FINAL FOCUSED FEASIBILITY STUDY

Acid Area 2

Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared for:

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
NASHVILLE, TENNESSEE
CONTRACT DACW62-03-D-0004-0010

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COMPLETION OF INDEPENDENT TECHNICAL REVIEW

Jacobs Engineering Group, Inc. has completed the Final Focused Feasibility Study, Acid Area 2, Former Plum Brook Ordnance Works, Sandusky, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy.

[signature] Geologist — 11/1/2012

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CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW

All comments provided by the Plum Brook Team from the review of the Draft version have been incorporated and the response to these comments have been reviewed and evaluated to ensure the concerns have been addressed and responses are appropriate.

Al Hardesty (Signature)

(Project Manager)

11/2/2012 (Date)

EXECUTIVE SUMMARY

This Focused Feasibility Study (FFS) for contaminated soil at Acid Area 2 (AA2) at the former Plum Brook Ordnance Works (PBOW) was prepared for the U.S Army Corps of Engineers by Jacobs Engineering Group Inc (Jacobs). The purpose of this FFS is to develop and evaluate alternatives to address contaminated soil at AA2, and to provide the basis for selection of a preferred alternative. It has been prepared in accordance with *Guidance on Conducting Remedial Investigations and Feasibility Studies Under CERCLA*.

PBOW was operated from 1941 to 1945 as a manufacturing plant for trinitrotoluene, dinitrotoluene, and pentolite. Production of explosives began in December 1941 and continued until 1945. The acid areas were used to produce oleum, sulfuric acid, nitric acid, and mixed acids for the manufacture of TNT. AA2 is adjacent to the western PBOW site boundary and is surrounded on the north, east, and south by NASA controlled property, which is fenced and maintained by security on a 24-hour basis. The area to the west outside of the NASA facility is currently being used for farming. Current on-site human populations include occasional workers and visitors. There are no facilities being operated by NASA within 4000 ft of AA2. The AA2 site has the potential to be declared excess by the government and made available to the public for unrestricted use.

Soil contamination at AA2 is present within the vicinity of former process facilities and storage tanks as a result of activities conducted by the Army in support of the former ordnance works. Surface soil and subsurface soil contamination at concentrations above the U.S. Environmental Protection Agency Regional Screening Levels are limited to polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and metals, which are widespread but at generally low concentrations. The PCB contamination is generally limited to the surface soil. Concentrations of PCBs in surface soil range as high as 49 mg/kg (combined aroclors). Concentrations in the subsurface soil range only as high as 2.6 mg/kg (combined aroclors).

A baseline human health risk assessment (BHHRA) and a screening level ecological risk assessment (SLERA) were prepared to evaluate the potential for adverse effects to human and ecological receptors from exposure to site contamination. The objective of the BHHRA was to evaluate the potential for cancer and noncancer human health effects posed to current and potential future receptors. While PBOW is currently classified for industrial use, future residential use was considered in the risk assessment to support evaluation of all plausible receptor scenarios. Accounting for natural background concentrations of metals and the isolated detections of elevated concentrations of some contaminants of concern, potential risks from exposure to contaminants detected in site environmental media appear to be limited to PCBs and PAHs; however, PAHs were eliminated as site-related contaminants because there is no history of their use for AA2 operations and because there are other likely sources. PAH concentrations at Acid Area 2 all fall within global background levels for urban areas compiled by the Agency for Toxic Substances and Disease Registry.

Remedial action objectives (RAOs) were developed based on the outcome of the BHHRA and SLERA. RAOs were developed only for residential land use of soil because soil is the only medium posing an unacceptable risk to human receptors from site-related contamination. A cleanup goal of 2 mg/kg for total combined PCBs is recommended for AA2 soil because it is protective for cancer and non-cancer health effects for all current and future receptors and is consistent with 40 CFR 761.61. PCBs 1254 and 1260 in surface soil at 0 to 18 inches are the only chemicals of concern.

A remediation technology screening was conducted to identify technologies that could meet the remedial objectives. Technology categories considered include excavation and disposal, ex-situ remediation, in-situ remediation, and incineration. A literature search was conducted to identify potential technologies available for remediation of PCB-contaminated soil for each of these technology categories. Established, demonstrated, and emerging technologies were evaluated to ensure selection of optimal technologies. Technologies/process options that were carried forward from the screening process to formulate alternatives were excavation, disposal, in-situ chemical reduction, ex-situ on-site enhanced bioremediation, and incineration.

Based on the selected technologies, four remedial action alternatives were developed that are considered capable of meeting the RAOs for the site. In addition to these four alternatives, the no action alternative, Alternative 1, was considered in accordance with CERCLA.

Alternative 2, Excavation and Off-Site Disposal, would involve excavation of the contaminated soil, waste characterization, and transportation to appropriate off-site disposal facilities. Excavation to a depth of 18 inches would be conducted using a bulldozer. Soil removal would progress both laterally and vertically as needed based on verification sampling to meet RAOs.

Alternative 3, In-Situ Remediation, involves the use of MuniRem®, which is based on a relatively new emerging technology that stimulates the production of sulfate free radicals, which are capable of degrading PCBs. The MuniRem® powder would be spread over the surface area to be remediated and then mixed with the soil. Several passes with a tiller would likely be required to ensure thorough mixing. The tilled area would be sprayed with water as needed to encourage agent mixing and maximum reaction with the contaminant. Soil would be remediated in 9-inch lifts to be effective.

Alternative 4, Ex-Situ Remediation, involves excavation and on-site remediation of soil using enhanced bioremediation. The remediated soil would be worked in windrows to affect both aerobic and anaerobic conditions as needed to degrade the PCBs. This approach would consist of adding manure, nutrients, and moisture to the soil as well as periodic aeration. The windrows would be mixed to aerate and stimulate microbial activity. Anaerobic conditions would be created by adding molasses. Contaminated soil would be excavated and transported to the on-site remediation areas. The remediated soil would be tested to verify that PCB remediation goals had been achieved and then placed back in the excavation, graded, and seeded.

Alternative 5, Excavation and Incineration, involves excavation of the contaminated soil, waste characterization, and transportation to an approved facility for incineration. Excavation to a depth of 18 inches would be conducted using a bulldozer. Soil removal would progress both laterally and vertically as needed based on verification sampling to meet RAOs. Transportation of waste soil would be conducted by rail.

The alternatives were compared against the threshold and balancing criteria defined in the National Contingency Plan (NCP) to evaluate the expected performance of remedial actions. These CERCLA criteria encompass three broad elements of effectiveness, implementability, and cost.

Alternative 1, No Action, offers no reduction in risk at the site and is therefore, unacceptable since it does not meet remedial objectives.

A comparison of the distinctive components shown in Table ES-1 indicates that Alternative 2, Excavation and Off-site Disposal, is the second lowest cost alternative and has the greatest potential to meet the project objectives since it is a proven method. This alternative; however, will not meet the statutory preference for reducing the toxicity, mobility, and contaminant volume through treatment. Alternative 2 offers the least amount of time required to remediate the site at 6 months.

Alternative 3, In-situ Chemical Reduction, has the potential to meet the statutory preference for reducing the toxicity, mobility, and contaminant volume through treatment; however the cost is approximately $300,000 higher than Alternative 2 and there are uncertainties with the effectiveness and implementation for this technology. The cost could be significantly more expensive if some of the process variables have significant increases. Alternative 3 could be tested in a small scale pilot test at the site for approximately $91,000.

Alternative 4, Enhanced Bioremediation, represents the least expensive option which has the potential to meet the statutory preference for reducing the toxicity, mobility, and contaminant volume through treatment. This alternative has been demonstrated to be effective on a small scale test at the Savannah River Site; however there are uncertainties with implementation in the winter months and remediation effectiveness with elevated concentrations of highly chlorinated PCB aroclors. The cost for Alternative 4 is $9,000 less than Alternative 2; however, the cost could be significantly more expensive if some of the process variables have significant increases. Alternative 4 would require significantly more time to remediate than alternatives 2 and 3, which is estimated at 15 months. The cost for a small scale pilot test is estimated at $258,000.

Alternative 5, Excavation and Incineration, Is the only technology that is both demonstrated to be effective to satisfy the statutory preference for reducing toxicity, mobility, and contaminant volume through treatment; however, this technology is an order of magnitude more expensive than any of the other alternatives and would require the greatest amount of time to implement.

Table ES-1

Criteria	Excavation & Disposal	In Situ Munirem®	Ex-Situ Enhanced Bioremediation	Excavation & Incineration
Reduction in Toxicity, Mobility, or Volume	No	Yes	Yes	Yes
Proven Technology	Yes	No	No	Yes
Implementation Issues/ Uncertainties	No	Yes	Yes	No
Duration (months)	6	8-20	15-26	24
Cost (MM)	2.02	2.33 – 4.33	2.01-2.94	19.7

TABLE OF CONTENTS

Section **Page**

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION....1
1.2 SITE DESCRIPTION AND BACKGROUND....2
1.2.2 AA2 Site Description....3
1.5 REGULATORY INITIATIVES....8
2.0 REMEDIAL ACTION OBJECTIVES....10
2.2 REMEDIAL ACTION OBJECTIVES FOR SOIL....10
2.2.1 Selection of COCs....10
2.2.3 Calculated Cleanup Goals....12
3.2.3 Chemical Oxidation....18
3.2.5 Alkali Metal Polyethylene Glycolate....19
3.2.6 Base Catalyzed Dechlorination....20
3.2.7 Windrow Composting....20
3.2.8 Enhanced Bioremediation....20
3.2.9 Incineration....22
3.2.10 Excavation/Landfilling....23
3.3 SUMMARY OF TECHNOLOGY SCREENING....23
4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES....25
4.1 ALTERNATIVE 1: NO ACTION....25
4.2 ALTERNATIVE 2: EXCAVATION AND OFF-SITE DISPOSAL....25
4.3 ALTERNATIVE 3: IN-SITU REMEDIATION, MUNIREM®....26
4.4 ALTERNATIVE 4: EX-SITU REMEDIATION, ENHANCED BIOREMEDIATION....27
4.5 ALTERNATIVE 5: INCINERATION....27
5.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES....29
5.1 EVALUATION CRITERIA....29
5.1.1 Threshold Criteria....29
5.1.2 Balancing Criteria....29
5.1.3 Modifying Criteria....30
5.2 ALTERNATIVE 1: NO ACTION....30
5.2.1 Overall Protection of Human Health and the Environment....30
5.2.2 Compliance with ARARs....31
5.2.3 Long-Term Effectiveness and Permanence....31
5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment....31
5.2.5 Short-Term Effectiveness....31
5.2.6 Implementability....31
5.2.7 Cost....31
5.3 ALTERNATIVE 2: EXCAVATION AND OFF-SITE DISPOSAL....31
5.3.1 Overall Protection of Human Health and the Environment....31
5.3.2 Compliance with ARARs....32
5.3.3 Long-Term Effectiveness and Permanence....32
5.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment....32
5.3.5 Short-Term Effectiveness....32
5.3.6 Implementability....32

5.3.7 Cost 33
5.4 ALTERNATIVE 3: IN-SITU REMEDIATION, MUNIREM® 33
5.4.1 Overall Protection of Human Health and the Environment 33
5.4.2 Compliance with ARARs 33
5.4.3 Long-Term Effectiveness and Permanence 33
5.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment 33
5.4.5 Short-Term Effectiveness 34
5.4.6 Implementability 34
5.4.7 Cost 34
5.5 ALTERNATIVE 4: EX-SITU REMEDIATION, EHNANCED BIOREMEDIATION 35
5.5.1 Overall Protection of Human Health and the Environment 35
5.5.2 Compliance with ARARs 35
5.5.3 Long-Term Effectiveness and Permanence 35
5.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment 36
5.5.5 Short-Term Effectiveness 36
5.5.6 Implementability 36
5.5.7 Cost 37
5.6 ALTERNATIVE 5: INCINERATION 37
5.6.1 Overall Protection of Human Health and the Environment 37
5.6.2 Compliance with ARARs 37
5.6.3 Long-Term Effectiveness and Permanence 37
5.6.4 Reduction of Toxicity, Mobility, or Volume through Treatment 38
5.6.5 Short-Term Effectiveness 38
5.6.6 Implementability 38
5.6.7 Cost 38
6.0 COMPARATIVE ANALYSIS OF ALTERNATIVES 39
6.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT 39
6.2 COMPLIANCE WITH ARARS 39
6.3 LONG-TERM EFFECTIVENESS AND PERMANENCE 39
6.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT 40
6.5 SHORT-TERM EFFECTIVENESS 40
6.6 IMPLEMENTABILITY 40
6.7 COST 41
6.8 CONCLUSIONS 42
7.0 REFERENCES R-1

APPENDICES

A Contaminant Delineation Summary Report
B Supporting Cost Information
C Enhanced Bioremediation Study Report – Savannah River Site
D Response to Comments

LIST OF TABLES

Tables

1-1 Summary of Noncancer Hazards and Cancer Risk Estimates from Potential Nonresidential Exposures at Acid Area 2
2-1 Summary of Hazard Index and Cancer Risk Estimates for COCs in Surface Soil at Acid Area 2
2-2 Risk Based Remediation Levels for Residential Exposures to Surface Soil at Acid Area 2
5-1 Cost Estimate Summary – Alternative 2: Excavation and Off-site Disposal
5-2 Cost Estimate Summary – Alternative 3: In-situ Remediation, MuniRem®
5-3 Cost Estimate Summary – Alternative 4: Ex-situ Remediation, Enhanced Bioremediation
5-4 Cost Estimate Summary – Alternative 5: Incineration
6-1 Alternative Evaluation Matrix, Acid Area 2

LIST OF FIGURES

Figures

1-1 Location Map, Plum Brook Ordnance Works
1-2 Location Map, Acid Area 2
1-3 Acid Area 2 – 1958 Aerial Photography
1-4 Distribution of Contaminants Exceeding PRGs in Surface Soil – Acid Area 2
1-5 Distribution of Contaminants Exceeding PRGs in Suburface Soil – Acid Area 2
2-1 Total PCBs – Acid Area 2

LIST OF ACRONYMS AND ABBREVIATIONS

AA2	Acid Area 2
APEG	alkali metal polyethylene glycolate
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
BCD	Base Catalyzed Dechlorination
BHHRA	baseline human health risk assessment
°C	degree Celsius
CELRH	Corps of Engineers, Huntington District
CELRN	Corps of Engineers, Nashville District
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COEC	contaminant of ecological concern
COPEC	contaminant of potential ecological concern
COC	contaminant of concern
CY	cubic yards
DNT	dinitrotoluene
EPC	exposure point concentration
ERDC	U.S. Army Engineer Research and Development Center
°F	degree Fahrenheit
FFS	focused feasibility study
ft	feet
ft amsl	feet above mean sea level
GML	Green Mountain Laboratories, Inc.
HI	hazard index
HSP	Health and Safety Plan
HQ	hazard quotients
ILCR	incremental lifetime cancer risk
ITRC	Interstate Technology & Regulatory Council
Jacobs	Jacobs Engineering Group Inc.
KPEG	potassium polyethylene glycolate
LDR	land disposal restriction
MDC	maximum detected concentration

mg/kg	milligrams/kilogram
mg/L	milligrams/liter
NanoFe	nanoscale iron
NaPEG	sodium polyethylene glycolate
NASA	National Aeronautics and Space Administration
NCP	National Contingency Plan
NOAEL	no observed adverse effect level
NTCRA	non-time-critical removal action
OEPA	Ohio Environmental Protection Agency
O&M	operation and maintenance
PAH	polynuclear aromatic hydrocarbon
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyls
PPE	personal protective equipment
PRG	preliminary remediation goal
RI	Remedial Investigation
RCRA	Resource Conservation and Recovery Act
RAO	remedial action objective
RBRL	risk-based remediation level
ROD	record of decision
RTE	rare, threatened, or endangered
SI	Site Investigation
SITE	Superfund Innovative Technology Evaluation
SLERA	screening level ecological risk assessment
SRS	Savannah River Site
TBC	to-be-considered
TNT	trinitrotoluene
TRV	toxicity reference value
TSCA	Toxic Substance Control Act
TSDF	treatment storage and disposal facility
UCL_{95}	95 percent upper confidence limit on the mean
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION

This Focused Feasibility Study (FFS) for contaminated soil at Acid Area 2 (AA2) at the former Plum Brook Ordnance Works (PBOW) in Sandusky, Ohio is being managed by the Corps of Engineers, Huntington District (CELRH) and technically overseen by the Corps of Engineers, Nashville District (CELRN). Jacobs Engineering Group Inc. (Jacobs) is conducting this work under contract DACW62-03-D-0004, Delivery Order 0010.

1.1 PURPOSE AND ORGANIZATION OF THE REPORT

The purpose of this FFS is to develop and evaluate alternatives to address contaminated soil at AA2, and to provide the basis for selection of a preferred alternative. This FFS has been prepared in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) *Guidance on Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988).

This report is organized as follows:

Section 1.0 - *Introduction,* summarizes the history of the facility, site description, previous actions, site risks, regulatory initiatives, and applicable or relevant and appropriate requirements (ARARs).

Section 2.0 - *Remedial Action Objectives*, presents remedial action objectives (RAOs) and goals, and soil volume estimates.

Section 3.0 - Screening of Remedial Technologies and Process Options, presents the technology screening and development of process options.

Section 4.0 - *Development of Remedial Alternatives*, describes the remedial alternatives developed for evaluation against the CERCLA criteria.

Section 5.0 - *Detailed Analysis of Remedial Alternatives*, describes the CERCLA FS criteria and presents the detailed analysis of alternatives relative to effectiveness, implementability, and cost.

Section 6.0 - *Comparative Analysis of Alternatives*, evaluates the alternatives relative to one another against the CERCLA criteria.

Section 7.0 - *References*

The main text of this report is supported by the following appendices:

Appendix A - *Contaminant Delineation Summary Report*, provides the data collected to further evaluate the extent of contamination and provides interpretive maps used to calculate soil volumes.

Appendix B - *Supporting Cost Information*, provides detailed back-up cost information for each alternative.

Appendix C - *Enhanced Bioremediation Study Report – Savannah River Site*, copy of actual report that provides the technical detail and basis for Alternative 4.

Appendix D – Response to Comments on the Draft Focused Feasibility Study

1.2 SITE DESCRIPTION AND BACKGROUND

The following sections provide abbreviated descriptions of the Plum Brook facility and the AA2 site. More complete descriptions can be found in the Final Site Characterization Report (Jacobs, 2007a).

1.2.1 Facility Location and History

PBOW was operated from 1941 to 1945 as a manufacturing plant for trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. Production of explosives began in December 1941 and continued until 1945. It is estimated that more than one billion pounds of explosives were manufactured during the four-year operating period. The site is currently controlled and maintained by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station of the John Glenn Research Center. NASA acquired control of the former PBOW in 1963 and presently utilizes about 6,400 acres for conducting space research. PBOW is located south of Sandusky, Ohio (Figure 1-1). The AA2 site is located in the northwestern portion of PBOW, adjacent to Patrol Road and approximately one mile west of Acid Area 3 (Figure 1-2).

The acid areas were used to produce oleum, sulfuric acid, nitric acid, and mixed acids for the manufacture of TNT. AA2 contained eight buildings (Bldgs. 701-704, Bldgs. 706-708, and a maintenance shop and warehouse building on the eastern edge of the site), 24 above-ground storage tanks, and a rail line (Figure 1-3). No information was obtained during the previous records reviews to indicate the type of process conducted at each building. Identification of three storage areas was determined from the drawings: Oleum Storage, Concentrating Mix Storage, and Sulfuric Acid Sales, as shown on Figure 1-3. Additional detail on the processes and facilities at the former AA2 site are provided in the Final Site Characterization Report (Jacobs, 2007a).

This site was not developed or contaminated prior to the establishment of the Plum Brook Ordnance Plant by the DOD. Since being excessed by the DOD, all above-ground facilities, including process buildings and storage tanks, have been removed from AA2 and the sites have not been used by NASA since acquiring the Plum Brook facility. NASA acquired the site from the DOD and has controlled access to the site which ensures no other party has contaminated the site. Based on aerial photography, the facilities at AA2 were dismantled between 1958 and 1968. Much of the demolition debris was transported to one of several onsite burning grounds for incineration. Incineration activities have been documented to have ceased in 1962, so it is likely that demolition of the AA2 facilities was completed by 1962, preceding the acquisition of PBOW by NASA in 1963. All above-ground facilities including process buildings and storage tanks have been removed from AA2 and the sites have not been used by NASA, nor was any dumping or spilling recorded on this site, since NASA acquired the Plum Brook facility. The entire body of evidence regarding this site, including the finding of contamination and the history of ownership and use indicates that DOD must have caused the contamination found.

1.2.2 AA2 Site Description

The AA2 site physical features include two drainage ditches running west to east: one on the northern perimeter of the site, and one on the southern perimeter of the site. A storm sewer system was constructed at the site, as evidenced by existing drainage grates, manhole covers, and open holes with brick lining. The remains of an old railroad grade with a few railroad ties and loose track are still evident at the site. Former building foundations are present on the north side of the site. There is evidence of concrete footers and/or concrete slabs present at the site based on refusal during drilling operations within the footprint of some of the former facilities. The extent of sub-grade building materials still in place is unknown. A paved service road completes a loop around the perimeter of the site. AA2 covers approximately 25 acres. The ground surface is relatively flat, with minimal slope toward the east and southeast. Elevations at the site range from 639.6 ft amsl near the southeastern portion of the site to 643.8 ft amsl in the western portion. The majority of the site is covered with small trees and brush, with occasional open grass areas with limited brush. The more densely wooded areas tend to be located in the eastern third and western third of the site, with the open areas concentrated in the central portion of the site. The areas outside of the site boundary are heavily wooded.

1.2.3 Surrounding Land Use, Populations, and Ecosystems

AA2 is adjacent to the western site boundary and is surrounded on the north, east, and south by NASA controlled property, which is fenced and maintained by security on a 24-hour basis. The area surrounding the site to the north, east, and south is wooded and is not being utilized by NASA. The area to the west, outside of the NASA facility, is currently being used for farming.

Current on-site human populations include occasional workers or visitors. There are no facilities being operated by NASA within 4000 ft of AA2. The AA2 site has the potential to be declared excess by the government and made available to the public for unrestricted use.

1.3 SUMMARY OF THE REMEDIAL INVESTIGATION

An in-depth description of the source, nature, and extent of contamination is provided in the Final Site Characterization Report (Jacobs, 2007a). This subsection summarizes the results relevant to the evaluation of remedial alternatives for soil.

Contamination at AA2 was detected during surface and subsurface soil investigations performed as part of the Site Investigation (SI) in 1998 (IT Corporation, 1998), during the Remedial Investigation (RI) conducted from 2004 through 2006, and during the FS delineation sampling conducted from 2008 through 2010. A total of 202 surface soil samples and 35 subsurface soil samples have been collected from AA2.

Soil contamination at AA2 is present within the vicinity of former process facilities and storage tanks, (Figure 1-4, Figure 1-5, and Appendix A, Figures A-1 through A-5). Surface soil and subsurface soil contamination at concentrations above the U.S. Environmental Protection Agency (USEPA) Regional Screening Levels are limited to polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and metals (Figures 1-4 and Figure 1-5).

The PCB contamination is generally limited to the surface soil. Only three of the 35 subsurface soil samples had PCB concentrations exceeding the PRGs, all of which were limited to the 3 to 5 ft interval. No PRG exceedances were identified from the 5 to 10 ft interval. Concentrations of PCBs in surface soil range as high as 49 mg/kg (combined aroclors). Concentrations in the subsurface soil only range as high 2.6 mg/kg (combined aroclors).

The metals contamination was limited to lead in surface soil at 2 locations. The PAH contamination included benzo(a)pyrene, benzo(a)anthracene, benzo(b)flouranthene, benzo(k)flouranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene and is primarily limited to surface soil. Based on the human health risk assessment discussed below, PCBs are the only contaminant warranting remedial action.

