for Hg) ASAP ASAP ASAP

°C - Degrees Celsius.

CWM - Clear widemouth.

H₂SO₄ - Sulfuric acid.

HCl - Hydrochloric acid.

HDPE - High-density polyethylene.

Hg - Mercury.

HNO₃ - 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 - Investigation-derived waste.

EPA - U.S. Environmental Protection Agency.

VOA - Volatile organic analysis.

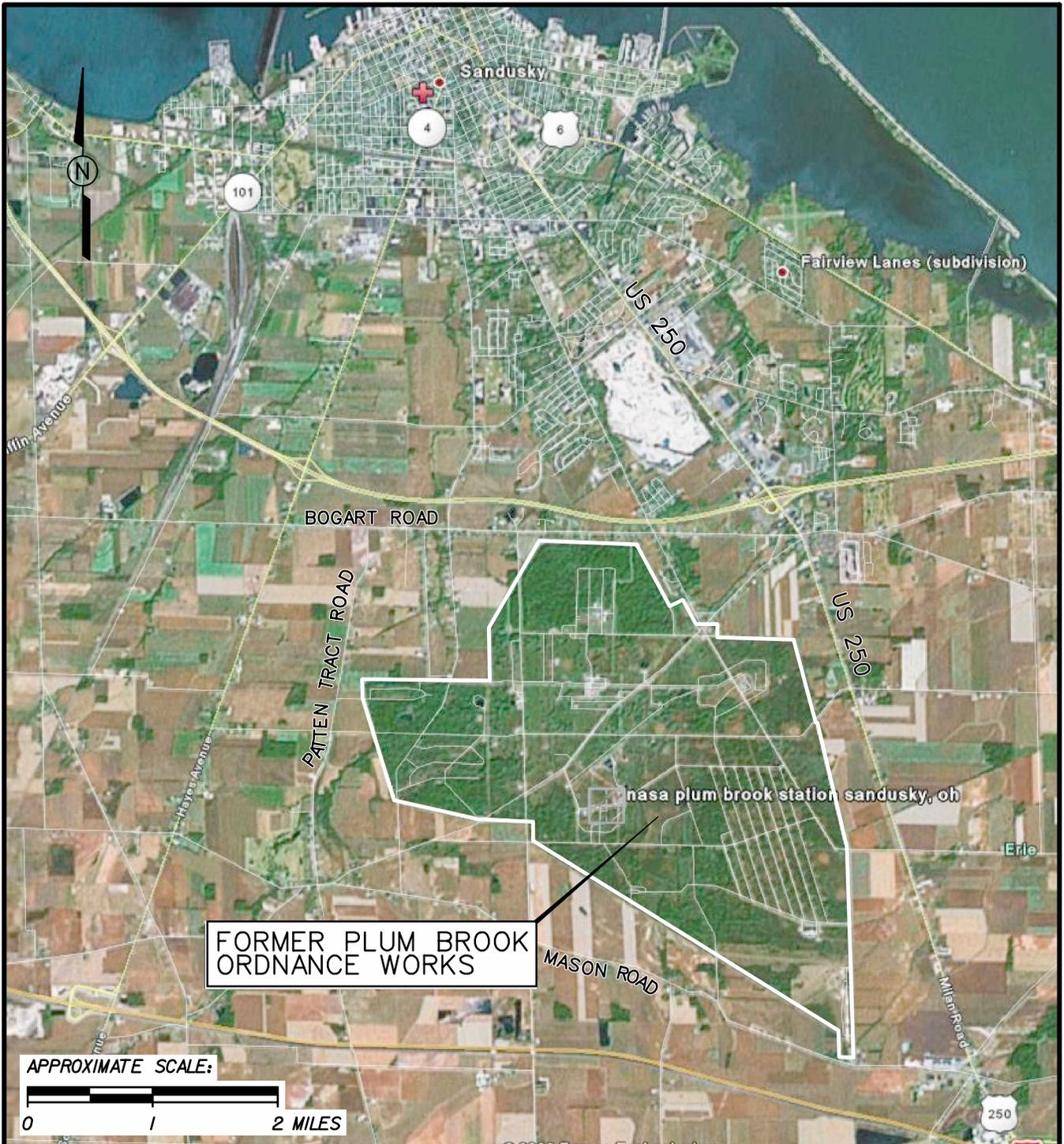
OZ - Ounces.

Ext. - Extraction

ASAP - As soon as possible.

*Number of containers required in ().

FIGURES



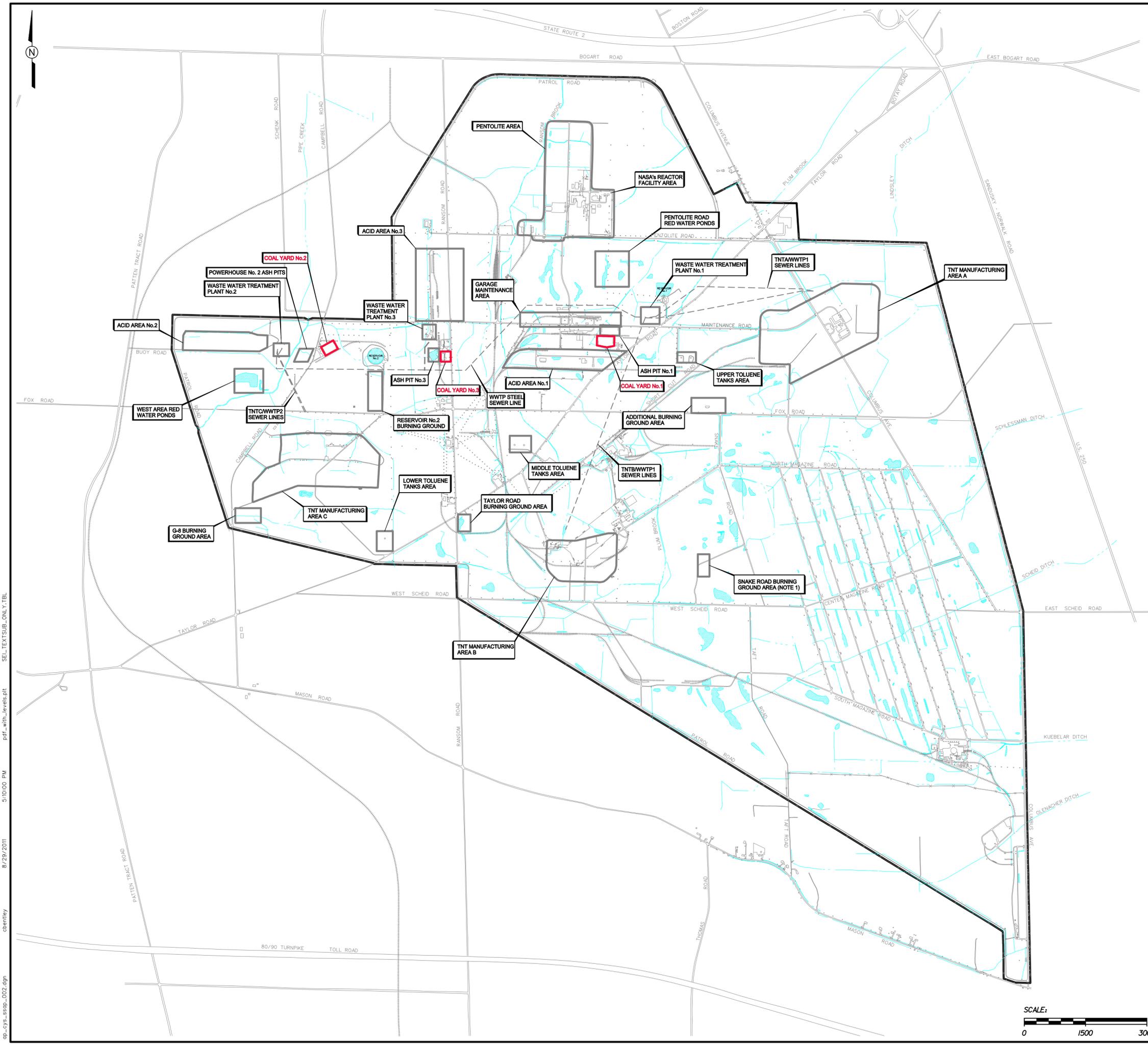
FORMER PLUM BROOK
ORDNANCE WORKS

FIGURE 1-1
PBOW VICINITY MAP



COAL YARDS SSAP
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO





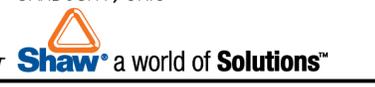
LEGEND:

- AREA OF CONCERN
- POND
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD
- FENCE
- FACILITY BOUNDARY

- NOTES:**
1. SNAKE ROAD BURNING GROUND AREA WAS ALSO REFERRED TO AS "SNAKE ROAD BURN PIT", "SCHEID ROAD BURNING GROUNDS", AND "DISPOSAL AREA THREE".
 2. REACTOR FACILITY CONSTRUCTED BY NASA POST WWII AND IS IDENTIFIED FOR LOCATION PURPOSES ONLY.

