Third Quarterly Background Report
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared for:

U.S. Army Corps of Engineers, Nashville District
P. O. Box 1070
Nashville, Tennessee 37202-1070

Prepared by:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

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List of Acronyms

DNT	dinitrotoluene
DOD	U.S. Department of Defense
DQO	data quality objective
Eh	oxidation-reduction potential
EPA	U.S. Environmental Protection Agency
FUDS	Formerly Used Defense Sites
GSA	General Services Administration
IDW	investigation-derived waste
IT	IT Corporation
NASA	National Aeronautics and Space Administration
OEPA	Ohio Environmental Protection Agency
PBOW	Plum Brook Ordnance Works
PBS	Plum Brook Station
pH	hydrogen ion concentration
PRG	preliminary remediation goal
PRRWP	Pentolite Road Red Water Ponds
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RI	remedial investigation
SAP	sampling and analysis plan
SSAP	site-specific sampling and analysis plan
SSHP	site-specific sampling health and safety plan
SVOC	semivolatile organic compound
TNT	trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B
TNTC	TNT Area C
VOC	volatile organic compound
USACE	U.S. Army Corps of Engineers
WARWP	West Area Red Water Ponds

1.0 Introduction

The U.S. Army is conducting studies of the environmental impact of suspected hazardous waste sites at properties previously owned by the U.S. Department of Defense (DOD). The former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio is currently being investigated under the Defense Environmental Restoration Program for Formerly Used Defense Sites (FUDS). Figure 1-1 shows the geographical location of the former PBOW site. This 9,000-acre facility was used for the manufacture of explosives during World War II. The site is currently owned by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station (PBS) of the John Glenn Research Center with headquarters based out of Lewis Field in Cleveland, Ohio.

The investigation is being managed and technically overseen by the Nashville, Tennessee and Huntington, West Virginia District Offices of the U.S. Army Corps of Engineers (USACE). IT Corporation (IT) was contracted by the USACE, Nashville District to continue a groundwater remedial investigation (RI) at two red water pond areas and three former trinitrotoluene (TNT) manufacturing areas at PBOW. The two red water pond areas are the West Area Red Water Ponds (WARWP) and the Pentolite Road Red Water Ponds (PRRWP). The three former TNT manufacturing areas are TNT Area A (TNTA), TNT Area B (TNTB), and TNT Area C (TNTC) (Figure 1-2). This work was begun under Delivery Order 0010 of Contract Number DACA62-00-D-0002, dated December 10, 2001, and negotiations held on December 7, 2001. Background quarterly sampling is being performed under Delivery Order 0014, of the same contract number.

Third quarter groundwater sampling activities were conducted pursuant to the following documents: the final site-specific sampling and analysis plan (SSAP) and final site-specific safety and health plan (SSHP) (IT, 2001), the March 2002 letter amendment to the SSHP (IT, 2002), the site-wide sampling and analysis plan (SAP) (IT, 1996a), the quality assurance project plan (QAPP) (IT, 1996b), and the site-wide safety and health plan (IT, 1996c).

The purpose of the quarterly background sampling is to provide four seasonal collection events to evaluate groundwater quality and determine if a trending pattern is present in the groundwater of the background monitoring wells. If chemical concentrations in the background wells have not changed significantly over the first year of quarterly sampling, background groundwater

concentrations may be established and a second year of quarterly sampling may not be necessary.

1.1 Objectives

The objectives, as scoped (USACE, 2001), for the quarterly background sampling were as follows:

1. Determine the quality of bedrock groundwater entering the PBOW site.
2. Determine the quality of residuum groundwater upgradient of selected sites at PBOW.
3. Determine the range of background concentrations for inorganics in both residuum and bedrock groundwater.
4. Perform trend analysis to determine if any change in the concentration of inorganics is seasonally dependent.
5. Establish background concentrations of inorganics in residuum and bedrock groundwater.

It should be noted that due to drought conditions, establishing background concentrations of inorganics in residuum groundwater was eliminated from the objectives.

The groundwater sampling is scoped to include four quarters of data collection. After collection and analysis of the fourth quarter data, a full evaluation will be prepared. Trend analysis will be reviewed to determine if the data obtained are sufficient to establish background concentrations of inorganics in groundwater. If the evaluation suggests the data set is inconclusive, an additional four quarters of data will be required. The decision for continued groundwater sampling beyond the initial four quarters will be made by the USACE in conjunction with the Ohio Environmental Protection Agency (OEPA).

This report presents:

- Groundwater sampling procedures
- Results of the first, second, and third quarterly groundwater sampling events

- Laboratory analytical data of the third quarter sampling (first quarter results were presented in the 2001 Groundwater Remedial Investigation report, second quarter results were presented in the Second Quarterly Background Report)

- Handling and disposal of investigation-derived waste (IDW).

1.2 Facility Location and Description

As mentioned above, the former PBOW site is currently owned by NASA. Most of the aerospace testing facilities at PBOW were constructed in the 1960s and are presently in a standby or inactive status. The site is located approximately 4 miles south of Sandusky, Ohio, and 59 miles west of Cleveland. Although primarily in Perkins and Oxford Townships, the eastern edge of the site extends into Huron and Milan Townships. PBOW is bounded on the north by Bogart Road, on the south by Mason Road, on the west by County Road 43, and on the east by U.S Highway 250. The immediate area surrounding PBOW is mostly agricultural but along the northern and northeast perimeter, residential sections are present. Public access at PBOW is restricted except during the annual deer hunting season.

1.3 Site History and Potential for Contamination

The PBOW site was built in early 1941 as a manufacturing plant for 2,4,6-TNT, dinitrotoluene (DNT), and pentolite. Production of explosives began on December 16, 1941 and continued until 1945. It is estimated that more than one billion pounds of explosives were manufactured during the 4-year operating period.

After the plant was shut down, decontamination of TNT, acid, pentolite, and DNT processing lines began. Decontamination was completed during the last quarter of 1945. The property was initially transferred to the Ordnance Department and then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration (GSA).

NASA acquired PBOW on March 15, 1963, and is presently utilizing the site. On April 18, 1978, NASA declared approximately 2,152 acres of land as excess. The Perkins Township Board of Education acquired 46 acres of the excess for use as a bus transportation center. The GSA retains the remaining acreage and currently has a use agreement with the Ohio National Guard for 604 acres of the land. NASA presently controls about 6,400 acres and is using the site to conduct space research as a satellite operation of its John Glenn Research Center. The details

of these land transactions are listed in the site management plan and can be found at the NASA PBS.

Based on review of historical use of the site and findings of previous investigations, potential chemicals in the groundwater at PBOW may include nitroaromatic compounds (nitroaromatics), volatile organic compounds (VOC), semivolatile organic compounds (SVOC), cyanide, and inorganics.

2.0 Field Activities

2.1 Investigative Methods

Third quarter groundwater sampling of background monitoring wells was conducted following the same procedures used during the second quarter groundwater sampling events. Specific sampling procedures are detailed in the approved 2001 SSAP/SSHP and include minimal drawdown (low-flow) purging and sample collection or bailing.

2.2 Groundwater Sampling

Third quarter/second semi-annual groundwater sampling was conducted from April 2-15, 2002. Sampled background wells included four bedrock wells (PB-BED-MW20, PB-BED-MW24, BG8-BEDGW-001, and PB-BED-MW25). Table 2-1 shows a list of the groundwater samples collected. The background monitoring wells sampled are located on the extreme west and southwest portion of PBOW and were selected by the USACE based on the groundwater investigation conducted in 1997 (USACE, 2001) (Figure 2-1). Bedrock well PB-BED-MW26 was scheduled for sampling, however the well was dry so no groundwater sample could be collected. Overburden monitoring well IT-MW01 was also to be included in the background groundwater sampling, however no groundwater sample was able to be collected due to a dent in the riser section that prevented the pump and bailer from entering the well.

Groundwater samples were analyzed for nitroaromatics, metals (filtered and unfiltered), VOCs, SVOCs, and water quality parameters (alkalinity, chloride, cyanide, hardness, nitrate, sulfate, total dissolved solids, total organic carbon, total suspended solids, and turbidity). Final field measurements of groundwater samples are presented in Table 2-2. Well locations are shown on Figure 2-1. Sample collection logs are provided in Appendix A.

Two procedures were used for purging and sampling wells. Minimal drawdown (low-flow) was the preferred purging and sampling method in wells where adequate recharge was present. If a well did not recharge adequately to use minimal drawdown (low-flow) sampling (i.e., water level dropped 6 inches or more), removal of 3 to 5 volumes of groundwater was performed and samples collected with a bailer.

Groundwater recharge rates permitted 4 of the 5 wells to be sampled with the minimal drawdown (low-flow) sampling methodology. A bladder pump was used for the low-flow minimal drawdown sampling. The pump was inserted into the screened portion of the monitoring well

and the well was pumped at a rate that minimized drawdown. Typically, purging rates were on the order of 200 to 500 milliliters per minute. The purge rate was set such that drawdown in the well was never greater than 0.5 foot. Water chemistry parameters (hydrogen ion concentration [pH], oxidation-reduction potential [Eh], conductivity, temperature, dissolved oxygen, and turbidity) were monitored for stability.

Samples collected for metals analysis were filtered in the field through a 0.45-micrometer high-capacity filter attached to the discharge line of the bladder pump. If the well was sampled with a disposable bailer and not with the bladder pump, a hand-operated 0.45-micrometer filter was used. Sample filtration, preservation, packing, and shipment were performed in accordance with Section 5.4 of the site-wide QAPP (IT, 1996b).

During the initial static water level measurement on April 2, 2002, very little groundwater was present in monitoring well PB-BED-MW26 (0.80 feet). Groundwater was removed from the well with a bailer to determine the recharge rate and determine if minimal drawdown (low-flow) sampling could be performed. No groundwater recharge was present. On April 9, 2002, the water level was measured and a groundwater column of 0.25 feet was calculated. Monitoring well PB-BED-MW26 was not sampled due to an inadequate groundwater volume.

2.3 Decontamination Procedures

Decontamination of all sampling equipment was performed in accordance with Section 4.3 of the SSAP (IT, 2001). Specifically, the water level indicator and low-flow pump were the only instruments that needed the complete decontamination procedures. Decontamination was performed in sequence by rinsing with soapy water, deionized water, isopropyl alcohol, and a final rinse with deionized water. The bladder pump was decontaminated by running the decontamination fluids through the pump head. Equipment was then air dried before use. The bladder pump was wrapped in aluminum foil (shiny side out) after decontamination. Bailers, if needed, and tubing were not decontaminated because new items were used for each well. To prevent damage to sensitive membranes, the water quality instrument (Horiba) was thoroughly rinsed only with deionized water.

2.4 IDW Management

IDW generated during the April 2002 groundwater sampling event included groundwater, decontamination water, and personnel protective equipment. All IDW was managed and handled in accordance with procedures described in the SAP (IT, 1996a).

An estimated total of 330 gallons of decontamination and purge water, as well as 3 gallons of free-phase hydrocarbon, were generated during sampling activities. All liquid was contained in labeled 55-gallon drums that were stored in a bermed, central IDW storage area. Soiled personal protective gear and disposable field equipment generated during the project was double-bagged and placed in an on-site industrial dumpster.

The IDW drums were removed on June 5, 2002 from the PBOW facility by U.S. Liquids of Detroit, Inc., following proper IDW disposal procedures. All water was transported to the U.S. Liquids office in Detroit, Michigan, treated, and disposed of at the facility.

3.0 Analytical Program

Primary and field duplicate project samples were analyzed by Severn Trent Laboratories, Inc. of Knoxville, Tennessee. Analyses for water quality data parameters were provided by Severn Trent's Canton, Ohio laboratory. Quality assurance samples and field splits were analyzed by Accutest Laboratory of Orlando, Florida. IT Corporation performed data validation. The validation summary is provided in Appendix B. The analytical results are summarized in Appendix C. Tables of detected hits that exclude "B" qualified data (data that were not detected significantly above method blank or field blank levels) are included in Appendix D. A data quality evaluation is located in Appendix E. U.S. Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goals (PRGs) are being used as preliminary screening levels for comparison to groundwater analytical results. These comparisons are not intended to imply remediation or clean-up levels but to provide a screening perspective of the data. The analytical summary tables provided in Section 4.0 include compounds detected above the preliminary screening levels only.

3.1 Analytical Program and Methodologies

Chemical analyses for the investigation were performed in accordance with guidelines detailed in the EPA's *Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods,* Third Edition, September 1986 (EPA, 1986) and subsequent revisions and EPA 600/4-79-020, *Method for Chemical Analysis of Water and Wastes.* The groundwater samples and associated quality assurance/quality control (QA/QC) samples were analyzed for VOCs, SVOCs, metals, and several water quality parameters. Methods used for analysis are summarized in Table 3-1.

All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following guidelines in the *EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999 (EPA, 1999) and *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, February 1994 (EPA, 1994a). Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness, and comparability goals established to meet the project data quality objectives (DQO). The criteria for blank evaluation were based on those detailed in *Region III Modifications to National Functional Guidelines for Organic Data Review,* September 1994 (EPA, 1994b) and *Region III*

Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses (EPA, 1993). The procedure is outlined in Section 3.3.

3.2 Data Quality Evaluation

The reliability of the sampling and analytical procedures used during the investigation was demonstrated by implementing the project-specific QA procedures specified in the site-wide SAP (IT, 1996a) and QAPP (IT, 1996b) and its site-specific attachments. Successful execution of these procedures provides supporting evidence that the data is representative of the background area under investigation.

The DQOs for this project were to produce scientifically valid data of known accuracy and precision that were complete with respect to identified critical samples, comparable with similar data types, and representative of the media sampled so as to be useful for the cited purposes. Evaluation of the data using the DQOs and the data validation process resulted in the determination that most of the data set is valid and of sufficient quality to meet the objectives of the investigation. Cyanide results were rejected in samples because of poor recovery of the matrix spike and matrix spike duplicate. All cyanide results were non-detects.

The laboratory did not meet requirements for completion. Samples were sent to the lab for analysis for nitroaromatics by SW-846 8330. Upon completion of analysis and subsequent review, it appeared that the project samples and laboratory QC samples were not spiked with surrogates or spike compounds. The data was not submitted.

A complete evaluation of the analytical results is given in the data quality evaluation found in Appendix E.

3.3 Blank Evaluation

The purpose of blank analysis is to detect contamination resulting from laboratory and field activities. Blank evaluation involves qualification of data based on the results of associated field blanks, trip blanks, equipment rinsates, and laboratory method blanks. The criteria for blank evaluation are as follows:

- If a parameter is found in a blank but not detected in the sample, no action is taken.
- For organics, if the sample result is greater than the contract-required quantitation limit, but is less than 5X or 10X of the blank result, the sample result is qualified "B."

- For organics, if the sample result is less than the contract-required quantitation limit and less than 5X or 10X of the blank result, the sample result is qualified "B." The "J" qualifier is not used.

- For inorganics, if the sample result is greater than the instrument detection limit but less than 5X of the blank result, the sample result is qualified "B."

- If the sample result is greater than 5X or 10X of the blank result, the sample result is not qualified.

In instances where more than one blank is associated with a given sample, qualification is based upon a comparison with the associated blank having the highest concentration of a chemical. Blank results are not subtracted from sample concentrations.

3.4 Screening Criteria

In order to give a better perspective of the data but without inferring a regulatory limit or mandated cleanup level, the analytical data were screened using PRGs published in EPA Region 9 tables (EPA, 2000). With a few exceptions, PRGs are chemical concentrations that correspond to a one-in-one million [10^{-6}] cancer risk or a noncarcinogenic hazard quotient of 1 in soil, air, and water, whichever is lower, for the media of concern.

The Region 9 PRG table combines EPA toxicity values with exposure factors to estimate "safe" chemical concentrations in soil, air, and water. In situations where a PRG is exceeded, further evaluation of the risks that may be posed by site chemicals is appropriate. Residential concentrations are used for screening.

No attempt was made to develop preliminary screening levels for ubiquitous, nutritionally essential elements unlikely to be toxic at concentrations ordinarily found in environmental media and for which toxicity values are unavailable (e.g., calcium, magnesium, potassium, and sodium). PRGs used in the screening of groundwater investigation data are presented in Section 4.0, Table 4-1. Chemicals detected in groundwater were compared to PRGs for tap-water. It was assumed that household use of groundwater results in the most restrictive contamination level.

4.0 Analytical Results

4.1 Groundwater Sampling Events

In April 2002, background groundwater samples representative of high groundwater levels (or wet season) conditions were collected. The background samples were collected from the same monitoring wells as sampled in November 1997 and May 1998 as well as from two of the three new wells installed in 2001. A quarterly sampling schedule was chosen for these wells to obtain background bedrock groundwater data to determine if similar patterns or trends of chemical constituents are present and thus establish background groundwater constituent concentrations for the bedrock groundwater.

4.2 Analytical Results

The following sections present the blank-corrected results of the first, second, and third quarterly sampling events. November 2000 PRGs have been used to evaluate the detected constituents. As a comparison tool, the November 1997, May 1998, fall 2001, and January 2002 results, compared to the preliminary screening levels, are shown on Figure 2-1 with the April 2002 data. Analytical detections above PRGs for the first, second, and third quarters are presented in Table 4-1. Analytes detected below preliminary screening levels are not discussed in detail but are presented in the referenced data table. All third quarter analytical data is presented in Appendices C and D.

4.2.1 Background Monitoring Wells

Five bedrock wells were selected to be sampled on a quarterly basis to determine background bedrock groundwater values. These background bedrock monitoring wells include PB-BED-MW20, PB-BED-MW24, PB-BED-MW25, and BG8-BEDGW-001, and PB-BED-MW26 (Figure 2-1). Overburden well IT-MW01 is included to be sampled as part of the quarterly sampling events and due to its location has previously been considered as providing information relative to possible background overburden groundwater values. Groundwater from these wells was analyzed for VOCs, SVOCs, nitroaromatics, metals (total and dissolved), cyanide, and water quality parameters.

4.2.2 Overburden

First Quarterly Sampling Event (Dry Season - September - October 2001). Due to an indentation of the polyvinyl chloride (PVC) riser, monitoring well IT-MW01 could not be sampled during the September-October 2001 dry season event.