The primary site contaminants; PCBs, PAHs, and lead are generally fixed to soil and sediment are thus not susceptible to leaching in shallow groundwater. The primary release mechanism for site contaminants is the removal of the vegetative layer. Removal of the vegetative layer is unlikely to occur by natural processes. Some form of construction or other human activity would be required for this release mechanism. If the contaminated soil were to be exposed, fugitive dust, localized to the immediate site, and dermal contact would represent the primary routes of exposure.

Release of site contaminants by leaching into the shallow groundwater has low potential based on the chemical affinity with soil for these compounds. The absence of these compounds in the subsurface soil supports this conclusion. Lateral migration of contaminants through the shallow groundwater and discharge into the drainage ditches is an unlikely exposure route. These contaminants were not detected in the surface water. Release of contaminants into the deeper bedrock groundwater is unlikely because of the absence of contaminants in the shallow groundwater. The more conductive silt deposits near the surface would serve as a preferential flow path for lateral migration of any contaminated groundwater toward the drainage ditches.

1.4 SUMMARY OF SITE RISKS

1.4.1 Human Health Risk Assessment

A baseline human health risk assessment (BHHRA) was completed to evaluate human health risks from potential exposure to soil, groundwater, surface water, and sediment associated with AA2 (Jacobs, 2008a). The BHHRA was prepared in accordance with the *Baseline Human Health Risk Assessment and Ecological Risk Assessment Work Plans* (Jacobs, 2007b) and was consistent with USEPA and Ohio EPA (OPEA) guidance and other risk assessments performed for PBOW.

The objective of the BHHRA was to evaluate potential for cancer and noncancer human health effects posed to current and potential future receptors. This objective was met through the process of data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis.

PBOW is currently classified for industrial use, but future residential use was considered in the risk assessment to support evaluation of all plausible receptor scenarios. Groundskeeper, construction worker and hunter scenarios were evaluated under the current site-use assumptions. Groundskeeper, construction worker, indoor worker, hunter (including a child venison consumer) and on-site residential scenarios were evaluated as plausible future exposure scenarios. This FFS is based on future unrestricted land use (i.e., residential). Results of the risk assessment for the nonresidential exposure scenarios are presented in Table 1-1.

The adult and child residential receptors were evaluated for exposure to surface and subsurface soil, groundwater, surface water and sediment. Total hazard index (HI) estimates summed across all media for the adult and child residential receptors were 7 and 31, respectively. HI sums for surface water and sediment were below 1; therefore, remedial action for these media is not required. Total HI estimates for surface soil were 1 and 10 for the adult and child, respectively. The surface soil contaminants of concern (COCs) were PCB-1254 for the adult, and aluminum, arsenic, iron, thallium, and PCB-1254 for the child. Total HI estimates for subsurface soil were 0.5 and 4 for the adult and child, respectively. The subsurface soil COCs were aluminum, arsenic, iron, manganese, thallium, and PCB-1254 for the child. There were no HI COCs for adult exposures to subsurface soil. Total HI estimates for groundwater were 6 and 10 for the adult and child, respectively. The groundwater COCs for the HI were aluminum, arsenic, barium, iron, manganese, thallium, vanadium, cyanide, benzene, bromomethane, and nitrobenzene for the adult, and aluminum, arsenic, barium, chromium, iron, manganese, thallium, vanadium, cyanide, 1,1,2-trichloroethane, 2-methylnaphthalene, benzene, bromomethane, nitrobenzene, and total xylenes for the child.

The total incremental lifetime cancer risk (ILCR) estimates summed across all media for the adult and child residential receptors were both 3E-4. ILCR sums for surface water and sediment were 5E-6 and 7E-6 for the adult and child, respectively. ILCR estimates for surface soil for adult and child residential receptors were 1E-4 and 2E-4, respectively. The surface soil COCs were arsenic, PCB-1254, PCB-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene for the adult, and arsenic, PCB-1254, PCB-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene for the child. ILCR estimates for subsurface soil for adult and child residential receptors were 5E-5 and 7E-5, respectively. The subsurface soil COCs were arsenic, PCB-1260. benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene for both the adult and child. ILCR estimates for groundwater for adult and child residential receptors were 1E-4 and 7E-5, respectively. The groundwater COCs for the ILCR were 1,1,2-trichloroethane, arsenic, bis(2-ethylhexyl)phthalate, and benzene for the adult and 1,1,2-trichloroethane, arsenic, and benzene for the child.

Based on analytical results, metals, PAHs, and PCBs appear to be widespread but generally at low concentrations in environmental media at AA2, with isolated areas of elevated PAH or PCB contamination. All inorganic constituents detected in environmental media were carried through the risk assessment to provide a conservative estimate of potential risks associated with exposure to site media. However, the maximum detected concentrations (MDCs) for arsenic and iron in surface soil and aluminum, arsenic, iron, and manganese in subsurface soil were lower than their respective background criteria. The MDC for aluminum exceeded its background criterion, which was based on the maximum concentration detected in background samples. The exposure point concentration (EPC) for aluminum was well below its background criterion. There are no site-specific background data for the PAHs, and several were selected as COCs. PAH concentrations at AA2 all fall within global background levels for urban areas compiled by the Agency for Toxic Substances and Disease Registry (ATSDR, 1995). Additionally, PCBs were not consistently detected in the subsurface soil samples; therefore, no further action is recommended for subsurface soil.

Cancer risk and noncancer hazard estimates for exposure to surface water were below 1E-6 and 1, respectively, for any receptor evaluated. Cancer risk estimates were within the cancer risk range of 1E-6 to 1E-4 for the construction worker and adult and child residential receptors for exposures to sediment.

The major contaminants in deep groundwater were metals, benzene, and bromomethane. Detection of metals in deep groundwater appears to be associated with sediment entrained in the samples. Specifically, samples with elevated turbidity had higher levels of metals detections while concentrations of metals in samples with low turbidity levels and filtered samples had low concentrations or were nondetect. Benzene may also be associated with background due to the presence of natural petroleum-derived compounds present in the vicinity of PBOW. Bromomethane may be an artifact of the analytical process caused by laboratory equipment (off-gassing of o-rings), but could not be eliminated during data validation (SW846/5030B, Section 3.1 and SW846/5030C, Section 6.2.5). This compound is also naturally occurring in the environment, and was only detected sporadically in groundwater (one of 14 deep groundwater samples at AA2). Given the likely association of groundwater COCs with turbidity and background levels and the uncertainty of the association of bromomethane with site activities, no further action is recommended for groundwater at AA2.

Accounting for natural background concentrations of metals and the isolated detections of elevated concentrations of some COCs, potential risks are limited to exposure to PCB 1254 and 1260 in surface soil.

1.4.2 Ecological Risk Assessment

A screening level ecological risk assessment (SLERA) was prepared to evaluate the potential for adverse effects to ecological receptors from exposure to hazardous substance releases at AA2 (Jacobs, 2008b). The SLERA was prepared in accordance with the Baseline Human Health Risk Assessment and Ecological Risk Assessment Work Plans (Jacobs, 2007a), and is consistent with USEPA and OEPA – Division of Emergency and Remedial Response (OEPA, 2003) guidance and with the procedures established for other Ecological Risk Assessments at PBOW.

Ecological surveys were performed in the Spring and Fall of 2006. The predominant community types observed at AA2 were Upland Old Fields, Shrub Thickets, Successional Woods, and Lowland Woods. During the ecological survey, AA2 was examined for vegetative stress, including plants displaying stunted growth, poor foliage growth, tissue discoloration, and a loss of leaf coverage. Vegetative stress attributable to chemicals was not observed. Based on site reconnaissance information, it does not appear that significant ecological threats exist at the site as there is no definitive absence of biota or animal life in areas expected to support these ecological components. No threatened or endangered species were found in AA2.

The primary objective of the SLERA was to evaluate the potential for adverse effects posed to ecological receptors as a result of possible hazardous substance releases. The objective was met by characterizing the ecological communities in the vicinity of the site, determining the particular hazardous substances released, identifying pathways for receptor exposure, and estimating the magnitude of the potential for adverse effects to identified receptors. The SLERA addresses the potential for adverse effects to the vegetation, wildlife, aquatic life, threatened and endangered species, and wetlands and other sensitive habitats associated with the site. There is limited habitat for fish in the area of concern (AOC) as the small streams within and adjacent to the area are intermittent.

Impacts from soil contaminants of potential ecological concern (COPECs) to terrestrial plants are considered to be generally insignificant as no vegetative stress was observed on site. Terrestrial receptors are predicted to incur elevated hazards from exposure to contaminants of ecological concern (COECs) PCB-1260, 2,4 dinitrotoluene, aluminum, and lead in soil, based on no observed adverse effect level - NOEL-based hazard quotient (HQ) approaches. Estimated hazards are above 1,000 for some receptors using the NOEL-based approach; however, the estimated HQs that are above 1,000 using the NOEL-based approach are considered unrealistic and toxicologically impossible (Tannenbaum et al, 2003).

The uncertainties associated with the SLERA likely resulting in an overestimation of the potential for adverse ecological effects include: assuming that COPECs are 100 percent bioavailable; use of laboratory-derived or empirically-estimated partitioning and transfer factors to predict COPEC concentrations in plants, invertebrates, prey species, and sediment pore water; use of laboratory-derived toxicity reference values (TRVs); and use of the HQ method to estimate risks to populations or communities. Many conservative assumptions and modeling approaches were used in the predictive assessment, and that actual hazards to wildlife may be orders of magnitude lower than predicted herein. As indicated earlier, estimated HQs greater than 1000 should be considered particularly suspect.

Based on uncertainties associated with estimates of EPCs and potential COEC toxicity and the fact that no rare, threatened, or endangered (RTE) wildlife species have been confirmed at the site, remedial actions solely to address ecological concerns do not appear to be warranted. Although HQs are estimated to be above 100 for the mallard using the NOEL-based approach, neither remedial action nor further study appear to be warranted for surface water and sediment at the site based on uncertainties associated with estimating COEC concentrations in aquatic insects and the limited amount and poor quality of aquatic habitat available to support waterfowl.

1.5 REGULATORY INITIATIVES

1.5.1 Compliance with ARARs

The National Contingency Plan (NCP) at 40 Code of Federal Regulations (CFR) 300.430(f)(1)(ii)(B) requires that on-site remedial actions selected under Section 104 of CERCLA must attain any federal environmental or more stringent state proposed environmental or facility siting standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate to conditions, contaminants, and/or actions at the site, unless waived pursuant to 40 CFR 300.430(f)(a)(ii)(C). The following is a general discussion of requirements for the identification of ARARs.

The CERCLA process for the identification of State ARARs is as follows: The lead agency (USACE) formally requests potential ARARs from the support agency (the State) no later than the time at which site characterization data is available (completion of the RI). The support agencies are required to provide potential ARARs in writing to the lead agency within 30 working days of receipt of the request for ARARs. (See 40 CFR 300.400(g)(6). 40 CFR 300.515 (d) the 30 day requirement is in CFR 300.515 (d)(2) which leads to 40 CFR 300.515(h)(2).) By definition, only those state standards that are "identified by a state in a timely manner and that are more stringent than federal requirements" are ARARs. When identifying ARARs, the citation to the statute or regulation from which the requirement is derived must be included. The citation should specifically address "a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site". During the FS, the lead and support agencies must identify their ARARs related to specific actions no later than the early stages of the comparative analysis.

The USACE (with support from a knowledgeable regulatory compliance personnel and Office of Counsel) will review the ARARs that are submitted and determine which ARARs are truly ARARs for this site. The USACE team will review and confirm the final list of ARARs and provide them to the contractor for inclusion in the proposed plan and the ROD. As the lead agency on non-NPL FUDS sites, USACE has the final decision on ARARs.

ARARs generally are divided into location-, chemical-, and action-specific requirements. Location-specific ARARs restrict actions or contaminant concentrations in certain environmentally sensitive areas. Chemical-specific ARARs are promulgated health- or risk-based numerical values or methods used to determine acceptable concentrations of chemicals that may be found in, or discharged to, the environment. Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances.

CERCLA 121(c)(1) provides that on-site remedial response actions must only comply with the substantive (and not administrative) requirements of regulations identified as ARARs. The NCP at 40 CFR 300.400(e)(1) also exempts on-site actions from having to obtain federal, state, or local permits; however, on-site actions must still be in compliance with any substantive promulgated permit requirements.

In addition to ARARs, the NCP at 40 CFR 300.400(g)(3) states that federal or state non-promulgated advisories or guidance “may, as appropriate,” be identified as to-be-considered

(TBC) guidance for contaminants, conditions, and/or actions at the site. TBCs are not ARARs because they are neither promulgated nor enforceable, but may be used at the discretion of the lead agency.

1.5.2 Method and Organization of the ARARs Analysis

Federal and State of Ohio regulations and guidance documents were reviewed to identify potential location-, chemical-, and action-specific ARARs and TBCs for the proposed alternatives in this FFS. The final determination of ARARs and TBCs rests with the U.S Army Corps of Engineers (USACE) as the lead federal agency.

A detailed analysis of federal requirements and ARARs proposed by the State of Ohio was conducted as described in section 1.5.1 to determine their potential applicability or relevance and appropriateness in relation to conditions, contaminants, and/or actions at AA2. The only ARAR identified is 40 CFR 761.61, identifying and properly managing soil that is a bulk PCB remediation waste. No chemical-specific ARARs were identified.

2.0 REMEDIAL ACTION OBJECTIVES

2.1 INTRODUCTION

This section identifies RAOs for AA2, addresses remedial goals (RGs) and risk-based remediation levels (RBRLs), and summarizes the soil remediation areas and volumes. RAOs are site-specific statements that define the purpose of remediation. RAOs specify the contaminants and media of interest, exposure pathways and receptors, and an acceptable contaminant level or range of levels for each exposure route. RBRLs are a subset of RGs and are numerical cleanup objectives that provide for the protection of human health and the environment and are developed based on the media, receptors, exposure routes, and COCs specified in the RAO statements when there are no ARARs. They are developed during the FS phase of the CERCLA process, and are finalized in the decision document. RGs may be based on ARARs, RBRLs, or other information such as reference doses developed by the USEPA.

2.2 REMEDIAL ACTION OBJECTIVES FOR SOIL

This section describes the development of cleanup goals for AA2 soil. The development of cleanup goals for AA2 is consistent with EPA guidance and the process described in *Final TNT Areas A and C Remedial Investigation, Former Plum Brook Ordnance Works, Sandusky, Ohio, Volume 4 – Focused Feasibility Study for Soil and Sediment* (Shaw, 2003).

These cleanup goals were developed to support remedial action decisions for the protection of human health and the environment. Cleanup goals address the preliminary COCs presented in the BHHRA (Jacobs, 2008a) that pose an unacceptable risk and may warrant corrective action. Cleanup goals were developed only for residential land use of soil because soil is the only medium posing an unacceptable risk to human receptors from site-related contamination, and it is assumed that AA2 may be released for unrestricted future land use. This assumption is appropriate because the area surrounding the former PBOW is rural and residential, and other PBOW sites have been remediated to meet residential clean-up criteria. The potential for adverse effects to ecological receptors was also evaluated and it was determined that remedial actions based on ecological considerations do not appear warranted (Jacobs, 2008b).

The RAO for AA2 is:

- Remedial actions will be taken to prevent adverse residential exposure via ingestion, dermal contact, and inhalation of PCB 1254 and 1260 at concentrations exceeding the AA2 RG in surface soil.

2.2.1 Selection of COCs

The first step in development of cleanup goals is selection of COCs identified in the BHHRA. As presented in *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual Part B – Development of Risk-Based Preliminary Remediation Goals* (USEPA, 1991), COCs based on cancer risks are selected for any medium for which the total

ILCR for a given receptor summed across all chemicals and exposure pathways exceeding the cancer risk range. The OEPA has required that an individual contaminant of potential concern in a given medium to be selected as a cancer-based COC, it must have an ILCR summed across all exposure pathways exceeding the mid point of the cancer risk range. COCs based on noncancer hazards are selected for any receptor for which the total HI summed across all chemicals and exposure pathways exceeds 1. Table 2-1 summarizes the HI and cancer risk estimates for the AA2 COCs identified in the BHHRA.

The potential for adverse impacts to ecological receptors were evaluated in the SLERA for AA2 (Jacobs, 2008b). Many conservative assumptions and modeling approaches were used in the predictive assessment, and actual hazards to wildlife may be orders of magnitude lower than predicted. Based on uncertainties in the SLERA associated with estimates of EPCs and potential COPEC toxicity, and on the fact that no RTE wildlife species have been confirmed at the site, remedial actions solely to address ecological concerns do not appear to be warranted at this time. . While remediation implemented at AA2 based on human health risk results will also reduce the calculated ecological HQs, there is no reason to believe that site ecological receptors are not being sufficiently protected with the site 'as is'."

The potential for adverse health effects associated with potential exposure to soil at AA2 were predicted in the BHHRA for several naturally occurring and anthropogenic constituents; however, with the exception of PCBs, these constituents are not related to historical process activities and are not pervasive in soil samples collected at AA2. Therefore, it is appropriate to develop cleanup goals only for PCB 1254 and 1260 in surface soil, which are suspected to be site-related contaminants and pose an unacceptable noncancer or cancer risk to potential future residential receptors.

2.2.2 Methods for Derivation of AA2 Cleanup Goals

RBRLs are risk- or hazard-specific concentrations of chemicals developed for the COCs in media selected by the criteria described above. RBRLs for cancer COCs were calculated using the following equation (USEPA, 2000):

$$RBRL_{coc} = \frac{EPC_{coc} TR}{ILCR_{cum}} \qquad \textbf{Eq. 1}$$

where:

$RBRL_{coc}$ = risk-based remediation level for a given COC, receptor and source medium (calculated)

EPC_{coc} = exposure point concentration of the COC in the given medium

TR = target risk level (1E-5)

$ILCR_{cum}$ = cumulative incremental lifetime cancer risk for all site-related COCs for a receptor and source medium combination

RBRLs for noncancer COCs were calculated as follows (USEPA 2000):

$$RBRL_{coc} = \frac{EPC_{coc} THI}{HI_{cum}} \qquad \textbf{Eq. 2}$$

where:

$RBRL_{coc}$ = risk-based remediation level for a given COC, receptor and source medium (calculated)

EPC_{coc} = exposure point concentration of the COC in the given medium

THI = target hazard index (1)

HI_{cum} = cumulative hazard index, specific to a target organ effect, for all site-related COCs for a receptor and source medium combination

2.2.3 Calculated Cleanup Goals

RBRLs for AA2 were developed for a cumulative ILCR level of 1E-5 and a cumulative HI level of 1 using equations 1 and 2 from the previous section. The EPC, ILCR, and HI terms are from the AA2 BHHRA (Jacobs 2008). Table 2-2 presents the RBRL's derived for AA2 surface soil for unrestricted residential land use.

For cancer risk-based RBRLs (Eq. 1), the ILCR resulting from the 6-year child resident exposure duration and the ILCR resulting from the 24-year adult exposure duration calculated in the BHHRA are summed as described in Section 3.1.3 of the BHHRA per current risk assessment guidance (EPA, 1991; 2002; 2011). This yields a combined child/adult resident ILCR based on 30 total years of exposure. The child and adult are summed because cancer risks are regarded as cumulative throughout an individual's lifetime.

The same cancer slope factor is used for Aroclor 1254 and Aroclor 1260, which means that the two COCs have the same cancer potency. Accordingly, if the summed child/resident ILCR value and the respective exposure point concentration term for each Aroclor shown in Table 2-1 are inserted into Equation 1 with a target cancer risk level of 1E-5, a cancer-based RBRL of 2 mg/kg results for each of these PCB mixtures.

For noncancer risk-based RBRLs (Eq. 2), the HI resulting from the 6-year child resident exposure duration is used, because childhood exposure results in a higher HI. Thus, the HI for the child will result in a more protective RBRL value than would the adult HI. Please note that because of differences in toxicological responses to cancer-based and noncancer-based effects, the child and adult HI values are not summed in the same way as ILCR values (described above for Equation 1).

Of the two COCs, only Aroclor 1254 has associated noncancer effects, as evaluated in the BHHRA. Thus, the EPC of 16 mg/kg and HI of 13 for the resident child (Table 2-1) are inserted into Equation 2 to yield a noncancer-based RBRL of 1 mg/kg.

As described above and shown in Table 2-2, there are two possible RBRLs for Aroclor 1254: 2 mg/kg based on cancer effects and 1 mg/kg based on noncancer effects. For health protectiveness, the lower of the two is selected as the Aroclor 1254 RG. The RBRL for Aroclor 1260 is 2 mg/kg. However, Aroclor 1254 has the same cancer potency and the same cancer-based RBRL as Aroclor 1260. As such, even though the noncancer-based RBRL is selected as the RG for Aroclor 1254, the cancer-based effects of Aroclor 1254 contribute to a receptor's overall ILCR and must be considered in the derivation of an RG for Aroclor 1260. Therefore, the RG for combined Aroclor 1254/1260 is 2 mg/kg.

Application of the combined RG for Aroclor 1254/1260 is contingent on the RG for Aroclor 1254 not being exceeded. For example, if a location has an Aroclor 1254 concentration of 1.5 mg/kg and an Aroclor 1260 concentration of 0.2 mg/kg, the location is in exceedance of an RG. This is because the Aroclor 1254 concentration exceeds the Aroclor 1254-specific RG of 1 mg/kg, even though the summed Aroclor 1254/1260 concentration (1.7 mg/kg) it does not exceed the combined Aroclor 1254/1260 RG of 2 mg/kg. Another location may have a higher summed Aroclor 1254/1260 concentration (e.g., Aroclor 1260 at 1.7 mg/kg; Aroclor 1254 at 0.3 mg/kg), but may not be in exceedance of either of the RGs. In summary, if the concentrations in soil at a location exceed either the combined Aroclor 1254/1250 RG or the chemical-specific RG for Aroclor 1254, the location is in exceedance of an RG and thus does not meet the RAO.

Aroclor 1254 and Aroclor 1260 are the only PCBs detected in AA2 soil during the SI and RI investigations. If during the remedial action another PCB is detected in a confirmation soil sample, this PCB will be regarded as site related unless information suggests otherwise (e.g., review of analytical data; discovery of additional site-related information, etc.). Unless there is information to indicate that this additional detected PCB is substantially less carcinogenic than 1254/1260, the concentration of this additional Aroclor will be added to those of Aroclor 1254 and Aroclor 1260 to determine the total Aroclor concentration, and this value will be compared to the summed Aroclor 1254/1260 RG of 2 mg/kg.

2.3 SOIL REMEDIATION AREA AND VOLUME

The area of contaminated soil requiring remediation is based on the contaminant delineation study performed as part of the FFS, as presented in Appendix A. AA2 contains three contamination areas as shown in Figure 2-1. From west to east these areas are 56,390 sq ft, 26,466 sq ft, and 44,849 sq ft respectively. The total area of contaminated soil is estimated at 127,705 sq ft. Confidence in the delineated boundary varies by location, as some areas may require additional delineation; however, there appears to be adequate definition to evaluate remedial alternatives. Verification sampling results at the time of remediation may result in additional expansion of the contaminated area, as is common with soil remediation projects.

The vertical extent of contamination is less clear since the delineation effort focused on surface soil only. Based on the RI sampling results, there is limited contamination below 36 inches and, therefore, extensive delineation of the subsurface was not warranted. Only one of the 35 subsurface samples exceeded the remediation goal of 2 mg/kg for PCBs. PCBs are hydrophobic and have a low aqueous solubility. Conversely, PCBs bind to organic matter in soils and often do not migrate to depths greater than a few inches from the surface. The PCBs that have been detected at depth at AA2 are more likely due to regrading of the site after demolition and removal of the AA2 process facilities.

The total volume of soil requiring remediation is estimated to be 14,189 cubic yards (CY) in-place or 16,375 CY after excavation, accounting for expansion. This is a conservative estimate based on a depth of 36 inches. It is possible that PCBs will not be detected below 18 inches over much of the contamination areas. Verification sampling results at the time of remediation may result in a reduction of the soil volume. It is possible that the vertical extent of contamination is less than half of this 36-inch estimate, but it is unlikely that the lateral extent of contamination is twice the current delineated area; therefore, the estimated volume of soil is believed to be conservative and should allow for an adequate evaluation of remedial alternatives.

This volume estimate represents a critical component of the cost estimates, which are a key component of the detailed remedial alternatives evaluation. Additional volume and area calculations affecting the cost estimates are provided in Appendix B.