FIGURE 1-2
LOCATIONS OF COAL YARDS
AT PBOW

COAL YARDS SSAP
 FORMER PLUM BROOK ORDNANCE WORKS
 NASA PLUM BROOK STATION
 SANDUSKY, OHIO



8/29/2011 5:10:00 PM pdf_with_levels.plt SEL TEXTSUB_ONLY.TBL c Bentley op_cvs_ssrp_002.dgn

SEL_TEXTSUB_ONL.Y.TBL
 pdf_with_levels.plt
 5:12:55 PM
 8/29/2011
 cbentley
 ap_cys_ssop_006.dgn

LEGEND:

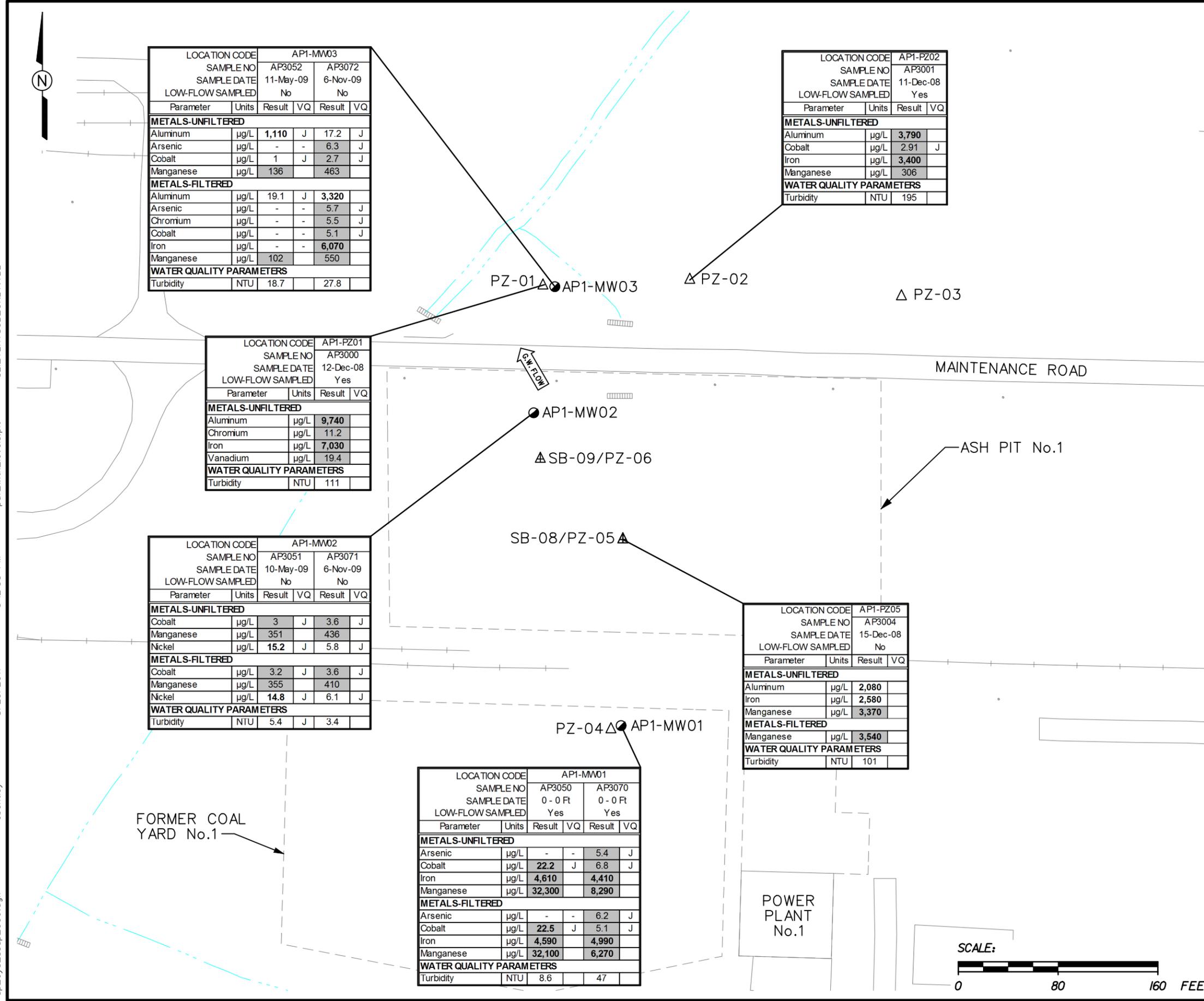
- OVERBURDEN MONITORING WELL (SCREENED IN SHALE)
- △ SOIL BORING/PIEZOMETER
- △ PIEZOMETER
- UTILITY POLE
- CREEK, DITCH, CONVEYANCE
- ug/L MICROGRAM PER LITER
- NE NOT ESTABLISHED (RBSCs)
- NOT DETECTED
- ← G.W. FLOW OVERBURDEN/SHALE GROUNDWATER FLOW DIRECTION (MAY 2009)

NOTES:

1. SHADED CELL INDICATES VALUE IS GREATER THAN THE RISK-BASED SCREENING CONCENTRATION (RBSC).
2. RBSC VALUES REFLECT AN INCREMENTAL LIFETIME CANCER RISK (ILCR) OF 1E-6 OR A NONCANCER HAZARD QUOTIENT (HQ) OF 0.1. FOR CHEMICALS THAT EXHIBIT BOTH CANCER AND NONCANCER EFFECTS, WHICHEVER TYPE OF EFFECT RESULTS IN A LOWER CONCENTRATION (USING AN ILCR OF 1E-6 AND AN HQ OF 0.1), THAT CONCENTRATION IS SELECTED AS THE RBSC.
3. BOLD TEXT INDICATES VALUE IS GREATER THAN THE BACKGROUND SCREENING CONCENTRATION (BSC).
4. RESULTS ONLY SHOWN IF ANALYTE EXCEEDED THE RBSC AND/OR BSC.
5. VALIDATION QUALIFIERS (VQ):
 J- THE COMPOUND/ANALYTE WAS POSITIVELY IDENTIFIED; THE REPORTED VALUE IS AN ESTIMATED CONCENTRATION.
 B- THE ANALYTE WAS NOT DETECTED SIGNIFICANTLY ABOVE THE LEVELS FOUND IN THE ASSOCIATED METHOD BLANK OR FIELD BLANKS.

FIGURE 1-3
 DETECTED CONSTITUENTS AT
 ASH PIT 1 IN OVERBURDEN/SHALE
 GROUNDWATER SAMPLES ABOVE
 RBSCs AND/OR BSCs (DECEMBER
 2008, MAY, AND NOVEMBER 2009)

COAL YARDS SSAP
 FORMER PLUM BROOK ORDNANCE WORKS
 NASA PLUM BROOK STATION
 SANDUSKY, OHIO



LOCATION CODE						AP1-MW03					
SAMPLE NO		AP3052			AP3072						
SAMPLE DATE		11-May-09			6-Nov-09						
LOW-FLOW SAMPLED		No			No						
Parameter		Units	Result	VQ	Result	VQ					
METALS-UNFILTERED											
Aluminum	µg/L	1,110	J	17.2	J						
Arsenic	µg/L	-	-	6.3	J						
Cobalt	µg/L	1	J	2.7	J						
Manganese	µg/L	136		463							
METALS-FILTERED											
Aluminum	µg/L	19.1	J	3,320							
Arsenic	µg/L	-	-	5.7	J						
Chromium	µg/L	-	-	5.5	J						
Cobalt	µg/L	-	-	5.1	J						
Iron	µg/L	-	-	6,070							
Manganese	µg/L	102		550							
WATER QUALITY PARAMETERS											
Turbidity	NTU	18.7		27.8							

LOCATION CODE				AP1-PZ02			
SAMPLE NO		AP3001					
SAMPLE DATE		11-Dec-08					
LOW-FLOW SAMPLED		Yes					
Parameter		Units	Result	VQ			
METALS-UNFILTERED							
Aluminum	µg/L	3,790					
Cobalt	µg/L	2.91	J				
Iron	µg/L	3,400					
Manganese	µg/L	306					
WATER QUALITY PARAMETERS							
Turbidity	NTU	195					