Second Quarterly Sampling Event (Wet Season - January 2002). On January 16, 2002, an attempt was made to sample IT-MW01. As with the September-October 2001 sampling, an indentation of the PVC riser (2 feet below the top of the casing) prevented sampling equipment (pump and bailer) from reaching groundwater in the well. Review of IT-MW01 well construction diagram showed that the bottom of the only riser joint (3.2 feet stickup to 4 feet below ground surface) is located within the filter pack. This, therefore, precludes removal of the riser for replacement. Sampling personnel attempted to remove or push back the indentation in the riser, but did not succeed.

Third Quarterly Sampling Event (Wet Season - April 2002). Due to an indentation of the PVC riser, monitoring well IT-MW01 could not be sampled during April 2002.

Fourth Quarterly Sampling Event (Dry Season - July 2002). Fieldwork occurred during the PBOW dry season, July 9-12, 2002. Report of the results is in preparation.

4.2.3 Bedrock

First Quarterly Sampling Event (Dry Season - September-October 2001). No nitroaromatics were detected in any of the background monitoring wells. VOCs benzene and methylene chloride were detected above screening levels in well PB-BED-MW24. Benzene and chloroform were detected above the preliminary screening levels in well PB-BED-MW25. No SVOCs were detected in any of the wells above preliminary screening levels. Only groundwater from well PB-BED-MW20 showed metals above preliminary screening levels. Barium was detected in both the total and dissolved metal samples, while arsenic was found above its preliminary screening level in only the dissolved sample.

Second Quarterly Sampling Event (Wet Season - January 2002). No nitroaromatics were reported in the analytical data from the second quarterly groundwater samples. Only VOC benzene and SVOC naphthalene was detected above preliminary screening levels. Both were

detected in background well PB-BED-MW24. Groundwater from all five background wells showed metals above preliminary screening levels. Thallium was detected above its preliminary screening level in both the total and dissolved metal samples from wells BG8-BEDGW-001, PB-BED-MW20, and PB-BED-MW24 and in the total sample in well PB-BED-MW25. All of the thallium detections are noted with a "B" qualifier. Barium was detected above its preliminary screening level in both the total and dissolved metals samples from well PB-BED-MW20. Due to the low water column present, only unfiltered metals were sampled in well PB-BED-MW26. Analytes above preliminary screening levels included aluminum, arsenic, chromium, iron, lead, and manganese.

Third Quarterly Sampling Event (Wet Season - April 2002). One nitroaromatic compound, 2,6-dinitrotoluene, was detected above its preliminary screening level in PB-BED-MW24. Benzene was the only VOC detected above the preliminary screening level during the third quarterly groundwater sampling event. The benzene was detected in PB-BED-MW24, which has displayed steady increases in benzene concentrations since the first quarterly sampling event. No SVOCs were detected above the preliminary screening levels during the third quarterly sampling event. The only metal detected above preliminary screening levels was barium in filtered and unfiltered samples collected from PB-BED-MW20.

Fourth Quarterly Sampling Event (Dry Season - July 2002). Fieldwork occurred during the PBOW dry season, July 9-12, 2002. Report of the results is in preparation.

4.2.4 Summary of Sampling Events

A summary of four quarters of background well sampling along with one wet season and one dry season sampling event from non-background wells, will be provided in a final report titled "First Annual Data Summary and Evaluation Report" at the completion of the first year of quarterly sampling (September-October 2001 [1st round] through July 2002 [4th round]).

5.0 Planned Activities

The following activities are scheduled:

- A fourth quarterly background sampling report in conjunction with the wet and dry season sampling analytical data titled "First Annual Data Summary and Evaluation Report" will be submitted following receipt and evaluation of the fourth quarterly background data.

- Evaluation of the data presented in the First Annual Data Summary and Evaluation Report by the USACE and OEPA will determine if the four quarters of analytical background data is sufficient to establish background metals concentrations or if an additional year of groundwater sampling will be required.

6.0 References

IT Corporation (IT), 2002, ***Letter Amendment to Site-Specific Sampling and Analysis Plan, Groundwater Remedial Investigation, TNT and Red Water Ponds Areas, Plum Brook Ordnance Works, Sandusky, Ohio,*** March.

IT Corporation (IT), 2001, ***Site-Specific Sampling and Analysis Plan, Groundwater Remedial Investigation, TNT and Red Water Ponds Areas, Plum Brook Ordnance Works, Sandusky, Ohio,*** July.

IT Corporation (IT), 1996a, ***Site-Wide Sampling and Analysis Plan in Site Investigations and Groundwater Investigation, Plum Brook Ordnance Works, Sandusky, Ohio,*** September.

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

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

U.S. Army Corps of Engineers (USACE), 2001, ***Scope of Work; Groundwater Remedial Investigation of TNT and Red Water Ponds Areas, Former Plum Brook Ordnance Works, Sandusky, Ohio,*** Nashville, Tennessee, Revised 19, March.

U.S. Environmental Protection Agency (EPA), 2000, ***Region 9 Preliminary Remediation Goals (PRGs) 2000 Update***, online, November 1.

U.S. Environmental Protection Agency (EPA), 1999, ***Contract Laboratory Program National Functional Guidelines of Organic Data Review***, October.

U.S. Environmental Protection Agency (EPA), 1994a, ***Contract Laboratory Program National Functional Guidelines for Inorganic Data Review***, February.

U.S. Environmental Protection Agency (EPA), 1994b, ***Region III Modifications to National Functional Guidelines for Organic Data Review***, September.

U.S. Environmental Protection Agency (EPA), 1993, ***Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses***, April.

U.S. Environmental Protection Agency (EPA), 1986, ***Test Methods for Evaluating Solid Waste (SW-846), Physical/Chemical Methods***, Third Edition, September.

TABLES

Table 2-1

Summary of Groundwater Samples Collected
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Well Identification	Sample Identification	Sample Date	Sample Number
PB-BED-MW20	PBOW-02-GW-PB-BED-MW20-CB3001	04/04/02	CB3001
PB-BED-MW25	PBOW-02-GW-PB-BED-MW25-CB3004	04/03/02	CB3004
PB-BED-MW25	PBOW-02-GW-PB-BED-MW25-CB3005	04/03/02	CB3005[1]
IT-BG8-BEDGW-001	PBOW-02-GW-IT-BG8-BEDGW-001-CB3007	04/03/02	CB3007
PB-BED-MW24	PBOW-02-GW-PB-BED-MW24-CB3008	04/03/02	CB3008

[1] Field duplicate.

Table 2-2

Final Field Measurements of Groundwater Samples
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Well Identification	Date	Time	Low-Flow Sampled	PID (ppm)	H_2S (ppm)	Eh (mV)	pH	Conductivity (µmhos/cm)	Turbidity (NTU)	Dissolved O_2 (ppm)	Temperature (°C)	Volume Purged (gal)
Overburden Wells (First, Second, and Third Quarterly Sampling)												
IT-MW01	4/2/02	NA	NA	NM	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
	1/16/02	NA	NA	NM	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
	9/27/01	1040	NA	NM	NM	Not sampled. Riser section dented and prohibited bailer from entering well.						
Bedrock Wells (First, Second, and Third Quarterly Sampling)												
BG8-BEDGW-001	4/3/02	1127	Yes	0.0	0.00	220	7.25	0.43	4.7	NM	6.7	3
	1/16/02	1450	Yes	0.0	0.00	-79	7.38	0.856	2.8	0.00	10.69	2.22
	9/27/01	1220	Yes	0.0	NM	-339	13.03	3.75	0.0	0.00	12.65	2.97
PB-BED-MW20	4/4/02	1013	Yes	0.0	NM	51	7.07	53	0.0	0.00	10.37	1.9
	1/15/02	1415	Yes	1.6	0.00	-55	6.83	52.60	15.0	0.00	7.22	1
	9/26/01	1415	No	0.0	NM	-73	8.95	53.60	53.5	0.00	10.54	10.33
PB-BED-MW24	4/3/02	1730	Yes	76.0	0.00	-318	7.06	1.98	0.0	NM	10.71	1.8
	1/17/02	1005	Yes	114	0.00	-333	6.82	1.99	2.5	0.00	9.69	2.11
	10/9/01	0935	Yes	NM	NM	-144	9.38	1.81	73.3	5.32	11.20	2.99
PB-BED-MW25	4/3/02	1120	Yes	NM	NM	-333	8.46	2.62	2.7	0.01	10.90	8
	1/16/02	1030	Yes	0.0	0.00	-291	7.23	2.42	5.8	0.00	10.54	4.44
	10/5/01	0920	Yes	0.0	0.01	-237	10.58	1.89	5.7	2.41	11.90	3.67
PB-BED-MW26	4/9/02	NA	NA	NM	NM	No sample collected due to insufficient water volume.						
	1/15/02[a]	1030	No	2.2	0.21	-59	6.87	31.0	999	8.04	8.69	0.5
	10/10/01	NA	NA	3.6	NM	No sample collected due to insufficient water volume.						

[a]Final water quality reading collected from last purged groundwater due to a very limited water volume. Well was purged on 1/15/02, sample was collected on 1/17/02 at 0820.

°C - Degrees Celsius.
Eh - Oxidation-reduction potential.
gal - Gallon.
µmhos/cm - Micromhos per centimeter.
mV - Millivolts.
NA - Not applicable.
NM - Not measured.
NTU - Nephelometric turbidity unit.
O_2 - Oxygen.
PID - Photoionization detector.
ppm - Parts per million.

Table 3-1

Summary of Analytical Parameters and Methods
Third Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Sample Matrix	Analytical Parameters[a]	Analytical Method[b]
Groundwater	TCL Volatile Organic Compounds	SW-846 5030/8260B
(Monitoring Well)	TCL Semivolatile Organic Compounds	SW-846 3510C/8270C
	TAL Metals (T/D)	SW-846 3005A/6010B/7470A
	Turbidity	EPA 180.1
	Alkalinity	EPA 310.1
	Hardness	EPA 200.7
	Total Organic Carbon	EPA 415.1
	Total Dissolved Solids	EPA 160.1
	Total Suspended Solids	EPA 160.2
	Chloride	EPA 325.2
	Cyanide, total	SW-846 9012A
	Nitrate	EPA 353.2
	Sulfate	EPA 375.4

[a]Target analyte list (TAL) and target compound list (TCL) are used to designate parameter lists with no requirements for Contract Laboratory Program (CLP) method quality control or data reporting packages.
[b] Analyses found in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* Third Edition and *Methods for Chemical Analysis of Water and Wastes*, March 1983 and their subsequent revisions.

T/D - Total/Dissolved.

Table 4-1

Detected Constituents in Bedrock Monitoring Wells
Third Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Sample Area:	Background Wells									
		Sample Location:	IT-BG8-BEDGW-001									
		Sample Number:	5410		5415		BD3007		CA3006		CB3007	
		Sample Date:	17-NOV-97		15-MAY-98		27-SEP-01		16-JAN-02		03-APR-02	
Parameter	Units	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Explosives												
Dinitrotoluene, 2,6-	ug/L	0.099										
Nitrobenzene	ug/L	3.4										
RDX	ug/L	0.61										
Volatiles												
Acetone	ug/L	610									3.5	J
Benzene	ug/L	0.35										
Butanone, 2-	ug/L	1900										
Carbon disulfide	ug/L	1000	0.65	J								
Chloroform	ug/L	0.16										
Chloromethane	ug/L	1.5										
Ethylbenzene	ug/L	1300										
Methyl-2-pentanone, 4-	ug/L	160										
Methylene chloride	ug/L	4.3	0.37	B								
Toluene	ug/L	720										
Xylenes, total	ug/L	1400	0.38	B							1.0	
Semivolatiles												
Bis(2-ethylhexyl)phthalate	ug/L	4.8	1.7	J	4.0	B						
Dimethylphenol, 2,4-	ug/L	730										
Methylnaphthalene, 2-	ug/L											
Naphthalene	ug/L	6.2										
Phenol	ug/L	22000										
Metals - Unfiltered												
Aluminum	ug/L	36000	9020		307		51.6	B	78.7	B	31.5	J
Antimony	ug/L	150										
Arsenic	ug/L	0.045	17.6									
Barium	ug/L	2600	520				285		68	J	29.9	J
Beryllium	ug/L	73							1.2	B		
Cadmium	ug/L	18										
Chromium	ug/L	110	18.2				1.4	B				
Cobalt	ug/L	2200										
Copper	ug/L	1400	59.5								3.3	J
Iron	ug/L	11000	22600		1230	J	204		118	B	38.2	J
Lead	ug/L	15	2613		6.8							
Manganese	ug/L	880	2240		130		71.6		107		29.0	
Mercury	ug/L	11										
Nickel	ug/L	730									6.8	J
Thallium	ug/L	2.4							33	B		
Vanadium	ug/L	260										
Zinc	ug/L	11000	126		49.7	B			12.6	J	15.6	J
Metals - Filtered												
Aluminum	ug/L	36000					56.6	B	83.6	B	52.0	B
Antimony	ug/L	150										
Arsenic	ug/L	0.045										
Barium	ug/L	2600	366				279		83.6	J	30.6	J
Beryllium	ug/L	73							1.5	B		
Chromium	ug/L	110										
Cobalt	ug/L	2200										
Copper	ug/L	1400										
Iron	ug/L	11000	563				169		216			
Manganese	ug/L	880	1300		658		73.5		117		23.6	
Mercury	ug/L	11										
Nickel	ug/L	730									7.0	J
Thallium	ug/L	2.4							4.6	B		
Vanadium	ug/L	260										
Zinc	ug/L	11000			44.9	B			13.5	J	17.3	J
Water Quality Parameters												
Alkalinity	ug/L		350000		180000		357000	J	200000		157000	
Chloride	ug/L		780000		34000		932000		78000		63200	J
Hardness	ug/L		1000000		340000		719000		380000		314000	
Nitrate	ug/L		200									
Nitrate	ug/L				7300				22000		10400	
Sulfate	ug/L		70000		45000		28300		68000		63300	
Total dissolved solids	ug/L		1800000		300000		1990000		500000		458000	
Total organic carbon	ug/L				1000							
Total suspended solids	ug/L		10000		280000		4000				3000	J
Turbidity	NTU						104	J			0.61	

Table 4-1

Detected Constituents in Bedrock Monitoring Wells
Third Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

(2 of 4)

		Sample Area:	Background Wells									
		Sample Location:	PB-BED-MW20									
		Sample Number:	5960		5965		BD3026		CA3005		CB3001	
		Sample Date:	17-NOV-97		28-MAY-98		26-SEP-01		15-JAN-02		04-APR-02	
Parameter	Units	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Explosives												
Dinitrotoluene, 2,6-	ug/L	0.099										
Nitrobenzene	ug/L	3.4									0.088	J
RDX	ug/L	0.61										
Volatiles												
Acetone	ug/L	610					1.2	J			5.3	J
Benzene	ug/L	0.35	0.93	J	1.6		0.25	J				
Butanone, 2-	ug/L	1900										
Carbon disulfide	ug/L	1000			0.17	J						
Chloroform	ug/L	0.16										
Chloromethane	ug/L	1.5										
Ethylbenzene	ug/L	1300	0.15	J								
Methyl-2-pentanone, 4-	ug/L	160										
Methylene chloride	ug/L	4.3	0.30	B	0.49	B						
Toluene	ug/L	720	0.73	B	0.95	B			2.4	B		
Xylenes, total	ug/L	1400	2.6		0.91	J					0.67	J
Semivolatiles												
Bis(2-ethylhexyl)phthalate	ug/L	4.8			5.4	B	2.9	J				
Dimethylphenol, 2,4-	ug/L	730										
Methylnaphthalene, 2-	ug/L		1.1	J								
Naphthalene	ug/L	6.2										
Phenol	ug/L	22000										
Metals - Unfiltered												
Aluminum	ug/L	36000	3290		678	J	207	J			48.6	J
Antimony	ug/L	150										
Arsenic	ug/L	0.045										
Barium	ug/L	2600	19000		18400		23900		22600		23700	
Beryllium	ug/L	73										
Cadmium	ug/L	18										
Chromium	ug/L	110					7.6	B			1.7	J
Cobalt	ug/L	2200					7.1	J			6.1	J
Copper	ug/L	1400	32.8				15.8	B	32.8		30.5	
Iron	ug/L	11000	13200		6770		5920	J	6480		853	
Lead	ug/L	15										
Manganese	ug/L	880	180		153		189	J	128		156	
Mercury	ug/L	11										
Nickel	ug/L	730					3.5	J			3.4	J
Thallium	ug/L	2.4							7.1	B		
Vanadium	ug/L	260										
Zinc	ug/L	11000	41.6		42.1	B	5.3		23.4		64.9	
Metals - Filtered												
Aluminum	ug/L	36000					40.9	B			55.9	B
Antimony	ug/L	150										
Arsenic	ug/L	0.045					2.8	J				
Barium	ug/L	2600	21000		4950		24400		21300		23800	
Beryllium	ug/L	73										
Chromium	ug/L	110										
Cobalt	ug/L	2200					6.4	J			5.9	J
Copper	ug/L	1400					2.0	B	5.7	J	26.5	
Iron	ug/L	11000	2310		1320		5350		6180		1130	
Manganese	ug/L	880	162		47.0		188		129		156	
Mercury	ug/L	11			0.24							
Nickel	ug/L	730					2.9	J			3.2	J
Thallium	ug/L	2.4							7.3	B		
Vanadium	ug/L	260										
Zinc	ug/L	11000					3.3	J	21.6		59.2	J
Water Quality Parameters												
Alkalinity	ug/L		240000		260000		255000	J	280000		229000	
Chloride	ug/L		19000000		21000000		22400000		18000000		17300000	J
Hardness	ug/L		20000000		10000000		9360000		8200000		8850000	
Nitrate	ug/L											
Nitrate	ug/L											
Sulfate	ug/L								3200			
Total dissolved solids	ug/L		32000000		24000000		27400000	J	26000000		27800000	
Total organic carbon	ug/L						500	J	1100	J	740	J
Total suspended solids	ug/L		74000		90000		125000		13000		13000	
Turbidity	NTU						48.4	J	8.8		10.5	

Table 4-1

Detected Constituents in Bedrock Monitoring Wells
Third Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

(3 of 4)