3.0 SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

3.1 SCREENING PROCESS

The objective of remediation at AA2 is to provide for protection of current and potential future human receptors from exposure to PCB-contaminated soil. The FFS approach is used when conditions are well defined and the remedial options to address site contamination are reasonably limited and straightforward. Accordingly, the screening for this FFS began with the identification and evaluation of technologies/process options to address PCB soil contamination, rather than starting with a broad spectrum of general response actions and technology types. Potentially viable technologies/process options were screened, and those carried forward from the screening were used to develop a range of alternatives to meet the RAOs for the site.

3.2 REMEDIAL TECHNOLOGY SCREENING SUMMARY

A remediation technology screening was conducted to identify technologies that could meet the remedial objectives. Technology categories considered included excavation and disposal, ex-situ remediation, and in-situ remediation. Established, demonstrated, and emerging technologies were evaluated to ensure selection of optimal technologies/process options.

Initially, a literature search was conducted to identify potential technologies available for remediation of PCB-contaminated soil within the technology categories listed above. Established, demonstrated and emerging technologies frequently proposed for remediation of media contaminated with PCBs (USEPA, 1997; UDSHHS and ATSDR, 1993) are listed below.

Established Technologies
Technologies Associated with Institutional Controls
Containment
Incineration
Landfilling

Demonstrated Technologies
Thermal Desorption
Dehalogenation
Solvent Extraction
Soil Washing

Emerging Technologies
Solidification/Stabilization
Enhanced Bioremediation
Vitrification

Some of these technologies deserve no further consideration based on their inability to address the site cleanup goals of reducing total combined PCB concentrations in soil below 2 mg/kg. Containment and institutional controls were screened out because they do not address the long-term reduction in contaminant concentrations and potential future exposures.

Solidification/Stabilization techniques such as Cement Based Stabilization and Activated Carbon were screened out as neither approach would meet the project goals of reducing total combined PCB concentrations in soil to below 2 mg/kg. Vitrification is not practical for this site due to the high cost of these methods. Likewise, the high costs associated with Thermal Desorption make this a non-viable alternative (USEPA, 2001). Soil Washing and Solvent Extraction are not being considered for this site because they do not destroy PCBs. Additionally, Solvent Extraction could cost as much as $805/ton (USEPA, 1997), and may not achieve the remedial goal of 1 mg/kg total combined PCBs.

The remaining technologies that were screened further are grouped into four broad categories: Chemical Dehalogenation, Bioremediation, Incineration, and Removal. A review of the existing published literature indicates that the following remediation technologies are either mature, have the greatest potential for success at PBOW, or show excellent promise as an emerging technology that are worth the investment to explore further development:

Chemical Dehalogenation
Technology 1 – Alkaline Hydrolysis
Technology 2 – Palladized Nanoscale Iron (NanoFe)
Technology 3 – Chemical Oxidation
Technology 4 – Chemical Reduction
Technology 5 – Alkali Metal Polyethylene Glycolate
Technology 6 – Base Catalyzed Dehalogenation

Bioremediation
Technology 7 – Windrow Composting
Technology 8 – Enhanced Bioremediation

Incineration
Technology 9 – Incineration

Contaminant Removal
Technology 10 – Excavation/Landfilling

An important criterion for selection of the most appropriate technologies is the application mode: whether in-situ or ex-situ remediation. In-situ remediation eliminates the costs associated with digging and hauling contaminated material and reduces or avoids earth moving costs and construction of storage or remediation areas. Ex-situ remediation is more practical for some applications. The advantages or disadvantages of each are discussed in the technology screening in the following sections.

3.2.1 Alkaline Hydrolysis

Calcium oxide (CaO) is also known as lime or "quicklime." Early tests to degrade PCBs with lime were regarded as unsuccessful, and reductions in PCB concentrations were attributed to volatilization due to the heat produced by quicklime application (Davila, et al., 1993, Eisenhaus, et al., 1991). Lime can be hydrated to make it more reactive. Hydrated lime [$Ca(OH)_2$] is made by adding 32 percent water to CaO in a hydrator. Hydrated lime can also be amended with activated carbon to produce an effective sorbent for vapor phase PCBs

(Licata, et al.,1996).

Researchers at the U.S. Army Engineer Research and Development Center (ERDC) degraded PCBs using hydrated lime application in multiple lab tests (Medina, et al., 2007) through alkaline hydrolysis. PCB concentrations decreased from 22.6 mg/kg to 6.78 mg/kg in one experiment and from 2.33 mg/kg to 1.3 mg/kg in another test; however, the experimental results did not meet the project remediation goals, and the authors were unable to fully explain the mechanism or identify all the breakdown products.

The application of this technology would involve in-situ addition of hydrated lime to the PCB-contaminated soils. The soils would be wetted and tilled to elevate the pH, suppress dust, homogenize the soil lime mixture, and catalyze the lime hydrolysis reactions. Multiple intervals of mixing and additional lime and water applications may be required to initiate the degradation process. Reaction time should be rapid, and remediated soil samples can be collected after approximately 24 hours.

Research conducted by Western Michigan University (Cassidy, 2010) confirms that there is no clear mechanism for the alkaline chemical destruction of PCBs. This study identified that the reduction in PCB concentrations from hydrated lime application was due to encapsulation of the PCBs with a coating of precipitated Ca(OH)2. This encapsulation masked the PCBs during laboratory analysis. The study demonstrated that once the soil pH was reduced, the encapsulation was reversible, and there was no degradation of the PCBs.

Research was conducted by ERDC in 2011 using both 2% NaOH and a mixture of NaOH/zero valent iron, which resulted in only a 20% reduction in PCBs in soils (Waisner, 2011).

3.2.2 Palladized (palladium catalyzed) Nanoscale Iron

NanoFe consists of extremely small (10^{-7} to 10^{-9} meter) particles of zero valent iron (Mikszewski, 2004). These particles have a high surface area to volume ratio and are extremely reactive with reducible chemicals due to their high surface energies, zero valency, and unique structure. Palladium (Pd), an uncommon element, can be added to NanoFe to increase the reactivity of the material. This process is accomplished by soaking the freshly prepared NanoFe in an ethanol solution with 1 wt percent ($[Pd(C_2H_3O_2)_2]_3$) which causes the reduction and deposition of Pd and Fe on the surface of the particles (Wang and Zhang, 1997).

The Pd/Fe bimetallic complex has been shown to completely degrade PCBs to biphenyl in a short period (17 hours) (Grittini, et al, 1995). Experimental evidence indicates that the palladium reduces the oxidation of the iron to enhance reactivity of the nano particles (Wang and Zhang, 1997). Additionally, the palladium releases hydrogen which displaces chlorine on the PCB molecule (Korte, 2000). One factor that may reduce the reaction rates is the lack of availability of the PCB molecules to the NanoFe, since the PCBs need to be desorbed from the soil particles. Addition of an innocuous surfactant may stimulate release of the PCBs from the organic soil particles to make them available for dechlorination by the NanoFe, however this would need to occur in an aqueous environment which would require significant engineering at the site or transportation to a facility.

3.2.3 Chemical Oxidation

Various chemical oxidants have been tested on PCBs. Limited studies with permanganate and ozone have shown that they were not effective at degrading PCBs, while limited success was achieved using Fenton's reagent (Fe/H_2O_2) and Ozone/H_2O_2 (ITRC, 2005). ISOTEC of West Windsor, NJ completed a field test using Fenton's reagent to degrade PCB concentrations from 35 percent to 99 percent at 10 of 12 locations, however, this data has apparently not been published. A study by the IT Corp. found that chemical oxidation was effective at degrading the dichlorobiphenyls (90 percent) and trichlorobiphenyls (81 percent) and were somewhat effective at degrading tetrachlorobiphenyls, but more highly chlorinated PCBs were unaffected (USEPA, 1994).

Although the Interstate Technology & Regulatory Council (ITRC) reported that PCBs were recalcitrant to degradation by activated persulfate oxidation alone, this technique has been demonstrated in laboratory tests. When persulfate is activated by heating (30-100 ^{o}C) or using ultraviolet radiation, sulfate free radicals ($SO_4^{-\bullet}$) are formed. Transition metal catalysts can also be used to stimulate the production of these free radicals. The sulfate free radicals are able to initiate reactions to degrade organic contaminants. Research has shown that lime and persulfate can be combined to form sulfate free radicals to degrade PCBs (ITRC, 2005). ERDC was also able to reduce Aroclor 1254 by 90% using heat activated sodium persulfate in an aqueous solution (Waisner, 2011). Studies by Lawrence Livermore Labs found that Direct Chemical Oxidation was capable of reducing Arochlor 1242 from 45 mg/kg to low ppb levels. All of these ex-situ techniques would involve large capital expenditures.

Several oxidation experiments were conducted by ERDC personnel at the USACE, Vicksburg (Medina, 2007). Experiments with lime persulfate showed a loss of 73 percent of the PCBs (22.6 mg/kg to 6.21 mg/kg and 22.6 mg/kg to 6.38 mg/kg) in bench scale tests. Fenton's oxidation tests resulted in a 78.4 percent removal of PCBs, but the reaction is vigorous and produces significant heat. Neither of these results was able to meet the project remediation goals. A similar study by Western Michigan University (Cassidy, 2010) using PCB contaminated sediment from the Kalamazoo River and employing a lime-persulfate mix in slurry reactor vessels, showed a reduction of PCB concentrations by as much as 77 percent. It is unknown how effective lime-persulfate would be if utilized on an in-situ basis.

A significant challenge to implementing this technology is the inherent heterogeneity present in soils or sediments. The heterogeneous nature of the soils results in uneven distributions of contaminants in these media. Uneven distribution of contaminants means that uncontaminated soil may be remediated along with contaminated soil, thus increasing remediation costs. During in-situ remediation, reactions between the reagent(s) and the contaminant(s) often produce reactant products that reduce soil porosity and permeability preventing efficient distribution of the reagents throughout the contaminated material. This problem can be alleviated by more thorough mixing or slurrying of the soils when possible.

3.2.4 Chemical Reduction

Little data is available on the chemical dehalogenation of PCBs. Gas-phase chemical reduction of PCBs has been demonstrated by a Canadian company, EcoLogic, using hydrogen at temperatures ≥850 °F. The process required application in an anaerobic reactor, which was claimed to prevent formation of dioxins and furans. The process degraded PCBs to methane, hydrogen chloride, and minor amounts of benzene and ethylene. Cost data is not available and no recent contact information was found in a search for EcoLogic. Additionally, PCBs were chemically dehalogenated in a reactor using activated elemental sodium, but this technology is slow and cost prohibitive. This company is apparently no longer in operation, which suggests there may not have been a significant market for this technology.

Zero-valent magnesium (ZVMG) has been tested on PCB contaminated soil in a bench scale study conducted by RemQuest. The RemQuest product is AMTS (Activated Metal Treatment System). AMTS was used in varying concentrations and at varying percent water content in the soil. The product reduced PCB concentrations by 85% using dry soil at a ratio of 1 ml AMTS to 1 g soil. Percent reductions decreased as the ratio of AMTS to soil was reduced and as the water content was increased. Effective treatment of soil at Plum Brook would require drying the soil and applying the agent at the ratio of 1 ml per gram of soil. Based on an estimate of 17240 tons of soil needing remediation, approximately 4 million gallons of AMST would be required, which is not practical. The AMTS agent costs $25 to $30 gallon.

MuniRem®, manufactured by PLANTECO Environmental Consultants, is a relatively new emerging technology that stimulates the production of sulfate free radicals ($SO_4^{-\bullet}$) which are capable of degrading PCBs (see discussion on Chemical Oxidation above). MuniRem® has been demonstrated in several field studies to effectively degrade explosives, but has not been field tested for PCBs; however, the effectiveness of sulfate free radicals in degrading PCBs has been demonstrated.

3.2.5 Alkali Metal Polyethylene Glycolate

Chemical dehalogenation using alkali metal polyethylene glycolate (APEG) involves removing chlorine atoms from the PCB molecule. Soil preparation for this technology involves suspending the contaminated media in a liquid phase in a reactor vessel. A dechlorinating reagent is added and sometimes the mixture is heated to catalyze or enhance the reaction. It may be necessary to capture hazardous vapor emissions. APEG reagents can dechlorinate PCBs in soils and liquids. Potassium polyethylene glycolate (KPEG) and sodium polyethylene glycolate (NaPEG) are common reagents used for the APEG process. Limitations of this technology include (USDHHS and ATSDR,1993):

- The process requires high chemical doses (50 percent per weight of soil)
- Reagent recycling is necessary for process economics
- Three to twelve hours of application time is required to obtain a high degree of dehalogenation
- Chlorinated phenols are not completely dechlorinated
- Partially dehalogenated byproducts remain
- Remediated soil requires neutralization
- The process has shown to be more effective for liquids than soils

3.2.6 Base Catalyzed Dechlorination

Base Catalyzed Dechlorination (BCD) involves replacement of the PCB chlorine atoms with hydrogen. The PCB-contaminated media must be pretreated to reduce it to approximately ½-inch in size. The soil and base (such as sodium bicarbonate) are placed in a reactor and heated to approximately 300 to 330 °C (572 to 626 °F) under a nitrogen atmosphere. The PCBs are vaporized from the soil and some dechlorination occurs. The vaporized organic compounds are then condensed and a patented catalyst, another base (sodium hydroxide), and a hydrogen donor such as fuel oil are added to the condensed material for dechlorination. The treated condensate is separated and the water is treated with activated carbon and the oil is combusted.

The process uses low cost chemicals and the waste is completely dechlorinated to less than 1 mg/kg. Process times are as short as 1 to 3 hours. Costs range from $335 to $865/ton (USEPA, 1997). EPA's attempt to use this technology to remediate liquid PCB waste at the Warren County, NC Landfill was unsuccessful due to improper sizing of the reactor vessel. The technology is currently being used in Australia.

3.2.7 Windrow Composting

Windrow composting is an ex-situ technique used to produce large volumes of compost. Organic waste is generally spread in long rows known as windrows in open air or within a ventilated building. The waste is usually periodically watered and/or turned to increase both porosity and oxygen content. Frequent turning and watering speeds the decomposition of the waste, promotes the development of compost, and enhances the growth of the microbial consortia living in the composted material.

Studies were conducted by USACE personnel to determine if windrow composting could degrade PCBs. PCB-contaminated dredge spoil was mixed with wood chips and biosolids and placed in windrows (2-4m W x 0.5-1.0m H x 50-60m L). The windrows were periodically watered and turned for three months. PCB concentrations were reduced, but published data appear to indicate that losses were generally by less than 50 percent (Myers and Bowman, 2000). Because this technique results in aerobic conditions in the compost, it is not likely to be suitable for more highly chlorinated PCBs, which are resistant to aerobic degradation (USEPA, 1993). It is possible that PCB losses were due to volatilization in the compost where exothermic reactions can raise the temperatures to 160 °F. A potentially more effective form of windrow composting, referred to as "Enhanced Bioremediation" is discussed below.

3.2.8 Enhanced Bioremediation

Bioremediation is an increasingly popular remediation technique that uses indigenous or exogenous microorganisms to degrade, accumulate, or precipitate contaminants. Research has shown that less chlorinated PCBs may be susceptible to aerobic bioremediation, but more highly chlorinated congeners are resistant to degradation under these conditions. More highly chlorinated PCBs can be partially degraded under anaerobic reducing conditions, and their lesser chlorinated metabolites may then be degraded under aerobic conditions (USEPA, 1993).

Four ex-situ approaches are generally used for bioremediation of PCBs: landfarming, slurrying, soil heaping and composting. Landfarming uses earth moving equipment to move the contaminated soils, mix in nutrients, and stimulate biodegradation. Slurrying involves mixing the PCB-contaminated soils with water and possibly nutrients in slurry tanks. Soil heaping (sometimes called biopiles) involves creating large piles of contaminated material and possibly bulking agents and nutrients with soil aeration (bioventing). Composting is a thermophilic process that is discussed above (windrow composting). Climate can affect each of these techniques as can space requirements and availability of water and electricity (USEPA, 1993). It is also possible to conduct in-situ bioremediation, and this process has been shown to be effective for perchlorate and explosive compounds; however, no data have been found to suggest it has been tested on PCBs (O'Niell and Nzengung, 2005).

Enhanced bioremediation utilizes windrow composting techniques, but includes amendments that enable biodegradation in an anaerobic environment. This technique was used at the Savannah River Site (SRS) to remediate soils contaminated with PCBs at concentrations of 0.005-5.52 mg/kg (see referenced website http://www.clu-in.org/PRODUCTS/NEWSLTRS/tnandt/view.cfm?issue=0303.cfm#2 and report in Appendix C). The technique consisted of adding nutrients and moisture to the soil as well as periodic aeration. Contaminated soils were placed in two remediation areas, each with a volume of approximately 600 CY spread in two 15 ft x 125 ft windrows. The windrows were mixed twice each week to aerate and stimulate microbial activity. Anaerobic conditions were created by adding organic matter (molasses and manure), nutrients (boron, calcium, cobalt, copper, iron potassium, magnesium, manganese, molybdenum, phosphorous, sulfur, and zinc) and maintaining moisture content at approximately 18 percent. This technique made it possible to continually cycle the soil conditions from aerobic to anaerobic and enhance microbial activity.

PCB reductions to levels below the remedial goal objective were accomplished; however, the starting concentrations were not as high as they are at AA2. The study also showed that anaerobic conditions are needed to degrade the more highly chlorinated aroclors such as PCB-1254 and PCB-1260, which represent the only aroclors detected at AA2. This approach differs from composting in that composting is an aerobic and thermophilic process and commonly involves the addition of bulking agents, such as straw or other plant matter. This approach cycles between aerobic and anaerobic conditions with the addition of molasses and maintains a mesophilic condition at temperatures below 105 ^{o}F.

It is not certain if this technology can lower the high PCB concentrations at AA2 to levels below the clean-up goals. It is also uncertain if the soil types at AA2 would respond as favorably as the soils at the SRS. A treatability study or pilot test would be required to evaluate the effectiveness at AA2 and to determine the amount of amendments needed and the duration of remediation. If the technology were determined to be effective only for soils with lower PCB concentrations, the soils with higher concentrations could be segregated and disposed off-site.

Another similar study was conducted in 1998 under the sponsorship of the New Hampshire - Department of Environmental Services, Green Mountain Laboratories, Inc. (GML) and the USEPA (SAIC, 2005). These parties agreed to carry out a Superfund Innovative Technology Evaluation (SITE) project to evaluate the effectiveness of GML's Bioremediation Process for the remediation of PCB contaminated soils at the Beede Waste Oil/Cash Energy Superfund site in Plaistow, New Hampshire. The remediation process involved inoculation/augmenting of the PCB contaminated soils with bulk microbial inoculum and nutrients, and allowing the microbes to aerobically degrade the PCBs. The bulk inoculum was produced on site by the developer using animal feed-grade oatmeal as the substrate, shredded pine needles that provided certain specific co-metabolite compounds, nutrients, and a proprietary consortium of microorganisms capable of degrading the PCBs to their eventual endpoints of carbon dioxide and mineral halides. Soil was placed in 10 controlled plot areas up to 18 inches deep, mixed with varying combinations of inoculum, and allowed to sit for approximately 2 months. The only maintenance performed on the test plots involved irrigation to maintain moisture contents.

The results of this field-scale treatability study indicate no removal/degradation of the PCBs. In September 2000, GML carried out a limited number of preliminary bench-scale tests at the Middlebury College in Middlebury, Vermont to reestablish the viability of its process. At the conclusion of the bench-scale tests, GML conceded that, at best, the tests were inconclusive and, at the worst, had failed. The project was terminated at that time. The study does not indicate whether oxygen content of the soils was monitored; however, based on the test set up and mechanics, it is unlikely that anaerobic conditions were created during the study.

Additional studies in bacterial metabolism of PCBs have been conducted (Pieper and Seeger, 2008). The research summarized in this report indicates that most bacteria have a limited range of PCB congeners that can be effectively degraded. The actual mechanics involved in the degradation process, resulting metabolites, and impact of metabolites in the process is complex and still relatively unknown.

Landfarming was used in Saginaw, Michigan for a pilot-scale study for dredged material contaminated with PCBs (Meyers and Horner, 2003). No amendments were added to the dredged sediment. The sediment was turned on a periodic basis, tilled, and allowed to interact with the climate at the site for approximately one year. PCB reductions of 75 percent were observed in all three test cells. The report does not indicate the specific aroclors involved or whether this technique would be successful in degrading the more highly chlorinated aroclors. The cost for this process is relatively inexpensive, but the time involved is considerably longer than other remediation methods.

3.2.9 Incineration

Incineration is a proven technology; however, this practice has the potential to produce dioxins/furans. In 2004 the EPA increased the technical criteria for incineration of PCBs to include a minimum of 1200 °C for 2 seconds, with 99.9 percent combustion efficiency, while maintaining oxygen in the stack gas. The complete consumption of oxygen in the combustion process is what has contributed to past production of dioxins/furans during PCB incineration.

Obtaining a 99.9 percent combustion efficiency with a soil medium is difficult. Because of these new requirements, there has been a drastic reduction in facilities that are TSCA permitted. These requirements have also resulted in cost increases for this technology. In addition, the lack of TSCA permitted facilities for PCBs has also resulted in increased shipping distances. The AA2 soils would have to be shipped via rail to Texas.

3.2.10 Excavation/Landfilling

Excavation and landfilling, either full or partial, is often a costly method of disposal but may be acceptable in some situations. The extent of contamination should be fully delineated to ensure that disposal of uncontaminated soil is minimized. Once the excavation area has been delineated on maps, the site should be surveyed and marked to identify excavation areas on the ground. A triad approach using a mobile lab for on-site analysis may be warranted at some sites based on the soil volumes and site heterogeneity. On-site analysis can be used to guide excavation activities to keep cost down while ensuring successful removal.

A bulldozer would be used to excavate to depths of less than 12 inches and a backhoe, trackhoe or loader to remove deeper soils. The excavated material may be stockpiled on site if a mobile lab is not used. Dust mitigation efforts such as soil wetting may be required as well as tarping of the stockpile. Additionally, fencing and other security measures may be instituted for safety purposes. The soils would be transported to a chemical waste landfill for disposal either during excavation or once excavation is completed.

3.3 SUMMARY OF TECHNOLOGY SCREENING

Most of the technologies discussed above have been eliminated from consideration because they can not meet the remediation goal of 2 mg/kg for total combined PCBs or because the process is too difficult, impractical, or expensive to implement. Maximum PCB concentrations of 49 mg/kg at AA2 will require a reduction of up to 96 percent in order to meet the remediation goals.

Hydrated lime was eliminated because it does not permanently degrade PCBs. Palladized NanoFe is shown to effectively and quickly degrade PCBs; however, it has been eliminated in part because of the measures needed to ensure interaction of the agent with the PCBs, but primarily because there is no commercial product readily available on the market. Chemical oxidation using lime-persulfate was eliminated because the maximum demonstrated reduction is 77 percent when utilized in a slurry reactor vessel. In-situ applications of lime-persulfate would likely be less effective.

APEG was eliminated because of the impractical measures needed for process set up and the cost implications of an APEG to soil ratio of 50 percent. BCD was eliminated because of the impractical measures needed for process set-up and the lack of a vendor available in the United States. Windrow composting without amendments was eliminated because it does not effectively degrade the more highly chlorinated aroclors such as 1254 and 1260, which are present at AA2.

The four remaining technologies that are under consideration are excavation/off-site disposal, in-situ chemical reduction using MuniRem®, ex-situ on-site enhanced bioremediation, and incineration. Only off-site disposal and incineration are proven methods for reducing risk at the site; however, the disposal option does not address the CERCLA statutory preference for remedial actions that "employ treatment technologies that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants as a principle element".

The chemical reduction process using MuniRem® has not been field demonstrated and is therefore unproven and has a high degree of uncertainty regarding effectiveness and cost to implement. The use of on-site enhanced bio-remediation has been field demonstrated, but at concentrations an order of magnitude lower than those found at AA2. There is a high degree of uncertainty regarding the effectiveness and costs associated with this technology. Both of these technologies would require a pilot study to determine if the target goals can be achieved, to determine the amount of materials and agents needed to be effective, to fine tune the processes needed to effectively treat AA2 soil, and to more accurately determine the cost of remediation. These technologies have been further developed in the following alternatives discussions to provide a comparison with the more proven technologies of excavation/off-site disposal and incineration.