LOCATION CODE						AP1-PZ01					
SAMPLE NO		AP3000									
SAMPLE DATE		12-Dec-08									
LOW-FLOW SAMPLED		Yes									
Parameter		Units	Result	VQ							
METALS-UNFILTERED											
Aluminum	µg/L	9,740									
Chromium	µg/L	11.2									
Iron	µg/L	7,030									
Vanadium	µg/L	19.4									
WATER QUALITY PARAMETERS											
Turbidity	NTU	111									

LOCATION CODE						AP1-MW02					
SAMPLE NO		AP3051			AP3071						
SAMPLE DATE		10-May-09			6-Nov-09						
LOW-FLOW SAMPLED		No			No						
Parameter		Units	Result	VQ	Result	VQ					
METALS-UNFILTERED											
Cobalt	µg/L	3	J	3.6	J						
Manganese	µg/L	351		436							
Nickel	µg/L	15.2	J	5.8	J						
METALS-FILTERED											
Cobalt	µg/L	3.2	J	3.6	J						
Manganese	µg/L	355		410							
Nickel	µg/L	14.8	J	6.1	J						
WATER QUALITY PARAMETERS											
Turbidity	NTU	5.4	J	3.4							

LOCATION CODE				AP1-PZ05			
SAMPLE NO		AP3004					
SAMPLE DATE		15-Dec-08					
LOW-FLOW SAMPLED		No					
Parameter		Units	Result	VQ			
METALS-UNFILTERED							
Aluminum	µg/L	2,080					
Iron	µg/L	2,580					
Manganese	µg/L	3,370					
METALS-FILTERED							
Manganese	µg/L	3,540					
WATER QUALITY PARAMETERS							
Turbidity	NTU	101					

LOCATION CODE						AP1-MW01					
SAMPLE NO		AP3050			AP3070						
SAMPLE DATE		0 - 0 Ft			0 - 0 Ft						
LOW-FLOW SAMPLED		Yes			Yes						
Parameter		Units	Result	VQ	Result	VQ					
METALS-UNFILTERED											
Arsenic	µg/L	-	-	5.4	J						
Cobalt	µg/L	22.2	J	6.8	J						
Iron	µg/L	4,610		4,410							
Manganese	µg/L	32,300		8,290							
METALS-FILTERED											
Arsenic	µg/L	-	-	6.2	J						
Cobalt	µg/L	22.5	J	5.1	J						
Iron	µg/L	4,590		4,990							
Manganese	µg/L	32,100		6,270							
WATER QUALITY PARAMETERS											
Turbidity	NTU	8.6		47							



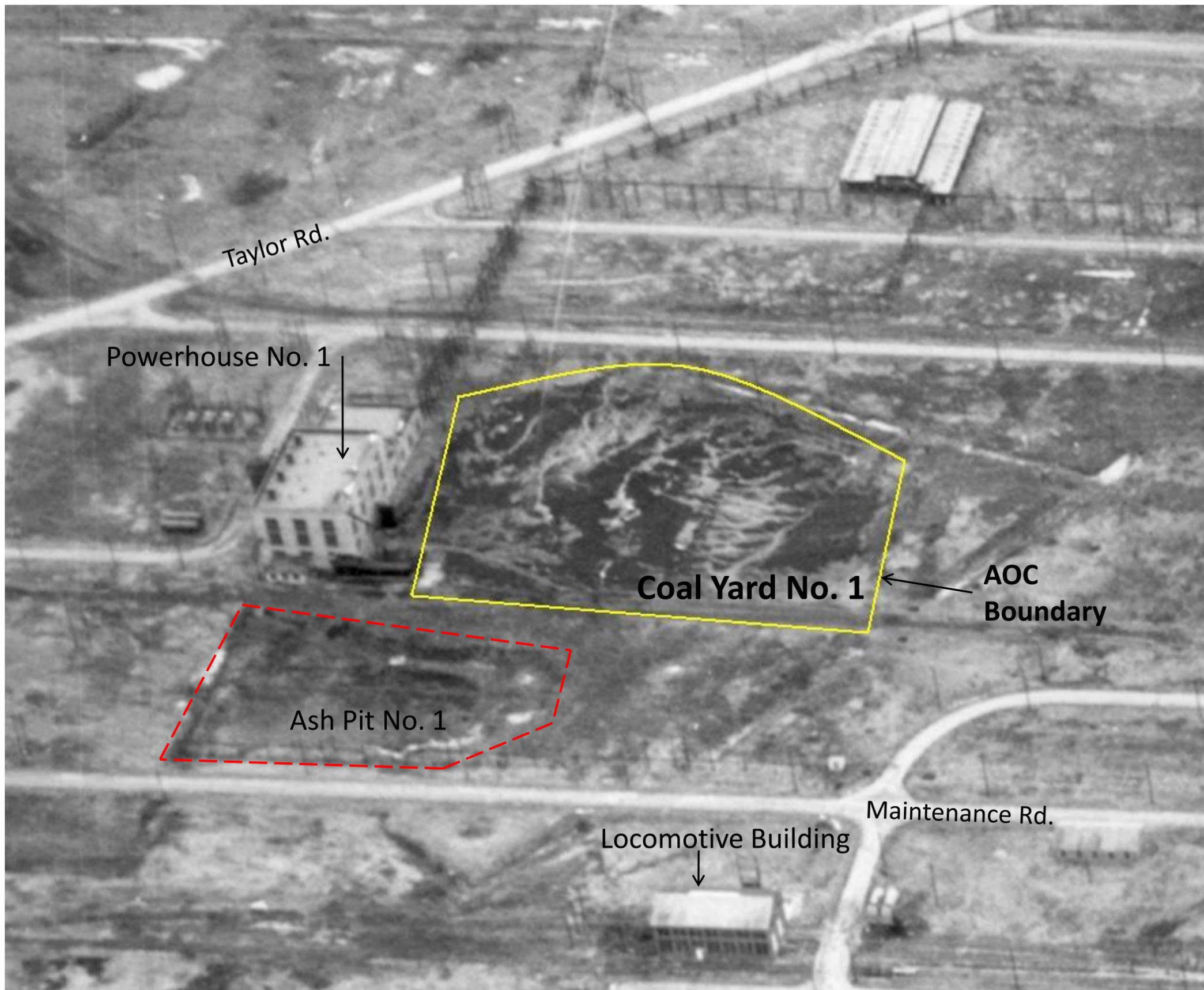


Figure 1-4
Coal Yard No. 1, Circa 1940s Photo (view is to the South)