		Sample Area:	Background Wells					
		Sample Location:	PB-BED-MW24					
		Sample Number:	BD3029		CA3001		CB3008	
		Sample Date:	09-OCT-01		17-JAN-02		03-APR-02	
Parameter	Units	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Explosives								
Dinitrotoluene, 2,6-	ug/L	0.099					0.43	
Nitrobenzene	ug/L	3.4					0.33	
RDX	ug/L	0.61					0.22	J
Volatiles								
Acetone	ug/L	610	120	J			170	J
Benzene	ug/L	0.35	60		93		110	
Butanone, 2-	ug/L	1900			8.1		17	J
Carbon disulfide	ug/L	1000			1.2		0.59	J
Chloroform	ug/L	0.16						
Chloromethane	ug/L	1.5			1.3	J		
Ethylbenzene	ug/L	1300	19	J	32		38	
Methyl-2-pentanone, 4-	ug/L	160						
Methylene chloride	ug/L	4.3	21	J				
Toluene	ug/L	720	58		90		100	
Xylenes, total	ug/L	1400	110		180		210	
Semivolatiles								
Bis(2-ethylhexyl)phthalate	ug/L	4.8						
Dimethylphenol, 2,4-	ug/L	730	1.1	J				
Methylnaphthalene, 2-	ug/L		3.6	J	5.6		4.6	J
Naphthalene	ug/L	6.2	2.9	J	7		4.0	J
Phenol	ug/L	22000	1.4	J				
Metals - Unfiltered								
Aluminum	ug/L	36000	37.8	J	77.7	B	35.7	J
Antimony	ug/L	150						
Arsenic	ug/L	0.045						
Barium	ug/L	2600	932		938		1160	
Beryllium	ug/L	73			1.2	B		
Cadmium	ug/L	18						
Chromium	ug/L	110						
Cobalt	ug/L	2200						
Copper	ug/L	1400						
Iron	ug/L	11000	48.3	J	72.7	B		
Lead	ug/L	15						
Manganese	ug/L	880	24.8		19.2		14.8	J
Mercury	ug/L	11						
Nickel	ug/L	730						
Thallium	ug/L	2.4			4.2	B		
Vanadium	ug/L	260						
Zinc	ug/L	11000						
Metals - Filtered								
Aluminum	ug/L	36000	55.1	B	89.6	B	74.0	B
Antimony	ug/L	150						
Arsenic	ug/L	0.045						
Barium	ug/L	2600	942		962		1170	
Beryllium	ug/L	73			1.5	B		
Chromium	ug/L	110						
Cobalt	ug/L	2200						
Copper	ug/L	1400						
Iron	ug/L	11000			40.7	B		
Manganese	ug/L	880	22.1		18.7		16.6	
Mercury	ug/L	11						
Nickel	ug/L	730						
Thallium	ug/L	2.4			4.1	B		
Vanadium	ug/L	260						
Zinc	ug/L	11000					3.4	J
Water Quality Parameters								
Alkalinity	ug/L		697000	J	810000		157000	
Chloride	ug/L		149000		140000		175000	J
Hardness	ug/L		566000		710000		715000	
Nitrate	ug/L							
Nitrate	ug/L							
Sulfate	ug/L		21400		150000		23600	
Total dissolved solids	ug/L		948000		1000000		2200000	
Total organic carbon	ug/L		3000		1800		2400	
Total suspended solids	ug/L						14000	
Turbidity	NTU		266		61		116	

Table 4-1

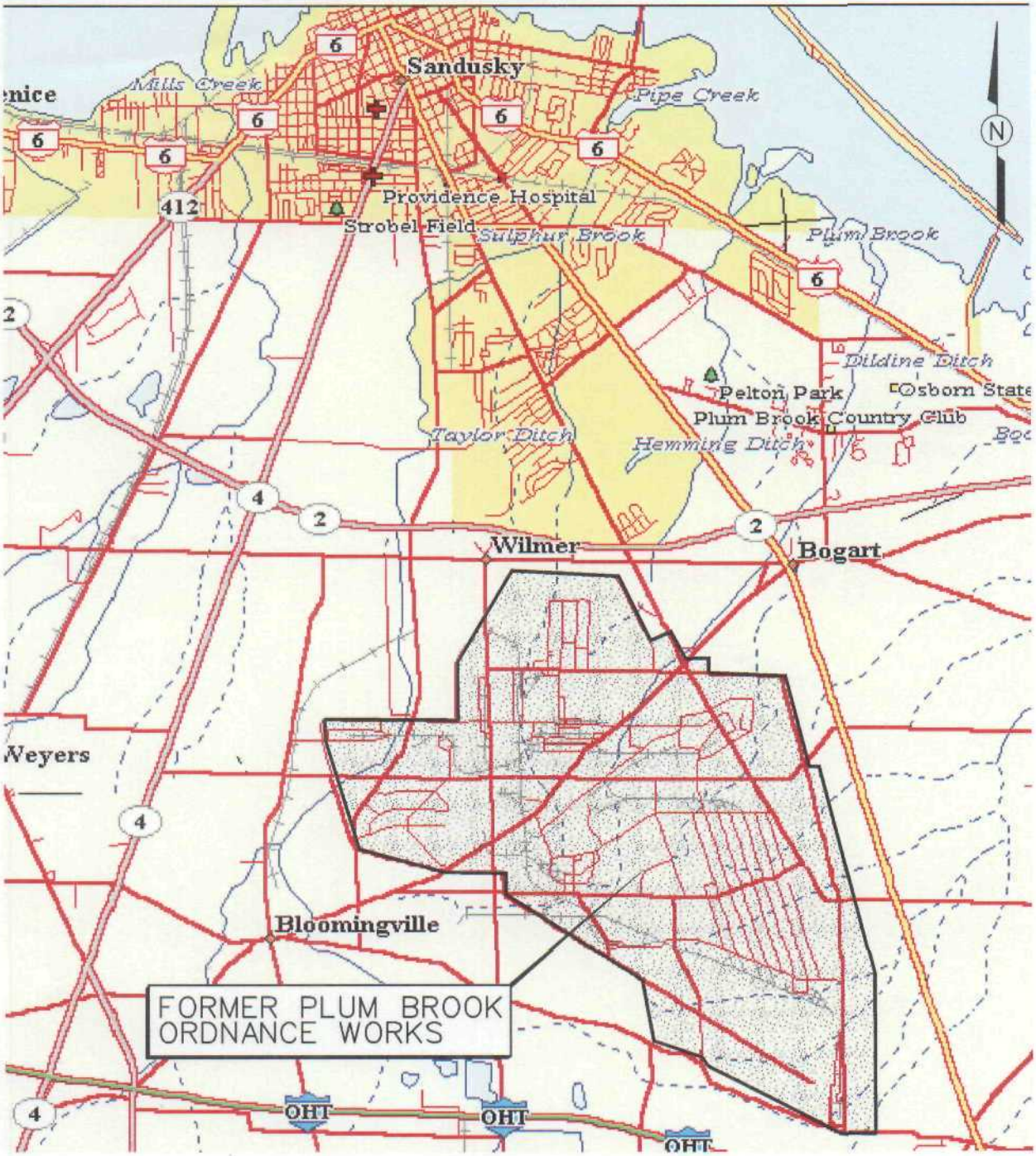
Detected Constituents in Bedrock Monitoring Wells
Third Quarterly Background Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

		Sample Area:	Background Wells							
		Sample Location:	PB-BED-MW25						PB-BED-MW26	
		Sample Number:	BD3030		CA3002		CB3004		CA3004	
		Sample Date:	05-OCT-01		16-JAN-02		03-APR-02		17-JAN-02	
Parameter	Units	PRG	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr	Result	Val Qlfr
Explosives										
Dinitrotoluene, 2,6-	ug/L	0.099							NS	
Nitrobenzene	ug/L	3.4					0.076	J	NS	
RDX	ug/L	0.61							NS	
Volatiles									NS	
Acetone	ug/L	610	1.7	B					NS	
Benzene	ug/L	0.35	0.37	J					NS	
Butanone, 2-	ug/L	1900							NS	
Carbon disulfide	ug/L	1000	0.48	J	1.5		0.36	J	NS	
Chloroform	ug/L	0.16	1.1						NS	
Chloromethane	ug/L	1.5							NS	
Ethylbenzene	ug/L	1300	0.22	J					NS	
Methyl-2-pentanone, 4-	ug/L	160	0.30	J					NS	
Methylene chloride	ug/L	4.3	0.30	B			0.21	B	NS	
Toluene	ug/L	720	0.80	J			0.25	J	NS	
Xylenes, total	ug/L	1400	1.5						NS	
Semivolatiles									NS	
Bis(2-ethylhexyl)phthalate	ug/L	4.8	0.86	J					NS	
Dimethylphenol, 2,4-	ug/L	730							NS	
Methylnaphthalene, 2-	ug/L								NS	
Naphthalene	ug/L	6.2							NS	
Phenol	ug/L	22000							NS	
Metals - Unfiltered										
Aluminum	ug/L	36000	78.2	B	79.8	B	41.3	J	93200	
Antimony	ug/L	150								
Arsenic	ug/L	0.045							56.8	
Barium	ug/L	2600	226		247		434		1970	
Beryllium	ug/L	73			1.2	B			5.2	
Cadmium	ug/L	18							3.3	J
Chromium	ug/L	110							454	
Cobalt	ug/L	2200							82.8	
Copper	ug/L	1400							293	
Iron	ug/L	11000	795		357		91.1	J	232000	
Lead	ug/L	15							79.2	
Manganese	ug/L	880	89.0		56.2		68.8		17470	
Mercury	ug/L	11							0.14	J
Nickel	ug/L	730							457	
Thallium	ug/L	2.4			14.7	B				
Vanadium	ug/L	260							142	
Zinc	ug/L	11000	7.7	J			79.5		789	
Metals - Filtered										
Aluminum	ug/L	36000	68.7	B			52.7	B	NS	
Antimony	ug/L	150							NS	
Arsenic	ug/L	0.045							NS	
Barium	ug/L	2600	224		234		452		NS	
Beryllium	ug/L	73							NS	
Chromium	ug/L	110							NS	
Cobalt	ug/L	2200							NS	
Copper	ug/L	1400							NS	
Iron	ug/L	11000	713		337				NS	
Manganese	ug/L	880	87.0		52.2		65.6		NS	
Mercury	ug/L	11							NS	
Nickel	ug/L	730							NS	
Thallium	ug/L	2.4							NS	
Vanadium	ug/L	260							NS	
Zinc	ug/L	11000	3.0	J			19.9	J	NS	
Water Quality Parameters									NS	
Alkalinity	ug/L		278000	J	320000		337000		NS	
Chloride	ug/L		404000		460000		558000	J	NS	
Hardness	ug/L		627000		720000		611000		NS	
Nitrate	ug/L								NS	
Nitrate	ug/L								NS	
Sulfate	ug/L		121000		79000		36200		NS	
Total dissolved solids	ug/L		1000000		1100000		1330000		NS	
Total organic carbon	ug/L		4000	B	2000		3000		NS	
Total suspended solids	ug/L		4000				9000		NS	
Turbidity	NTU		21.7	J	21		112		NS	

µg/L - Micrograms per liter.
PRG - Preliminary remedial goal.
NTU - Nephelometric turbidity unit.
NS - Not sampled.
NE - Not established.
Shaded cell indicates value is above PRG limit.

Validation Qualifiers
B - The analyte was not detected significantly above the level found in the associated blank or field blanks.
J - The compound/analyte was positively identified; the reported value is an estimated concentration.

FIGURES



NOT TO SCALE

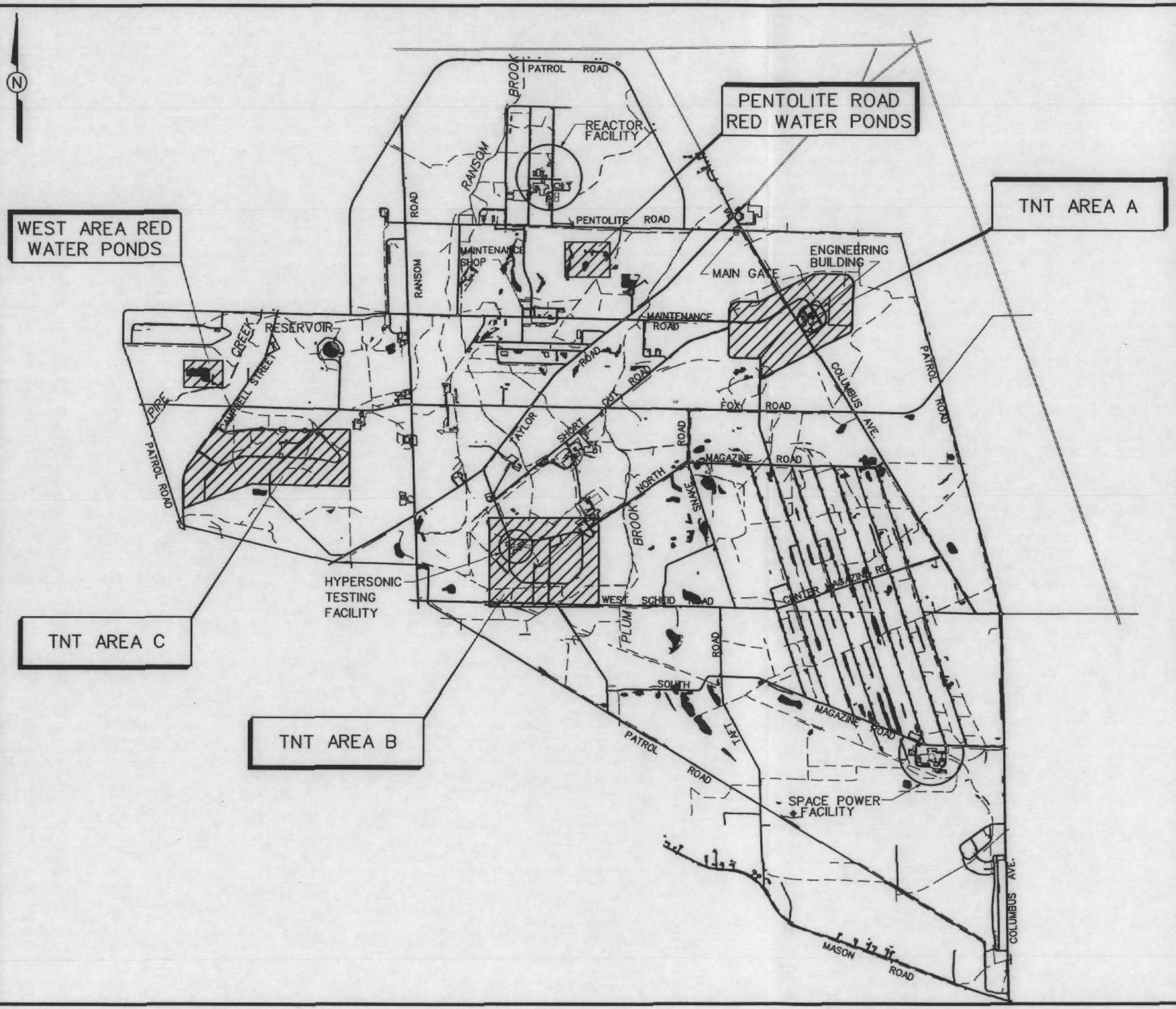
FIGURE 1-1
VICINITY MAP

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 12/16/97 | DATE LAST REV.: 10/30/01 | DRAFT. CHCK. BY: | INITIATOR: D. KESSLER | DWG. NO.: \773701ES.001
DRAWN BY: D. BILLINGSLEY | DRAWN BY: bvanderg | ENGR CHCK. BY: D. KESSLER | PROJ. MGR: M.SPANGBERG | PROJ. NO.: 773701

01:08:58 10/30/01
bvanderg
c:\cadd\design\773701es.001



LEGEND:

- BUILDINGS
- STREAMS OR DITCHES
- ROAD
- SURFACE WATER
- AREAS OF CONCERN

NOTES:

BACKGROUND MONITORING WELLS ARE LOCATED ALONG THE WEST AND SOUTHWEST SIDE OF THE FACILITY.