4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Based on the selected technologies described in Section 3, four remedial action alternatives were developed that are considered capable of meeting the RAOs for the site. In addition to these four alternatives, the option to leave the site in its current state (no action) is also evaluated. The no action alternative is considered in accordance with CERCLA requirements to provide a baseline for comparison with other alternatives. The alternatives evaluated are as follows:

- Alternative 1 – No Action
- Alternative 2 – Excavation and Off-Site Disposal
- Alternative 3 – In-situ Remediation, MuniRem®
- Alternative 4 – Ex-situ Remediation, Enhanced Bioremediation
- Alternative 5 - Incineration

Each of these alternatives is described in the following sections.

4.1 ALTERNATIVE 1: NO ACTION

The no action alternative would leave the property in its current state. The no action alternative provides a comparative baseline against which other alternatives are evaluated. Under this alternative, no remedial action would be taken and contaminants would be left "as is" without the implementation of containment, removal, remediation, or other remedial actions. This alternative does not provide for the monitoring of environmental media and does not provide any physical or administrative institutional controls such as fencing or deed restrictions to reduce the potential for human exposure.

4.2 ALTERNATIVE 2: EXCAVATION AND OFF-SITE DISPOSAL

This alternative would involve excavation of the contaminated soil, waste characterization, and transportation to appropriate off-site disposal facilities. The contaminated area would be marked in the field based on the delineation sampling. Initial excavation to a depth of 18 inches would be conducted using a bulldozer and excavator. Soil removal would progress both laterally and vertically as needed based on verification sampling.

Verification samples would be collected from the excavation floor using the USACE guidance for incremental sampling approach. A total of 30 to 100 incremental samples will be collected from each sample unit, to be determined based on the statistical approach outlined in the USACE Interim Guidance 09-02 (July, 2009). The sample unit will be defined as a 20 ft by 20 ft area, consistent with the sample area currently being used at other remediation sites at Plum Brook for excavation verification. Excavation wall samples will also be collected using the incremental sampling approach. Each unit area will be defined by 20 linear feet of exaction wall, consistent with current site practices as negotiated with the OEPA. Samples will be analyzed on-site using a portable GC unit. Duplicate samples will be sent to an off-site laboratory at a rate of 10% for quality assurance.

The cost estimate for Alternative 2 discussed later in this document is based on an excavation to 36 inches; however, excavation would be conducted in 18-inch lifts to potentially reduce soil volumes.

Soil would be characterized to ensure that the waste meets the requirements for the disposal facility, and transported in accordance with state, federal, and local requirements to the appropriate disposal facility.

Soil backfill material would be selected from either on-Base or off-Base sources. Soil backfill would be used to regrade the excavated site. Once the backfill material is placed and graded, the site would be reseeded.

As a component of this alternative, ambient air monitoring would be performed at the perimeter of the excavation area. The purpose of air monitoring is to protect the health of site workers, and to assess off-site migration of contaminants.

4.3 ALTERNATIVE 3: IN-SITU REMEDIATION, MUNIREM®

Alternative 3 involves in-situ remediation using MuniRem® powder. MuniRem® would be spread over the surface area to be remediated and then mixed into the soil with a tiller/rotovator. Several passes with the tiller would likely be required to ensure thorough mixing of the agent. The tilled area would be sprayed with water as needed to encourage agent mixing and maximum reaction with the contaminant. Soil would be remediated in 9-inch lifts to be effective. The soil would be remediated within the footprint of the contaminated area. This method would also incorporate the procedures outlined in Alternative 2 for vertical and horizontal delineation of the contaminated area and depth.

Prior to full-scale remediation of the AA2 soil, a test plot would be remediated to evaluate optimum soil to MuniRem® proportions, optimum moisture content, frequency and amount of mixing required, and length of time needed to meet remediation goals. Frequent samples would be collected and analyzed on-site during this phase to evaluate progress and effectiveness of the various parameters.

Assuming that the in-situ alternative is effective, the contaminated area would be subdivided into 10 equal sized areas from left to right or right to left and designated as areas 1-10. The soil from areas 1 and 10 would be excavated and stockpiled on a liner and covered adjacent to areas 5 and 6. Soil from area 2 would be moved into the Area 1 excavation in 9-inch lifts and evenly spread over the Area 1 excavation. This soil would be remediated with MuniRem® as described above. While this area is being tilled and remediated, soil from area 9 would be moved into area 10 for similar remediation. Tiller and excavator would rotate sides and slowly add lifts and work from area to area until areas 5 and 6 have been excavated. At that point the stockpiled soil from areas 1 and 10 would be placed in areas 5 and 6 for remediation.

Samples of the tilled soil would be collected and field screened to evaluate the effectiveness of the remediation. Field screening will incorporate the incremental sampling methodology to ensure more accurate results. Based on field screening results, additional rounds of remediation may be required to achieve the remediation objectives. The soil would be left in place and graded for final seeding of the area.

4.4 ALTERNATIVE 4: EX-SITU REMEDIATION, ENHANCED BIOREMEDIATION

This alternative would involve excavation and on-site remediation of soil using enhanced bioremediation. This alternative would involve working the soil in windrows to affect both aerobic and anaerobic conditions as needed to degrade the PCBs. This approach would consist of adding nutrients and moisture to the soil as well as periodic aeration. Contaminated soils would be placed in an area capable of handling 9200 CY of soil. This would involve using the existing compost area at Pentolite Rd and development of a new pad at the AA2 site. The new area would be 296 ft wide by 260 ft long, capable of accommodating 13 windrows each 12 ft wide by 200 ft long, and 6 ft high. Ten similar windrows would be accommodated at the existing pad. The windrows would be mixed three times each week to aerate and stimulate microbial activity. Anaerobic conditions would be created by adding molasses. Moisture content would be maintained at approximately 18 percent.

Contaminated soil would be excavated and transported to the on-site remediation areas. This method would also incorporate the procedures outlined in Alternative 2 for vertical and horizontal delineation of the contaminated area and depth. The remediated soil would be tested to verify PCB remediation goals had been achieved and then placed back in the excavation, graded, and seeded. Testing would incorporate the incremental sampling methodology to ensure accurate results.

4.5 ALTERNATIVE 5: INCINERATION

This alternative would involve excavation of the contaminated soil, waste characterization, and transportation to a TSCA permitted incinerator. The contaminated area would be marked in the field based on the delineation sampling and vertical and lateral delineation verification will be conducted as outlined in Alternative 2. The cost estimate for Alternative 5 discussed later in this document is based on an excavation to 36 inches; however, excavation would be conducted in 18-inch lifts to potentially reduce soil volumes.

The excavated soil would be loaded into roll-off boxes at the site and transported to a rail yard in Willard, Ohio for rail shipment to the Triad Rail Spur in Houston, Texas. The roll-off boxes would be off-loaded and transported by truck to the TSCA incinerator managed by Veolia Environmental Services, in Port Arthur, Texas.

Veolia Services can handle approximately 15 roll-off boxes per week. A maximum of six roll-off boxes can be stacked on a single flat bed rail car; therefore, this alternative would utilize a shipment rate of two railcars per week, or 12 roll-off boxes per week.

Soil backfill material for the excavation at the site would be selected from either on-Base or off-Base sources. Soil backfill would be used to regrade the excavated site. Once the backfill material is placed and graded, the site would be reseeded.

As a component of this alternative, ambient air monitoring would be performed at the perimeter of the excavation area. The purpose of air monitoring is to protect the health of site workers, and to assess off-site migration of contaminants.

5.0 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

This section describes the criteria used for the detailed and comparative analysis of alternatives, and presents the results of the detailed analysis. Statutory requirements that guide the FS evaluation under CERCLA 40 CFR 300.430(e)(9)(iii), state that a remedial action must be protective of human health and the environment; attain ARARs or define criteria for invoking a waiver; be cost effective; and, use permanent solutions to the maximum extent practicable. CERCLA requires that nine criteria, as defined in the NCP, be used to evaluate the expected performance of remedial actions. The criteria are categorized as threshold, balancing, and modifying criteria, and encompass three broad elements of effectiveness, implementability, and cost.

5.1 EVALUATION CRITERIA

5.1.1 Threshold Criteria

According to 40 CFR 300.430(f)(1)(i)(A), two threshold criteria must be satisfied for an alternative be considered.

- Overall Protection of Human Health and the Environment. This criterion requires that the alternative adequately protect human health and the environment. The evaluation under this criterion focuses on whether an alternative achieves adequate protection, and draws on assessments conducted under other evaluation criteria including long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

- Compliance with ARARs. Congress specified in CERCLA 121 (d) that remedial actions for cleanup of hazardous substances must comply with the substantive requirements, criteria, standards, or limitations under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances at a site [40 CFR 300.430(e)(9)(iii)(B)] unless a waiver is granted. Evaluation under this criterion summarizes which requirements that are applicable or relevant and appropriate to an alternative and describes how the alternative meets those requirements.

5.1.2 Balancing Criteria

The balancing criteria evaluate alternatives in terms of the following five aspects.

- Long-Term Effectiveness and Permanence. This criterion assesses the effectiveness of the remedial action over the long term, including the magnitude of residual risk, the adequacy and reliability of controls, and operations and maintenance (O&M) requirements [40 CFR 300.430(e)(9) (iii)(C)].

- Reduction of Toxicity, Mobility, or Volume through Treatment. This criterion evaluates the degree to which the alternative addresses the USEPA's preference for the use of treatment technologies that permanently and significantly reduce the toxicity, mobility or volume of contamination.

- Short-Term Effectiveness. This criterion evaluates the effect of implementing the alternative relative to potential risks to the general public, potential threat to workers, and time required until protection is achieved [40 CFR 300.430(e)(9)(iii)(E)]. Potential impacts are examined, as well as appropriate mitigative measures for maintaining protectiveness for the community, workers, environmental receptors, and potentially sensitive resources.

- Implementability. This criterion addresses the technical and administrative feasibility of implementing an alternative, and the availability of materials and services required for implementation [40 CFR 300.430(e)(9)(iii)(F)].

- Cost. This criterion weighs the capital cost, annual O&M, and the combined net present value [40 *CFR* 300.430(e)(9)(iii)(G)]. Each alternative is evaluated to determine its projected costs within a +50 to -30 percent range. The cost evaluation includes the direct and indirect capital costs. Direct capital costs include construction; equipment and material; transportation and disposal, chemical analyses; and contingency allowances. Indirect capital costs include engineering and design expenses.

5.1.3 Modifying Criteria

The CERCLA modifying criteria, state acceptance and community acceptance, allow for the influences of the state and community. Public comments on the Proposed Plan will be addressed in the ROD.

- State Acceptance. This criterion requires the consideration of any comments by the state regarding any action to be performed [40 CFR 300.430(e)(9)(iii)(H)].

- Community Acceptance. This criterion requires the consideration of any comments by the community regarding any action to be performed [40 CFR 300.430(e)(9)(iii)(I)].

5.2 ALTERNATIVE 1: NO ACTION

5.2.1 Overall Protection of Human Health and the Environment

The NCP requires that the no action alternative be carried through the FS analysis in order to provide a baseline for comparison against the other alternatives. This alternative would not be protective of human health because no action would be taken to reduce the concentrations of contaminants in soil to meet OEPA risk management criteria or to prevent current or future receptors from exposure to the contaminants.

5.2.2 Compliance with ARARs

No ARARs were identified for this alternative.

5.2.3 Long-Term Effectiveness and Permanence

This alternative would not result in any permanent reduction of risk from site contamination, and no periodic review would take place to evaluate future site conditions.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative would not employ any treatment component that would permanently or significantly reduce the toxicity, mobility, or volume of contaminants in soil.

5.2.5 Short-Term Effectiveness

There would be no short-term impacts from this alternative as no remedial action would be taken.

5.2.6 Implementability

This alternative is technically feasible, as no implementation is required. This alternative is not administratively feasible as it is likely that OEPA would require action to be taken to address PCB-contaminated soil at AA2. There are no issues related to the availability of services and materials for this alternative, as no services or materials would be required.

5.2.7 Cost

There is no cost associated with implementation of this alternative.

5.3 ALTERNATIVE 2: EXCAVATION AND OFF-SITE DISPOSAL

5.3.1 Overall Protection of Human Health and the Environment

This alternative would be expected to effectively reduce risks to human health and the environment by removing contaminated soil from AA2 and disposing of this soil at a local permitted off-site disposal facility. Contaminants would be removed from the site by this alternative to allow unrestricted use.

5.3.2 Compliance with ARARs

No chemical-specific ARARs were identified for this alternative. The alternative would be expected to comply with the requirements stated in 40 CFR 761.61, identifying and properly managing soil that is a bulk PCB remediation waste.

5.3.3 Long-Term Effectiveness and Permanence

This alternative would result in all soil with contaminant concentrations above cleanup levels being excavated and disposed of in an off-site landfill. Excavated soils would be disposed of consistent with 40 CFR 300.440 in a properly permitted treatment storage and disposal facility (TSDF). Since the soil has been characterized as RCRA non-hazardous, it would be disposed of directly into a sanitary landfill. Sanitary landfills are lined and capped such that the residential human health hazard presented by the soils would be controlled, thus reducing the calculated risk values that are driving remedial action at the AA2 site. Even after closure of the sanitary landfill, the soils would be controlled as part of landfill management. Accordingly, this alternative would not require future action to manage the risk of unremediated waste or residuals associated with site soil. This alternative would be expected to be an effective, reliable, and permanent option for addressing contaminated soil at AA2.

5.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This alternative does not involve treatment to reduce the toxicity, mobility, or volume of site contamination. All soil with contaminant concentrations above cleanup levels would be excavated and disposed at a local sanitary landfill. While this alternative would not satisfy the USEPA's preference for treatment, the excavated soil would likely be homogenized by the process, which would more evenly distribute the concentrations and perhaps reduce the overall maximum concentrations. Placement of soil excavated from AA2 in a sanitary landfill would ultimately reduce the potential for contaminant migration, although not through treatment.

5.3.5 Short-Term Effectiveness

Worker exposure to contaminants during implementation of this alternative would be controlled by implementation of a site-specific HSP. Adherence to the HSP would prevent contact with and inhalation of contaminants through the use of controls such as chemical-resistant clothing and respiratory protection. Exposure of the surrounding community and environment to site contaminants would also be controlled by minimizing run-off and dust emissions, and implementing perimeter air monitoring. Physical risks to members of the community would be minimal, as the site is in a fenced, restricted area; however, truck traffic would increase. The time required to implement this alternative is estimated to be 6 months after mobilizing to the site.

5.3.6 Implementability

No significant technical or operational difficulties would be anticipated in implementing this alternative. The alternative consists of well-established excavation and soil-handling processes, and the services and materials needed for its implementation are readily available.

5.3.7 Cost

The total capital cost for Alternative 2 is estimated to be $2,022,000. Table 5-1 presents a summary of the cost estimate for this alternative. Supporting information is provided in Appendix B.

5.4 ALTERNATIVE 3: IN-SITU REMEDIATION, MUNIREM®

5.4.1 Overall Protection of Human Health and the Environment

This alternative is not field tested and its ability to provide overall protection, accordingly, is uncertain. It would require a pilot test to determine if it is effective in reducing PCBs and to determine if it can be evenly distributed throughout the soil to effectively remediate the soil. Field screening and confirmation sampling would be used to verify that the remediated soil left in place meets the contaminant concentration thresholds for residential land use. Remediated soils would remain on site under this alternative.

5.4.2 Compliance with ARARs

No chemical-specific ARARs were identified for this alternative. The alternative would be expected to comply with the requirements stated in 40 CFR 761.61, identifying and properly managing soil that is a bulk PCB remediation waste.

5.4.3 Long-Term Effectiveness and Permanence

This alternative would result in all soil with contaminant concentrations above soil risk-based thresholds being remediated. Remediated soil meeting the thresholds for residential land use would be left at the site. No future action would be required for the site as the risk associated with contaminants would be removed. This alternative would be expected to be a permanent reduction in PCB concentrations in soil at AA2.

As with all emerging technologies, there are uncertainties in the effectiveness of this product when not used in a controlled laboratory environment. There are also uncertainties relative to the ability to adequately mix the product with all of the soil and effectively introduce the product to the interior portions of soil clumps. Additional soil working or smaller lifts may be required. Prior to full-scale implementation of this technology at AA2, an in-situ pilot study should be performed on a small test plot at the site prior to finalizing the proposed plan. Minimal capital would be required to conduct this study.

5.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous contaminants would be reduced or eliminated by treatment with Munirem® through the process of chemical reduction, which would effectively degrade the PCBs in soil. Treatment of soil on-site would also reduce the volume of waste requiring off-site disposal. This alternative satisfies the USEPA's preference for the use of treatment to reduce the toxicity, mobility, or volume of contamination.

5.4.5 Short-Term Effectiveness

Worker exposure to contaminants during implementation of this alternative would be controlled by following a site-specific HSP. Adherence to the requirements of the HSP would prevent contact with and inhalation of contaminants through administrative and engineering controls, and the use of PPE. Exposure of the surrounding community and environment to site contaminants would also be controlled by minimizing run-off and dust emissions, and covering soil stockpiles. Physical risks to members of the community would be minimal as the site is in a fenced, restricted area. The time required to implement this alternative is estimated to be 8 months after mobilizing to the site.

As with all emerging technologies, there are uncertainties in the effectiveness of this product when not used in a controlled laboratory environment. There are also uncertainties relative to the ability to adequately mix the product with all of the soil and effectively introduce the product to the interior portions of soil clumps. Additional soil working or smaller lifts may be required. Prior to full-scale implementation of this technology at AA2, an in-situ treatability study should be performed on a small test plot at the site prior to finalizing the proposed plan. Minimal capital would be required to conduct this study.

5.4.6 Implementability

Because of the high clay content in the soil, there are uncertainties regarding the ability to reduce soil clumps to a size that would allow for effective remediation. This technology may require excessive soil working and excessive residence times to effectively reduce the PCB concentrations below the action levels. In order to manage this uncertainty, field screening would be required to evaluate real-time reduction of PCB concentrations and to determine if elaborate measures are needed to overcome these potential problems.

All other elements associated with this alternative are easily implemented, and the services and goods necessary are readily available. This alternative would not trigger RCRA LDR remediation standards for soil since the soil would not be removed from the AOC.

5.4.7 Cost

The total capital cost for Alternative 3 is estimated to be $2,327,000 based on the following criteria:

- $60 of Munirem® per ton of soil per Manufacturers recommendation
- Effective treatment can be achieved using 9" lifts
- Effective treatment can be achieved tilling the soil on three separate occasions
- Residence time for agent to effectively treat the soil is 72 hours

Table 5-2 presents a summary of the cost estimate for this alternative. Supporting information is provided in Appendix B.

There are uncertainties relative to the cost of this alternative. Based on discussions with the Munirem® vendor (PLANTECO), PCBs degrade readily within in a few days; however, it is not clear what the duration would need to be to effectively remediate the AA2 soil. Increased treatment time would result in an increase in cost.

This cost estimate also assumes that the soil could be effectively remediated in 9-inch lifts with three passes of the rototiller. If the Munirem® cannot be effectively mixed down to 9 inches, shorter lifts would be required which would increase the costs. Likewise, if additional passes with the rototiller are required or if there is an increase in the required residence time, costs would increase accordingly. If all of these variables were doubled, including the amount of Munirem® needed, the cost of remediation would increase to $4,330,000 and the time required would increase to 20 months. Cost sheets for this estimate are provided in the back-up materials section in Appendix B.

The cost to conduct a pilot test is estimated at $91,000. This estimate is based on conducting a test on a 20 ft x 100 ft plot over a period of 2 weeks. Treatment verification samples would be collected on a daily basis. The cost includes a post-study performance evaluation report. Cost sheets for this estimate are provided in the back-up materials section in Appendix B.

5.5 ALTERNATIVE 4: EX-SITU REMEDIATION, EHNANCED BIOREMEDIATION

5.5.1 Overall Protection of Human Health and the Environment

This alternative would be expected to effectively reduce site risks by remediating contaminated soil, thereby significantly reducing contaminant concentrations. Field screening and confirmation sampling would be used to verify that the remediated soil meets the thresholds for residential land use.

5.5.2 Compliance with ARARs

No chemical-specific ARARs were identified for this alternative. The alternative would be expected to comply with the requirements stated in 40 CFR 761.61, identifying and properly managing soil that is a bulk PCB remediation waste.

5.5.3 Long-Term Effectiveness and Permanence

This alternative would result in all soil with contaminant concentrations above soil risk-based contaminant concentration thresholds being remediated; therefore, no future action would be required for the site as the risk associated with contaminants would be removed. This alternative is considered to be permanent.

There are uncertainties relative to the effectiveness of this technology. The soil remediated at the SRS (Section 3.2.8; Appendix C) did not have PCB concentrations as high as the soil at AA2. In order for this technology to be successful at AA2, a reduction of up to 96 percent would be required. It is unclear what the optimum ratios of amendments to soil would be for the AA2 soil. It is also unclear what the optimum aerobic/anaerobic cycle time would be for

AA2 soil. Prior to full-scale implementation of this technology, an on-site treatability study should be performed to evaluate effectiveness and to optimize the process variables.

5.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous contaminants would be reduced or eliminated by enhanced bioremediation, which would effectively degrade the PCBs in soil. Remediation of soil on-site would also reduce the volume of waste requiring off-site disposal. This alternative would satisfy the USEPA's preference for the use of treatment to reduce the toxicity, mobility, or volume of contaminants.

5.5.5 Short-Term Effectiveness

Worker exposure to contaminants during implementation of this alternative would be controlled by following a site-specific HSP. Adherence to the requirements of the HSP would prevent contact with and inhalation of contaminants through administrative and engineering controls, and the use of PPE. Exposure of the surrounding community and environment to site contaminants would also be controlled by minimizing run-off and dust emissions, and covering soil stockpiles. Physical risks to members of the community would be minimal as the site is in a fenced, restricted area; however, truck traffic would increase. The time required to implement this alternative is estimated to be 15 months.

There are uncertainties relative to the effectiveness of this technology. The soil remediated at the SRS (Section 3.2.8; Appendix C) did not have PCB concentrations as high as the soil at AA2. In order for this technology to be successful at AA2, a reduction of up to 96 percent would be required. It is unclear what the optimum ratios of amendments to soil would be for the AA2 soil. It is also unclear what the optimum aerobic/anaerobic cycle time would be for AA2 soil. Prior to full-scale implementation of this technology, an on-site pilot study should be performed to evaluate effectiveness and to optimize the process variables prior to finalizing the proposed plan. More capital would be required to conduct this study than the in-situ alternative because of the cost associated with use of a windrow turner. A rental option could be exercised for the pilot study, or a dozer could be used as an alternative to mix the amendments in with the soil.

5.5.6 Implementability

Composting in windrows has been conducted successfully at both Plum Brook and SRS; however, there are inherent uncertainties. The use of molasses in the winter months would likely require delivery in a conditioned tanker. Also adequate mixing of soil with molasses may not be feasible or may require additional turning. The anaerobic conditions needed to degrade highly chlorinated PCBs, such as are present at AA2, may be impractical to maintain for sufficient periods of time.

Because of these potential issues, it is uncertain if this alternative can be an effective, reliable, and permanent option for addressing contaminated soil at AA2.

5.5.7 Cost

The total capital cost for Alternative 4 is estimated to be $2,013,000. Table 5-3 presents a summary of the cost estimate for this alternative. Supporting information is provided in Appendix B.

There are uncertainties associated with the cost of this alternative. Based on discussions with the technical team at SRS (Section 3.2.8; see Appendix C), the process should take 12 weeks; however, because of the higher PCB concentrations at AA2, it is not clear what duration would be needed to effectively remediate the AA2 soil. This cost estimate is based on 12 weeks of application per batch. Increased application time would result in an increase in cost.

If the process time and required amendments were doubled, the cost of remediation would increase to $2,948,000 and the time required would increase to 26 months. Cost sheets for this estimate are provided in the back-up materials section in Appendix B.