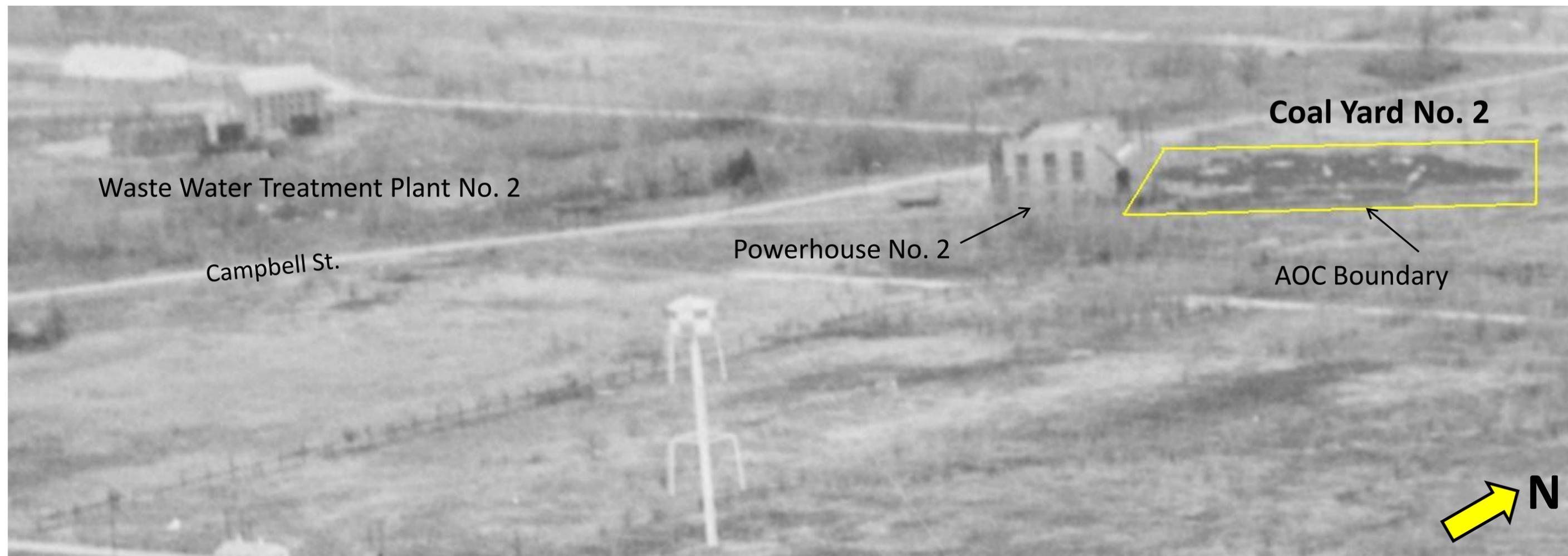
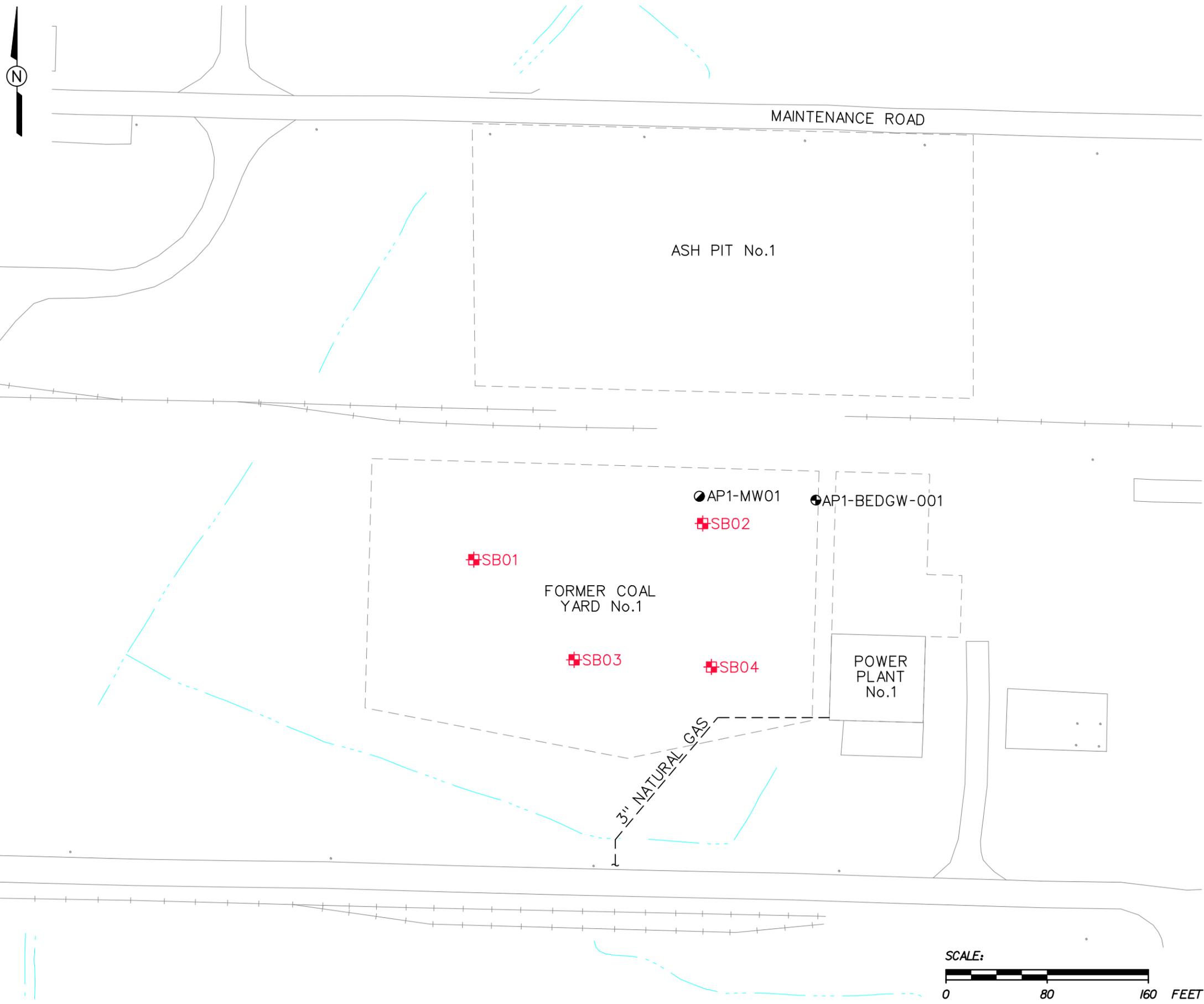


Figure 1-5
Coal Yard No. 2, Circa 1940s Photo
(View is to the Northwest)



Figure 1-6
Coal Yard No. 3, Circa 1940s Photo
(View is to the Southeast)

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LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- PROPOSED SOIL BORING
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD

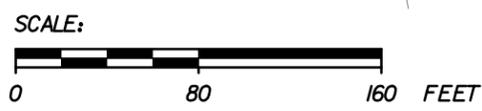
COORDINATES		
LOC_ID	EAST	NORTH
SB01	1918613	623314
SB02	1918795	623343
SB03	1918693	623235
SB04	1918801	623229

NOTES:

1. PROPOSED LOCATIONS MAY BE MOVED BASED ON FIELD OBSERVATIONS.
2. UTILITIES ARE BASED ON PRELIMINARY REVIEW OF NASA UTILITY MAPS. FINAL APPROVAL OF AREAS OF INTRUSIVE ACTIVITIES WILL BE DEPENDENT ON THE APPROVED NASA DIG PERMIT.

FIGURE 3-1
PROPOSED SOIL BORING
LOCATIONS AT COAL YARD No.1

COAL YARDS SSAP
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO



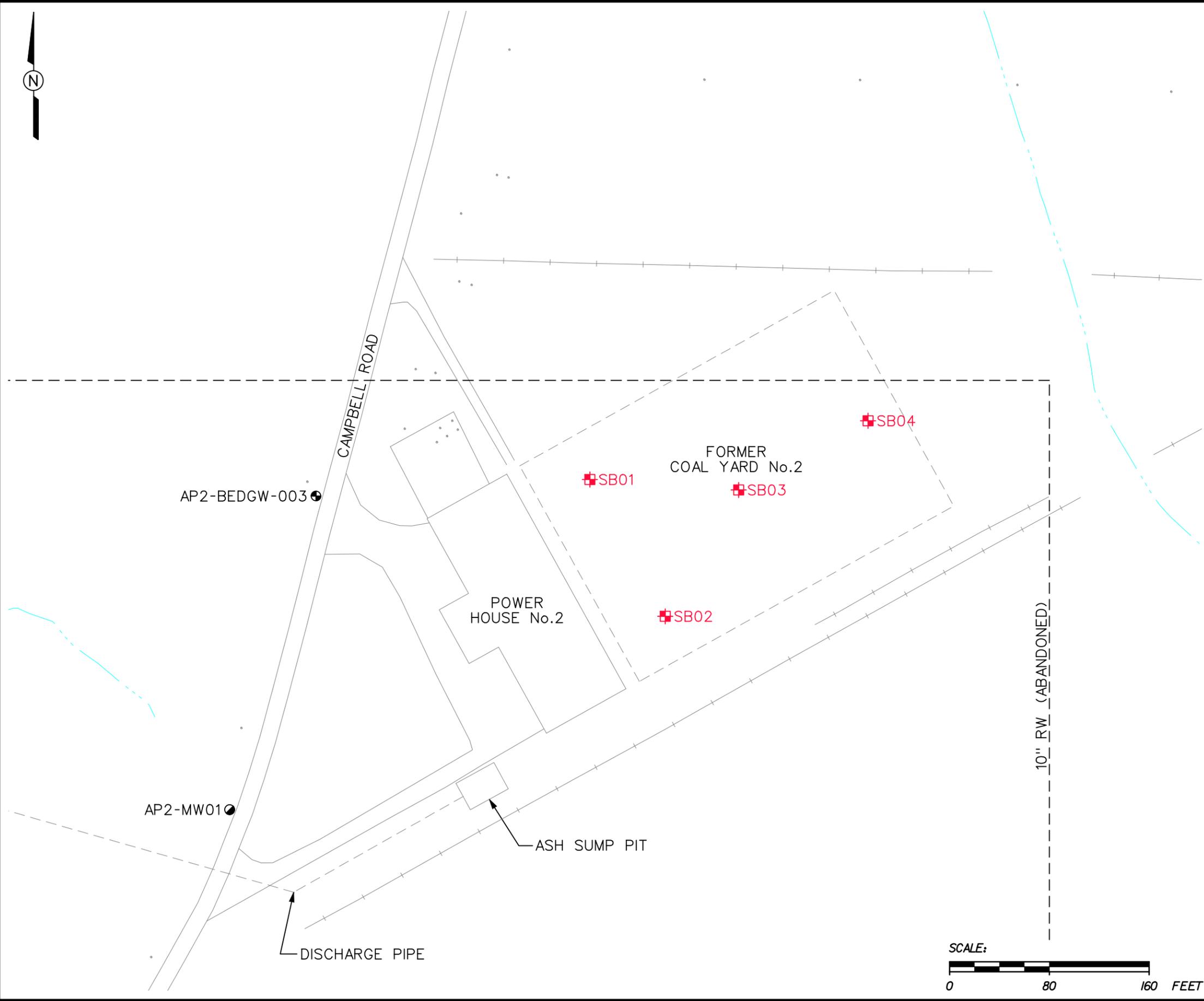


LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- PROPOSED SOIL BORING
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD

COORDINATES		
LOC_ID	EAST	NORTH
SB01	1911831	623123
SB02	1911891	623013
SB03	1911950	623114
SB04	1912054	623170

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NOTES:

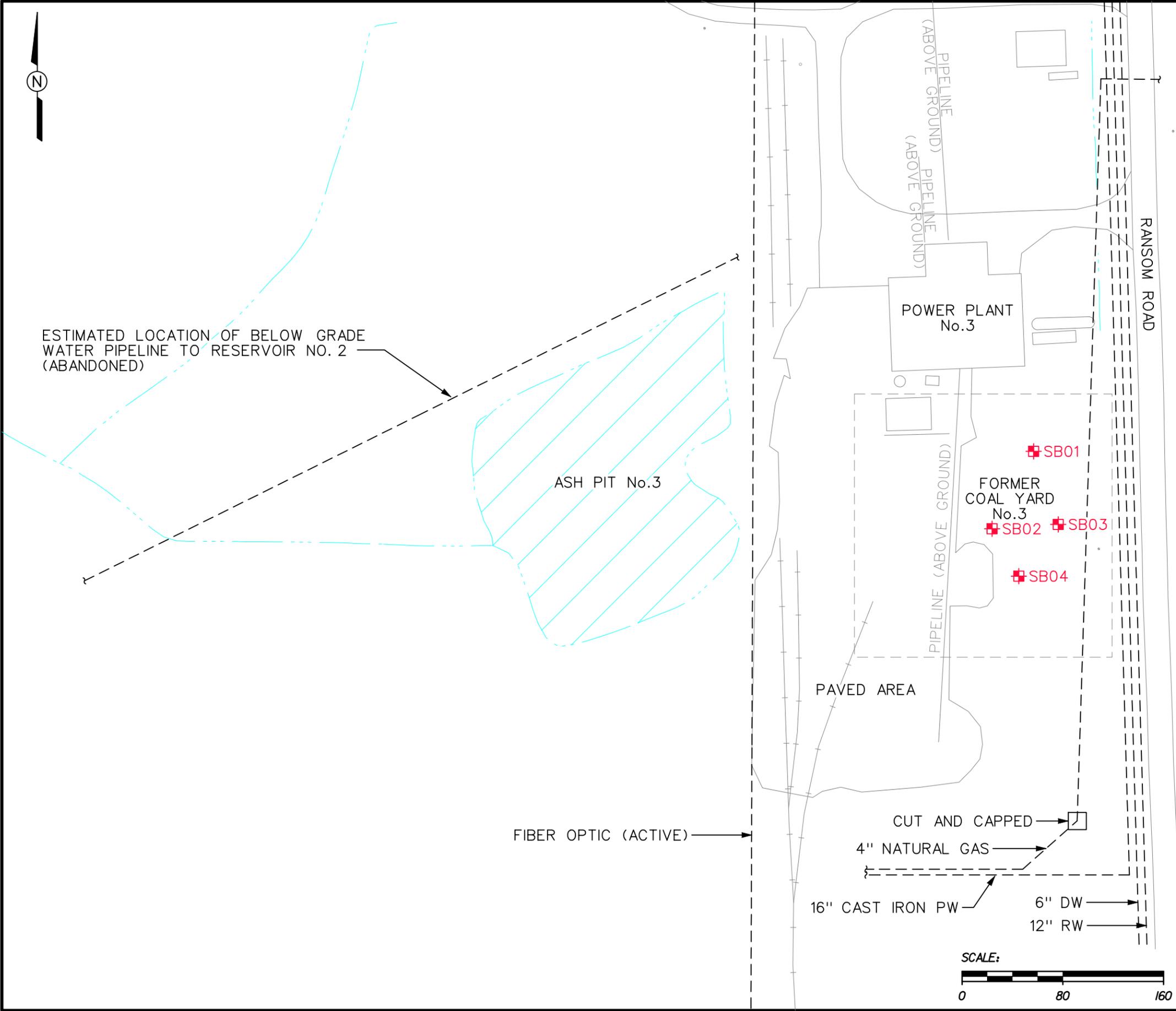
1. PROPOSED LOCATIONS MAY BE MOVED BASED ON FIELD OBSERVATIONS.
2. UTILITIES ARE BASED ON PRELIMINARY REVIEW OF NASA UTILITY MAPS. FINAL APPROVAL OF AREAS OF INTRUSIVE ACTIVITIES WILL BE DEPENDENT ON THE APPROVED NASA DIG PERMIT.

FIGURE 3-2
PROPOSED SOIL BORING
LOCATIONS AT COAL YARD No.2

COAL YARDS SSAP
 FORMER PLUM BROOK ORDNANCE WORKS
 NASA PLUM BROOK STATION
 SANDUSKY, OHIO



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LEGEND:

- + PROPOSED SOIL BORING
- CREEK, DITCH, CONVEYANCE
- RAILROAD
- ROAD

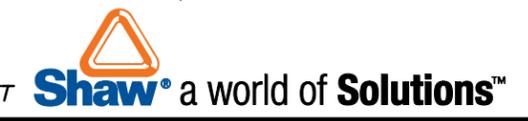
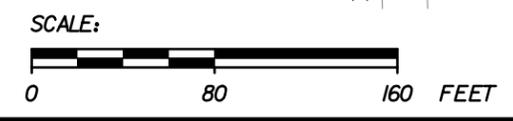
COORDINATES		
LOC_ID	EAST	NORTH
SB01	1914833	622966
SB02	1914800	622905
SB03	1914852	622908
SB04	1914821	622867

NOTES:

1. PROPOSED LOCATIONS MAY BE MOVED BASED ON FIELD OBSERVATIONS.
2. UTILITIES ARE BASED ON PRELIMINARY REVIEW OF NASA UTILITY MAPS. FINAL APPROVAL OF AREAS OF INTRUSIVE ACTIVITIES WILL BE DEPENDENT ON THE APPROVED NASA DIG PERMIT.

FIGURE 3-3
PROPOSED SOIL BORING
LOCATIONS AT COAL YARD No.3

COAL YARDS SSAP
 FORMER PLUM BROOK ORDNANCE WORKS
 NASA PLUM BROOK STATION
 SANDUSKY, OHIO



APPENDIX A

LABORATORY REPORTING AND QUALITY CONTROL LIMITS

Target Compound List
Volatile Organic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-8260B
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

(Page 1 of 2)

Compound	Soils Reporting Limit ^a (µg/kg)	Groundwater Reporting Limit (µg/L)
Acetone	50	25
Benzene	5	1
Bromodichloromethane	5	1
Bromoform	5	1
Bromomethane	5	2
2-Butanone	25	10
Carbon disulfide	5	2
Carbon tetrachloride	5	1
Chlorobenzene	5	1
Chlorodibromomethane	5	1
Chloroethane	5	2
Chloroform	5	1
Chloromethane	5	2
cis-1,3-Dichloropropene	5	1
1,1-Dichloroethane	5	1
1,1-Dichloroethene	5	1
1,2-Dichloroethane	5	1
1,2-Dichloroethene (total)	5	1
1,2-Dichloropropane	5	1
trans-1,3-Dichloropropene	5	1
Ethyl benzene	5	1
2-Hexanone	25	10
Methylene chloride	10	5

Target Compound List
Volatile Organic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-8260B
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

(Page 2 of 2)

Compound	Soils Reporting Limit ^a (µg/kg)	Groundwater Reporting Limit (µg/L)
4-Methyl-2-pentanone	25	10
Styrene	5	1
Tetrachloroethene	5	1
1,1,2,2-Tetrachloroethane	5	1
Toluene	5	1
Trichloroethene	5	1
1,1,1-Trichloroethane	5	1
1,1,2-Trichloroethane	5	1
Vinyl chloride	5	1
Xylenes (total)	15	3

a. Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factors, etc. Reporting limits are based on the LOQ (DOD QSM 4.2 [2010]).