SCALE

0 2400 4800 FEET

FIGURE 1-2
SITE MAP WITH AREAS OF CONCERN

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 05/06/02	DATE LAST REV.:	DRAFT. CHCK. BY:	INITIATOR: D. KESSLER	DWG. NO.:\825635es.027
DRAWN BY: B. VANDERGRIFF	DRAWN BY:	ENGR. CHCK. BY: D. KESSLER	PROJ. MGR.:S. DOWNEY	PROJ. NO.: 825635

09:43:15 05/22/02 bvanderg c:\cadd\design\825635es.027

PB-BED-MW24							
SAMPLE NO.		BD3029		CA3001		CB3008	
SAMPLE DATE		09-OCT-01		17-JAN-02		03-APR-02	
UNITS		ug/L		ug/L		ug/L	
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ
Explosives							
Dinitrotoluene, 2,6-	0.099					**0.43**	
Nitrobenzene	3.4					0.33	
RDX	0.61					0.22	J
Volatiles							
Acetone	610	120	J			170	J
Benzene	0.35	**60**		**91**		**110**	
Butanone, 2-	1900			8.1		17	J
Carbon disulfide	1000			1.2		0.59	J
Chloromethane	1.5			1.3	J		
Ethylbenzene	1300	19	J	32		38	
Methylene chloride	4.3	**21**	J				
Toluene	720	58		90		100	
Xylenes, total	1400	110		180		210	
Semivolatiles							
Dimethylphenol, 2,4-	730	1.1	J				
Methylnaphthalene, 2-		3.6	J	5.6		4.6	J
Naphthalene	6.2	2.9	J	**7**		4.0	J
Phenol	22000	1.4	J				
Metals - Unfiltered							
Aluminum	36000	37.8	J	77.7	B	35.7	J
Barium	2600	932		938		1160	
Beryllium	73			1.2	B		
Iron	11000	48.3	J	72.7	B		
Manganese	880	24.8		19.2		14.8	J
Thallium	2.4			**4.2**	B		
Metals - Filtered							
Aluminum	36000	55.1	B	89.6	B	74.0	B
Barium	2600	942		962		1170	
Beryllium	73			1.5	B		
Iron	11000			40.7	B		
Manganese	880	22.1		18.7		16.6	
Thallium	2.4			**4.1**	B		
Zinc	11000					3.4	J

BCB-BEDGW-001											
SAMPLE NO.		5410		5415		BD3007		CA3006		CB3007	
SAMPLE DATE		17 NOV 97		05 MAY 98		27 SEP 01		16-JAN 02		03-APR-02	
UNITS		ug/L		ug/L		ug/L		ug/L		ug/L	
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ
Volatiles											
Acetone	610									3.5	J
Carbon disulfide	1000	0.65	J								
Methylene chloride	4.3	0.37	B								
Xylenes, total	1400	0.38	B							1.0	
Semivolatiles											
Bis(2-ethylhexyl)phthalate	4.8	1.7	J	4.0	B						
Metals - Unfiltered											
Aluminum	36000	9020		307		51.6	B	78.7	B	31.5	J
Arsenic	0.045	**17.6**									
Barium	2600	520				285		68	J	29.9	J
Beryllium	73							1.2	B		
Chromium	110	18.7				1.4	B				
Copper	1400	59.5								3.3	J
Iron	11000	**22600**		1230	J	204		118	B	38.7	J
Lead	15	**26.3**		6.8							
Manganese	880	**2240**		130		71.6		107		29.0	
Nickel	730									6.8	J
Thallium	2.4							**3.3**	B		
Zinc	11000	126		49.7	B			12.6	J	15.6	J
Metals - Filtered											
Aluminum	36000					56.6	B	83.5	B	52.0	B
Barium	2600	366				279		83.6	J	30.6	J
Beryllium	73							1.5	B		
Iron	11000	563				169		216			
Manganese	880	**1300**		658		73.5		117		23.6	
Nickel	730									7.0	J
Thallium	2.4							**4.8**	B		
Zinc	11000			44.9	B			13.5	J	17.3	J

PB-BED-MW25							
SAMPLE NO.		BD3030		CA3002		CB3004	
SAMPLE DATE		05-OCT-01		16 JAN 02		03-APR-02	
UNITS		ug/L		ug/L		ug/L	
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ
Explosives							
Nitrobenzene	3.4					0.076	J
Volatiles							
Acetone	610	1.7	B				
Benzene	0.35	**0.37**	J				
Carbon disulfide	1000	0.48	J	1.5		0.36	J
Chloroform	0.16	**1.1**					
Ethylbenzene	1300	0.22	J				
Methyl-2-pentanone, 4-	160	0.30	J				
Methylene chloride	4.3	0.30	B			0.21	B
Toluene	720	0.80	J			0.25	J
Xylenes, total	1400	1.5					
Semivolatiles							
Bis(2-ethylhexyl)phthalate	4.8	0.86	J				
Metals - Unfiltered							
Aluminum	36000	78.2	B	79.8	B	41.3	J
Barium	2600	226		247		434	
Beryllium	73			1.2	B		
Iron	11000	795		357		911	J
Manganese	880	89.0		56.2		68.8	
Thallium	2.4			**4.7**	B		
Zinc	11000	7.7	J			79.5	
Metals - Filtered							
Aluminum	36000	68.7	B			52.7	B
Barium	2600	224		234		452	
Iron	11000	713		337			
Manganese	880	87.0		52.2		65.6	
Zinc	11000	3.0	J			18.9	J

IT-MW01									
SAMPLE NO.		5530		5535/5535R		--			
SAMPLE DATE		19 NOV 97		16 MAY 98		01 SEP-01		16-JAN-02	
UNITS		ug/L		ug/L		ug/L		ug/L	
PARAMETER	RHC	RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ
		No detects		No detects		Unable to Sample		Unable to Sample	

PB-BED-MW26							
SAMPLE NO.		Not Sampled		CA3004		Not Sampled	
SAMPLE DATE		SEP 01		17 JAN 02		APR 02	
UNITS		ug/l		ug/l		ug/l	
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ
Metals - Unfiltered							
Aluminum	36000	NS		**93200**		NS	
Arsenic	0.045	NS		**56.8**		NS	
Barium	2600	NS		1970		NS	
Chromium	110	NS		**454**		NS	
Iron	11000	NS		**232000**		NS	
Lead	15	NS		**79.2**		NS	
Manganese	880	NS		**7470**		NS	

PB-BED-MW20											
SAMPLE NO.		5960		5965		BD3026		CA3005		CB3001	
SAMPLE DATE		17 NOV 97		28 MAY 98		26 SEP 01		15-JAN-02		04-APR 02	
UNITS		ug/L		ug/L		ug/L		ug/L		ug/L	
PARAMETER	PRG	RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ	RESULT	VQ
Explosives											
Nitrobenzene	3.4									0.088	J
Volatiles											
Acetone	610					1.7	J			5.3	J
Benzene	0.35	**0.93**	J	**1.6**		0.25	J				
Carbon disulfide	1000			0.17	J						
Ethylbenzene	1300	0.15	J								
Methylene chloride	4.3	0.30	B	0.49	B						
Toluene	720	0.73	B	0.95	B			2.4	B		
Xylenes, total	1400	2.6		0.91	J					0.67	J
Semivolatiles											
Bis(2-ethylhexyl)phthalate	4.8			**5.4**	B	2.9	J				
Methylnaphthalene, 2-		1.1	J								
Metals - Unfiltered											
Aluminum	36000	3290		678	J	207	J			48.6	J
Barium	2600	**19000**		**18400**		**23900**		**22500**		**23700**	
Chromium	110					7.6	B			1.7	J
Cobalt	2200					7.1	J			6.1	J
Copper	1400	32.8				15.8	B	32.8		30.5	
Iron	11000	**13200**		6770		5920	J	6480		853	
Manganese	880	180		153		189	J	128		156	
Nickel	730					3.5	J			3.4	J
Thallium	2.4							**7.1**	B		
Zinc	11000	41.6		42.1	B	5.3		23.4		64.9	
Metals - Filtered											
Aluminum	36000					40.9	B			55.9	B
Arsenic	0.045					**2.8**	J				
Barium	2600	**21000**		**4950**		**24400**		**21300**		**23800**	
Cobalt	2200					6.4	J			5.9	J
Copper	1400					2.0	B	5.7	J	26.5	
Iron	11000	2310		1320		5350		6180		1130	
Manganese	880	162		47.0		188		129		156	
Mercury	11			0.24							
Nickel	730					2.9	J			3.2	J
Thallium	2.4							**7.3**	B		
Zinc	11000					3.3	J	21.6		59.2	J

LEGEND:

- IT-MW01 — OVERBURDEN MONITORING WELL LOCATION
- BED-MW20 — BEDROCK MONITORING WELL LOCATION
- BUILDINGS
- RAILROAD
- SURFACE WATER
- DITCH
- FENCE
- O.B. FLOW — OVERBURDEN GROUNDWATER FLOW DIRECTION
- BED FLOW — BEDROCK GROUNDWATER FLOW DIRECTION

NOTES:

1. GROUNDWATER FLOW DIRECTION ON NOVEMBER 14-16, 2001.
2. UNABLE TO SAMPLE IT-MW01. PVC CASING WAS DAMAGED AND PREVENTED ACCESS.
3. BOLDED VALUES ABOVE PRELIMINARY SCREENING LIMITS.

SCALE
0 800 1600 FEET

NO	DATE	REVISION	BY	CHKD	DSGN ENGR	ENGR	PROJ MGR	APPR

STARTING DATE 07/21/02 | INITIATOR D. KESSLER | CHKD | DRAWN VANDERGRIFT | CHKD C. TUMLIN | PROJECT MNGR S. DOWNEY

IT CORPORATION
A Member of The IT Group
KNOXVILLE, TENNESSEE

THIRD QUARTERLY BACKGROUND SAMPLING REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 2-1
DETECTED CONSTITUENTS IN OVERBURDEN/BEDROCK BACKGROUND MONITORING WELLS
(NOVEMBER 1997, MAY 1998, SEPTEMBER-OCTOBER 2001, JANUARY 2002 & APRIL 2002)

AREA	JOB NO.	DRAWING NO.	REV
	833886	833886ES.002	

APPENDIX A

SAMPLE COLLECTION LOGS

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 **PLUM BROOK ORDNANCE WK**

Manager: Steve Downey

RFA / COC Number: 04042002N / 04042002B

Location Code: **PB-BED-MW20**

Sample Number: **CB3001**

Sample Name: **PBOW-02-GW-PB-BED-MW20-CB3001-(00-(**

Sampling Method: **LF**

Sample Type: **GW** *Sample Purpose:* **REG**

Collection Date: 4/4/02

Collection Time: 1013

Start Depth: 16.5

End Depth: 16.5

Sample Matrix: **WATER**

Sample Team: JH, LN

QC Partners:

(TB) CB5006 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Analytical Suite	Flt	Frtn	Containers Qty	Size	Units	Type	
METALS3-W-F	Y	A	1	500	mL	HDPE	HNO_3
METALS3-W	N	B	1	500	mL	HDPE	HNO_3
EXPLOSIVES	N	C	1	1	L	Amb. Glass	None
VOLATILES3	N	D	3	40	mL	GVIAL,SEP	HCl
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass	None
TOC	N	F	3	40	mL	GVIAL,SEP	H_2SO_4
CYANIDE	N	G	1	500	mL	HDPE	NaOH
ALKALINITY	N	H	1	1	L	HDPE	
CHLORIDE	N	H	1	1	L	HDPE	
NITRATE-W	N	H	1	1	L	HDPE	None
SULFATE	N	H	1	1	L	HDPE	
TDS	N	H	1	1	L	HDPE	
TSS	N	H	1	1	L	HDPE	
TURB 180.1	N	H	1	1	L	HDPE	
HARDNESS	N	I	1	250	mL	HDPE	HNO_3

- PID = 0.0 ppm.
- Pump settings:
  a) CPM 4
  b) Refill: 8.0 - 7.0
  c) Throttle speed: 20-40 ft.

Comments: Top of pump was set @ 15ft. purge rate 200ml/min

Sketch Location:

Logged BY / Date: J Hafer 4/4/02 *Reviewed BY / Date:* D M Nill 4/7/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW20**

Sample Number: **CB3001**

- Well ID was labeled as: DM-BED_MW20
- Well was installed by DM
- Initial water level 14.34 ft

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume ml ~~(gal)~~
	0952	14.49	100	6.67	52.9	7.2	2.72	10.22	1000 ml
	0958	14.50	98	6.88	53.0	0.0	0.00	10.32	3200 ml
	1003	14.55	95	6.92	53.1	0.0	0.00	10.21	4.2 L
	1008	14.54	93	6.97	53.1	0.0	0.00	10.35	5.2 L
	1013	14.56	90	6.99	53.0	0.0	0.00	10.58	6.2 L
Sample:	1040	14.65	51.0	7.07	53.0	0.0	0.00	10.37	7.2 L

midway through sampling

Logged BY / Date: [signature] 4/4/02 *Reviewed BY / Date:* [signature] 4/7/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

~~04~~ 04042002B

RFA / COC Number: 04032002 / 04042002N

Location Code: PB-BED-MW24

Sample Number: CB3008

Sample Name: PBOW-02-GW-PB-BED-MW24-CB3008-(00-(

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: 4/3/02

Collection Time: 1730

Start Depth: 36

End Depth: 36

Sample Matrix: WATER

Sample Team: JH, LN

QC Partners:

(TB) CB5006 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Analytical Suite	Containers Flt	Frtn	Qty	Size	Units	Type	
METALS3-W-F	Y	A	1	500	mL	HDPE	HNO_3
METALS3-W	N	B	1	500	mL	HDPE	HNO_3
EXPLOSIVES	N	C	1	1	L	Amb. Glass	None
VOLATILES3	N	D	3	40	mL	GVIAL,SEP	HCl
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass	None
TOC	N	F	3	40	mL	GVIAL,SEP	H_2SO_4
CYANIDE	N	G	1	500	mL	HDPE	NaOH
ALKALINITY	N	H	1	1	L	HDPE	
CHLORIDE	N	H	1	1	L	HDPE	
NITRATE-W	N	H	1	1	L	HDPE	None
SULFATE	N	H	1	1	L	HDPE	
TDS	N	H	1	1	L	HDPE	
TSS	N	H	1	1	L	HDPE	
TURB 180.1	N	H	1	1	L	HDPE	
HARDNESS	N	I	1	250	mL	HDPE	HNO_3

PID = 76 ppm

H_2S = 0 ppm

LEL = 14%

Comments: WL - 25.44, purge rate 200 ml/min

Sketch Location:

Logged BY / Date: [signature] 4/3/02

Reviewed BY / Date: [signature] 4/7/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW24**

Sample Number: **CB3008**

Initial water level : 25.44 ft

Purge rate 200 ml/min.

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
	1702	25.63	-260	8.11	2.37	9.3	NA	11.00	1/2 gal (940 ml)
	1707	25.64	-288	7.62	2.22	2.4	NA	10.85	1940 ml
	1712	25.60	-299	7.51	2.15	-2.5	NA	10.77	2940 ml
	1717	25.62	-308	7.30	2.07	-5.0	—	10.67	3940 ml
	1722	25.60	-310	7.23	2.05	-6.0	—	10.62	4940 ml
	1727	25.59	-316	7.14	2.01	-7.0	—	10.51	5940 ml
Sample:	1730	25.60	-318	7.06	1.98	0.0	NA	10.71	6940

Logged BY / Date: [signature] 4/3/02 *Reviewed BY / Date:* [signature] 4/7/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 **PLUM BROOK ORDNANCE WK**

Manager: Steve Downey

RFA / COC Number: 04042002B 04032002

Location Code: PB-BED-MW25

Sample Number: CB3004

Sample Name: PBOW-02-GW-PB-BED-MW25-CB3004-(00-(

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: 4/3/02

Collection Time: 1120

Start Depth: 13.65

End Depth: 13.80

Sample Matrix: WATER

Sample Team: D. Kessler / D. Dill

QC Partners:

(TB) CB5006 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

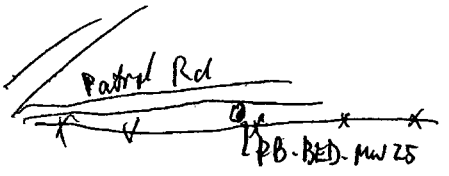
Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
TOC	N	F	3	40	mL	GVIAL,SEP
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
NITRATE-W	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE
HARDNESS	N	I	1	250	mL	HDPE

Comments: Static - 13.55 ft TD = 40.60 ft, water column = 27.05 ft
Have no instruments for PID/LEL readings.

Sketch Location:

N↑



Logged BY / Date: David Kessler 4/3/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW25**

Sample Number: **CB3004**

Static = 13.55 TD = 40.60, water column 27.05 ft
pump set at 35 ft., pumping ~ ~~750 ml/min~~ slowed to 600 ml/min

PURGE RECORD:

Initial 4/3/02	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
~~1040~~	1040	13.67-~~13~~.96	-233	8.41	3.28	13.9	0.68	11.1	2
~~1045~~	1045	13.67-13.96	-272	8.57	2.63	13.4	0.76	11.2	3
	1050	13.67-13.96	-290	8.61	2.61	8.5	0.57	11.2	4 — slowed discharge
	1055	13.76-13.97	-297	8.58	2.53	7.2	0.41	11.3	~~4.5~~ 5
	1100	13.76-13.97	-309	8.55	2.61	4.5	0.18	11.4	6 - slowed to 600 ml
	1105	13.65-13.80	-322	8.49	2.60	3.3	0.04	11.2	6.5
	1110	13.65-13.80	-326	8.49	2.60	3.0	0.06	10.9	7
	1115	"	-330	8.47	2.62	3.0	0.06	10.9	7.5
Sample:	1120	13.65-13.80	-333	8.46	2.62	2.7	0.01	10.9	8 gal
Finished collection 1240			-350	8.05	2.56	2.9	0.03	10.7	

Logged BY / Date: David Kessler 4/3/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 **PLUM BROOK ORDNANCE WK**

Manager: Steve Downey

04042002B

RFA / COC Number: 04032002

Location Code: **PB-BED-MW25**

Sample Number: **CB3004-MS**

Sample Name: **PBOW-02-GW-PB-BED-MW25-CB3004-MS-**

Sampling Method: **LF**

Sample Type: **GW** *Sample Purpose:* **MS**

Collection Date: 4/3/02

Collection Time: 1120

Start Depth: 13.65

End Depth: 13.80

Sample Matrix: **WATER**

Sample Team: DKK/DD

QC Partners:

(TB) CB5006 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	~~2~~ 1	1	L	Amb. Glass
TOC	N	F	3	40	mL	GVIAL,SEP
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
NITRATE-W	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE
HARDNESS	N	I	1	250	mL	HDPE

Comments:

Sketch Location:

Logged BY / Date: David Kursky 4/3/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW25**

Sample Number: **CB3004-MS**

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
		See p. 2 of CB3004							
Sample:									

Logged BY / Date: David Kessler 4/3/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

RFA / COC Number: 04042002B 04032002

Location Code: PB-BED-MW25

Sample Number: CB3004-MSD

Sample Name: PBOW-02-GW-PB-BED-MW25-CB3004-MSI

Sampling Method: LF

Sample Type: GW *Sample Purpose:* MSD

Collection Date: 4/3/02

Collection Time: 1120

Start Depth: 13.65

End Depth: 13.80

Sample Matrix: WATER

Sample Team: DKK/DD

QC Partners:

(TB) CB5006 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
TOC	N	F	3	40	mL	GVIAL,SEP
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
NITRATE-W	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE
HARDNESS	N	I	1	250	mL	HDPE

Comments:

Sketch Location:

Logged BY / Date: David Kusch 4/3/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW25**

Sample Number: **CB3004-MSD**

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
		See page 2 of CB 3004							
Sample:									

Logged BY / Date: David Kusch 4/3/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

RFA / COC Number: 04042002B

Location Code: PB-BED-MW25

Sample Number: CB3005

Sample Name: PBOW-02-GW-PB-BED-MW25-CB3005-(00-(

Sampling Method: LF

Sample Type: GW

Sample Purpose: FD

Collection Date: 4/3/02

Collection Time: 1120

Start Depth: 13.65

End Depth: 13.80

Sample Matrix: WATER

Sample Team: DKU/DP

QC Partners:

(TB) ~~CB5006~~ NA CB5006 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass

Comments:

Sketch Location:

Logged BY / Date: David Kersch 4/3/02 *Reviewed BY / Date:* D M Dell 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW25**

Sample Number: **CB3005**

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:									

See page 2 of CB3004

Logged BY / Date: David Kressler 4/4/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

RFA / COC Number: 04042002

Location Code: PB-BED-MW25

Sample Number: CB3006

Sample Name: PBOW-02-GW-PB-BED-MW25-CB3006-(00-(

Sampling Method: LF

Sample Type: GW *Sample Purpose:* FS

Collection Date: 4/3/02

Collection Time: 1120

Start Depth: 13.65

End Depth: 13.80

Sample Matrix: WATER

Sample Team: DKK/DD

QC Partners:

(TB) ~~NA~~ CB5007 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass

Comments:

Sketch Location:

Logged BY / Date: David Krosch 4/3/02 *Reviewed BY / Date:* [illegible] 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW25**

Sample Number: **CB3006**

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
			See page 2 of CB3004						
Sample:									

Logged BY / Date: David Kreash 4/3/02 *Reviewed BY / Date:* MM 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

RFA / COC Number: 04032002 / 04042002B

Location Code: IT-BG8-BEDGW-001

Sample Number: CB3007

Sample Name: PBOW-02-GW-IT-BG8-BEDGW-001-CB3007

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: 4/3/02

Collection Time: 1127

Start Depth: 14.0

End Depth: 14.0

Sample Matrix: WATER

Sample Team: JH, LN

QC Partners:

(TB) CB5006 (ER) NA (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Analytical Suite	Flt	Frtn	Containers Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
TOC	N	F	3	40	mL	GVIAL,SEP
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
NITRATE-W	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE
HARDNESS	N	I	1	250	mL	HDPE

PID = 0.0 ppm
H_2S = 0.0 ppm

Pump was set @ 12 ft.