The cost to conduct a pilot test is estimated at $258,000. This estimate is based on excavating 200 yds of soil and transportation to the existing Pentolite Rd composting facility. A single 200' windrow will be worked for a period of three months. Treatment verification sampling will be performed on a weekly basis. The cost includes a post-study performance evaluation report. Cost sheets for this estimate are provided in the back-up materials section in Appendix B.

5.6 ALTERNATIVE 5: INCINERATION

5.6.1 Overall Protection of Human Health and the Environment

This alternative would be expected to effectively reduce site risks by removing the contaminants from the site and would also reduce or eliminate contaminants through remediation. Field screening and confirmation sampling would be used to verify that the remediated soil meets the thresholds for residential land use.

5.6.2 Compliance with ARARs

No chemical-specific ARARs were identified for this alternative. The alternative would be expected to comply with the requirements stated in 40 CFR 761.61; identifying and properly managing soil that is a bulk PCB remediation waste.

5.6.3 Long-Term Effectiveness and Permanence

This alternative would result in all soil with contaminant concentrations above soil risk-based contaminant concentration thresholds being removed from the site and remediated; therefore, no future action would be required for the site as the risk associated with contaminants would be removed. This alternative is considered to be permanent.

5.6.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The toxicity, mobility, and volume of hazardous contaminants would be reduced or eliminated by the process of incineration, which would effectively degrade the PCBs in soil. This alternative would satisfy the USEPA's preference for the use of treatment technologies.

5.6.5 Short-Term Effectiveness

Worker exposure to contaminants during implementation of this alternative would be controlled by following a site-specific HSP. Adherence to the requirements of the HSP would prevent contact with and inhalation of contaminants through administrative and engineering controls, and the use of PPE. Exposure of the surrounding community and environment to site contaminants would also be controlled by minimizing run-off and dust emissions, and covering soil stockpiles. Physical risks to members of the community would be minimal as the site is in a fenced, restricted area; however, truck traffic would increase. The time required to implement this alternative is estimated to be 24 months.

5.6.6 Implementability

Incineration has been conducted successfully for many years and continues to be a proven technology; however, the requirements imposed by the USEPA in 2004 have significantly raised the level of difficulty, the required quality assurance measures to ensure dioxins/furans are not produced, and the associated costs.

5.6.7 Cost

The total capital cost for Alternative 5 is estimated to be $19,723,000. Table 5-4 presents a summary of the cost estimate for this alternative. Supporting information is provided in Appendix B.

6.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents the comparative analysis of alternatives, which evaluates the relative expected performance of the alternatives against the 9 CERCLA evaluation criteria. The purpose of the comparative analysis is to identify relative advantages and disadvantages of the alternatives so that key tradeoffs that would affect alternative selection can be identified. These criteria comparisons are summarized in Table 6-1 and are addressed in detail below.

6.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 does not employ removal, containment, or remediation actions and therefore would retain the unsafe levels of PCBs that would endanger residential receptors in the future. It fails to provide protection of human health. It does not present a danger to the environment. Alternative 2, Excavation and Off-Site Disposal, would remove the contaminated soil from AA2 and dispose of this soil at a local permitted off-site disposal facility. This would make the site protective for human health and the environment. Alternatives 3 and 4, by treatment of the contamination to reduce the contamination to safe levels, would leave the site protective of human health and the environment. Alternative 5, Incineration, would remove the contaminated soil from AA2 and burn away the unsafe levels of PCBs, which would protect human health and the environment and permanently reduce the risk through contaminant destruction.

6.2 COMPLIANCE WITH ARARS

All of the action alternatives would comply with location- and action-specific ARARs. No chemical-specific ARARs were identified.

6.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

No long-term controls would be required for the successful implementation of Alternatives 2 through 5, as these alternatives are considered permanent. Alternatives 2 and 5 would provide for the best long-term effectiveness and permanence at the site, as all PCB-contaminated soil above risk-based threshold contaminant concentrations would be excavated and removed from the site. Alternative 2; however, would not permanently eliminate the risk as the contaminants would not be destroyed, but would be managed at another facility.

Because of uncertainties associated with an emerging technology as well as site-specific implementation challenges at AA2, Alternative 3 may not be an effective, reliable, and permanent option for addressing PCB-contaminated soil. While Alternative 4 has been demonstrated at another site, it is not certain if the enhanced bioremediation technology would be effective at AA2. An on-site treatability study would be required prior to implementation for Alternatives 3 and 4.

6.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternative 1 does not employ treatment and would have no effect on the toxicity, volume, or mobility of soil contamination. Although Alternative 2 would remove contamination from the site, this alternative does not result in any reduction of contaminant mass. It would potentially reduce concentrations through mixing at the disposal site and, ultimately, limit the potential for migration – but not through treatment. Alternatives 3 and 4, if successfully implemented, would satisfy the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances as their principal element. Alternative 5 is the only proven technology being considered to permanently destroy PCBs.

6.5 SHORT-TERM EFFECTIVENESS

Implementing a site-specific HSP and minimizing off-site migration of contaminants would minimize potential risks to workers and the surrounding community. There would be some risks, however, due to the heavy equipment operating on site and the presence of contaminants. Implementation of Alternatives 2, 4 and 5 would result in the greatest amount of truck traffic.

No threatened or endangered animal or plant species would be affected or destroyed by Alternatives 2, 3 4, or 5. There would be short-term disturbances to ecological habitats as a result of the proposed remediation (e.g., tree and brush clearing and excavation); however, once the action was completed, the site would be restored with a vegetative cover and displaced species would be expected to recolonize the area over time.

Because of uncertainties associated with an emerging technology as well as site-specific implementation challenges at AA2, Alternative 3 may not be an effective, reliable, and permanent option for addressing PCB-contaminated soil. While Alternative 4 has been demonstrated at another site, it is not certain if the enhanced bioremediation technology would be effective at AA2.

Alternatives 2 and 3 would require the least amount of time to execute, at 6 months and 8 months respectively. Implementation of Alternatives 4 and 5 would require the greatest amount of time to implement at approximately 15 and 24 months respectively.

6.6 IMPLEMENTABILITY

There is no implementation involved with Alternative 1. There are no appreciable technical, operational, or administrative difficulties anticipated for implementation of Alternatives 2 and 5. Alternatives 3 and 4 may require specific soil handling procedures. Alternative 3 may require the use of smaller lifts, additional tilling, additional residence time, and soil wetting. Alternative 4 may require an increase of amendments, additional residence time, and stop-work conditions during the winter months. In order to manage these uncertainties, a field-scale pilot study would be required for both alternatives prior to finalizing the proposed plan to determine optimum process parameters.

6.7 COST

No cost would be incurred as a direct result of implementation of Alternative 1, as no action would be performed.

The cost estimates for Alternatives 2 through 5 were prepared in a similar manner. The costs are based on estimates provided by regional companies including local sanitary waste landfills, and cost factors from R.S. Means cost data publications applied to quantities in Appendix B. The cost for sampling and analysis of waste soil and confirmatory samples for the site are estimated based on recent quotes. Indirect costs (professional services) are based on the projected level of effort required to perform a detailed design and field oversight for each alternative.

The total cost for Alternative 2 is estimated at $2,022,000. This estimate includes planning documents, site preparation, staging area set up, mobilization, excavation, waste transportation and disposal, site restoration, and demobilization.

The total cost for Alternative 3 is estimated between $2,327,000 and $4,330,000 depending on the amount of time required, the amount of agent needed, and the thickness of the individual lifts. This estimate includes planning documents, site preparation, staging area set up, mobilization, in-situ remediation, site restoration, and demobilization. The cost for an on-site pilot study is estimated at $91,000 which is not included in the cost estimate above.

The total cost for Alternative 4 is estimated between $2,013,000 and 2,948,000 depending on the amount of time required and the amount of amendments needed. This estimate includes planning documents, site preparation, staging area set up, mobilization, ex-situ remediation, site restoration, and demobilization. The cost for an on-site pilot study is estimated at $258,000 which is not included in the cost estimate above.

The total cost for Alternative 5 is estimated at $19,723,000. This estimate includes planning documents, site preparation, staging area set up, mobilization, excavation, waste transportation and incineration, site restoration, and demobilization.

The uncertainties associated with the costs are as follows:

- It is uncertain how much chemical agent would be required for Alternative 3. An increase in the amount of agent would result in higher costs.

- It is not clear what the optimal duration for implementation of Alternative 3 would be to effectively remediate the AA2 soil. Increased time above the amount assumed for the estimate would result in an increase in cost.

- It is uncertain whether remediation through Alternative 3 could be effective in 9-inch lifts with three passes of a rototiller. Shorter lifts and additional passes with the rototiller would increase costs.

- Because of the higher PCB concentrations at AA2, it is not clear what the optimal duration and amount of amendments needed for Alternative 4 to effectively remediate the soil. Increased time and amount of amendments would result in an increase in cost.

6.8 CONCLUSIONS

The comparative analysis indicates that Alternative 2, Excavation and Off-site Disposal, is one of the lowest cost alternatives and has the greatest potential to meet the project objectives since it is a proven method. This alternative; however, will not meet the statutory preference for reducing the toxicity, mobility, and contaminant volume through treatment.

Alternative 4 represents the least expensive option which has the potential to meet the statutory preference for reducing the toxicity, mobility, and contaminant volume through treatment. This alternative has been demonstrated to be effective on a small scale test at the Savannah River Site; however there are uncertainties with implementation in the winter months and remediation effectiveness with elevated concentrations of highly chlorinated PCB aroclors. A small-scale test, with minimal up front capital cost, should first be performed prior to finalizing the proposed plan to further evaluate this alternative.

Alternatives 2 and 5, Excavation/Disposal and Excavation/Incineration, are the only alternatives that have been demonstrated to be effective that have no significant implementation issues. Alternative 2 does not satisfy the statutory preference for reducing toxicity, mobility, and contaminant volume through treatment. Alternative 2 is the least expensive option and requires the least amount of time (6 months) to remediate the site. Alternative 5 meets the statutory preference for reducing the toxicity, mobility, and contaminant volume through remediation, but requires the most time to implement (24 months) and is not cost competitive with the other alternatives.

Alternative 3 and Alternative 4 are similar in having the potential to reduce toxicity and contaminant volume and to allow the treated soil to remain on site; however, both alternatives have inherent process uncertainties and consequently a high degree of uncertainty regarding the cost. Alternative 3 would likely be more expensive than Alternative 4; however, Alternative 3 could be tested in a small scale pilot test at the site for considerably less cost than a pilot scale test for Alternative 4. If Alternatives 3 or 4 were to be considered, a pilot should be performed prior to finalizing the proposed plan.

Alternative 1 offers no reduction in risk at the site and is therefore, unacceptable since it does not meet remedial objectives.

Alternatives 2, 3, and 4, would cost approximately \$143, \$164, and \$142 per CY of remediated soil, respectively, with Alternatives 3 and 4 potentially costing as high as \$305 and \$208 per CY respectively. For comparison purposes, many of the technologies that were screened out in Section 3 had an estimated per cubic yard cost ranging from \$343 to \$1490 escalated to current value (USEPA, 2001). Alternative 5 would cost an estimated \$1,390 per CY. The major difference between these three alternatives is that Alternative 2 is a proven method to reduce risk at the site but does not permanently deal with the contamination, while Alternatives 3 and 4 offer the potential for permanent reduction in the toxicity, mobility, or volume of contaminants, but have a high degree of uncertainty, potential implementation issues, and would require site testing before full-scale implementation. Testing should be conducted prior to finalizing the proposed plan.

The uncertainty in the total volume of soil requiring remediation is inherent to all of the alternatives. Overall costs for each alternative could rise if it is determined that the contamination zone is larger than estimated; however the volume estimates are believed to be conservative.

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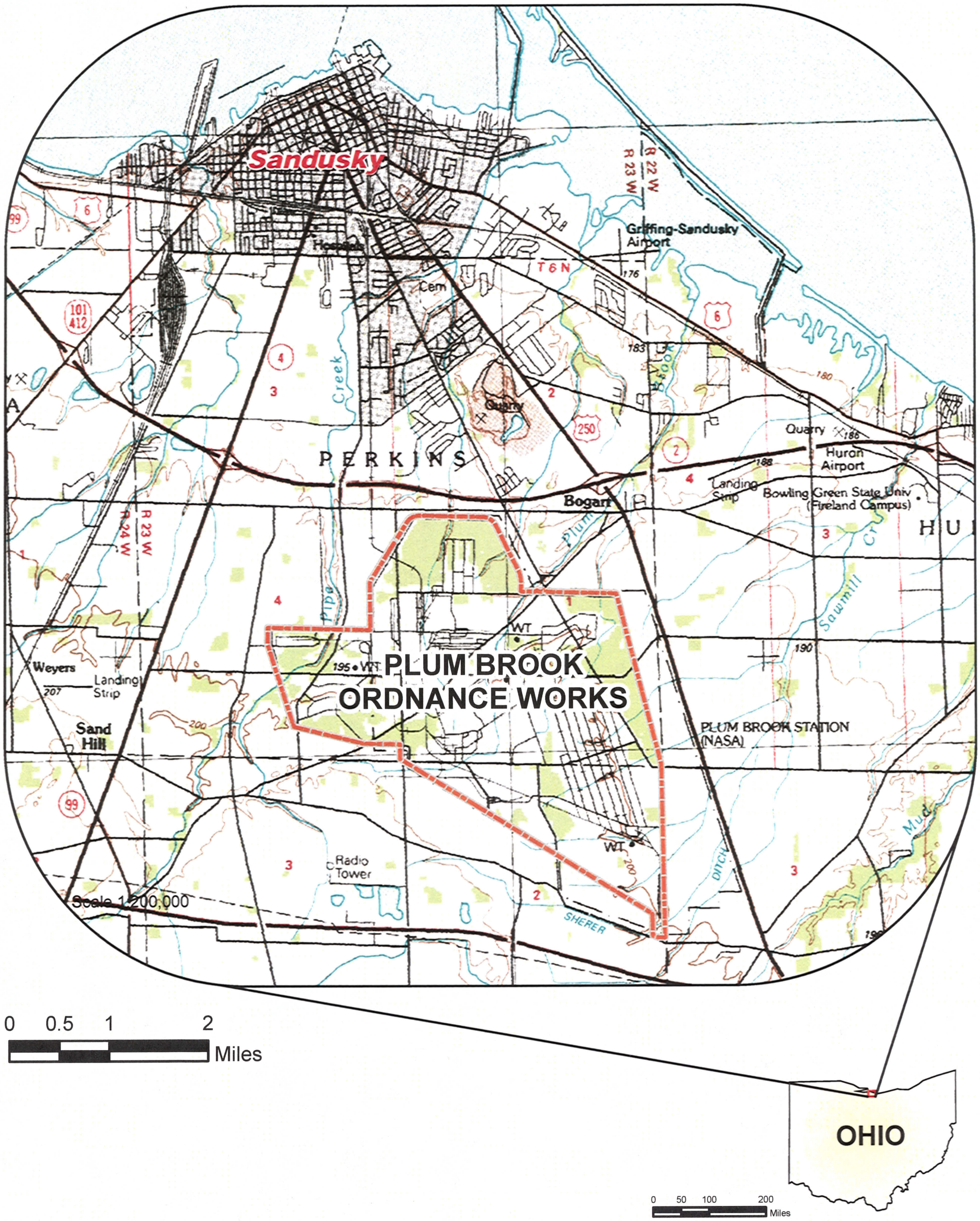
Figures



Legend

Plum Brook Ordnance Works Boundary

N

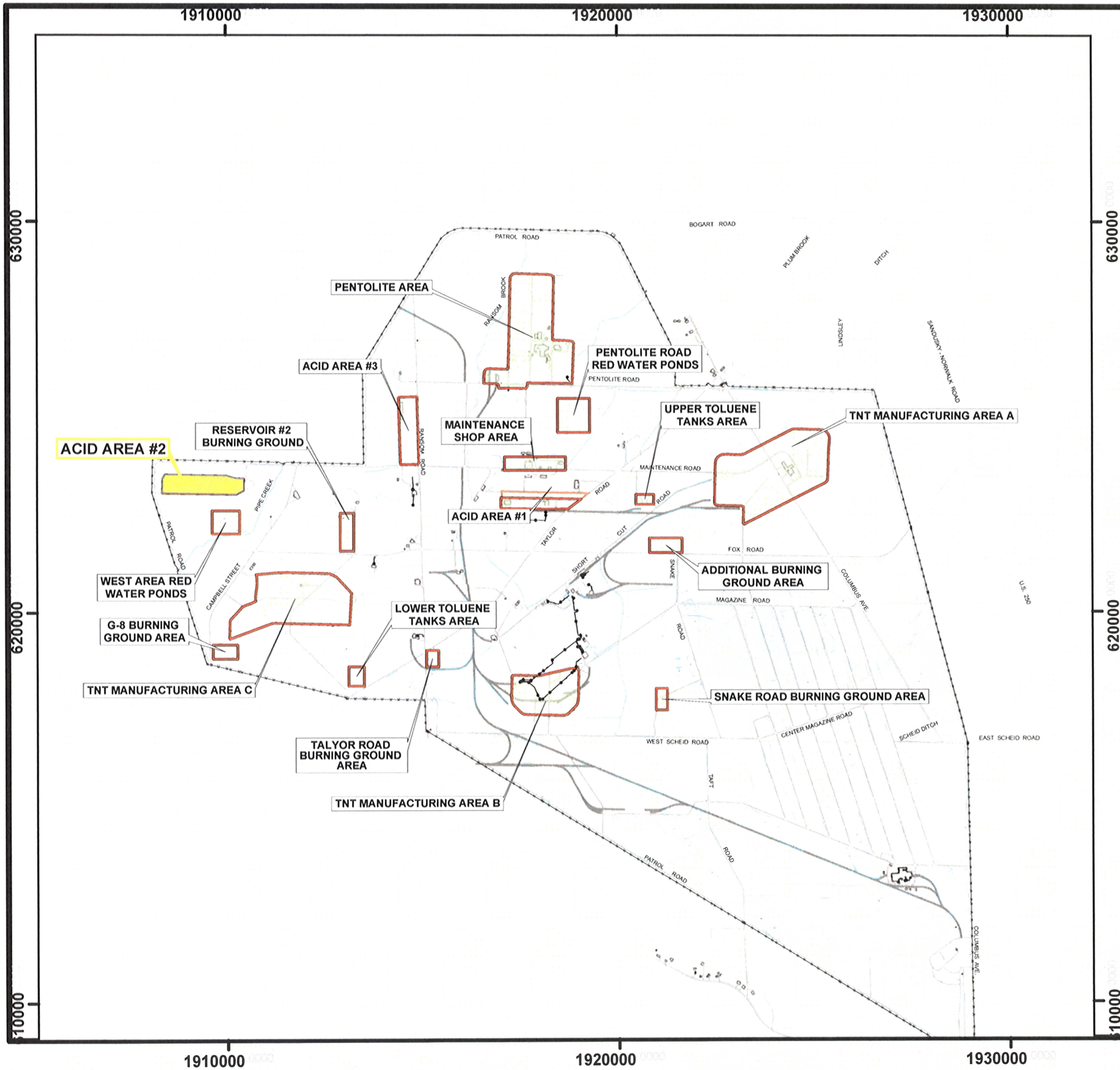
JACOBS

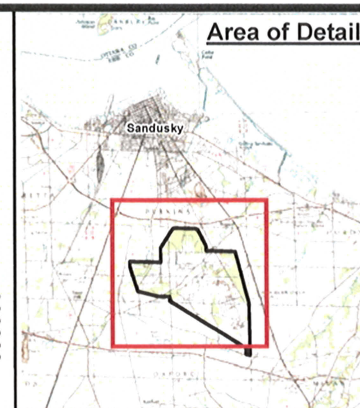
Location Map,
Plum Brook Ordnance Works
Sandusky, Ohio

Plumbrook Ordnance Works
Sandusky, Ohio

04/04/10 S:/GIS/Projects/Plumbrook/Projects/AA2_AA3_FS/ArcGIS/PBOW_Site_Location.mxd

Figure 1-1





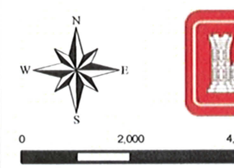
Legend

Area of Concern

Creek, Ditch, Conveyance

Sources

Data mapped to Ohio State Plane North NAD83, map grid units in feet.



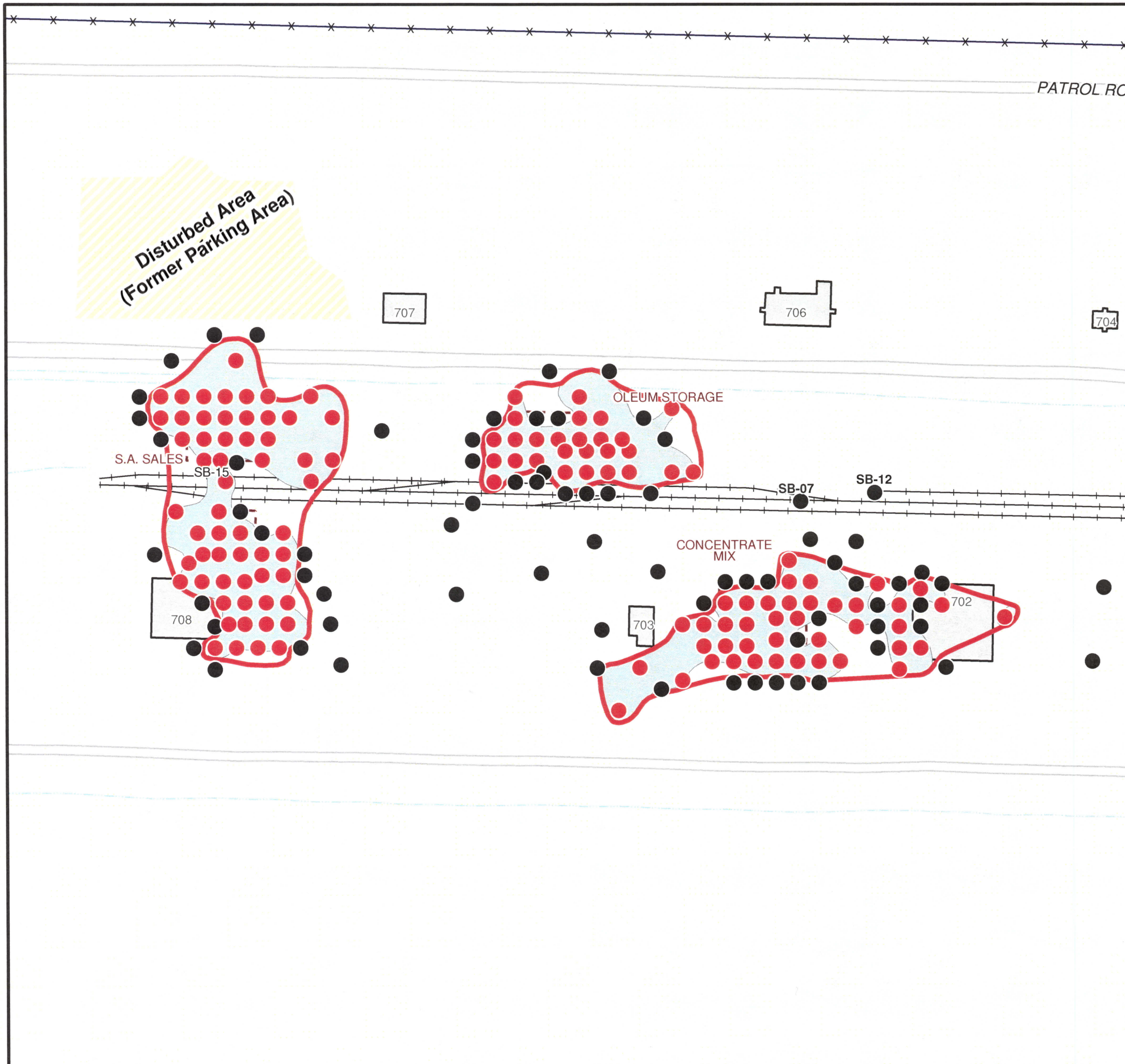
JACOBS

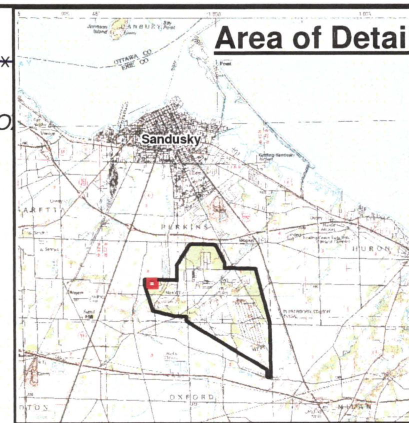
Location Map, Acid Area 2

Plum Brook Ordnance Works
Sandusky, Ohio

04/04/10 S:/GIS/Projects/Plumbrook/Projects/AA2_AA3_FS/ArcGIS/AA2_Loc_Map.mxd

Figure 1-2





Legend

- Exceedances
- Non-exceedances

Note:
bgs = below ground surface
Bkg. = Background Sample (values are provided in units consistent with the reported sample values)
PRG = Preliminary Remediation Goal (values are provided in units consistent with the reported sample values)

Contamination Boundary about 1 mg/kg total combined PCBs

Creek, Ditch, Conveyance

Buildings

Railway

0 125 Feet

N

Sources
Data mapped to Ohio State Plane North NAD83, map grid units in feet.