Target Compound List
Semivolatile Organic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-8270D
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

(Page 1 of 3)

Compound	Soils Reporting Limits ^a (µg/kg)	Groundwater Reporting Limits (µg/L)
Acenaphthene	170	5
Acenaphthylene	170	5
Anthracene	170	5
Benzo(a)anthracene	170	5
Benzo(a)pyrene	170	5
Benzo(b)fluoranthene	170	5
Benzo(g,h,i)perylene	170	5
Benzo(k)fluoranthene	170	5
4-Bromophenyl-phenyl ether	170	5
Butyl benzyl phthalate	170	5
Carbazole	170	5
Chrysene	170	5
bis(2-Chloroethoxy)methane	170	5
bis(2-Chloroethyl)ether	170	5
4-Chloro-3-methylphenol	170	5
4-Chloroaniline	170	5
2-Chloronaphthalene	170	5
2-Chlorophenol	170	5
4-Chlorophenyl-phenyl ether	170	5
Di-n-butyl phthalate	170	5
Di-n-octyl phthalate	170	5
Dibenzo(a,h)anthracene	170	5
Dibenzofuran	170	5

Target Compound List
Semivolatile Organic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-8270D
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

(Page 2 of 3)

Compound	Soils Reporting Limits ^a (µg/kg)	Groundwater Reporting Limits (µg/L)
1,2-Dichlorobenzene	170	5
1,3-Dichlorobenzene	170	5
1,4-Dichlorobenzene	170	5
3,3'-Dichlorobenzidine	330	10
2,4-Dichlorophenol	170	5
Diethyl phthalate	170	5
Dimethyl phthalate	170	5
2,4-Dimethylphenol	170	5
4,6-Dinitro-2-methylphenol	330	10
2,4-Dinitrophenol	830	25
2,4-Dinitrotoluene	170	5
2,6-Dinitrotoluene	170	5
bis(2-Ethylhexyl)phthalate	170	5
Fluoranthene	170	5
Fluorene	170	5
Hexachlorobenzene	170	5
Hexachlorobutadiene	170	5
Hexachlorocyclopentadiene	330	10
Hexachloroethane	170	5
Indeno(1,2,3-cd)pyrene	170	5
Isophorone	170	5
2-Methylnaphthalene	170	5
2-Methylphenol	170	5

Target Compound List
Semivolatile Organic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-8270D
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

(Page 3 of 3)

Compound	Soils Reporting Limits ^a (µg/kg)	Groundwater Reporting Limits (µg/L)
4-Methylphenol	170	5
Naphthalene	170	5
2-Nitroaniline	170	5
3-Nitroaniline	170	5
4-Nitroaniline	170	5
Nitrobenzene	170	5
2-Nitrophenol	170	5
4-Nitrophenol	830	25
N-Nitroso-di-n-propylamine	170	5
N-nitrosodiphenylamine	170	5
2,2'-oxybis (1-Chloropropane)	170	5
Pentachlorophenol	830	25
Phenanthrene	170	5
Phenol	170	5
Pyrene	170	5
1,2,4-Trichlorobenzene	170	5
2,4,5-Trichlorophenol	170	5
2,4,6-Trichlorophenol	170	5

a Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factor, etc. Reporting limits are based on the LOQ (DOD QSM 4.2 [2010]).

**Target Compound List
Pesticides/PCB Compounds and Laboratory Reporting Limits
for Soil and Groundwater Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio
(Methods SW-846 8081B/8082A)**

(Page 1 of 2)

Compound	Soil/Sediment Reporting Limit ^a (µg/kg)	Water Reporting Limit (µg/L)
Aldrin	1.7	0.05
Aroclor 1016	17	0.5
Aroclor 1221	17	0.5
Aroclor 1232	17	0.5
Aroclor 1242	17	0.5
Aroclor 1248	17	0.5
Aroclor 1254	17	0.5
Aroclor 1260	17	0.5
alpha-BHC	1.7	0.05
beta-BHC	1.7	0.05
delta-BHC	1.7	0.05
gamma-BHC (Lindane)	1.7	0.05
Chlordane (Technical)	17	0.5
4,4'-DDD	3.3	0.1
4,4'-DDE	3.3	0.1
4,4'-DDT	3.3	0.1
Dieldrin	1.7	0.05
Endrin	3.3	0.1
Endrin aldehyde	3.3	0.1
Endosulfan I	1.7	0.05
Endosulfan II	1.7	0.05
Heptachlor	1.7	0.05
Heptachlor epoxide	1.7	0.05

**Target Compound List
Pesticides/PCB Compounds and Laboratory Reporting Limits
for Soil and Groundwater Samples
Former Plum Brook Ordnance Works
Sandusky, Ohio
(Methods SW-846 8081B/8082A)**

(Page 2 of 2)

Compound	Soil/Sediment Reporting Limit ^a (µg/kg)	Water Reporting Limit (µg/L)
Methoxychlor	3.3	0.1
Toxaphene	83	2.5

a Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factors, etc. Reporting limits are based on the LOQ (DOD QSM 4.2 [2010]).

**Target Compound List
Nitroaromatic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-846 8330A
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio**

Compound	Soils Reporting Limit ^a (mg/kg)	Groundwater Reporting Limit (µg/L)
4-Amino-2,6-dinitrotoluene	0.2	0.2
1,3-Dinitrobenzene	0.2	0.2
2,4-Dinitrotoluene	0.2	0.2
2,6-Dinitrotoluene	0.2	0.2
HMX	0.2	0.2
Nitrobenzene	0.2	0.2
2-Nitrotoluene	0.2	0.2
3-Nitrotoluene	0.2	0.2
RDX	0.2	0.2
Tetryl	0.2	0.2
1,3,5-Trinitrobenzene	0.2	0.2
2,4,6-Trinitrotoluene	0.2	0.2

a Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factor, etc. Reporting limits are based on the LOQ (DOD QSM 4.2 [2010]).

Target Analyte List
Inorganic Compounds and Laboratory Reporting Limits
for Soil and Groundwater Sample SW-846, 6010C/7470A/7471B
Site Investigations and Groundwater Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

Analyte	Soils Reporting Limit ^a (mg/kg)	Groundwater Reporting Limit (mg/L)
Aluminum	10	0.2
Antimony	1.0	0.006
Arsenic	0.5	0.01
Barium	10	0.2
Beryllium	0.25	0.004
Cadmium	0.2	0.005
Calcium	250	1
Chromium	0.5	0.01
Cobalt	2.5	0.05
Copper	1.25	0.025
Iron	15	0.3
Lead	1.0	0.005
Magnesium	250	5
Manganese	0.75	0.015
Mercury	0.083	0.001
Nickel	2	0.04
Potassium	500	10
Selenium	1	0.01
Silver	0.5	0.01
Sodium	500	10
Thallium	0.5	0.01
Vanadium	2.5	0.05
Zinc	1.0	0.02
Total Cyanide	0.5	0.01

a Specific reporting limits are highly matrix dependent. Reporting limits are adjusted based on dryness calculations, dilution factor, etc. Reporting limits are based on the LOQ (DOD QSM 4.2 [2010]).

RESPONSES TO COMMENTS

Response to Review Comments
Draft Site-Specific Sampling and Analysis Plan
Investigation of Coal Yards in the Areas of Ash Pit Nos. 1 & 3 and
Powerhouse No. 2 Ash Pit
Former Plum Brook Ordnance Works, Sandusky, Ohio

Comments received September 27, 2011 from Carol Lee Dona, USACE-CX

Comment 1: Page 1-2, Section 1-2, and Figure 1-3: As evidenced in Figure 1-3, a number of the wells with elevated manganese in the groundwater also have elevated iron. As iron and manganese both show the tendency to dissolve under reducing geochemical conditions, the coupling of elevated iron and manganese together may indicate (and be due to) reducing geochemical conditions. Recommend that the coupling of elevated iron and manganese, along with the potential that the elevated concentrations may be due, at least in part, to reducing geochemical conditions, be included in the discussion in Summary of Existing Data, Section 1.2.

Response 1: Review of the site specific overburden/shale groundwater data for Ash Pit 1 presented in the Final Ash Pit 1 and Ash Pit 3 Site Characterization Report (Shaw, 2010) indicates possible correlations between some of the groundwater geochemical parameters and dissolved iron and manganese concentrations. Groundwater quality data suggests that the overburden/shale may be characterized as being in a reduced state with relatively low dissolved oxygen concentrations (less than 3 mg/l) and negative oxidation/reduction potentials. Ferrous iron was only detected in one overburden/shale monitoring well (AP-MW01 at 2 mg/l and 4 mg/l). The text has been revised to incorporate additional information (DO, Eh, pH, ferrous iron, etc) from previous groundwater sampling events at Ash Pit No. 1.

Comment 2: Page 1-2, Section 1-2: Recommend that the relative contributions of thallium and manganese to the hazard coefficient be included, i.e. is one a much larger contributor than the other?