Pump settings:
1) CPM4
2) Refill 8.0 - 7.0
3) Depth 20-40 ft (Throttle speed).

Comments: TD = 20 ft., micro purge rate 100 ml/min

Removed ≈ 3 gals.

Sketch Location:

Logged BY / Date: J Hf 4/3/02 *Reviewed BY / Date:* M mi Rell 4/4/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **IT-BG8-BEDGW-001**

Sample Number: **CB3007**

Initial static water level = 5.85 ft

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
	1007	5.96	310	6.64	0.378	4.3	9.48	5.04	1/4 gal
	1012	5.97	268	6.86	0.400	3.8	7.93	5.31	
	1017	5.97	257	6.99	0.409	4.3	7.37	5.44	
	1022	5.96	253	7.07	0.415	3.8	6.74	5.50	
	1027	5.96	247	7.12	0.411	3.7	—	5.72	
	1032	5.97	245	7.14	0.413	3.9	—	5.80	
	1037	5.97	239	7.16	0.421	3.5	—	6.04	
	1042	5.96	234	7.18	0.423	4.0	—	6.22	
	1048	5.94	230	7.21	0.424	3.9	—	6.28	
	1052	5.94	229	7.23	0.430	3.9	—	6.09	
	1117	5.99	226	7.24	0.424	4.3	—	6.65	
	1122	5.99	223	7.24	0.423	4.5	—	6.58	
	1127	5.98	220	7.25	0.423	4.7	—	6.70	
Sample:	1127	5.98	220	7.25	0.43	4.7	—	6.70	3 gal

Logged BY / Date: John Hofer 4/3/02 *Reviewed BY / Date:* D m Bill 4/7/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

RFA / COC Number:

Location Code: PB-BED-MW26

Sample Number: CB3002

Sample Name: PBOW-02-GW-PB-BED-MW26-CB3002-(00-(

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: Not Sampled

Collection Time:

Start Depth:

End Depth:

Sample Matrix: WATER

Sample Team:

QC Partners:

(TB) (ER) (FB)

ERPIMS Values:

Sacode:

Lot Control#:

Analytical Suite	Flt	Frtn	Containers Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
TOC	N	F	3	40	mL	GVIAL,SEP
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
NITRATE-W	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE
HARDNESS	N	I	1	250	mL	HDPE

- water level = 60.06 ft (4/4/02)
- Not sufficient water to collect sample at this time.

UCN 4/4/02.

- Water level = 60.12 ft (4/7/02)
- water level = 60.20 ft (4/9/02)

Comments: Not Sampled

Sketch Location:

Logged BY / Date: David Kersh 4/2/02 *Reviewed BY / Date:* David Kersh 4/9/0

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **PB-BED-MW26**

Sample Number: **CB3002**

4/2/02 - Depth to water ~59.55 Ft Total Depth = 60.35 Ft. Water Column - 0.80 Ft

Took no water quality readings. Removed ~200 ml water (not enough)

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
			Not Sampled						
Sample:									

Logged BY / Date: David Kessler 4/2/02 *Reviewed BY / Date:* David Kessler 4/9/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

RFA / COC Number: _____

Location Code: IT-MW01

Sample Number: CB3003

Sample Name: PBOW-02-GW-IT-MW01-CB3003-(00-00)

Sampling Method: LF

Sample Type: GW *Sample Purpose:* REG

Collection Date: _____

Collection Time: _____

Start Depth: _____

End Depth: _____

Sample Matrix: WATER

Sample Team: DKK / D.D.

QC Partners:

(TB) _____ (ER) _____ (FB) _____

ERPIMS Values:

Sacode: _____

Lot Control#: _____

4/2/02
Not Sampled.

Containers

Analytical Suite	Flt	Frtn	Qty	Size	Units	Type
METALS3-W-F	Y	A	1	500	mL	HDPE
METALS3-W	N	B	1	500	mL	HDPE
EXPLOSIVES	N	C	1	1	L	Amb. Glass
VOLATILES3	N	D	3	40	mL	GVIAL,SEP
SEMIVOLATILES3	N	E	2	1	L	Amb. Glass
TOC	N	F	3	40	mL	GVIAL,SEP
CYANIDE	N	G	1	500	mL	HDPE
ALKALINITY	N	H	1	1	L	HDPE
CHLORIDE	N	H	1	1	L	HDPE
NITRATE-W	N	H	1	1	L	HDPE
SULFATE	N	H	1	1	L	HDPE
TDS	N	H	1	1	L	HDPE
TSS	N	H	1	1	L	HDPE
TURB 180.1	N	H	1	1	L	HDPE
HARDNESS	N	I	1	250	mL	HDPE

Comments: _____

Sketch Location:

Logged BY / Date: David Kessler 4/2/02

Reviewed BY / Date: [illegible] 4/2/02

INTERNATIONAL TECHNOLOGY CORPORATION

Sample Collection Log

Project: 825635 PLUM BROOK ORDNANCE WK

Manager: Steve Downey

Location Code: **IT-MW01**

Sample Number: **CB3003**

4/2/02 Depth to water = 4.50 Ft, TD 9.5 Ft - Water column 5.0 Ft.

Unable to remove dent in riser. Used metal bar to attempt to push through. (Would not push back)

PURGE RECORD:

Initial	Time(24hr)	DepthtoWater (ft)	Eh (mV)	pH (SU)	Conductivity (mS/cm)	Turbidity (NTU)	DissOxygen (ppm)	Temperature (C)	Purge Volume (gal)
Sample:									

Logged BY / Date: David Kussh

Reviewed BY / Date: [illegible] 4/2/02

APPENDIX B

DATA VALIDATION SUMMARY

Data Validation Summary Report
April 2002 Background Site Investigation
Former Plum Brook Ordnance Works
Sandusky, Ohio

1.0 Introduction

Level III data validation was performed on 100 percent of the environmental samples collected for LTM. The analytical data consisted of delivery group (SDG) CB001 which was analyzed by Severn Trent Laboratories (STL). In addition, validation of the field-split data, which was analyzed by Accutest Laboratories, was performed and findings are discussed in section 5.0 of this report. Water matrix was validated. The chemical parameters for which the samples were analyzed, are identified below:

Parameter (Method)
Volatile Organics by GC/MS SW846 8260B
Semivolatile Organics by GC/MS SW846 8270C
Total and Dissolved Metals by SW846 6010B and 7470A
Nitroaromatic and Nitramine Explosives by SW846 8330
Wet Chemistry (TOC, sulfate, Nitrate, Chloride, Alkalinity, Turbidity, TSD, TSS, Hardness, Cyanide)

2.0 Procedures

The sample data were validated following the logic identified in the 1994 *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* and the 1999 *EPA Contract Laboratory Program National Functional Guidelines for Organic Review* for all areas except blanks. *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (April 1993) and *Region III Modifications to National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration* (September 1994) were applied to the areas associated with blank contamination. Specific quality control (QC) criteria as identified in the quality assurance plan (QAP), analytical methods, and laboratory standard operating procedures (SOP) were applied to all sample results. As a result of the use of Update III SW846 test methods for the analytical data and the application of the Contract Laboratory Program (CLP) guidelines during the validation process, there were instances where specific QC requirements for all target compounds were not defined. This primarily occurred in the organic, gas chromatography (GC) and GC/mass spectrometry (MS) calibration areas and is due to the fact that the analytical methods are performance-based and allow the use of average calibration responses in lieu of individual responses, which are defined by CLP protocol. In light of applying CLP guidelines to SW846 methods and evaluating the usability of the data during the validation process, specific QC

criteria were determined to address all target compounds and are identified in this report for each parameter, as well as in the validation checklists, which function as worksheets. All completed validation checklists are included in attachment A. For those analytical methods not addressed by the CLP and Region III guidelines, the validation was based on the method requirements (i.e., SW846, Code of Federal Regulations, SOPs) and technical judgement, following the logic of the CLP validation guidelines.

3.0 Summary of Data Validation Findings

The overall quality of the data was determined to be acceptable with minimal qualifications. The only rejected data ("R" qualified) was due to "poor performing" volatile compounds (ketones, some halogenated hydrocarbons, etc.), which experienced poor calibration responses in the associated calibration data, and semivolatile compounds which experienced extremely low LSC % recoveries. Also, explosive compound Tetryl which had no recovery in the MS/MSD analysis, and samples that were reanalyzed and have more than one set of results reported.

Individual validation reports have been prepared for each parameter, and the overall results of the validation findings are summarized in this report. A listing of the validation qualifiers and the reason codes, along with their definitions, is found in Attachment A. The following section highlights the key findings of the data validation for each analysis.

4.0 Analysis-Specific Data Validation Summaries

4.1 Volatile Organics by GC/MS SW846 8260B

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Preservation

Preservation criteria were met for all samples.

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria with the following exception(s):

- The following exhibited individual ICAL/CCAL relative response factor (RRF) <0.05:

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
CB001	All Samples: CB3001, CB3004, CB3005, CB3007, CB3008	Acetone	J/R/B
	CB3007	2-Butanone	R
	CB3001, CB3004, CB3005, CB3008	Bromomethane	R

- The following exhibited individual ICAL relative standard deviation (%RSD) >30 and/or CCAL percent difference (%D) >25:

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
CB001	CB3001, CB3004, CB3005, CB3008	2-Butanone, Bromomethane, Chloromethane, 1,2-Dichloroethene	J/R/UJ
	CB3007	Methylene chloride	J/UJ

Blanks

The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable with the following exception(s):

SDG	Samples Affected	Compound(s)	Blank Contaminant	Validation Qualifier
CB001	CB3004, CB3005	Methylene chloride	Method/TB	B

Surrogate Recoveries

All surrogate recoveries were within QC limits.

Matrix Spike / Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample

Laboratory Control Sample (LCS) analysis was performed for the project samples, and all QC criteria were met.

Field Duplicates

Original and field duplicate results were evaluated and no problems were identified with the following exception(s):

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
CB001	CB3004 (original), CB3005 (FD)	Carbon disulfide	J

Internal Standards

All internal standards met QC criteria.

Quantitation

Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.2 Semivolatile Organics by GC/MS SW846 8270C

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks

The 5X/10X rule for contaminants found in the associated equipment rinses and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries

All surrogate recoveries were within QC criteria.

Matrix Spike / Matrix Spike Duplicate

MS/MSD analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample

LCS analysis was performed for the project samples, and all QC criteria were met.

Field Duplicates

Original and field duplicate results were evaluated, and all QC criteria were met.

Internal Standards

All internal standards met QC criteria.

Quantitation

Results quantified between the MDL and the RL, which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.3 Metals by SW846 6010B/7470A

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibrations

All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks

The 5X rule for contaminants found in the associated equipment rinse, calibration, and method blanks was applied to all sample results. All criteria were acceptable with the following exception(s):

SDG	Samples Affected	Compound(s)	Blank Contaminant	Validation Qualifier
CB001	CB3001, CB3004, CB3005, CB3007, CB3008	Aluminum (dissolved)	Calibration	B

Matrix Spike / Matrix Spike Duplicate

MS/MSD analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample

LCS analysis was performed for the project samples, and all QC criteria were met.

Interference Check Sample All Interference Check Sample (ICS) percent recoveries were acceptable. All QC criteria were met.

Inductively Coupled Plasma Serial Dilutions

All QC criteria were met for the serial dilutions associated with the project samples with the following exception(s):

SDG	Samples Affected	Compound(s)	Validation Qualifier
CB001	All Samples: CB3001, CB3004, CB3005, CB3007, CB3008	Potassium (total and dissolved)	J
	CB3001, CB3004, CB3005, CB3007, CB3008	Zinc (dissolved)	J

Field Duplicates

Original and field duplicate results were evaluated, and no problems were identified with the following exception(s):

SDG	Samples Affected	Compound(s)	Validation Qualifier
CB001 (dissolved)	CB3004 (original), CB3005 (FD)	Zinc	J

Quantitation

Results quantified between the MDL and the RL, which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

4.4 Nitroaromatic and Nitramine Explosives by SW846 8330

Overall, the data are of good quality and are usable as reported by the laboratory. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks

The 5X rule for contaminants found in the associated equipment rinses and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries

All surrogate recoveries were within QC criteria.

Matrix Spike / Matrix Spike Duplicate

MS/MSD analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
CB001	All Samples: CB3001, CB3004, CB3005, CB3007, CB3008	Tetryl	*R

*R qualified due to 0% recovery of MS/MSD sample.

Laboratory Control Sample

LCS analysis was performed for the project samples, and all QC criteria were met.

2ND Column Confirmation

The percent difference QC criteria between columns for analyte concentrations were met.

Field Duplicates

Original and field duplicate results were evaluated, and no problems were identified.

Quantitation

Results quantified between the MDL and the RL, which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected

4.5 Wet Chemistry (TOC, Sulfate, Nitrate, Chloride, Alkalinity, Turbidity, TDS, TSS, Hardness, Cyanide)

Overall, the data are of good quality and are usable as reported by the laboratory. Data were reviewed for the following:

Preservation

Preservation criteria were met for all samples with the following exception(s):

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
CB001	CB3001	Cyanide	UJ

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks

The 5X rule for contaminants found in the associated equipment rinses and method blanks was applied to all sample results. All were found to be acceptable.

Matrix Spike / Matrix Spike Duplicate

MS/MSD analysis was performed for the project samples, and all QC criteria were met with the following exception(s):

SDG Number	Samples Affected	Compound(s)	Validation Qualifier
CB001	All Samples: CB3001, CB3004, CB3007, CB3008	Chloride	J

Laboratory Control Sample

LCS analysis was performed for the project samples, and all QC criteria were met.

Field Duplicates

Original and field duplicate results were evaluated, and no problems were identified.

Quantitation

Results quantified between the MDL and the RL, which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.0 Quality Assurance Field Split Sample Data Evaluation

Data from the quality assurance split samples: SDG F12806 sample BB3006 was validated. The FS sample was analyzed for Volatiles by SW846 8260B, Semivolatiles by SW846 8270C, Explosives by WS846 8330, and Metals by SW846 6010B and 7470A. The following section highlights the key findings of the data validation for each analysis.

5.1 Volatile Organics by GC/MS SW846 8260B

Overall, the data are of good quality and are usable as reported by the laboratory. Data were reviewed for the following:

Preservation

Preservation criteria were met for all samples.

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

The initial calibration (ICAL) and continuing calibrations (CCAL) associated with the project samples met QC criteria.

Blanks

The 5X/10X rule for contaminants found in the associated equipment rinses, trip blanks, and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries

All surrogate recoveries were within QC limits.

Matrix Spike / Matrix Spike Duplicate

Matrix Spike/Matrix Spike Duplicate (MS/MSD) analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample

Laboratory Control Sample (LCS) analysis was performed for the project samples, and all QC criteria were met.

Internal Standards

All internal standards met QC criteria.

Field Split/Original Sample Comparison

SDG F12806

CB3004 (original) and CB3006 (FS) results were evaluated. It should be noted that CB3006 (FS) were non-detect for all compounds. CB3004 (original) had hits for methylene chloride, carbon disulfide, and toluene below the reporting limits. It should also be noted that Methylene chloride results were blank qualified due to method and trip blank contamination.

Quantitation

Results quantitated between the method detection limit (MDL) and the reporting limit (RL), which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.2 Semivolatile Organics by GC/MS SW846 8270C

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

The initial calibration and continuing calibrations associated with the project samples met QC criteria.

Blanks

The 5X/10X rule for contaminants found in the associated blanks was applied to all sample results and all were found to be acceptable.

Matrix Spike / Matrix Spike Duplicate

Batch QC was performed for the project samples and all QC criteria were met.

Laboratory Control Sample

LCS analysis was performed for the project samples, and all QC criteria were met.

Surrogate Recoveries

All surrogate recoveries were within QC criteria.

Internal Standards

All internal standards met QC.

Field Split/Original Sample Comparison

SDG F12806

CB3004 (original) and CB3006 (FS) results were evaluated. It should be noted that CB3004 (original) and CB3006 (FS) were non-detect for all compounds.

Quantitation

Results quantified between the MDL and the RL, which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.3 Metals by SW846 6010B/7470A

Overall, the data are of good quality and are usable as reported by the laboratory. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks

The 5X rule for contaminants found in the associated blanks was applied to all sample results and all were found to be acceptable.

Matrix Spike / Matrix Spike Duplicate

Batch QC was performed for the project samples and all QC criteria were met.

Laboratory Control Sample (LCS)

All QC criteria were met for the LCS associated with the project sample analyses.

Interference Check Sample All Interference Check Sample (ICS) percent recoveries were acceptable. All QC criteria were met.

Inductively Coupled Plasma Serial Dilutions

All QC criteria were met for the serial dilutions associated with the project samples.

Field Split/Original Sample Comparison

SDG F12806

CB3004 (original) and CB3006 (FS) results were evaluated. It should be noted that total results for CB3004 (FS) had a high RPD for potassium. All RPD QC criteria results for dissolved results were met.

Quantitation

Results quantified between the MDL and the RL, which the lab qualified as "J," were qualified as estimated "J" unless blank contamination was present or the results were rejected.