JACOBS

Total PCBs — Acid Area 2

Plum Brook Ordnance Works
Sandusky, Ohio

08/19/11 S:\GIS\Projects\Plumbrook\Projects\AA2_AA3_FS\ArcGIS\AA2_surface_soil_pcb_results_2010_Dec.mxd

Figure 2-1

Tables

Table 1-1. Summary of Noncancer Hazards and Cancer Risk Estimates from Potential Non Residential Exposures at Acid Area 2, Plum Brook Ordnance Works, Sandusky, OH

Groundskeeper Risks From Exposure to Surface Soil		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	9.E-01	4.E-05
Dermal Contact	1.E-01	6.E-06
Inhalation	2.E-03	3.E-09
Total	1.E+00	5.E-05

Adult Hunter Risks From Exposure to Surface Soil		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	5.E-02	3.E-06
Dermal Contact	6.E-02	3.E-06
Inhalation	NA	NA
Total	1.E-01	6.E-06

Adult Hunter Risks From Ingestion of Venison		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	6.E-04	9.E-09
Dermal Contact	NA	NA
Inhalation	NA	NA
Total	6.E-04	9.E-09

Child Risks From Ingestion of Venison		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	1.E-03	3.E-09
Dermal Contact	NA	NA
Inhalation	NA	NA
Total	1.E-03	3.E-09

Construction Worker Risks From Exposure to Surface Soil		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	5.E+00	5.E-06
Dermal Contact	2.E+00	2.E-06
Inhalation	3.E-03	1.E-10
Total	7.E+00	7.E-06

Construction Worker Risks From Exposure to Subsurface Soil		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	2.E+00	2.E-06
Dermal Contact	6.E-02	8.E-07
Inhalation	NA	NA
Total	2.E+00	3.E-06

Construction Worker Risks From Exposure to Surface Water		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	NA	NA
Dermal Contact	4.E-03	8.E-09
Inhalation	NA	NA
Total	4.E-03	8.E-09

Construction Worker Risks From Exposure to Sediment		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	6.E-01	4.E-07
Dermal Contact	3.E-02	1.E-07
Inhalation	NA	NA
Total	7.E-01	5.E-07

Indoor Worker Risks From Exposure to Groundwater		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	2.E+00	5.E-05
Dermal Contact	2.E-02	8.E-07
Inhalation	NA	NA
Total	2.E+00	5.E-05

Indoor Worker Risks From Exposure to Surface Soil		
Exposure Route	Hazard Quotient	Excess Cancer Risk
Ingestion	5.E-01	2.E-05
Dermal Contact	NA	NA
Inhalation	NA	NA
Total	5.E-01	2.E-05

Table 2-1
Summary of Hazard Index and Cancer Risk Estimates for COCs in Surface Soil at Acid Area 2
Plum Brook Ordnance Works, Sandusky, Ohio

Analyte	Percent Detection	Range of Deteced Concentrations (mg/kg)	Mean Concentration (mg/kg)	Background Concentration of Inorganics (mg/kg)	EPC (mg/kg)	EPC Basis	Hazard Index Summed Across All Pathways	Percent Contribution to Hazard Index[a]	Cancer Risk Summed Across All Pathways	Percent Contribution to Cancer Risk[a]	Cancer Risk at Mean Concentration
Adult Residential Scenario - Surface Soil											
PCB-1254	39	0.0167 - 16	2.00		16.00	Max. Concentration	1.E+00	100%	3.E-05	79%	4.E-06
PCB-1260	75	0.045 - 31.4	4.27		4.29	Non-Parametric UCL	b		8.E-06	21%	8.E-06
						Total Hazard Index	**1.E+00**				
						Total Risk			**4.E-05**		**1.E-05**
Child Residential Scenario - Surface Soil											
PCB-1254	39	0.0167 - 16	2.00		16.00	Max. Concentration	1.E+01	87%	4.E-05	79%	5.E-06
PCB-1260	75	0.045 - 31.4	4.27		4.29	Non-Parametric UCL	b		1.E-05	21%	1.E-05
						Total Hazard Index	**1.3.E+01**				
						Total Risk			**5.E-05**		**2.E-05**

a - The percent contribution to the hazard index and cancer risk may not add up to 100% due to the elimination of constituents that do not meet the definition of a COC.

b - Toxicity values are not available to evaluate whether the constituent causes noncancer effects.

Table 2-2. Risk Based Remediation Levels (RBRLs) for Residential Exposures to Surface Soil at Acid Area 2, Former Plum Brook Ordnance Works, Sandusky, Ohio			
Adult			
Analyte	**Units**	**RBRL for Noncancer Endpoint[a]**	**RBRL for Cancer Endpoint[b]**
PCB-1254	mg/Kg	13	5
PCB-1260	mg/Kg	NA	5

Child			
Analyte	**Units**	**RBRL for Noncancer Endpoint[a]**	**RBRL for Cancer Endpoint[b]**
PCB-1254	mg/Kg	1	4
PCB-1260	mg/Kg	NA	4

RGO = Remedial Goal Option

a Target Hazard Index 1.0

b Target Cancer Risk 10-5

Table 5-1 Cost Estimate Summary - Alternative 2

Alternative 2
Excavation and Off-site Disposal

COST ESTIMATE SUMMARY

Site: PBOW, Acid Area 2
Location: Sandusky, Ohio
Phase: Feasibility Study (-30% to +50%)
Base Year: 2011
Date: April

Description: This alternative would involve excavation of the contaminated soil, waste characterization, and transportation to a local landfill. The excavation would be backfilled witl local clean soil, re-graded, and seeded.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST	NOTES
Submittals/Implemenation Plans	1	LS	$ 40,403	see cost worksheet B-1, Appendix B
Mobilize equipment and personnel	1	LS	$ 38,064	see cost worksheet B-2, Appendix B
Clearing & Grubbing	1	LS	$ 17,137	see cost worksheet B-3, Appendix B
Waste characterization sampling	1	LS	$ 30,143	see cost worksheet B-4, Appendix B
Excavation, transportation, and disposal	1	LS	$ 854,490	see cost worksheet B-5, Appendix B
Verification sampling	1	LS	$ 75,767	see cost worksheet B-6, Appendix B
Backfill excavation, grade site, seed	1	LS	$ 270,561	see cost worksheet B-7, Appendix B
Monthly Facilities Charges	1	LS	$ 7,458	see cost worksheet B-8, Appendix B
Site Management	1	LS	$ 179,617	see cost worksheet B-9, Appendix B
De-mobilization	1	LS	$ 27,152	see cost worksheet B-10, Appendix B
SUBTOTAL			$ 1,540,792	
Contingency	25%		$ 385,198	10% scope, 15% bid
SUBTOTAL			$ 1,925,990	
Project Management	5%		96,300	
TOTAL CAPITAL COST			**$ 2,022,290**	

Table 5-2 Cost Estimate Summary - Alternative 3

Alternative 3 In-Situ Remediation, MuniRem®					COST ESTIMATE SUMMARY
Site: PBOW, Acid Area 2 **Location:** Sandusky, Ohio **Phase:** Feasibility Study (-30% to +50%) **Base Year:** 2011 **Date:** April			**Description:**		This alternative would involve in-situ remediation. Soil will be excavted in 9" lifts, spread in an ajacent area within the excavtion and remediated with Munirem® powder using a rototiller. Remediated soil will be compacted in place. After remediation of all soil, the site will be graded and seeded.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST		NOTES
Submittals/Implemenation Plans	1	LS	$	43,703	see cost worksheet B-11, Appendix B
Mobilize equipment and personnel	1	LS	$	37,734	see cost worksheet B-12, Appendix B
Clearing & Grubbing	1	LS	$	16,660	see cost worksheet B-13, Appendix B
In-situ remediation	1	LS	$	1,330,975	see cost worksheet B-14, Appendix B
Verification sampling	1	LS	$	29,905	see cost worksheet B-15, Appendix B
Site Restoration	1	LS	$	28,656	see cost worksheet B-16, Appendix B
Monthly Facilities Charges	1	LS	$	10,868	see cost worksheet B-17, Appendix B
Site Management	1	LS	$	248,637	see cost worksheet B-18, Appendix B
Demobilization	1	LS	$	25,887	see cost worksheet B-19, Appendix B
SUBTOTAL			$	1,773,025	
Contingency	25%		$	443,256	10% scope, 15% bid
SUBTOTAL			$	2,216,281	
Project Management	5%			110,814	
TOTAL CAPITAL COST			**$**	**2,327,095**	

Table 5-3 Cost Estimate Summary - Alternative 4

Alternative 4
Ex-situ Remediation, Enhanced Bioremediation

COST ESTIMATE SUMMARY

Site: PBOW, Acid Area 2
Location: Sandusky, Ohio
Phase: Feasibility Study (-30% to +50%)
Base Year: 2011
Date: April

Description: This alternative would involve excavation of the contaminated soil, transportation to an on-site facility for remediation using enhanced bioremediation in windrows, and backfill of the excavation using the remediated soil.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST	NOTES
Submittals/Implemenation Plans	1	LS	$ 49,533	see cost worksheet B-20, Appendix B
Mobilize equipment and personnel	1	LS	$ 39,384	see cost worksheet B-21, Appendix B
Clearing & Grubbing	1	LS	$ 21,243	see cost worksheet B-22, Appendix B
Ex-situ Remediation	1	LS	$ 573,707	see cost worksheet B-23, Appendix B
Verification sampling	1	LS	$ 29,365	see cost worksheet B-24, Appendix B
Backfill excavation, grade site, seed	1	LS	$ 306,013	see cost worksheet B-25, Appendix B
Monthly Facilities Charges	1	LS	$ 20,378	see cost worksheet B-26, Appendix B
Site Management	1	LS	$ 466,917	see cost worksheet B-27, Appendix B
De-mobilization	1	LS	$ 27,537	see cost worksheet B-28, Appendix B
SUBTOTAL			$ 1,534,077	
Contingency	25%		$ 383,519	10% scope, 15% bid
SUBTOTAL			$ 1,917,596	
Project Management	5%		95,880	
TOTAL CAPITAL COST			**$ 2,013,476**	

Table 5-4 Cost Estimate Summary - Alternative 5

Alternative 5
Incineration

COST ESTIMATE SUMMARY

Site: PBOW, Acid Area 2
Location: Sandusky, Ohio
Phase: Feasibility Study (-30% to +50%)
Base Year: 2011
Date: August

Description: This alternative would involve excavation of the contaminated soil, transportation to a TSCA permitted facility for incineration.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST	NOTES
Submittals/Implemenation Plans	1	LS	$ 40,403	see cost worksheet B-29, Appendix B
Mobilize equipment and personnel	1	LS	$ 38,064	see cost worksheet B-30, Appendix B
Clearing & Grubbing	1	LS	$ 16,667	see cost worksheet B-31, Appendix B
Waste Charaterization	1	LS	$ 30,143	see cost worksheet B-32, Appendix B
Excavation, transportation, and incineration	1	LS	$ 14,141,087	see cost worksheet B-33, Appendix B
Verification sampling	1	LS	$ 76,757	see cost worksheet B-34, Appendix B
Backfill excavation, grade site, seed	1	LS	$ 270,550	see cost worksheet B-35, Appendix B
Monthly Facilities Charges	1	LS	$ 29,832	see cost worksheet B-36, Appendix B
Site Management	1	LS	$ 356,661	see cost worksheet B-37, Appendix B
De-mobilization	1	LS	$ 27,152	see cost worksheet B-38, Appendix B
SUBTOTAL			$ 15,027,316	
Contingency	25%		$ 3,756,829	10% scope, 15% bid
SUBTOTAL			$ 18,784,145	
Project Management	5%		939,207	
TOTAL CAPITAL COST			**$ 19,723,352**	

Table 6-1
Alternative Evaluation Matrix
Acid Area 2

Criteria	Alternative 1 No Action	Alternative 2 Excavation and Off-Site Disposal	Alternative 3 In-Situ Treatment	Alternative 4 Ex-Situ Treatment	Alternative 5 Incineration
Overall protection of human health and environment	Worker and public exposure will not be controlled.	Will remove all contaminated soil. Worker and public exposure will be controlled.	Potential to reduce contamination. Worker and public exposure will be controlled.	Potential to reduce contamination. Worker and public exposure will be controlled.	Will remove all contaminated soil. Worker and public exposure will be controlled.
Compliance with ARARs	There are no ARARs for the no action alternative.	Will comply with substantive requirements of all ARARs.	Will comply with substantive requirements of all ARARs.	Will comply with substantive requirements of all ARARs.	Will comply with substantive requirements of all ARARs.
Long-term effectiveness and permanence	Will not remove or destroy contaminants.	Will permanently remove contaminated soil.	Potential to permanently destroy contaminants in the soil, but uncertainties.	Potential to permanently destroy contaminants in the soil, but uncertainties.	Will permanently destroy contaminants in the soil.
Reduction of toxicity, mobility, or volume through treatment	Will not employ treatment to reduce toxicity, mobility, and volume of contaminants.	Will not reduce toxicity and volume of contaminants, but will control mobility. Will not satisfy USEPA's preference for treatment.	Potential to reduce toxicity, mobility, and volume of contaminants. Will satisfy USEPA's preference for treatment.	Potential to reduce toxicity, mobility, and volume of contaminants. Will satisfy USEPA's preference for treatment.	Will reduce toxicity, mobility, and volume of contaminants. Will satisfy USEPA's preference for treatment.
Short-term effectiveness	No impacts because no action is taken.	Worker and public exposure will be controlled during removal.	Worker and public exposure will be controlled during removal.	Worker and public exposure will be controlled during removal.	Worker and public exposure will be controlled during removal.
Implementability	Technically feasible. Not administratively feasible; it is likely that OEPA would require action to be taken to address contamination.	Technical or operational difficulties are not anticipated. All personnel, services, and equipment are available.	Technically feasible, but uncertainties with amount of contaminant reduction and adjustments needed during remediation.	Technically feasible, but uncertainties with amount of contaminant reduction and adjustments needed during remediation.	Technical or operational difficulties are not anticipated. All personnel, services, and equipment are available.
Cost	$0 M	$2.02 M	$2.33 M	$2.01 M	$19.7 M
Soil volume (approximate)	None	Disposal of 17,240 tons of nonhazardous waste at the local sanitary landfill	No waste disposal	No waste disposal	Transportation of 17,240 tons of nonhazardous waste to TSCA incinerator
Deed restrictions	Probable	None	None	None	None
Time required to implement	None	6 months after mobilization	8 months after mobilization	15 months after mobilization	24 months after mobilization

CONTAMINANT DELINEATION SUMMARY REPORT

Feasibility Study at Acid Area 2
Former Plum Brook Ordnance Works
Sandusky, Ohio

Prepared for:

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
NASHVILLE, TENNESSEE
CONTRACT DACW62-03-D-0004-0010

Prepared by:

JACOBS ENGINEERING GROUP, INC.
125 BROADWAY
OAK RIDGE, TN 37830

September 2011

INTRODUCTION

The U.S. Army is conducting investigations of the environmental impacts at previously owned U.S. Department of Defense (DOD) properties. This work is being performed by the U.S. Army Corps of Engineers (USACE) under the Defense Environmental Restoration Program (DERP). Chemical contamination related to DOD activities has been documented at the former Plum Brook Ordnance Works (PBOW) located near Sandusky, Ohio. The PBOW site is a formerly used defense site under DERP, currently being managed by the Corps of Engineers, Huntington District (CELRH) and technically overseen by the Corps of Engineers, Nashville District (CELRN).

PBOW was operated from 1941 to 1945 as a manufacturing plant for trinitrotoluene (TNT), dinitrotoluene (DNT), and pentolite. The site is currently controlled and maintained by the National Aeronautics and Space Administration (NASA) and is operated as the Plum Brook Station (PBS) of the John Glenn Research Center, which is located at Lewis Field, Cleveland, Ohio.

A Remedial Investigation (RI) of Acid Area 2 (AA2) was performed from October 2004 through June 2006 by Jacobs Engineering Group (Jacobs) under contract DACW62-03-D-0004, Delivery Order 0004. The work included an investigation of soil, sediment, surface water and groundwater. The RI identified soil contamination, which exceeds the USEPA Region 9 PRGs for PCBs, PAHs, and lead. A Baseline Human Health Risk Assessment (BHHRA) and Screening Level Ecological Risk Assessment (SLERA) were conducted in 2007. Results of these studies show an unacceptable risk due to elevated concentrations of PCBs in soil. A Feasibility Study (FS) of AA2 is being conducted by Jacobs Engineering Group (Jacobs) under contract DACW62-03-D-0004, Delivery Order 0010. This work includes engineering services to conduct additional delineation sampling for surface soil contamination and evaluation and cost estimating for various remedial alternatives. This report addresses the findings of the subsequent delineation studies conducted at AA2 during the period November 2008 through August 2010.

Data collected during November 2004 show elevated concentrations of PCBs in the vicinity of former process buildings and storage tanks. Additional information regarding site background, previous investigations, and environmental setting for AA2 are provided in the Final Site Characterization Report.

The objectives of this delineation study are to further define the boundary of surface soil contamination exceeding the risk based action levels. This information is needed to determine the volume of impacted soil which directly affects the cost for the various remedial alternatives being evaluated as part of the FS.

INVESTIGATION PROCEDURES

The delineation study was conducted during over six separate mobilizations from November 2008 through August 2010. All field work was performed in accordance with the Final Site-Wide Sampling and Analysis Plan (SWSAP) and the Final Site-Specific Field Sampling Plan for AA2 (SWFSP). All work was performed in accordance with the Final Site-Wide Safety and Health

Plan and the Final Site-Specific Safety and Health Plan Addendum for AA2. Modified Level D PPE was used for soil sampling activities, safety glasses, steel-toed boots, nitrile gloves, and tyvek coveralls as needed.

Surface soil samples were collected on a 50 ft grid spacing north, south, east, and west of the RI samples with PCB concentrations exceeding the risk based action level of 1 mg/kg combined (total) aroclors. Samples were collected from a depth of 6 to 12 inches. Soil sampling was performed utilizing a hand auger equipped with dedicated disposable stainless steel sleeves. Samples were extruded from the sleeve and homogenized in a dedicated disposable glass bowl using a stainless steel spoon. Dedicated disposable spoons and bowls and/or certified clean sample bags were used for each sample.

All sampling equipment was cleaned prior to use; first with an alqinox wash, then a potable water rinse, and a final ASTM Type 2 DI water rinse. Equipment was then individually wrapped in aluminum foil to ensure no contaminants were introduced. The hand auger was decontaminated between each sample using the same procedure.

All soil sampling locations were surveyed using conventional methods. The northing, easting, and ground elevation correspond to Ohio State Plane North NAD83.

Sample packaging, shipping, and documentation procedures described in the Site-Wide Sampling and Analysis Plan (SAP) were followed during the field investigation of the AA2 site. Samples were packaged and shipped to the analytical laboratories via Federal Express. Chain of custodies were completed and maintained throughout the collection, shipping and laboratory analysis phase.

No soil investigation derived waste (IDW) was generated, since all remaining soil was returned to the borehole after collection of an environmental sample. Decontamination fluid was containerized and sampled at the conclusion of the sampling event. Two 55-gallon drums of liquid IDW are staged at an indoor temperature-controlled facility, awaiting IDW characterization.

ANALYTICAL LABORATORY ANALYSIS AND DATA EVALUATION

All soil samples were analyzed for PCBs only. Empirical Laboratories performed the analysis of PCB aroclors. Empirical Laboratories provided complete data packages including the laboratory quality control documentation and raw data required by the SAP. Each data package included a case narrative describing the analytical methods used and documenting any quality control problems encountered. Jacobs evaluated 100 percent of the sample data collected. The data evaluations were performed in accordance with the requirements of the SAP, the guidance in "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review," and "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review."

A Chemical Data Quality Report was prepared which summarizes the Jacobs' data evaluation in terms of precision, accuracy, representativeness, comparability, and completeness, and is included with this report. The qualifiers applied as part of the data evaluation are defined in the

Chemical Data Quality Report and the limitations implied by the qualification were considered when reviewing the data.

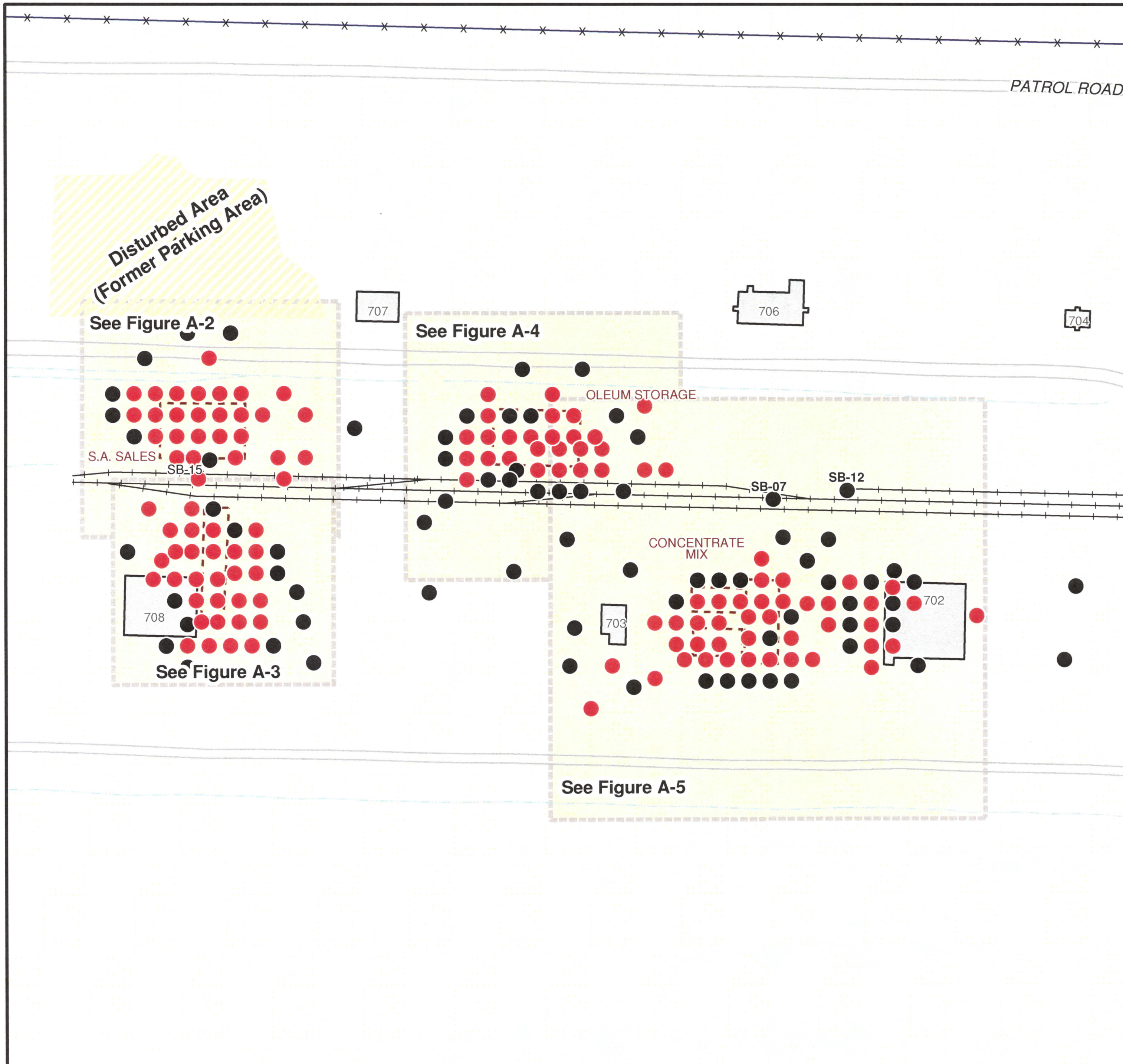
The PCB results for the 2008-2010 sampling events are definitive and are acceptable for the intended data usages. The primary laboratory reporting limits were below the Region 9 PRG values for all samples with non-detect results.