Response 2: The last full sentence at the bottom of the page 1-2 will be revised consistent with the following: “Results of the Baseline Human Health Risk Assessment (Shaw, 2011) concluded that the *elevated concentrations of manganese and thallium in well AP-MW01 would result in noncancer hazard quotient values for both of these analytes that would exceed the hazard index goal (i.e., ≤ 1) by more than an order of magnitude*, assuming residential consumption of overburden/shale groundwater.”

Comment 3: **General:** Recommend that data be collected that can be used to determine the geochemical conditions in the groundwater. No description of this type of data collection was found in the SAP. Collection of this type of data will be helpful in determining if the elevated metals, particularly manganese, are due to reducing geochemical conditions (See Comment #1). The minimum set of

parameters recommended are dissolved oxygen, oxidation reduction potential, and ferrous iron in the field and nitrate and sulfate in the lab. The information from this data can be used to both determine if the groundwater is reducing and, if so, how reducing the groundwater is. This information in turn, can be used to determine if the manganese is being released naturally. Please indicate where collection of this type of data is located, if included in the current SAP, or, if not included, please include.

Response 3: See response to comment #1.

Comments received September 27, 2011 from Terry L. Walker, USACE-CX.

Comment 1: Section 2.2.4, page 2-3. The goal of an RI is to determine nature and extent of contamination. Insure that adequate samples are taken for this goal such that the statement in Section 2.2.7 (“If after completion of the sampling activities, results indicate that contamination is encountered at concentrations that pose a significant threat to public health or the environment, then additional evaluation will be recommended.”) is not necessary.

Response 1: The coal yards have not yet been sampled. Therefore, no determination has been made as to whether contamination exists within these areas. The 12 samples planned to be collected from the four borings are intended to determine the nature and vertical extent of contamination, if present. In addition, lithologic borings have been added to determine the extent of the coal yards. Please see the response to Mao Comment No. 3 for the suggested revision to the referenced sentence.

Comments received September 30, 2011 from Janet K. Wolfe, LRH

Comment 1: Section 1.2, Summary of Existing Site Data. Provide information on whether PAH semi-volatiles were included in the groundwater investigation of Ash Pit No. 1. If no previous groundwater investigation included PAHs, then investigation of groundwater for PAHs may be warranted at the Coal Yards.

Response 1: Ash Pit No. 1 groundwater samples were analyzed for semivolatiles. This information will be included in the revised report.

Comment 2: Section 2.2.7, Decision Rules. A copy of the current residential soil RSLs needs to be included in the SAP.

Response 2: The decision rules reference the RI report, which is where the current RBSCs, which are based on the RSLs, will be provided. Please note that the current RSLs at the time of RI report commencement will be used and referenced in the RI reports for the respective coal yards. It is expected that now-current June 2011 RSLs will be updated later this year. A current RSL web site will be added to the reference for the RSLs. Also note that the SAP is intended primarily as a field document and the addition of the RSLs would not make the document any more useful to field personnel.

Comment 3: Section 2.2, Site-Specific Data Quality Objectives & Section 3.0, Field Activities. Provide a statement that indicates whether groundwater at the Coal Yards will be investigated in the future. Provide a statement justifying why volatiles analysis is not a parameter of concern for the coal yards.

Response 3: Agreed. Review of existing information does not indicate volatiles are a concern at this site. Additional information has been added to the section discussing the potential sources of contamination that dictate the selection of the analytical suite proposed in this work plan. As noted in the second paragraph of this section, groundwater use in this area is implausible due to insufficient yield and therefore, no additional groundwater investigation is planned. The investigation is focused on determining if there is a concern from direct contact to any contaminants in site soil.

Comment 4: Section 2.2.5, Information Input. Discuss problematic RSLs that may be lower than any reporting limits. For instance, the residential screening level for benzo(a)pyrene is often lower than typical reporting limits.

Response 4: Text consistent with the following will be added: “The detection limits achieved using the specified methods are generally less than screening levels used for risk assessments. Cases where these methods exceed the screening levels will be addressed in the human health and ecological risk assessment reports.”

Comment 5: Section 3.1, Soil Remedial Investigation and Table 4-1. Justify why the incremental sampling approach under Test Method 8330B is not warranted for collection of surface soil samples for nitroaromatics analysis.

Response 5: The sampling of the soil at the Coal Yards is anticipated to involve judgment with respect to the coal material. As described in Section 3.1.1, the sampling intervals at each location, including surface soil, may be adjusted to ensure that soil is sampled and not the coal material. Thus, the “surface soil in some areas may be the soil that is directly below coal material. The actual depth sampled at each location may provide critical information for that location. The use of MIS would likely result in multiple sampling depths being combined into a single composited sample. Also, the coal yard samples are being collected to fill a potential data gap overlooked during the site investigations that were conducted during the 1990’s for the respective ash pit areas. These ash pit investigations were conducted using grab samples. Thus, the use of grab samples at the ash pits would provide for better comparability to the adjacent ash pit samples.

Comment 6: Section 4.1, Sample Numbering system. The Well ID for location shown in one of the table columns is not applicable to this sampling event.

Response 6: Agreed. The text will be revised as requested.

Comment 7: Section 4.3, Decontamination Procedures. The IDW Plan, including decon procedures, is discussed in Chapter 6.0. Therefore, change the reference to Chapter 5.0 to Chapter 6.0.

Response 7: Agreed. The text will be revised as requested.

Comment 8: **Section 6.2, Decontamination Fluid. Justify that the evaporation of small quantities of solvents meets USEPA guidance for IDW waste.**

Response 8: Reference will be made to EPA IDW guidance (Guide to Management of Investigation-Derived Wastes, Publication 9345.3-03FS) and the text revised accordingly.

Comment 9: **Tables 4-1 & 5-1. No groundwater IDW will be generated for this project. Revise the tables to eliminate references to groundwater.**

Response 9: Agreed. The table will be revised to reflect that this is for liquid IDW (decon water).

Comments received September 27, 2011 from Chung-Rei Mao, USACE-CX

Comment 1: **Page 2-4, Section 2.2.5, 2nd bullet: Please clarify that “Data will have reporting limits based on the limit of detection (as defined in the DoD Quality Systems Manual, Version 4.2)...” According to Page B-8 of DoD QSM V4.2, a reporting limit (RL) is defined as “A client-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix.” A project-specific RL could be the regulatory levels, RBSC, RSC, etc. and shall be greater than the Limit of Quantitation (LOQ) of the contract laboratory if the data precision and bias between the RL and the LOQ are equivalent. How much the RL shall be greater than the LOQ shall be determined based on the anticipated data quality (i.e., precision and bias) and project tolerable decision errors (i.e., Types I and II) as established based on the DQO process during project planning meeting.**

Response 1: This work is being performed under the Basewide QAPP (Shaw, 2008). At the onset of the project, it was determined and accepted by the regulators the laboratory’s LOQs are sufficient to use as project RLs.

Comment 2: **Page 2-5, Section 2.2.7, 1st paragraph: Please clarify the “qualitative evaluation” process in “Background contributions associated with these organic compounds will be qualitatively evaluated in the risk assessments as appropriate.” Also, which organic compounds? Typically, PAHs are the only naturally occurring and/or non-site related anthropogenic organic contaminants. Suggest that background PAH concentration in surface soils be investigated too.**

Response 2: Surface soil samples were collected from nearby off-site locations and analyzed for PAHs several years ago. All of these sample results were nondetect for PAHs. However, burning has been used historically and is still used at PBOW for weed control. Please note that PBOW has been used by NASA for nearly 50 years. This burning represents a known, but unquantifiable source of non-DoD-related PAH

contamination. Therefore, a qualitative evaluation of PAHs is appropriate, especially where no DoD-related source of PAHs is known and PAHs are otherwise unexpected. It is agreed that typically only PAHs and pesticides (not evaluated at PBOW) are typically the only organics evaluated with respect to background soil. However, all risk-driving chemicals including organics are considered, as appropriate, for a qualitative evaluation of site relatedness, based on site-specific information. The referenced sentence will be revised as follows: Background contributions associated with these organic compounds will be qualitatively evaluated in the risk assessments, *as appropriate, based on relevant site-specific information that may exist for the chemicals in question.*

Comment 3: **Page 2-5, Section 2.2.7, last paragraph: Please clarify the actual procedures to be used for making reliable decisions. For example, how will the data be compared with the RBSC and BSC? How will the results of a small number of non-random samples be used for reliable decision making?**

Response 3: The text will be revised to state that each detected concentration will be compared to the RBSC and BSC (for inorganics). A table which presents all of the detected analytes will also list the maximum detected concentration of each analyte beside the RBSC and (for inorganics) BSC. With respect to a public health concern, the coal yards are not currently being used for any purpose, so there is very little opportunity for exposure under current land use. However, if highly elevated concentrations of contaminants are identified, then the Shaw and USACE risk assessors and/or health and safety personnel will be consulted. The bullets at the end of Section 2.2.7 will be revised consistent with the following:

- If after completion of the sampling activities, results indicate that contamination is not encountered at concentrations that *may* pose a significant threat to public health or the environment, then additional evaluation will not be recommended *prior to the risk assessments*. Results will be reported in an RI report.
- If after completion of the sampling activities, results indicate that contamination is encountered at concentrations that *may* pose a significant threat to public health or the environment, then *Shaw and USACE risk assessors and/or health and safety personnel will be consulted*. Additional evaluation *may* be recommended *prior to the risk assessments, which would be documented in an RI report*.