5.4 Nitroaromatic and Nitramine Explosives by SW846 8330

Overall, the data are of good quality and are usable as reported by the laboratory with the exceptions noted below. Data were reviewed for the following:

Holding Times

Technical holding time criteria were met for all samples.

Initial and Continuing Calibration

All initial and continuing calibrations associated with the project samples met QC criteria.

Blanks

The 5X rule for contaminants found in the associated equipment rinses and method blanks was applied to all sample results. All were found to be acceptable.

Surrogate Recoveries

All surrogate recoveries were within QC criteria.

Matrix Spike / Matrix Spike Duplicate

MS/MSD analysis was performed for the project samples, and all QC criteria were met.

Laboratory Control Sample

LCS analysis was performed for the project samples, and all QC criteria were met.

2ND Column Confirmation

The percent difference QC criteria between columns for analyte concentrations were met.

Field Split/Original Sample Comparison

SDG F12806

CB3004 (original) and CB3006 (FS) results were evaluated. It should be noted that CB3006 (FS) were non-detect for all compounds. CB3004 (original) had a hit for nitrobenzene below the reporting limits.

Quantitation

Results quantified between the MDL and the RL, which the lab qualified as "J", were qualified as estimated "J" unless blank contamination was present or the results were rejected.

Attachment A:

Data Validation Qualifier Entry Verification Report

Validation Qualifiers

U Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

B The concentration reported was detected significantly above the levels reported in the associated equipment rinse samples and/or laboratory method and trip blanks. (5X/10X Rule was applied).

R The reported sample results are rejected due to the following:

1. Severe deficiencies in the supporting quality control data.
2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data.
3. The presence or absence of the constituent cannot be verified based on the data provided.
4. To indicate not to use a particular result in the event of a reanalysis.

UJ The compound/analyte was analyzed for, but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the "nondetect" may be inaccurate or imprecise. The nondetect result should be estimated.

Validation Reason Code Definitions

Reason Code	Definition
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding time exceeded
02A	Extraction
02B	Analysis
03	Instrument performance – outside criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	Retention time windows
03E	Resolution
04	Initial calibration results outside specified criteria
04A	Compound mean RRF QC criteria not met
04B	Individual % RSD criteria not met
04C	Correlation coefficient >0.995
05	Continuing calibration results outside specified criteria
05A	Compound mean RRF QC criteria not met
05B	Compound % D QC criteria not met
06	Result qualified as a result of the 5x/10x blank correction
06A	Method or preparation blank
06B	ICB or CCB
06C	ER
06D	TB
06E	FB
07	Surrogate recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	% RPD outside acceptance criteria (precision)
09	Post digestion spike outside criteria (GFAA)
10	Internal standards outside specified control limits
10A	Recovery
10B	Retention time
11	Laboratory control sample recoveries outside specified limits
11A	Recovery
11B	% RPD (if run in duplicate)
12	Interference check standard
13	Serial dilution
14	Tentatively identified compounds
15	Quantitation
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria is exceeded
18	Percent difference between original and second column exceeds QC criteria
19	Professional judgement was used to qualify the data
20	Pesticide clean-up checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantitation
24	Reported result and/or lab qualifier revised to reflect validation findings

APPENDIX C

CHEMICAL ANALYTICAL DATA SUMMARY

PROJECT NARRATIVE
CB001

The results reported herein are applicable to the samples submitted for analysis only.

This report shall not be reproduced except in full, without the written approval of the laboratory.

The original chain of custody documentation is included with this report.

Sample Receipt

The cyanide portion of sample CB3013 was received but was not listed on the chain of custody.

Sample CB3007 for total organic carbon was listed on the chain of custody but was not received.

The cyanide portion of samples CB3001 and CB3015 were received at pH 11. The samples were preserved to pH 12 by laboratory personnel.

An extra 500ml container was received for the cyanide portion of sample CB3004.

The filtered metals portion of sample CB3004 was listed on the chain of custody but was not received.

One of the three vials of sample CB3015 was received with headspace.

The hardness portion of sample CB3019 was received by STL Knoxville and the cyanide portion of sample CB3019 was received by STL North Canton. The samples were shipped to the correct laboartories for analysis.

Subcontract

The following analyses were performed by STL North Canton Laboratory, 4101 Shuffel Drive, NW, North Canton, OH 44720: Total Dissolved Solids (MCAAW 160.1), Total Suspended Solids (MCAAW 106.2), Hardness (MCAAW 130.2), Turbidity (MCAAW 180.1), Alkalinity (MCAAW 310.1), Chloride (MCAAW 325.2), Nitrate (MCAAW 353.2), Sulfate (MCAAW 375.4) and Total Organic Carbon (SW846 9060).

STL Knoxville maintains the following certifications, approvals and accreditations: Arkansas DEQ, California DHS ELAP Cert. #2423, Connecticut DPH Cert. #PH-0223, Florida DOH Cert. #E87177, Georgia DNR Cert. #906 (SDWA, 5/14/01-6/21/02), Hawaii DOH, Illinois EPA Cert. #000510, Indiana DOH Cert. #C-TN-02, Kentucky DEP Lab ID #90101, Louisiana DEQ Cert. #03079, Maryland DHMH Cert. #277, Massachusetts DEP Cert. #M-TN009, Michigan DEQ Lab ID #9933, New Jersey DEP Cert. #TN001, New York DOH Lab #10781, North Carolina DPH Lab ID #21705, North Carolina DEHNR Cert. #64, Oklahoma DEQ ID #9415, Pennsylvania DEP Cert. #68-576, South Carolina DHEC Lab ID #84001, Tennessee DOH Lab ID #02014, Virginia DGS Lab ID #00165, Washington DOE Lab #C120, Wisconsin DNR Lab ID #998044300, US Army Corps of Engineers, Naval Facilities Engineering Service Center, US EPA Perchlorate Approval and USDA Soil Permit #S-46424. This list of approvals is subject to change and does not imply that laboratory certification is available for all parameters reported in this environmental sample data report.

PROJECT NARRATIVE
CB001

Quality Control

Unless otherwise noted, all holding times and QC criteria were met and the test results shown in this report meet all applicable NELAC requirements.

Volatiles

Laboratory control duplicate sample EXNW71AD had a recovery for 1,1-dichloroethene that was slightly above QC limits (121% vs. 120%). However, since the recovery was high, and no target analytes were detected in the associated samples, the validity of the data is unaffected.

Samples CB3010, CB3013, and CB3009 were reported with elevated reporting limits for all analytes due to the presence of non-target compounds. A dilution was necessary prior to analysis, and the reporting limits were adjusted accordingly.

Sample CB3022 was reported with elevated reporting limits for all analytes due to a difficult foaming sample matrix. A dilution was necessary prior to analysis, and the reporting limits were adjusted accordingly.

Sample CB3008 and CB3015 were reported with elevated reporting limits for all analytes. Based on screening results, a dilution was necessary prior to analysis; the reporting limits were adjusted accordingly.

Surrogate recoveries for CB3015 were outside QC limits due to matrix interferences.

The surrogate recoveries for the matrix spike/matrix spike duplicate for sample CB3004 were outside criteria. However, the laboratory control sample also showed acceptable results indicating that the analysis was in control.

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PROJECT NARRATIVE
CB001

Semivolatiles

Samples CB3016, CB3018, CB3019, CB3020, CB3017, CB3029, MS/MSD for CB3004, and LCS EXFGV had high internal standard #6 and high surrogate # 5. Samples CB3001, CB3004, CB3007, CB3023 and method blank EXFGV had high internal standard #6; sample CB3013 and CB3022 had high surrogate #5. This was likely due to cumulative detrimental effects on the column/MS from the samples that were high in sulfur. The higher mass analytes increased in response. Since this IS and SS had the higher masses, their response increased. A similar increase would be expected for target analytes having higher masses also, but there were none detected. In addition, the LCS/MS/MSD results showed all control analytes in control. Therefore the impact on the data is minimal or none at all.

Sample CB3015 had a high recovery of 2-fluorophenol due to matrix interference. There were ion interferences with this surrogate. Since only one target analyte was detected slight above the reporting limit, the date should not be affected.

Internal standard #6 was lost in sample CB3022 at the first analysis. The sample was re-run at a one to10 dilution in order to have it within the QC criteria, both analyses were reported. Target analytes not referencing internal standard #6 were reported from the 1st analysis; only target analytes associated with internal standard #6 were reported from the diluted analysis and the reporting limits were elevated accordingly.

Explosives

The matrix spike/matrix spike duplicate recoveries and/or RPDs for sample CB3004 were acceptable for all analytes except tetryl. The laboratory control sample showed acceptable results indicating that the analysis was in control. The matrix spike/matrix spike duplicate results are, therefore, attributed to matrix effects.

Due to sample matrix interferences, estimated results below the reporting limit were not reported for several analytes for samples CB3013 and CB3015. The result was qualified with an "I" flag to indicate the presence of matrix interferences.

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PROJECT NARRATIVE
CB001

Explosives (continued)

The following samples were reported with elevated reporting limits for one or more analytes due to sample matrix interferences: CB3008, CB3013 and CB3015. The affected analytes are flagged on the sample report.

Sample CB3022 was reported with elevated reporting limits for all analytes due to sample matrix interferences, sample was run at at 1/10 dilution.

Metals

The serial dilution of sample CB3004 was outside control limits for potassium due to physical or chemical matrix interferences.

The serial dilution of sample CB3004D was outside control limits for potassium and zinc due to physical or chemical matrix interferences.

Cyanide

Samples CB3004, CB3008, CB3009, CB3013, CB3015, CB3018, CB3019 and the method standards were treated for sulfide prior to distillation.

Chloride

The matrix spike/matrix spike duplicate recoveries and/or RPDs for sample CB3004 were outside limits for chloride. The laboratory control sample showed acceptable results indicating that the analysis was in control. The matrix spike/matrix spike duplicate results are, therefore, attributed to matrix effects.

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Appendix C

Laboratory and Validation Qualifier Definitions
Former Plum Brook Ordnance Works
Sandusky, Ohio

Qualifier	Lab	Definition
Laboratory - Organic		
B	STL	The compound was detected in the sample and in an associated method blank.
G	STL	Elevated reporting limit due to matrix interference.
J	STL	The compound was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
U	STL/Accutest	Not detected. The compound was analyzed for, but not detected above the associated reporting limit.
Laboratory - Inorganic		
B	STL	The analyte was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
J	STL	The compound was detected in the sample and in an associated method blank.
N	STL	Spiked sample recovery not within control limits
U	STL/Accutest	Not detected. The analyte was analyzed for, but not detected above the associated reporting limit.
Validation - All		
B		The analyte was not detected significantly above the levels found in the associated method blank or field blanks
J		The compound/analyte was positively identified; the reported value is an estimated concentration.
R		Rejected due to severe deficiencies in the analytical process or supporting quality control data. The presence or absence of the compound/analyte cannot be verified.
U		Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.
UJ		Not detected. The associated reporting limit may be inaccurate or imprecise.

Plum Brook Ordnance Works
Groundwater
Data Summary

Report Date: 07/18/02

Location Code:			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:			ABG			WELLS-W			WELLS-W			WELLS-W		
Sample No:			CB3007			CB3001			CB3008			CB3004		
Sample Date:			03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
EXPLOSIVES														
Amino-2,6-dinitrotoluene, 4-		ug/L	0.20	U	U	0.20	U	U	0.20	U	U	0.20	U	U
Amino-4,6-dinitrotoluene, 2-		ug/L	0.20	U	U	0.20	U	U	0.20	U	U	0.20	U	U
Dinitrobenzene, 1,3-		ug/L	0.20	U	U	0.20	U	U	0.20	U	U	0.20	U	U
Dinitrotoluene, 2,4-		ug/L	0.20	U	U	0.20	U	U	0.20	U	U	0.20	U	U
Dinitrotoluene, 2,6-		ug/L	0.20	U	U	0.20	U	U	0.43			0.20	U	U
HMX		ug/L	0.50	U	U	0.50	U	U	0.50	U	U	0.50	U	U
Nitrobenzene		ug/L	0.20	U	U	0.088	J	J	0.33			0.076	J	J
Nitrotoluene, 2-		ug/L	0.20	U	U	0.20	U	U	1.7	G U		0.20	U	U
Nitrotoluene, 3-		ug/L	0.20	U	U	0.20	U	U	0.23	G U		0.20	U	U
Nitrotoluene, 4-		ug/L	0.20	U	U	0.20	U	U	0.20	U	U	0.20	U	U
RDX		ug/L	0.50	U	U	0.50	U	U	0.22	J	J	0.50	U	U
Tetryl		ug/L	0.20	U	R	0.20	U	R	0.20	U	R	0.20	U	R
Trinitrobenzene, 1,3,5-		ug/L	0.20	U	U	0.20	U	U	0.20	U	U	0.20	U	U
Trinitrotoluene, 2,4,6-		ug/L	0.20	U	U	0.20	U	U	0.20	U	U	0.20	U	U
GEN CHEMISTRY														
Alkalinity		ug/L	157000	J		229000	J		157000	J		337000	J	
Chloride		ug/L	63200		J	17300000		J	175000		J	558000		J
Cyanide, total		ug/L	10	U	U	10	U	UJ	10	U	U	10	U	U
Hardness		ug/L	314000			8850000			715000			611000		
Nitrate		ug/L	10400			2000	G U		1000	G U		100	U	U
Sulfate		ug/L	63300	J		5000	U	U	23600	J		36200	J	
Total dissolved solids		ug/L	458000			27800000			2200000			1330000		
Total organic carbon		ug/L				740	B	J	2400			3000		
Total suspended solids		ug/L	3000	B	J	13000			14000			9000		
Turbidity		NTU	0.61			10.5			116			112		
METALS														
Aluminum	Y	ug/L	52.0	B	B	55.9	B	B	74.0	B	B	52.7	B	B
Aluminum		ug/L	31.5	B	J	48.6	B	J	35.7	B	J	41.3	B	J

Plum Brook Ordnance Works
Groundwater
Data Summary

Report Date: 07/18/02

		Location Code:	IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
		Associated Site:	ABG			WELLS-W			WELLS-W			WELLS-W		
		Sample No:	CB3007			CB3001			CB3008			CB3004		
		Sample Date:	03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
METALS														
Antimony	Y	ug/L	60.0	U	U	60.0	U	U	60.0	U	U	60.0	U	U
Antimony		ug/L	60.0	U	U	60.0	U	U	60.0	U	U	60.0	U	U
Arsenic	Y	ug/L	10.0	U	U	10.0	U	U	10.0	U	U	10.0	U	U
Arsenic		ug/L	10.0	U	U	10.0	U	U	10.0	U	U	10.0	U	U
Barium	Y	ug/L	30.6	B	J	23800			1170			452		
Barium		ug/L	29.9	B	J	23700			1160			434		
Beryllium	Y	ug/L	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
Beryllium		ug/L	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
Cadmium	Y	ug/L	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
Cadmium		ug/L	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
Calcium	Y	ug/L	82900			1910000			161000			176000		
Calcium		ug/L	81500			1890000			161000			173000		
Chromium	Y	ug/L	10.0	U	U	10.0	U	U	10.0	U	U	10.0	U	U
Chromium		ug/L	10.0	U	U	1.7	B	J	10.0	U	U	10.0	U	U
Cobalt	Y	ug/L	50.0	U	U	5.9	B	J	50.0	U	U	50.0	U	U
Cobalt		ug/L	50.0	U	U	6.1	B	J	50.0	U	U	50.0	U	U
Copper	Y	ug/L	25.0	U	U	26.5			25.0	U	U	25.0	U	U
Copper		ug/L	3.3	B	J	30.5			25.0	U	U	25.0	U	U
Iron	Y	ug/L	100	U	U	1130			100	U	U	100	U	U
Iron		ug/L	38.2	B	J	853			100	U	U	91.1	B	J
Lead	Y	ug/L	3.0	U	U	3.0	U	U	3.0	U	U	3.0	U	U
Lead		ug/L	3.0	U	U	3.0	U	U	3.0	U	U	3.0	U	U
Magnesium	Y	ug/L	32300			888000			82800			69700		
Magnesium		ug/L	31700			884000			82900			68000		
Manganese	Y	ug/L	23.6			156			16.6			65.6		
Manganese		ug/L	29.0			156			14.8	B	J	68.8		
Mercury	Y	ug/L	.2	U	U	.2	U	U	.2	U	U	.2	U	U
Mercury		ug/L	.2	U	U	.2	U	U	.2	U	U	.2	U	U
Nickel	Y	ug/L	7.0	B	J	3.2	B	J	40.0	U	U	40.0	U	U
Nickel		ug/L	6.8	B	J	3.4	B	J	40.0	U	U	40.0	U	U

		Location Code:	IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
		Associated Site:	ABG			WELLS-W			WELLS-W			WELLS-W		
		Sample No:	CB3007			CB3001			CB3008			CB3004		
		Sample Date:	03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
METALS														
Potassium	Y	ug/L	2470	B	J	86900		J	44400		J	14900		J
Potassium		ug/L	2530	B	J	86700		J	47600		J	14500		J
Selenium	Y	ug/L	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
Selenium		ug/L	5.0	U	U	5.0	U	U	5.0	U	U	5.0	U	U
Silver	Y	ug/L	10.0	U	U	10.0	U	U	10.0	U	U	10.0	U	U
Silver		ug/L	10.0	U	U	10.0	U	U	10.0	U	U	10.0	U	U
Sodium	Y	ug/L	24400			7830000			105000			196000		
Sodium		ug/L	23600			7770000			106000			196000		
Thallium	Y	ug/L	10.0	U	U	10.0	U	U	10.0	U	U	10.0	U	U
Thallium		ug/L	10.0	U	U	10.0	U	U	10.0	U	U	10.0	U	U
Vanadium	Y	ug/L	50.0	U	U	50.0	U	U	50.0	U	U	50.0	U	U
Vanadium		ug/L	50.0	U	U	50.0	U	U	50.0	U	U	50.0	U	U
Zinc	Y	ug/L	17.3	B	J	59.2		J	3.4	B	J	19.9	B	J
Zinc		ug/L	15.6	B	J	64.9			20.0	U	U	79.5		
SEMIVOLATILES														
Acenaphthene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Acenaphthylene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Anthracene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(a)anthracene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(a)pyrene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(b)fluoranthene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(ghi)perylene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Benzo(k)fluoranthene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-chloroethoxy)methane		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-chloroethyl)ether		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-chloroisopropyl)ether		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Bis(2-ethylhexyl)phthalate		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Bromophenyl phenyl ether, 4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Butyl benzyl phthalate		ug/L	10	U	U	10	U	U	10	U	U	10	U	U