SOIL INVESTIGATION RESULTS

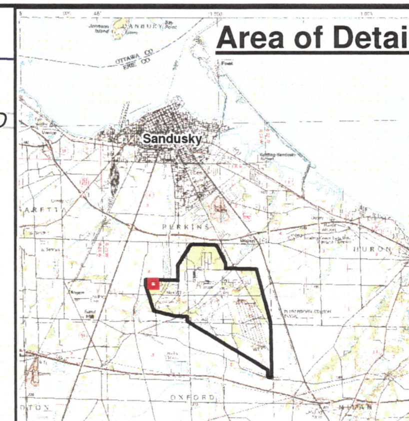
A total of 202 surface soil samples have been collected from the site dating back to the 1998 SI. A total of 35 subsurface soil samples have been collected as part of the 1998 SI and the 2004 RI sampling event. No subsurface soil samples have been collected as part of this delineation effort, since there is limited PCB contamination in the subsurface soil. PCB concentrations in surface soil range as high as 49 mg/kg. Soil contamination is generally concentrated around the former process buildings and storage tanks as shown in Figures A-1 through A-5.

CONCLUSIONS AND RECOMMENDATIONS

Sufficient data has been collected to approximate the area of contamination for remedial evaluation purposes and to develop cost estimates for the various alternatives. Additional confirmation sampling will be required during remedial activities to verify contaminant extent.



Area of Detail



Legend

- Exceedances
- Non-exceedances

Note:
bgs = below ground surface
Bkg. = Background Sample (values are provided in units consistent with the reported sample values)
PRG = Preliminary Remediation Goal (values are provided in units consistent with the reported sample values)

- Storage Tank Areas from Engineering Drawings
- Creek, Ditch, Conveyance
- Buildings
- Railway

0 125 Feet

N

Sources
Data mapped to Ohio State Plane North NAD83, map grid units in feet.

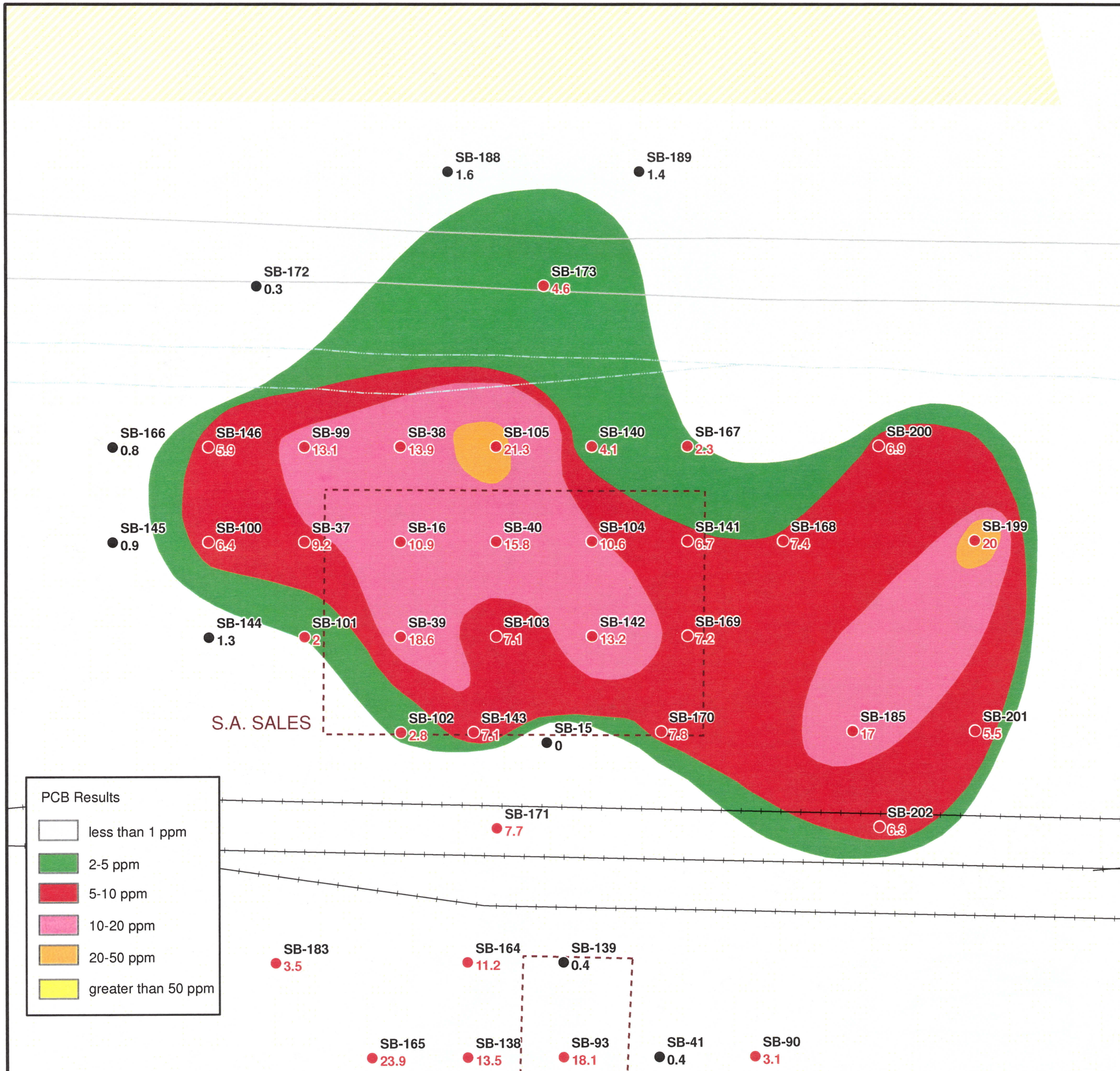
JACOBS

Total PCBs — Acid Area 2

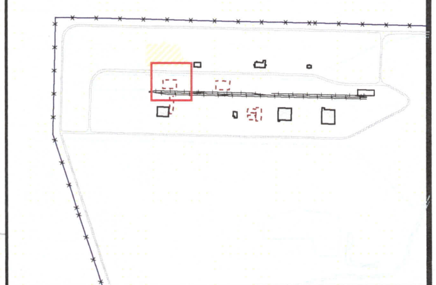
Plum Brook Ordnance Works
Sandusky, Ohio

03/02/12 S:\GIS\Projects\Plumbrook\Projects\AA2_AA3_FS\ArcGIS\AA2_surface_soil_pcb_results_2010_Dec_85x11_Appendix_Rev1.mxd

Figure A-1



Area of Detail



Legend

- Exceedances
- Non-exceedances

Note:
bgs = below ground surface
Bkg. = Background Sample (values are provided in units consistent with the reported sample values)
PRG = Preliminary Remediation Goal (values are provided in units consistent with the reported sample values)

Storage Tank Areas from Engineering Drawings

Creek, Ditch, Conveyance

Buildings

Railway

0 25 Feet

N

Sources
Data mapped to Ohio State Plane North NAD83, map grid units in feet.

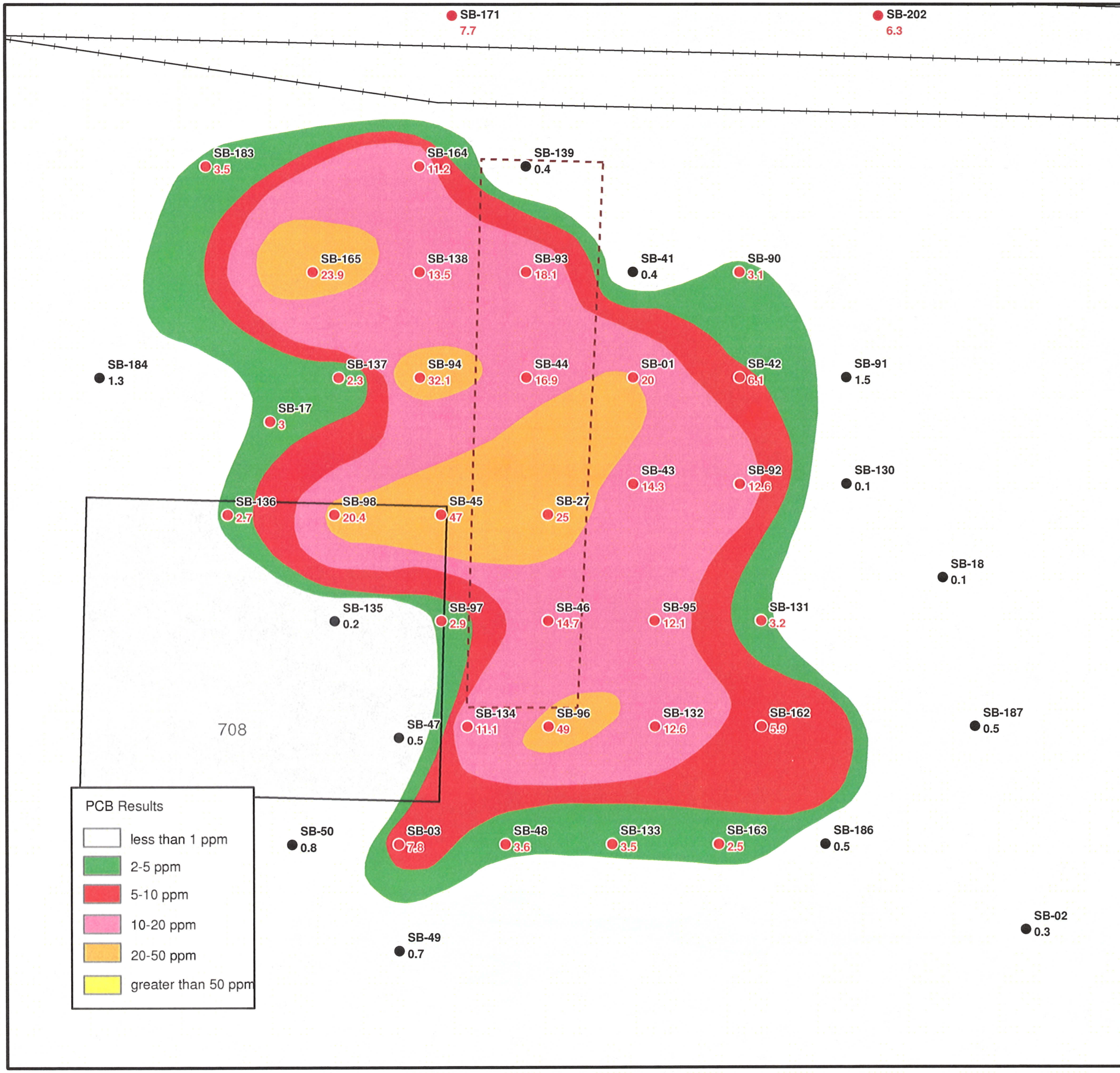
JACOBS

Total PCBs — Acid Area 2 (Cluster 1)

Plum Brook Ordnance Works
Sandusky, Ohio

03/01/12 S:\GIS\Projects\Plumbrook\Projects\AA2_AA3_FS\ArcGIS\AA2_surface_soil_pcb_cluster1_2010_Dec_85x11_Rev1.mxd

Figure A-2



Area of Detail

Legend

- Exceedances
- Non-exceedances

Note:
bgs = below ground surface
Bkg. = Background Sample (values are provided in units consistent with the reported sample values)
PRG = Preliminary Remediation Goal (values are provided in units consistent with the reported sample values)

- Storage Tank Areas from Engineering Drawings
- Creek, Ditch, Conveyance
- Buildings
- Railway

N

0 25 Feet

Sources
Data mapped to Ohio State Plane North NAD83, map grid units in feet.

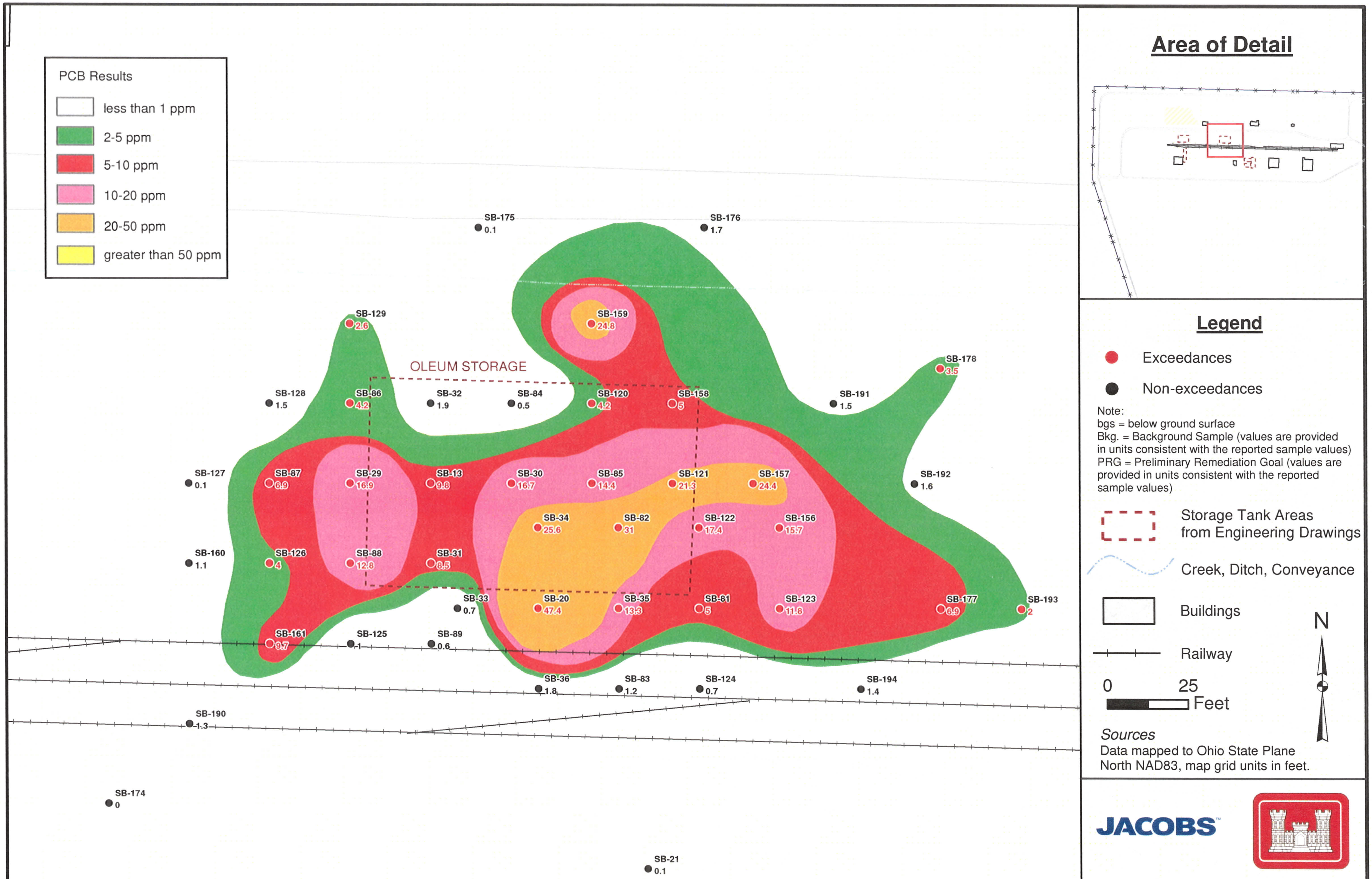
JACOBS

Total PCBs — Acid Area 2 (Cluster 2)

Plum Brook Ordnance Works
Sandusky, Ohio

03/01/12 S:\GIS\Projects\Plumbrook\Projects\AA2_AA3_FS\ArcGIS\AA2_surface_soil_pcb_cluster2_2010_Dec_85x11_Rev1.mxd

Figure A-3



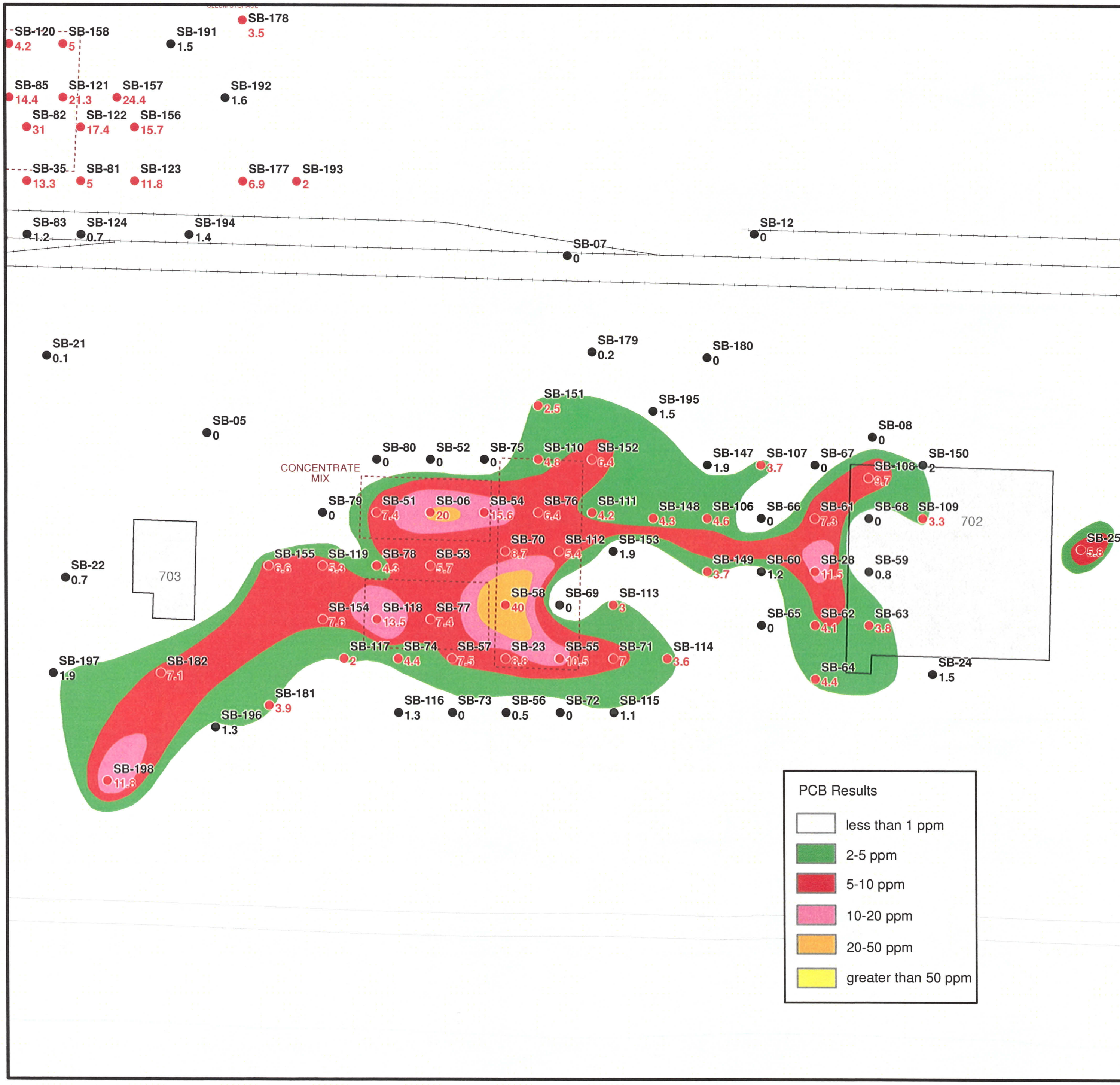
Total PCBs — Acid Area 2 (Cluster 3)

Plum Brook Ordnance Works

Sandusky, Ohio

03/01/12 S:\GIS\Projects\Plumbrook\Projects\AA2_AA3_FS\ArcGIS\AA2_surface_soil_pcb_cluster3_2010_Dec_85x11_Rev1.mxd

Figure A-4



Area of Detail

Legend

- Exceedances
- Non-exceedances

Note:
bgs = below ground surface
Bkg. = Background Sample (values are provided in units consistent with the reported sample values)
PRG = Preliminary Remediation Goal (values are provided in units consistent with the reported sample values)

Storage Tank Areas from Engineering Drawings

Creek, Ditch, Conveyance

Buildings

Railway

0 25 Feet

N

Sources
Data mapped to Ohio State Plane North NAD83, map grid units in feet.

JACOBS

Total PCBs — Acid Area 2 (Cluster 4)

Plum Brook Ordnance Works
Sandusky, Ohio

08/19/11 S:\GIS\Projects\Plumbrook\Projects\AA2_AA3_FS\ArcGIS\AA2_surface_soil_pcb_cluster1_2010_Dec_Rev1.mxd

Figure A-5

CHEMICAL DATA QUALITY REPORT

DATA FOR THE
REMEDIAL INVESTIGATION,
ACID AREA 2 (AA2)

FORMER PLUM BROOK ORDNANCE WORKS
SANDUSKY, OHIO

Prepared for:

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
NASHVILLE, TENNESSEE
CONTRACT DACW62-03-D-0004-0010

Prepared by:

JACOBS

JACOBS ENGINEERING GROUP, INC.
125 BROADWAY
OAK RIDGE, TN 37830

April 2011

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS ii
1.0 INTRODUCTION 1-1
1.1 REPORT ORGANIZATION 1-1
1.2 DATA QUALITY ASSURANCE PROGRAM 1-1
1.2.1 Project Analytical Laboratories 1-2
1.2.2 Sampling Program Design/Project Samples 1-2
1.2.3 Project Analytical Methods and Measurement Parameters 1-3
1.2.3.1 Deviations from Planned Analytical Procedures 1-3
1.2.4 Data Evaluation Procedure 1-4
1.2.5 Data Reporting Formats 1-5
1.2.5.1 Laboratory Data Packages and Analytical Results 1-5
1.2.5.2 Data Quality Non-Conformances 1-6
2.0 DATA QUALIFIER DEFINITIONS 2-1
3.0 DATA EVALUATION SUMMARY 3-1
3.1 OVERALL ASSESSMENT OF PROJECT DATA QUALITY 3-1
4.0 DATA QUALITY NARRATIVES 4-1
4.1 SOIL DATA 4-1
4.1.1 Soil Data Precision 4-1
4.1.1.1 Field QC Duplicate Precision Review 4-1
4.1.1.2 Laboratory Duplicate Precision Review 4-1
4.1.2 Soil Data Accuracy 4-2
4.1.2.1 Field Data Accuracy Review 4-2
4.1.2.2 Laboratory Data Accuracy Indicators Review 4-2
4.1.3 Soil Data Representativeness 4-3
4.1.4 Soil Data Sensitivity 4-3
4.1.5 Soil Data Completeness 4-3

TABLES

ATTACHMENTS

Attachment 1 Sample Information Tables
Attachment 2 Test Result Tables with Review Qualifiers Applied

ABBREVIATIONS AND ACRONYMS

CDQR	Chemical Data Quality Report
CLP	USEPA Contract Laboratory Program
DoD	Department of Defense
DQO	data quality objectives
ELAP	Environmental Laboratory Accreditation Program
HTRW-CX	Hazardous, Toxic, and Radioactive Waste - Center of Expertise
ID	identification
Jacobs	Jacobs Engineering Group, Inc.
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyl
QA	quality assurance
QC	quality control
QAPP	Quality Assurance Project Plan
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SDG	sample delivery group
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

1.0 INTRODUCTION

This Chemical Data Quality Report (CDQR) presents an evaluation of the quality and usability of the analytical data generated in support of the remedial investigation at Acid Area 2 (AA2) at the former Plum Brook Ordnance Works (PBOW). Jacobs Engineering Group, Inc. (Jacobs) performed this remedial investigation for the U.S. Army Corps of Engineers (USACE) Nashville District under contract number DACW62-03-D-0004, Task Order 0010.