Comment 4: **Page 2-6, Section 2.2.8, 3rd paragraph: The sentence of “...if the analytical reporting limits exceed target goals, or if the analytical methods have an unacceptably high margin of error” seems to indicate that the RLs are lab’s LOQ, instead of “project-specific required RL (see comment 1). If the RLs are lab’s LOQs, the lab’s LOQ may be higher than the project-specific RL or target goals and still meet project DQOs if the data quality of lab’s LOQ are better than those of the project RLs. Also, please clarify and quantify the “unacceptably high” margin of error.**

- Response 4:** The RLs are the labs LOQs instead of project specific RLs. The laboratory LOQs meet the project DQOs. The analytical methods and laboratory error is measured via the collection of field splits. Split samples will be collected in conjunction with field duplicate samples. The split samples will be submitted to the laboratory for the same analysis as their corresponding field duplicates and original field samples. The split samples are used to determine if data results are reproducible when analyzed by two different laboratories. Results are also evaluated to determine if a contracted laboratory's preparation and analysis procedures are in control and meet the approved method criteria. An acceptance criterion of 30 percent RPD for waters and 50 percent RPD for soils will be used to evaluate these sample results.
- Comment 5:** **Page 2-7, Section 3.0, 1st paragraph and Page 3-2, Section 3.1.1, 1st paragraph: The sample size of 4 bore holes per AOC is too small for reliable determination of the "extent" of contamination area at each AOC.**
- Response 5:** Agreed. The lateral extent of the coal yards will be delineated based on visual evidence. As noted in the work plan, residual coal is still present at the site. Additional lithologic borings coupled with historical air photographs will be used to verify the extent of the coal yards. The four borings will be used to determine if contamination is present and if additional work is required for delineation. The text has been revised to reflect this information.
- Comment 6:** **Table 3-1: Please clarify footnotes "a" and "b". Regarding footnote "a", there is no Table 3-2. There is no footnote "b" for Source Water. Also, please clarify the "RCI" of Water IDW Samples. In addition, please state the purpose of "TOC" analysis.**
- Response 6:** Table 3-1: Footnote a will be removed. There are no water samples associated with this field effort. Footnote b will be changed to footnote a and the source water defined. RCI (Reactivity, Corrosivity, and Ignitability) will be added to the definitions.
- Comment 7:** **Page 3-3, Section 3.1.1, 2nd paragraph: Because Coal Yard 3 was regraded and covered with 6" of gravels to serve as a parking area by NASA, the soils immediately below the fill material may be contaminated with petroleum hydrocarbons, including TPHs, PAHs and metals, from NASA activities.**
- Response 7:** There is the potential for NASA-related contamination at this site as noted in this comment. Therefore, sampling will focus on the area outside (east) of the gravel area that NASA has not impacted.
- Comment 8:** **Page 3-3, Section 3.1.1, last paragraph: Explosives analyses were not addressed in this paragraph.**
- Response 8:** Nitroaromatics analysis is mention in the third paragraph, first sentence.
- Comment 9:** **Table 4-1: Suggest that Table 4-1 be revised to include only project-specific requirements. For example, please clarify why ignitability, pH, corrosivity,**

reactive cyanide, and reactive sulfate of Groundwater IDW are needed. Also, SW-846 9045D is for soil or waste samples, not aqueous samples. For aqueous samples, SW-846 9040C or 9041A should be used for pH measurements.

Response 9: Ignitability, pH, corrosivity, reactivity are only required for disposal. No site-related decisions are made from these data. The pH Method for aqueous waste will be revised to 9040C.

Comment 10: **Page 4-2, Section 4.3, 6th bullet: Dilute (0.1 N) hydrochloric acid is generally preferred to nitric acid when cleaning stainless steel because nitric acid may oxidize stainless steel. (See Page 107 of OSWER-9950.1.)**

Response 10: Agreed. Dilute hydrochloric acid will be used in lieu of nitric acid for decontamination of all stainless steel augers.

Comment 11: **Page 5-1, Section 5.0, 2nd paragraph: Sample holding time should be based on both date and time of sample collection, preparation, and analysis.**

Response 11: Page 5-1, Section 5.0, 2nd paragraph: The second sentence will be revised to read as follows: "Sample holding times will be calculated from the data and time the sample is collected."

Comment 12: **Page 6-1, Section 6.1: The final disposal of drummed IDW soil is not addressed.**

Response 12: Additional text has been added to reference Section 6.4 where sampling and IDW disposal are addressed.

Comment 13: **Page 6-2, Section 6.4, last paragraph: Please delete non-project-specific information regarding VOC samples. Needs to discuss how to collect a representative IDW waste sample from the water and soil IDW drums.**

Response 13: The VOC sampling information is project specific and required for IDW disposal. VOC samples are grab samples and not composite samples. VOCs are lost when samples are composited. Composite samples are collected based upon the judgment of the sampler. A sample of all materials present in the IDW will be composited and submitted for analysis.

Comment 14: **Appendix A: Those reporting limits seem to be the LOQs required for the project. Please clarify how those RLs were established and what the associated precision and bias are. Also, the footnote should be changed to QSM Version 4.2 (2010).**

Response 14: The reporting limits are the laboratory LOQs. The LOQs are established by the laboratory per the QSM Version 4.2 (2010). The footnote will be changed to QSM Version 4.2 (2010).

Comments received November 8, 2011 from Jim Beaujon, USACE-Nashville

Comment 1: Page (Pg) 1-1, 2nd paragraph (pph), 3rd & 5th lines: Change appropriate to read "indicated that a former powerhouse coal yard (Coal Yard 1)" and "In addition, two other powerhouse coal yards".

Response 1: Agreed.

Comment 2: Pg 1-2, 6th line of partial pph at top of pg: Change "maintained PBOW since" to "maintained the former PBOW site since".

Response 2: Agreed.

Comment 3: Pg 6-1, Section 6.1: This section seems to be out of sync with Section 3.2. Please revise appropriately.

Response 3: Agreed.

Comment 4: Pg 6-1, Section 6.3: There is no groundwater sampling planned at the coal yards. Please revise appropriately and specify "on-site Shaw contract dumpster".

Response 4: Agreed.

Comments received October 27, 2011 from Dr. Janusz Z. Byczkowski, Ohio EPA – Division of Emergency and Remedial Response

Comment 1: Several chemicals listed in "Target Compound List..." tables have reporting limits (RL) which exceed the respective OEPA-adjusted screening levels (SL) for soil and/or water. For example: Benzene in ground water (RL=1 ug/L > SL=0.41 ug/L); Carbon tetrachloride in ground water (RL=1 ug/L > SL=0.44 ug/L); Chloroform in ground water (RL=1 ug/L > SL=0.19 ug/L); 2-Hexanone in ground water (RL=10 ug/L > SL=4.7 ug/L); Tetrachloroethene in ground water (RL=1 ug/L > SL=0.11 ug/L); Vinyl chloride in ground water (RL=1 ug/L > SL=0.016 ug/L); Benzo(a)anthracene in soil (RL=170 ug/kg > SL=150 ug/kg) and in ground water (RL=5 ug/L > SL=0.029 ug/L); Benzo(a)pyrene in soil (RL=170 ug/kg > SL=15 ug/kg) and in ground water (RL=5 ug/L > SL=0.0029 ug/L); Chrysene in ground water (RL=5 ug/L > SL=2.9

For any chemical whose RL > SL, please consider analyzing samples by more sensitive method. The chemicals with RL > SL should be evaluated quantitatively in BHRA assuming their concentration in the medium = 1/2 of RL.

Response 1: The RLs and analytical methods listed in this SAP represent the current state of practice of environmental laboratories. The project RLs listed in the SAP coincide with the laboratory's LOQ. The laboratory's limit of detection for many of these

compounds is an order of magnitude lower than the LOQ. The RLs are based on the LOQ due to the uncertainty in quantitation when the concentration of a constituent is between the LOD and the LOQ. The data generated using this SP will be sufficient for risk assessment purposes, but this SAP is not intended to address specific risk assessment issues.