Plum Brook Ordnance Works
Groundwater
Data Summary

Report Date: 07/18/02

	Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
	Associated Site:		ABG			WELLS-W			WELLS-W			WELLS-W		
	Sample No:		CB3007			CB3001			CB3008			CB3004		
	Sample Date:		03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES														
Carbazole		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Chloro-3-methylphenol, 4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Chloroaniline, 4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Chloronaphthalene, 2-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Chlorophenol, 2-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Chlorophenyl phenyl ether, 4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Chrysene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Di-n-butyl phthalate		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Di-n-octyl phthalate		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dibenz(a,h)anthracene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dibenzofuran		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzene, 1,2-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzene, 1,3-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzene, 1,4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dichlorobenzidine, 3,3'-		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Dichlorophenol, 2,4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Diethyl phthalate		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dimethyl phthalate		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dimethylphenol, 2,4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dinitro-2-methylphenol, 4,6-		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Dinitrophenol, 2,4-		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Dinitrotoluene, 2,4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Dinitrotoluene, 2,6-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Fluoranthene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Fluorene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Hexachlorobenzene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Hexachlorobutadiene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Hexachlorocyclopentadiene		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Hexachloro[illegible]e		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Indeno(1,2, [illegible]yrene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U

Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:		ABG			WELLS-W			WELLS-W			WELLS-W		
Sample No:		CB3007			CB3001			CB3008			CB3004		
Sample Date:		03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group													
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
SEMIVOLATILES														
Isophorone		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Methylnaphthalene, 2-		ug/L	10	U	U	10	U	U	4.6	J	J	10	U	U
Methylphenol, 2-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Methylphenol, 4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Naphthalene		ug/L	10	U	U	10	U	U	4.0	J	J	10	U	U
Nitroaniline, 2-		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Nitroaniline, 3-		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Nitroaniline, 4-		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Nitrobenzene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Nitrophenol, 2-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Nitrophenol, 4-		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Pentachlorophenol		ug/L	50	U	U	50	U	U	50	U	U	50	U	U
Phenanthrene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Phenol		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Pyrene		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Trichlorobenzene, 1,2,4-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Trichlorophenol, 2,4,5-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
Trichlorophenol, 2,4,6-		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
n-Nitroso-di-n-propylamine		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
n-Nitrosodiphenylamine		ug/L	10	U	U	10	U	U	10	U	U	10	U	U
VOLATILES														
Acetone		ug/L	3.5	J	J	5.3	J	J	170		J	10	U	R
Benzene		ug/L	1.0	U	U	1.0	U	U	110			1.0	U	U
Bromodichloromethane		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Bromoform		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Bromomethane		ug/L	2.0	U	U	2.0	U	R	10	U	R	2.0	U	R
Butanone, 2-		ug/L	5.0	U	R	5.0	U	UJ	17	J	J	5.0	U	UJ
Carbon disulfide		ug/L	1.0	U	U	1.0	U	U	0.59	J	J	0.36	J	J
Carbon tetrachloride		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U

Plum Brook Ordnance Works
Groundwater
Data Summary

Report Date: 07/18/02

Location Code:		IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:		ABG			WELLS-W			WELLS-W			WELLS-W		
Sample No:		CB3007			CB3001			CB3008			CB3004		
Sample Date:		03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group													
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
VOLATILES														
Chlorobenzene		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Chloroethane		ug/L	2.0	U	U	2.0	U	U	10	U	U	2.0	U	U
Chloroform		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Chloromethane		ug/L	2.0	U	U	2.0	U	UJ	10	U	UJ	2.0	U	UJ
Dibromochloromethane		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Dichloroethane, 1,1-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Dichloroethane, 1,2-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Dichloroethene, 1,1-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Dichloroethene, 1,2-		ug/L	1.0	U	U	1.0	U	UJ	5.0	U	UJ	1.0	U	UJ
Dichloropropane, 1,2-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Dichloropropene, cis-1,3-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Dichloropropene, trans-1,3-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Ethylbenzene		ug/L	1.0	U	U	1.0	U	U	38			1.0	U	U
Hexanone, 2-		ug/L	5.0	U	U	5.0	U	U	25	U	U	5.0	U	U
Methyl-2-pentanone, 4-		ug/L	5.0	U	U	5.0	U	U	25	U	U	5.0	U	U
Methylene chloride		ug/L	2.0	U	UJ	2.0	U	U	10	U	U	0.21	J B	B
Styrene		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Tetrachloroethane, 1,1,2,2-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Tetrachloroethene		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Toluene		ug/L	1.0	U	U	1.0	U	U	100			0.25	J	J
Trichloroethane, 1,1,1-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Trichloroethane, 1,1,2-		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Trichloroethene		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Vinyl chloride		ug/L	1.0	U	U	1.0	U	U	5.0	U	U	1.0	U	U
Xylenes, total		ug/L	1.0			0.67	J	J	210			1.0	U	U

APPENDIX D

DETECTED HITS SUMMARY EXCLUDING "B" QUALIFIERS

Plum Broo. .dnance Works
Groundwater
Data Summary of Hits

Report Date: 07/18/02

Location Code:			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:			ABG			WELLS-W			WELLS-W			WELLS-W		
Sample No:			CB3007			CB3001			CB3008			CB3004		
Sample Date:			03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
EXPLOSIVES														
Dinitrotoluene, 2,6-		ug/L							0.43					
Nitrobenzene		ug/L				0.088	J	J	0.33			0.076	J	J
RDX		ug/L							0.22	J	J			
GEN CHEMISTRY														
Alkalinity		ug/L	157000	J		229000	J		157000	J		337000	J	
Chloride		ug/L	63200		J	17300000		J	175000		J	558000		J
Hardness		ug/L	314000			8850000			715000			611000		
Nitrate		ug/L	10400											
Sulfate		ug/L	63300	J					23600	J		36200	J	
Total dissolved solids		ug/L	458000			27800000			2200000			1330000		
Total organic carbon		ug/L				740	B	J	2400			3000		
Total suspended solids		ug/L	3000	B	J	13000			14000			9000		
Turbidity		NTU	0.61			10.5			116			112		
METALS														
Aluminum		ug/L	31.5	B	J	48.6	B	J	35.7	B	J	41.3	B	J
Barium	Y	ug/L	30.6	B	J	23800			1170			452		
Barium		ug/L	29.9	B	J	23700			1160			434		
Calcium	Y	ug/L	82900			1910000			161000			176000		
Calcium		ug/L	81500			1890000			161000			173000		
Chromium		ug/L				1.7	B	J						
Cobalt	Y	ug/L				5.9	B	J						
Cobalt		ug/L				6.1	B	J						
Copper	Y	ug/L				26.5								
Copper		ug/L	3.3	B	J	30.5								
Iron	Y	ug/L				1130								
Iron		ug/L	38.2	B	J	853						91.1	B	J
Magnesium	Y	ug/L	32300			888000			82800			69700		
Magnesium		ug/L	31700			884000			82900			68000		

Plum Brook Ordnance Works
Groundwater
Data Summary of Hits

Report Date: 07/18/02

Location Code:			IT-BG8-BEDGW-001			PB-BED-MW20			PB-BED-MW24			PB-BED-MW25		
Associated Site:			ABG			WELLS-W			WELLS-W			WELLS-W		
Sample No:			CB3007			CB3001			CB3008			CB3004		
Sample Date:			03-APR-02			04-APR-02			03-APR-02			03-APR-02		
User Test Group														
Parameter	*Flt*	*Units*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*	*Result*	*Qual*	*VQ*
METALS														
Manganese	Y	ug/L	23.6			156			16.6			65.6		
Manganese		ug/L	29.0			156			14.8	B	J	68.8		
Nickel	Y	ug/L	7.0	B	J	3.2	B	J						
Nickel		ug/L	6.8	B	J	3.4	B	J						
Potassium	Y	ug/L	2470	B	J	86900		J	44400		J	14900		J
Potassium		ug/L	2530	B	J	86700		J	47600		J	14500		J
Sodium	Y	ug/L	24400			7830000			105000			196000		
Sodium		ug/L	23600			7770000			106000			196000		
Zinc	Y	ug/L	17.3	B	J	59.2		J	3.4	B	J	19.9	B	J
Zinc		ug/L	15.6	B	J	64.9						79.5		
SEMIVOLATILES														
Methylnaphthalene, 2-		ug/L							4.6	J	J			
Naphthalene		ug/L							4.0	J	J			
VOLATILES														
Acetone		ug/L	3.5	J	J	5.3	J	J	170		J			
Benzene		ug/L							110					
Butanone, 2-		ug/L							17	J	J			
Carbon disulfide		ug/L							0.59	J	J	0.36	J	J
Ethylbenzene		ug/L							38					
Toluene		ug/L							100			0.25	J	J
Xylenes, total		ug/L	1.0			0.67	J	J	210					

APPENDIX E

DATA QUALITY EVALUATIONS

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List of Acronyms

AR/COC	Analysis Request/Chain of Custody
CFR	Code of Federal Regulations
CI	Chemical Investigation
DI	deionized
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
ID	identification
LCS	laboratory control sample
MB	material blank or method blank
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NFG	national functional guidelines
PQL	practical quanitation limit
PBOW	Plum Brook Ordnance Works
QA/QC	quality assurance/quality control
SAP	quality assurance project plan
RI	remedial investigation
RL	reporting limit
RPD	relative percent difference
SDG	Sample Delivery Group
SOP	Standard Operating Procedures
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compounds

E.1.0 Introduction

This appendix of the Third Quarter Background Groundwater Report presents results of the quality assurance/quality control (QA/QC) measures implemented for the sampling and analysis activities at the Plum Brook Ordnance Works (PBOW) – Sandusky, Ohio. The quality indicators from every aspect of the data collection have been reviewed, and an assessment of the data with regard to project-specific objectives is presented. Successful execution of project-specific objectives and procedures provides strong support for the acceptance of the data generated as adequate for the purpose of evaluating the analytical results from this assessment at PBOW.

Shaw Environmental and Infrastructure conducted field-sampling activities at PBOW in April 2002. Severn Trent Laboratories in Knoxville, Tennessee and Canton, Ohio analyzed the project samples. Accutest Laboratories of Orlando, Florida analyzed the field split sample. All data analyzed were reviewed for accuracy and completeness. One hundred percent of the data analyzed were subjected to data validation following guidelines in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999 (EPA, 1999) and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, February 1994. The criteria for blank evaluation were based on those detailed in *Region III Modifications to National Functional Guidelines for Organic Data Review* (September 1994) and *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses,* (April 1993). Data were evaluated against specific criteria to verify the achievement of precision, accuracy, representativeness, completeness and comparability goals established to meet the project data quality objectives (DQO). To verify that these DQOs were met, field measurements, sampling and handling procedures, laboratory analysis and reporting, and all nonconformances and discrepancies in the data were examined to determine compliance with the appropriate and applicable procedures defined in the SAP. The results of this review are presented in the following sections, with all analytical outliers or nonconformances discussed where they occurred.

This report is divided into three subsections. Section E.2.0 discusses the field investigation and QC procedures used during the sampling effort. Section E.3.0 outlines the analytical program and the associated QC activities performed. The final part of this document, Section E.4.0, summarizes the data findings and their overall impact on the usability of the analytical data.

E.2.0 Field Sampling and QC Activities

Shaw was retained by the U. S. Army Corps of Engineers, Nashville District to conduct investigation and sampling activities at PBOW. Field activities at this site included collection of groundwater samples. The collection of five of the background well samples along with their associated QA and QC samples is discussed in this section of the Data Quality Evaluation (DQE).

All project and field duplicate samples collected were submitted to STL. Sample shipments from the field were performed under custody and documented using standard Shaw Analysis Request/Chain of Custody (AR/COC) forms. These forms provided project-specific analytical specifications and QC instructions to the laboratory. A formal COC transfer record was prepared and included with these forms to document custody during sample transportation, storage, and disposition by the laboratory. Table E-1 summarizes the field sample number, location, sample type, date of collection, and lot number for each sample collected. Table E-2 summarizes the detected compounds in the method blanks associated with the PBOW samples.

E.2.1 Trip Blanks

Aqueous samples designated for volatile organic compound (VOC) analysis may be susceptible to contamination by diffusion of organic compounds into the sample container. Trip blanks are analyzed in order to assess the potential for contamination to be introduced to an aqueous volatile sample during transport and handling procedures. A trip blank is a sample of analyte-free deionized (DI) water that is prepared at the laboratory, shipped to the field with sample containers, and returned to the laboratory with the water matrix samples receiving VOC analysis. A trip blank is then analyzed for volatile organics using the same sample preparation and analysis procedures used for the actual field samples.

The data validator applied the 5X-10X rule to the samples for the analytes detected. The following samples were qualified "B" by the data validator indicating that sample results are indicative of blank contamination:

Lot Number	Samples Affected	Blank Contaminant	Validation Qualifier
CB001	CB3004, CB3005	Methylene Chloride	B

E.2.2 Field Duplicates

Field duplicate samples are collected and submitted to the laboratory for analysis along with their corresponding original sample. The data generated from the analysis of field duplicate samples are used to evaluate the precision of the sample collection and analysis procedures. High relative percent difference (RPD) between an original sample and its field duplicate may indicate a difference in sample matrix or sample collection rather than true problems with precision of sample analysis. Also, when estimated "J" or nondetected "U" results are reported, there is a potential for increased variability between the primary and duplicate sample results

Field duplicate samples were collected at a frequency of approximately one for every ten samples collected (10 percent). One field duplicate sample was collected from the background wells during this sampling event.

Table E-3 compares the original and field duplicate results and shows the RPDs calculated for detected analytes. Analytes not presented in the table were not detected in either the original or field duplicate samples. In cases where duplicates were performed and one result is less than the reporting limit, but greater than the method detection limit, the RPD is reported, but should be considered an estimated value.

The acceptance criterion of 30 percent RPD for waters and 50 percent for soils was used to evaluate these sample results. In most cases, original and field duplicate data compared well as demonstrated by the RPDs calculated. RPD is calculated by using the following formula:

$$RPD = \left| \frac{A - B}{(A + B)/2} \right| \quad x \quad 100$$

where:

RPD = relative percent difference
A = original result
B = field duplicate result.

E.2.5 Field Split Samples

One split sample was collected in conjunction with the field duplicate sample and sent to Accutest Laboratories. The split sample was submitted to the laboratory for the same analysis as its corresponding field duplicate and original field sample. The split sample is 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. Accutest's compound lists for 8260B and 8270C were more extensive than needed for the project. Although all compounds were validated, only the TCL list is discussed in this DQE.

Field split samples were collected at a frequency of approximately one for every ten regular samples. One split sample was collected from the background wells during this sampling event. Table E-3 compares the original and field split results and shows the RPDs calculated for those detected compounds. Compounds not presented in the table were not detected in either the original or field split samples.

E.3.0 Analytical Program and QC Activities

The project QA/QC program described in the SAP was followed for the collection and laboratory analysis of samples. Each of the analytical methods used require that method-specific QA/QC protocols be followed during sample analysis. These protocols are a critical part of the methods employed and were followed by the laboratory during sample analysis. Specific measures included detailed record keeping procedures, instrument calibrations, and analysis of method blanks, blank spikes, MS/MSD, surrogates, and internal standards. The following SW-846 and USEPA Methods were used to analyze PBOW samples:

Parameter	SW-846 Method
Volatiles	SW-846 8260B
Semivolatiles	SW-846 8270C
Nitroaromatic Compounds	SW-846 8330
Metals	SW-846 6010B/7470A/7471A
Gasoline/Diesel Range Organics	SW-846 8015B
Turbidity	EPA 180.1
Alkalinity	EPA 310.1

TOC	SW-846 9060
Hardness	EPA 130.2
Total Dissolved Solids	EPA 160.1
Total Suspended Solids	EPA 160.2
Chloride	EPA 325.2
Total Cyanide	SW-846 9012A
Nitrate	EPA 353.2
Sulfate	EPA 375.4

Appendix C contains the validated analytical data summary for the samples collected during this field investigation. The QA/QC criteria defined in the SAP were used by the validator to evaluate the data for all parameters for which criteria were provided. If acceptance criteria were not provided in the SAP, laboratory-derived acceptance criteria were used by the validator to qualify data or the criteria established in the analytical method were used. Any qualifiers added to these data by the data validator are included in the summaries.

E.3.1 Laboratory QA/QC Procedures

The following sections discuss specific QA/QC protocols required and performed by the laboratory during this investigation.

E.3.1.1 Method/Calibration Blanks

Method blanks are analyzed with each analytical "batch" processed on a per matrix (i.e., soil and water) basis. Method blanks are carried step-wise through the same analytical procedure as their associated field samples including the addition of solvents, surrogate and standard spikes, and reagents as required in the analysis process. The purpose of a method blank is to identify any possible contaminants that may be introduced to the sample as a result of any part of the analytical process. Table E-2 summarizes the compounds detected in associated blanks by lot number. The data validator evaluated all blank data associated with each sample. When estimated or positive concentrations of compounds/analytes were reported in the corresponding field samples, associated samples were evaluated and qualified using the 5X-10X rule.

For some analyses, an initial and continuing calibration blank are performed throughout the run sequence. These blanks verify the presence of carry over contamination for the analytes of interest.

Qualifiers applied to samples based on detects in the method or calibration blanks are summarized below:

Lot Number	Sample Number Affected	Blank Contaminant	Blank	Validation Qualifier
Volatiles				
CB001	CB3004, CB3005	Methylene chloride	Method	B
Metals				
CB001	CB3001(F), CB3004(F), CB3005(F), CB3007(F), CB3008(F)	Aluminum	Calibration	B

E.3.1.2 Matrix Spikes and Laboratory Control Spikes

Two types of spikes were generally performed for all analyses: matrix spikes (MS) and laboratory control samples (LCS). MS compounds are spiked into an aliquot of a field sample. LCS compounds are spiked into a blank matrix. The spiked compounds are representative compounds that are quantified during performance of the method. Recovery of the spiked compound is used as an assessment of analytical accuracy on the sample matrix analyzed. These results are useful in distinguishing sample matrix interferences from analysis interferences through a comparison of MS and LCS recovery data. Often, spikes are performed in duplicate (as an MSD or LCS duplicate). In this manner, the precision of the assessment can be quantified as the RPD of the original and duplicate spike.

Matrix spikes were assigned at a frequency of 1 for every 20 field samples collected. One MS/MSD pair was assigned to one background well: sample CB3004 at location PB-BED-MW25. Additional sample volume was provided to the laboratory for the MS/MSD analyses. This sampling frequency meets the collection criteria for this program as specified in the SAP. In addition to the overall collection frequency, the analytical method requires that the laboratory analyze 1 set of spikes per analytical batch. To comply with this method requirement, the laboratory may have to analyze "batch" QC with a work order. The validator evaluated the "batch" QC. The laboratory statistically determined target acceptance limits were used to assess the spike recovery and RPD.

The MS/MSD criteria were met with the exception of the following, which exhibited % recoveries and/or RPDs outside QC limits:

Lot Number	Sample Number Affected	Compound(s)	Validation Qualifier
Explosives			
CB001	CB3001, CB3004, CB3005, CB3007, CB3008	Tetryl	R
Water Quality			
CB001	CB3001, CB3004, CB3007, CB3008	Chloride	J

LCS results are used to evaluate lab method performance in the same manner as the MS/MSD results except the LCS is not performed on an actual field sample matrix. A LCS is prepared for each analytical "batch" for each parameter and matrix analyzed.

All LCS recoveries met the established QC criteria.

E.3.1.3 Calibration

Several analytes were qualified because of unacceptable performance in the calibration standards. For specific examples refer to the validation report in Appendix B and Table E-5.

E.3.2 Reporting Limits

Practical quantitation limits (PQL) or RLs, used for this project are those statistically determined by the laboratories. The analytical program executed for this project required the use of SW-846 methods, which specify the procedure for calculating the PQLs presented. Each laboratory is required to demonstrate method performance through method detection limit (MDL) studies for every method employed. These studies are required to be laboratory-specific so that individual laboratory variables such as equipment brands, reagent suppliers, and chemist technique are factored into the performance study. MDLs are established using controlled matrices (i.e., DI water). The PQL calculation adjusts the limit by a predetermined mathematical factor for the analysis of actual environmental sample matrices (i.e. soil, groundwater, etc.). For purposes of clarity and consistency with respect to terminology, the term "reporting limit" has been substituted for PQL when referencing the limit of detection reported by the laboratory for each

individual sample and parameter. The actual values reported have been corrected for all necessary dilutions, dryness, and interference factors as applicable based on the resulting analytical data for a sample.

Standard operating procedures (SOP) address MDLs, PQLs, and RLs when dealing with low concentrations of analytes in samples. These limits are generally defined as follows:

- ***MDL.*** The minimum concentration of an analyte that can be determined with 99 percent confidence that the true value is greater than zero.
- ***PQL.*** The lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
- ***RL.*** This number is equivalent to the PQE.

An MDL is the lower limit at which the laboratory can differentiate a measurement from background. The MDL is determined in accordance with the procedures in 40 CFR Part 136. A PQL, or RL, is the lower limit at which a measurement becomes meaningful. This measurement (the PQL or the RL) is generally a multiple of three to five times the MDL.

All samples were handled and analyzed as expected without significant changes to the anticipated project RLs due to matrix interference or high dilutions.

E.3.3 Holding Times/Preservation

All laboratory results submitted for this investigation have been reviewed with respect to laboratory adherence to extraction and analysis holding times. Maximum sample extraction and analysis hold times were those specified in USACE document EM200-1-3.

All holding time criteria were acceptable for the samples collected.

CB3001 was qualified because of improper sample preservation for cyanide.

E.4.0 Data Evaluation and Usability

The analytical data review process identified a few analytical nonconformance issues that were noted during this analytical program. These anomalies have been discussed in the previous sections of this appendix. Table E-5 summarizes all analytes requiring qualifier application due to anomalies discovered during data validation. Analytes that were qualified "J" because they were less than the reporting limits are not included in Table E-5. Table E-4 defines the reason codes for qualification and Table E-6 defines the data validation qualifiers.

The following definitions are used for defining precision, accuracy, representativeness, completeness, and comparability as they have been applied to this evaluation.

Precision. Precision is a measurement of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision data were obtained through the analysis and evaluation of duplicate QA samples. Accuracy was determined through the analysis and evaluation of method blanks, LCSs, trip blanks, equipment rinsates, and MS samples.

Accuracy. Accuracy is a measurement of bias in a system and is expressed as a percent recovery. These QA samples were collected and/or analyzed at the frequency established in the SAP, verifying the completeness element of the DQOs along with the evaluation of holding times and reporting limits. Percent recovery is calculated as follows:

$$Percent\ \text{Recov}ery = \left(\frac{(x-s)}{T}\right) * 100$$

Where:

X = the lab determined concentration of a spiked sample

S = the sample native concentration prior to spike

T = the true concentration of the spike

Relative Percent Difference is calculated as follows:

$$Relative\ Percent\ Difference = \left[\frac{|D1 - D2|}{\frac{D1 + D2}{2}} \right] * 100$$

Where:

D1 and D2 = the results of duplicate measurements

Representativeness. Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix and site conditions. For example, in conducting ground water monitoring, representativeness requires proper location of wells and the collection of samples under consistent, documented procedures. Wells are located based upon the results of the hydrological study in progress and are designed to provide maximum coverage of the flow conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness also can be monitored by reviewing field documentation and by performing field audits.

The samples were collected using Shaw SOPs and were fully documented through the use of standard Shaw field forms. Samples are representative of the matrix and site sampled.

Completeness. Completeness is a measure of the amount of valid data that are obtained during a sampling event as compared to the amount of data planned to be collected under optimum conditions. Some data for this project were qualified as estimated in the validation process because of the outliers noted in the MS recoveries, duplicate results for certain elements, and various other calibration and inductively coupled plasma serial dilution results. A total of 76 data points were qualified as rejected in the validation process due to various QC criteria as described in the previous sections of this report. Precision is calculated as follows:

$$Completeness\ \% = \left(\frac{D_r}{D_c} \right) X\ 100$$

Where:

D_r = the number of data points for which valid results are reported

D_c = the number of valid samples/data points that are collected and reach the laboratory for analysis.

During this task, 6 samples were collected resulting in approximately 980 analytical records. Less than 2 percent of the data points were rejected due to anomalies discovered during the **validation** process. Using the above calculation, 98% completeness is achieved for the task.

Comparability. Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability ensures that results for the sampling event can be compared with data from other past and/or future sampling programs. Comparability for this sampling event was achieved through the use of established and recognized techniques and accepted standard EPA methods. All samples collected and analyzed were subjected to the same sampling, handling, preparation, analysis, reporting, and validation criteria for the purpose of achieving comparability goals within the data set.

E.4.1 Statement of Data Usability

The overall results of the analyses, as discussed in this evaluation, suggest that representative samples were collected and analyzed, and the results are indicative of the media analyzed, with the exception of the few anomalies noted. The data do reflect expected site conditions and are usable for their intended purpose.

Tables E-1 through E-6 summarize the analytical program and the results for the data validation effort for the background well samples collected by Shaw at PBOW.

Table E - 1

Sample Cross-reference
Former Plum Brook Ordnance Works
Sandusky, Ohio

Sample Type	Sample Location	Sample Number	Sample Date	Sample Purpose	Lot Mumber
Monitoring Well	IT-BG8-BEDGW-001	CB3007	3-Apr-02	REG	CB001
	PB-BED-MW20	CB3001	4-Apr-02	REG	CB001
	PB-BED-MW24	CB3008	3-Apr-02	REG	CB001
	PB-BED-MW25	CB3004	3-Apr-02	REG	CB001
	PB-BED-MW25	CB3005	3-Apr-02	FD	CB001
	PB-BED-MW25	CB3006	3-Apr-02	FS	F12806

Table E - 2

Summary of Compounds Detected in Method Blanks
Former Plum Brook Ordnance Works
Samdusky, Ohio

Lot Number	Sample Number	Sample Date	Parameter	Result	Units	Lab Qualifier
CB001	EXHCTBW	3-Apr-02	Alkalinity	3.9	mg/L	B
CB001	EXKF7BW	5-Apr-02	Alkalinity	3.9	mg/L	B
CB001	EXLDXBW	4-Apr-02	Sulfate	0.38	mg/L	B
CB001	EXMJRBW	8-Apr-02	Alkalinity	4.2	mg/L	B
CB001	EXNW7BW	8-Apr-02	Methylene Chloride	0.52	ug/L	J

Table E - 3

Summary of Original, Field Duplicate, and Field Split Results
Former Plum Brook Ordnanve Works
Sandusky, Ohio

LOCATION_CODE				PB-BED-MW25			PB-BED-MW25			PB-BED-MW25			Relative	Relative
SAMPLE_NO				CB3004			CB3005			CB3006			Percent	Percent
SAMPLE_DATE				3-Apr-02			3-Apr-02			3-Apr-02			Difference	Difference
SAMPLE_PURPOSE				REG			FD			FS			REG and FD	REG and FS
Test Group	Parameter	Units	Filtered	Result	Qual	ValQual	Result	Qual	ValQual	Result	Qual	ValQual		
EXPLOSIVES	Nitrobenzene	ug/L	N	0.076	J	J	0.2	U	U	0.2	U		89.86	89.86
METALS	Aluminum	ug/L	N	41.3	B	J	46.7	B	J	200	U		12.27	131.54
METALS	Aluminum	ug/L	Y	52.7	B	B	66.9	B	B	200	U		23.75	116.58
METALS	Barium	ug/L	N	434			422			438			2.80	0.92
METALS	Barium	ug/L	Y	452			437			434			3.37	4.06
METALS	Calcium	ug/L	N	173000			169000			175000			2.34	1.15
METALS	Calcium	ug/L	Y	176000			172000			165000			2.30	6.45
METALS	Iron	ug/L	N	91.1	B	J	74.2	B	J	300	U		20.45	106.83
METALS	Magnesium	ug/L	N	68000			65900			68700			3.14	1.02
METALS	Magnesium	ug/L	Y	69700			67600			65900			3.06	5.60
METALS	Manganese	ug/L	N	68.8			65.8			66.7			4.46	3.10
METALS	Manganese	ug/L	Y	65.6			64.1			59.9			2.31	9.08
METALS	Potassium	ug/L	N	14500		J	14000		J	21100			3.51	37.08
METALS	Potassium	ug/L	Y	14900		J	13600		J	20700			9.12	32.58
METALS	Sodium	ug/L	N	196000			191000			218000			2.58	10.63
METALS	Sodium	ug/L	Y	196000			191000			203000			2.58	3.51
METALS	Zinc	ug/L	N	79.5			77.1			71.3			3.07	10.88
METALS	Zinc	ug/L	Y	19.9	B	J	32.8		J	20	U		48.96	0.50
VOLATILES	Acetone	ug/L	N	10	U	R	2.2	J	J	50	U		127.87	133.33
VOLATILES	Carbon disulfide	ug/L	N	0.36	J	J	0.63	J	J	10	U		54.55	186.10
VOLATILES	Methylene chloride	ug/L	N	0.21	J B	B	0.2	J B	B	5	U		4.88	183.88
VOLATILES	Toluene	ug/L	N	0.25	J	J	0.27	J	J	2	U		7.69	155.56

Table E-4
Summary of Data Validation Reason Codes
Former Plum Brook Ordnance Works

Reason Code	Description
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding Time Exceeded
02A	Extraction
02B	Analysis
03	Instrument Performance - Outside Criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	retention time windows
03E	Resolution
04	Initial Calibration results outside specified criteria
04A	Compound mean RRF<0.05
04B	Compound %RSD>30
04C	Correlation Coefficient<0.995
05	Continuing Calibration results outside specified criteria
05A	Compound mean RRF<0.05
05B	Compound %D>25
06	Result qualified as a result of the 5x/10x blank correction
06A	Method or Preparation Blank
06B	ICB or CCB
06C	ER
06D	TB
06E	FB
07	Surrogate Recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	%RPD outside acceptance criteria (precision)
09	Post Digestion Spike outside criteria (GFAA)
10	Internal Standards outside specified control limits
10A	Recovery
10B	Retention Time
11	Laboratory Control Sample recoveries outside specified control limits
11A	Recovery
11B	%RPD (if run in duplicate)
12	Interference Check Standard
13	Serial Dilution
14	Tentatively Identified Compounds
15	Quantitation
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria exceeded
18	Percent difference between original and second column > 25%
19	Professional judgement was used to qualify the data
20	Pesticide clean-up checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantitation
24	Reported result and/or lab qualifier revised to reflect validation findings
999	See hard copy for details.

Table E-5

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification Former Plum Brook Ordnance Works Sandusky, Ohio

SDG	Sample Number	Analysis	Parameter	VQ	Reason Codes (1,2) R1	R2	R3	R4
CB001	CB3001	Chloride	Chloride	J	08A			
CB001	CB3001	Cyanide	Cyanide	UJ	01A			
CB001	CB3001	Explosives	Tetryl	R	08A			
CB001	CB3001	Metals	Potassium	J	13			
CB001	CB3001	Volatiles	1,2-Dichloroethene (Total)	UJ	05B			
CB001	CB3001	Volatiles	2-Butanone	UJ	05B			
CB001	CB3001	Volatiles	Acetone	J	04A	05A	15	
CB001	CB3001	Volatiles	Bromomethane	R	05A	05B		
CB001	CB3001	Volatiles	Chloromethane	UJ	05B			
CB001	CB3001(F)	Metals	Aluminum	B	06B	15		
CB001	CB3001(F)	Metals	Potassium	J	13			
CB001	CB3001(F)	Metals	Zinc	J	13			
CB001	CB3004	Chloride	Chloride	J	08A			
CB001	CB3004	Explosives	Tetryl	R	08A			
CB001	CB3004	Metals	Potassium	J	13			
CB001	CB3004	Volatiles	1,2-Dichloroethene (Total)	UJ	05B			
CB001	CB3004	Volatiles	2-Butanone	UJ	05B			
CB001	CB3004	Volatiles	Acetone	R	04A	05A		
CB001	CB3004	Volatiles	Bromomethane	R	05A	05B		
CB001	CB3004	Volatiles	Carbon Disulfide	J	17	15		
CB001	CB3004	Volatiles	Chloromethane	UJ	05B			
CB001	CB3004	Volatiles	Methylene Chloride	B	06A	06D	15	
CB001	CB3004(F)	Metals	Aluminum	B	06B	15		
CB001	CB3004(F)	Metals	Potassium	J	13			
CB001	CB3004(F)	Metals	Zinc	J	13	17	15	
CB001	CB3005	Explosives	Tetryl	R	08A			
CB001	CB3005	Metals	Potassium	J	13			
CB001	CB3005	Volatiles	1,2-Dichloroethene (Total)	UJ	05B			
CB001	CB3005	Volatiles	2-Butanone	UJ	05B			
CB001	CB3005	Volatiles	Acetone	J	04A	05A	15	
CB001	CB3005	Volatiles	Bromomethane	R	05A	05B		
CB001	CB3005	Volatiles	Carbon Disulfide	J	17	15		
CB001	CB3005	Volatiles	Chloromethane	UJ	05B			
CB001	CB3005	Volatiles	Methylene Chloride	B	06A	06D	15	
CB001	CB3005(F)	Metals	Aluminum	B	06B	15		
CB001	CB3005(F)	Metals	Potassium	J	13			
CB001	CB3005(F)	Metals	Zinc	J	13	17		
CB001	CB3007	Chloride	Chloride	J	08A			
CB001	CB3007	Explosives	Tetryl	R	08A			
CB001	CB3007	Metals	Potassium	J	13	15		
CB001	CB3007	Volatiles	2-Butanone	R	04A	05A		
CB001	CB3007	Volatiles	Acetone	J	04A	05A	15	
CB001	CB3007	Volatiles	Methylene Chloride	UJ	04B			
CB001	CB3007(F)	Metals	Aluminum	B	06B	15		

Table E-5

Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification Former Plum Brook Ordnance Works Sandusky, Ohio

SDG	Sample Number	Analysis	Parameter	VQ	Reason Codes (1,2) R1	R2	R3	R4
CB001	CB3007(F)	Metals	Potassium	J	13	15		
CB001	CB3007(F)	Metals	Zinc	J	13	15		
CB001	CB3008	Chloride	Chloride	J	08A			
CB001	CB3008	Explosives	Tetryl	R	08A			
CB001	CB3008	Metals	Potassium	J	13			
CB001	CB3008	Volatiles	1,2-Dichloroethene (Total)	UJ	05B			
CB001	CB3008	Volatiles	2-Butanone	J	05B	15		
CB001	CB3008	Volatiles	Acetone	J	04A	05A		
CB001	CB3008	Volatiles	Bromomethane	R	05A	05B		
CB001	CB3008	Volatiles	Chloromethane	UJ	05B			
CB001	CB3008(F)	Metals	Aluminum	B	06B	15		
CB001	CB3008(F)	Metals	Potassium	J	13			
CB001	CB3008(F)	Metals	Zinc	J	13	15		

Footnotes:

defines all reason codes.

importance to the validation qualifiers applied with R1 being

most important.

Definitions:

validation qualifier

Table E - 6

Laboratory and Validation Qualifier Definitions
Former Plum Brook Ordnance Works
Sandusky, Ohio

Qualifier	Lab	Definition
Laboratory - Organic		
B	STL	The compound was detected in the sample and in an associated method blank.
G	STL	Elevated reporting limit due to matrix interference.
J	STL	The compound was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
U	STL/Accutest	Not detected. The compound was analyzed for, but not detected above the associated reporting limit.
Laboratory - Inorganic		
B	STL	The analyte was positively identified; the reported value is an estimated concentration between the method detection limit and the reporting limit.
J	STL	The compound was detected in the sample and in an associated method blank.
N	STL	Spiked sample recovery not within control limits
U	STL/Accutest	Not detected. The analyte was analyzed for, but not detected above the associated reporting limit.
Validation - All		
B		The analyte was not detected significantly above the levels found in the associated method blank or field blanks
J		The compound/analyte was positively identified; the reported value is an estimated concentration.
R		Rejected due to severe deficiencies in the analytical process or supporting quality control data. The presence or absence of the compound/analyte cannot be verified.
U		Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.
UJ		Not detected. The associated reporting limit may be inaccurate or imprecise.