Both primary and quality assurance (QA) environmental samples were collected by Jacobs and were submitted to approved laboratories for chemical analyses. Jacobs provided data quality evaluation services for the primary data. This CDQR covers Jacobs' evaluation of the primary data.

This evaluation meets and completes the requirement of Step 2 "data verification" of the project data quality assessment (DQA) process. Completion of this step completes Jacob's portion of the requirement in the DQA process. A description of the DQA process is included in Section 8.2.2 of the approved Quality Assurance Project Plan (QAPP). As specified in the QAPP, the findings of this evaluation were discussed in terms of data precision, accuracy, representativeness, sensitivity, and completeness.

1.1 REPORT ORGANIZATION

The CDQR has been organized into four sections and two attachments:

- Section 1: Report organization and data quality program including analytical laboratory used, analytical samples included in the evaluation, analytical protocols/methods employed, data evaluation procedures followed, and summary of data reporting formats.
- Section 2: Definitions of qualifiers that may be assigned to data based on this evaluation.
- Section 3: Statement of the project overall data quality and summary of qualifiers applied to the data as a result of this evaluation.
- Section 4: Data quality narratives.
- Attachment 1: - Sample information tables including field and laboratory identification (ID) cross-reference.
- Attachment 2: Test result tables with review qualifiers applied.

1.2 DATA QUALITY ASSURANCE PROGRAM

In order to verify compliance with project objects, it was required that certain measurements of chemical constituents in environmental samples be made that met definitive data quality standards. This CDQR is applicable to those data.

Definitive data standards are specified by the U.S. Environmental Protection Agency (USEPA) in "Data Quality Objectives Process for Superfund," EPA540-R-93-071, USEPA Office of Emergency and Remedial Response, September 1993. Definitive data are defined as follows:

> "Definitive data are generated using rigorous analytical methods, such as approved USEPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the QA/quality control (QC) requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined."

Specific project data quality objectives (DQO) and procedures to achieve the DQOs are documented in the approved project Sampling and Analysis Plan (SAP) Addendum. Key elements of the quality program relating to this evaluation include:

- Use of approved, USACE-validated laboratories.
- Use of a sampling program designed to meet the project objectives.
- Use of appropriate analytical methods and measurement parameters.
- Evaluation of reported QA/QC to verify compliance with DQOs.
- Use of appropriate analytical data reporting formats.

These elements are discussed in the following paragraphs.

1.2.1 Project Analytical Laboratories

The analytical laboratory employed on this project was originally evaluated by the USACE Hazardous, Toxic, and Radioactive Waste - Center of Expertise (HTRW-CX) and held a current letter of validation from HTRW-CX to perform sample analyses in support of the USACE HTRW Program. Subsequent to this certification, the laboratory has since received and maintains current Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) certification. These validations confirm their ability to produce reliable and defensible data. The primary analytical laboratory that was used was:

Empirical Laboratories
Contact: Ms. Sonya Gordon, Project Manager (PM)
621 Mainstream Drive, Suite 270
Nashville, TN 37228
Phone: (615) 345-1115

1.2.2 Sampling Program Design/Project Samples

The sampling program was designed to collect samples representative of site conditions at the time of sampling and to generate data of sufficient quality and quantity to make the intended decisions. Project analytical samples were collected using standardized, USACE approved procedures documented in the SAP. The SAP was approved by the USACE prior to collection of the associated project samples and included the basis for selecting the sampling locations, sample collection procedures, frequency and type of samples collected, and the analytical parameters for each sample. There were no known deviations to the sample collection procedures presented in the SAP.

Definitive data measurements were required for the samples collected in support of this investigation. The investigation utilized the USEPA Target Analyte List/Target Compound List (TAL/TCL) of analytes as the constituents of concern. The rationale for required analytical measurements and resulting data use is specified in the project QAPP.

Project samples included in this evaluation consist of 174 surface soil sample and 12 field duplicate (FD) samples collected from November 2008 to August 2010. The laboratory reported the analyses in several sample delivery groups (SDG). The SDGs included in this evaluation are:

- SDG # 0811206
- SDG # 0904132
- SDG # 0904149
- SDG # 0905018
- SDG # 0906007
- SDG # 0911185
- SDG # 1008273

A listing of specific project samples contained in each SDG, along with a cross reference of sample field ID numbers to laboratory ID numbers, is included with this report as Attachment 1.

1.2.3 Project Analytical Methods and Measurement Parameters

In order to obtain definitive data and promote data comparability, the laboratory was required to perform testing within the guidelines of standardized, USEPA and USACE approved methods and procedures included in the following protocols:

- *"Test Methods for Evaluating Solid Waste,"* SW-846, 3rd Edition, Update III, USEPA, November 1986, (SW-846).
- "Shell for Analytical Chemistry Requirements," Appendix I, from EM 200-1-3 "Requirements for the Preparation of Sampling and Analysis Plans" USACE HTRW-CX, February 2001.

The project included collection of definitive data for all soil, sediment, surface water, and groundwater samples for all measurement parameters. Specific analytical methods used in the analysis of each project sample were included in the laboratory case narratives included in each SDG and are summarized below for each primary sample type.

Soil Samples

- Polychlorinated biphenyls (PCB) by SW846/354OC/8082 or SW846/3546/8082.

1.2.3.1 Deviations from Planned Analytical Procedures

The only deviation from the QAPP prescribed analytical methods was for the PCB soil preparatory method. The QAPP requires soxhlet extraction by SW846/3540C. Empirical Laboratories had previously requested permission to perform soxtherm extraction by SW846/3541. This minor modification was approved in advance with Jacobs and the Nashville District Chemist. This modification to the preparatory method for PCBs will not adversely affect data comparability with the initial soils data from the site.

1.2.4 Data Evaluation Procedure

The quality of this data has been evaluated following the "data verification/data validation" procedure included in the QAPP as Step 2 of the five-step USACE DQA process. The procedure was derived from the USACE "Shell for Analytical Chemistry Requirements" and the USACE Engineering Manual EM 200-1-10 "Guidance for Evaluating Performance-Based Chemical Data" and considers the project DQOs, project QAPP guidance, DoD Quality Systems Manual Version 4.1 guidance, QC requirements of the analytical methods, and informed professional judgment of the evaluator. Qualified Jacobs personnel, experienced in the evaluation of analytical data quality, performed data evaluation.

A brief description of the procedure followed in this evaluation is presented below.

Data Verification Procedure

At a minimum, the following data quality issues were addressed in this evaluation with respect to 100 percent of the sample data.

- Review of chain-of-custody and sample receipt forms to evaluate sample receipt data, damaged sample containers, etc.
- Review of laboratory testing methods, detection limits, holding times, data qualifiers, etc.
- Review of field QC blank data to detect contamination from outside sources.
- Review of field QC duplicates to evaluate data reproducibility.
- Review of laboratory QC including laboratory blanks, spike recoveries, and duplicates.
- Verification of calibrations as summarized by the laboratory on the USEPA Contract Laboratory Program- (CLP) like reporting forms and within their case narratives.
- Qualification of unusable data as rejected and attachment of appropriate qualifiers to usable data.
- Presentation of data evaluation findings in terms of the data quality parameters precision, accuracy, representativeness, sensitivity, and completeness.

Data quality parameters were evaluated as follows:

- Precision: Precision is defined as the degree to which two or more measurements are in agreement. Precision is measured by comparing duplicate sample results and is expressed as the relative percent difference (RPD) between native and FD samples results, native and laboratory replicate samples results, matrix spike (MS) and matrix spike duplicate (MSD) recoveries, and/or laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) recoveries.

Field precision is measured by comparing FD sample results. FD samples are collected by taking two sequential aliquots of the same soil/sediment sample or aqueous sample, and submitting the samples to the laboratory for analysis as two separate samples. The maximum allowable RPD for soil and sediment samples, when concentrations in the native and field duplicate sample are greater than five times the reporting limit (RL), is 50 percent. Results that exceed the allowable RPD are qualified as estimated in both the native and FD sample.

Laboratory precision is measured by the analysis of MS/MSD samples, LCS/LCSD samples, and/or laboratory replicate samples. Precision objectives for respective analyses are listed in the Plum Brook QAPP. For organic analyses where MS/MSD RPD values exceed the accepted criteria, results in the parent sample are qualified as estimated. For inorganic analyses where the MS/MSD or laboratory replicate RPD values exceed the accepted criteria, results in the associated preparatory or analysis batch are qualified as estimated. For LCS/LCSD RPD values that exceed criteria, all samples in the associated batch are qualified as estimated.

- Accuracy: Accuracy is defined as the degree to which the detected value represents the true value. Accuracy is frequently used synonymously with bias. The term bias describes the systematic or persistent error associated with a measurement process. Accuracy is assessed through the collection and analysis of blanks (field and laboratory) and other QC samples or spikes.

  Accuracy in the field is assessed through the collection and analysis of equipment blanks (EB). Contamination in blanks indicates that false positive results or results that are biased high may exist for samples associated with the affected blanks. During data review, sample data are qualified as non-detect based on EB results when the analyte in the associated sample is less than five times the result in the EB.

  Accuracy in the laboratory is measured by a variety of means including sample holding times and preservation; instrument calibration; analysis of QC samples such laboratory blanks, MS samples and LCS samples; internal standard (IS) areas; and surrogate recovery in organic analyses. Laboratory blank qualifications are applied in the same manner as field blank qualifications. Accuracy is quantitatively measured by calculating percent recoveries for MS samples, LCS samples and surrogates.

- Representativeness: Representativeness expresses the degree to which data collected for a sample accurately and precisely represent the in situ conditions of the sample. Representativeness is a qualitative parameter that is dependent upon the proper design of the sampling program and proper laboratory protocol. Sampling plans are designed to provide data representative of the areas of investigation.

- Completeness: Completeness is calculated by comparing the number of valid measurements obtained to the number of measurements planned for the samples.

- Sensitivity: By evaluation of laboratory detection limits, reporting units, and the overall performance of the chosen methods.

1.2.5 Data Reporting Formats

1.2.5.1 Laboratory Data Packages and Analytical Results

The laboratory reported field sample and supporting QC data in a format consistent with the CLP data reporting requirements. This "CLP-like" format included most applicable report summary forms and was sufficient to complete Step 2 of the DQA process. In a few cases the raw quantitation reports had to be reviewed to evaluate dilutions, manual integrations, and to check for proper quantitation.

The supplied reports did include chromatograms and other raw data that are necessary to complete a third party validation of the DQA process for all parameters of interest. However, third party validation is not currently planned for AA2.

The complete analytical data packages received from the project laboratories and evaluated in this review are available from Jacobs upon request from the CELRN.

1.2.5.2 <u>Data Quality Non-Conformances</u>

Data quality non-conformances identified as a result of this review are presented in Section 4.0, Data Quality Narratives. The data quality narratives are detailed explanations of the findings of this evaluation in terms of precision, accuracy, representativeness, sensitivity, and completeness. They are intended to present a compilation of laboratory QC results found outside project acceptance criteria and provide an assessment of the potential impact those results had on the analytical data. Typically, the bulk of the project analytical protocol requirements are fulfilled and, therefore, are not summarized in the narratives.

Tabular presentations of the analytical sample results were included in the SDG. The respective laboratory test results tables were compiled into Data Summary Tables from the Electronic Data Deliverable (EDD) and were included with this report as Attachment 2. In addition, the validation qualifiers were applied to sample data to indicate data use limitations based on the findings of this evaluation.

2.0 DATA QUALIFIER DEFINITIONS

The following definitions provide explanations of the data qualifiers that may be assigned to results based on this evaluation. The data qualifier definitions are consistent with those used within the USEPA NFG referenced in Section 1.2.3 of this report.

U- The analyte was analyzed for but not detected (ND). The value preceding the U is the Contract Required Quantitation Limit (CRQL).

J- The ID of the analyte is acceptable, but the QA criteria indicate that the quantitative values may be outside the normal expected range of precision (i.e., the quantitative value is considered estimated).

UJ- This flag is a combination of the U and J qualifiers. This indicates that the analyte is not present and the reported value is considered to be an estimated CRQL.

R- Data are considered to be rejected and shall not be used. This flag denotes the failure of QC criteria such that it cannot be determined if the analyte is present or absent from the sample.

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3.0 DATA EVALUATION SUMMARY

3.1 OVERALL ASSESSMENT OF PROJECT DATA QUALITY

In general, QA/QC results associated with this data indicated that the data met “definitive data” standards and were of known quality. QC data demonstrated that the QA mechanisms were effective in ensuring measurement data reliability within expected limits of sampling and analytical error and were considered, as qualified, representative of actual site conditions at the time sampled.

Data reported are acceptable for the uses as intended with the required qualifications and limitations. The data users are urged to review the Data Quality Narratives and associated data qualifications before utilizing this data for decision-making.

Summary Of Required Data Qualifications

This section provides a summary of qualifiers applied to the data as a result of this evaluation. Attachment 2 includes tabular presentations of the analytical sample results with data qualifiers applied based on the findings of this evaluation. The data qualifier definitions applied during this review are presented in Section 2.0. Section 4.0, Data Quality Narratives, contains discussion of the evaluation findings along with an assessment of the impact on project data. Data qualified as estimated due to detection at a level below the laboratory quantitation limit but above the method detection limit (MDL) were not included in this summary since they were not qualified due to QC non-conformance.

Soil Data

Several soil results were qualified as estimated (coded “J” or “UJ”) due to QC non-conformances detailed in Section 4.1, below. No data was rejected. The PCB results can be used for decision making without further qualification.

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4.0 DATA QUALITY NARRATIVES

The findings of this data quality evaluation are presented below in terms of precision, accuracy, representativeness, sensitivity, and completeness.

4.1 SOIL DATA

4.1.1 Soil Data Precision

4.1.1.1 Field QC Duplicate Precision Review

Twelve FD soil samples were collected with the PCB samples. RPD values were found to be in control with the exception of the results noted below.

Specific Findings

FD RPD: The detected results for Aroclor 1254 in samples PBOW-08-SO-AA2-SB45-A/D, PBOW-08-SO-AA2-SB58-A/D, PBOW-09-SO-AA2-SB108-A/D, and PBOW-09-SO-AA2-SB138-A/D; and the detected results for Aroclor 1260 in samples PBOW-08-SO-AA2-SB58-A/D, PBOW-09-SO-AA2-SB103-A/D, and PBOW-09-SO-AA2-SB108-A/D exceeded the RPD limit of 50 percent and were qualified as estimated (coded "J") due to potential sample inhomogeneity. Aroclor concentrations and RPD values are summarized in Table 4-1.

4.1.1.2 Laboratory Duplicate Precision Review

Project laboratory duplicate precision indicators were found to be in control for each analytical method, with the exceptions noted below as Specific Findings. Each exception was evaluated to determine whether it had any impact on data use or resulted in data qualification.

Specific Findings

LCS/LCSD RPD: All LCS/LCSD RPD results were within accepted criteria; no qualifiers were required.

MS/MSD RPD: All MS/MSD RPD values were within accepted criteria; qualifiers were not required.

Second Column Confirmation RPD: The second column confirmation for Aroclor 1254 results in three soil samples were found to exceed the RPD criteria of 40 percent. Based on interferences in the samples leading to high RPD between the primary and confirmatory result values, results were qualified as estimated (coded "J") to indicate the potential imprecise measurement. The column RPD outliers are detailed in Table 4-2.

4.1.2 Soil Data Accuracy

4.1.2.1 Field Data Accuracy Review

Samples were collected using dedicated sampling equipment; therefore, EB samples were not required for the samples.

4.1.2.2 Laboratory Data Accuracy Indicators Review

Project accuracy indicators were found to be in control for each analytical method, with the exceptions noted below as Specific Findings. Each exception was evaluated to determine whether it had any impact on data use or resulted in data qualification. Instances were dilutions caused surrogate or spike recoveries to be diluted out are not discussed as findings if qualification was not deemed necessary.

Specific Findings

Hold Time: Several results for Aroclor 1254 for samples collected on 11 November 2008 and 12 November 2008 were not correctly identified or quantitated in the original sample analysis if they were analyzed at a dilution due to high Aroclor concentrations. The diluted sample extracts were reanalyzed specifically for Aroclor 1254 ,17 to 18 days past the 40 day hold time for sample extracts. The Aroclor 1254 results in these samples are qualified as estimated (coded "J") with a possible low bias because they were analyzed after the 40 day hold time for sample extracts, but within 80 days of sample extraction. Affected samples and Aroclor 1254 results are summarized in Table 4-3.

Sample Temperature: Samples were received within temperature range; qualifications based on sample receipt were not required.

Initial Calibration Results: All initial calibration results were within acceptance criteria; qualifications were not required.

Continuing Calibration Results: All continuing calibration results were within acceptance criteria; qualifications were not required.

Calibration Verification Results: All calibration verification results were within acceptance criteria; qualifications were not required.

LCS/LCSD Recovery Results: The recovery for Aroclor 1260 in two extraction batches exceeded the upper control limit of 125 percent. Detected results for Aroclor 1260 in samples associated with these two batches were qualified as estimated (coded "J") with a possible high bias. The results associated with high LCS recoveries are summarized in Table 4-4.

MS/MSD Recovery Results: The recoveries for Aroclor 1260 in the MS/MSD samples analyzed on sample PBOW-08-SO-AA2-SB52-A were higher than the upper control limit of 125 percent. The detected result for Aroclor 1260 in sample PBOW-08-SO-AA2-SB52-A was qualified as estimated (coded "J") with a possible high bias due to the high MS/MSD recoveries (Table 4-5).

<u>Laboratory Blank Results</u>: Aroclor 1254 and Aroclor 1260 were detected at low levels in on or more laboratory blanks. Aroclor 1254 and 1260 results in associated samples that were less than five times the blank value (adjusted for dilutions and percent solids) were qualified as non-detect (coded "U") with the DL being elevated to the result value, and the RL elevated to five times the blank value (if that value was greater than the original RL). Results qualified as non-detect due to laboratory blank concentrations are summarized in Table 4-6.

<u>Surrogate Standard Recoveries</u>: Surrogate results were not evaluated in samples analyzed at 1:5 dilutions or greater because they could not be accurately evaluated, and results were not qualifed based on surrogate recovery outliers in these diluted samples. The recoveries for the surrogates tetrachloro-m-xylene and/or decachlorobiphenyl were less than their respective lower quantitation limits in several samples. Aroclor results in these samples were qualified as estimated (coded "J" for detects and "UJ" for non-detects) with a possible low bias. These samples are summarized in Table 4-7.

4.1.3 Soil Data Representativeness

Samples collected as part of the soil sampling event followed the Plum Brook AA2 Field Sampling Plan and, with the exception of the hold time exceedances described above in Section 4.1.2, represent as much as possible the in situ field conditions. The impact is most likely minimal because PCBs are stable and are generally minimally impacted by hold time exceedances. Results associated with these outliers have been qualified as estimated (coded "J" or "UJ"), as appropriate.

4.1.4 Soil Data Sensitivity

PCB samples were analyzed at dilutions in several samples in order to bring results within the respective method or instrument calibration range. PCB analyses analyzed at dilutions due to high concentrations (e.g., above the calibration range) resulted in elevated DLs and RLs for all Aroclors in the sample. In all cases, however, the DLs for the nondetect Aroclors were below the Region IX preliminary remediation goals.

4.1.5 Soil Data Completeness

In general, the data collected during this sampling event met the established DQOs and can be considered valid for decision making purposes. Data for specific results were qualified as estimated (coded "J") for noncompliance with established criteria.

All of the planned samples were collected, and all of the planned sample analyses were performed, resulting in a 100 percent field completeness for the soil sampling event. None of the data were rejected, resulting in a 100 percent analytical data completeness.

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TABLES

ATTACHMENT 1

Sample Information Tables

Attachment 1
Table 4-7
Acid Area 2 Surrogate Recovery Exceedances

Location	Date Sampled	Type	Sample ID	Matrix	Test	Analyte	Result	Qualifier	Detection Limit	Reporting Limit	Units
AA2-SB188	8/29/2010	N1	PBOW-10-SO-AA2-SB188-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	19.2	77.8	ug/Kg
AA2-SB188	8/29/2010	N1	PBOW-10-SO-AA2-SB188-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	19.2	77.8	ug/Kg
AA2-SB188	8/29/2010	N1	PBOW-10-SO-AA2-SB188-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	19.2	77.8	ug/Kg
AA2-SB188	8/29/2010	N1	PBOW-10-SO-AA2-SB188-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	19.2	77.8	ug/Kg
AA2-SB188	8/29/2010	N1	PBOW-10-SO-AA2-SB188-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	19.2	77.8	ug/Kg
AA2-SB188	8/29/2010	N1	PBOW-10-SO-AA2-SB188-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	444	J	19.2	77.8	ug/Kg
AA2-SB188	8/29/2010	N1	PBOW-10-SO-AA2-SB188-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	1190	J	19.2	77.8	ug/Kg
AA2-SB189	8/29/2010	N1	PBOW-10-SO-AA2-SB189-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	9.34	37.8	ug/Kg
AA2-SB189	8/29/2010	N1	PBOW-10-SO-AA2-SB189-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	9.34	37.8	ug/Kg
AA2-SB189	8/29/2010	N1	PBOW-10-SO-AA2-SB189-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	9.34	37.8	ug/Kg
AA2-SB189	8/29/2010	N1	PBOW-10-SO-AA2-SB189-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	9.34	37.8	ug/Kg
AA2-SB189	8/29/2010	N1	PBOW-10-SO-AA2-SB189-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	9.34	37.8	ug/Kg
AA2-SB189	8/29/2010	N1	PBOW-10-SO-AA2-SB189-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	991	J	9.34	37.8	ug/Kg
AA2-SB189	8/29/2010	N1	PBOW-10-SO-AA2-SB189-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	383	J	9.34	37.8	ug/Kg
AA2-SB190	8/29/2010	N1	PBOW-10-SO-AA2-SB190-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	9.74	39.4	ug/Kg
AA2-SB190	8/29/2010	N1	PBOW-10-SO-AA2-SB190-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	9.74	39.4	ug/Kg
AA2-SB190	8/29/2010	N1	PBOW-10-SO-AA2-SB190-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	9.74	39.4	ug/Kg
AA2-SB190	8/29/2010	N1	PBOW-10-SO-AA2-SB190-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	9.74	39.4	ug/Kg
AA2-SB190	8/29/2010	N1	PBOW-10-SO-AA2-SB190-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	9.74	39.4	ug/Kg
AA2-SB190	8/29/2010	N1	PBOW-10-SO-AA2-SB190-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	328	J	9.74	39.4	ug/Kg
AA2-SB190	8/29/2010	N1	PBOW-10-SO-AA2-SB190-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	980	J	9.74	39.4	ug/Kg
AA2-SB191	8/29/2010	N1	PBOW-10-SO-AA2-SB191-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	10.7	43.3	ug/Kg
AA2-SB191	8/29/2010	N1	PBOW-10-SO-AA2-SB191-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	10.7	43.3	ug/Kg
AA2-SB191	8/29/2010	N1	PBOW-10-SO-AA2-SB191-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	10.7	43.3	ug/Kg
AA2-SB191	8/29/2010	N1	PBOW-10-SO-AA2-SB191-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	10.7	43.3	ug/Kg
AA2-SB191	8/29/2010	N1	PBOW-10-SO-AA2-SB191-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	10.7	43.3	ug/Kg
AA2-SB191	8/29/2010	N1	PBOW-10-SO-AA2-SB191-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	1080	J	10.7	43.3	ug/Kg
AA2-SB191	8/29/2010	N1	PBOW-10-SO-AA2-SB191-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	452	J	10.7	43.3	ug/Kg
AA2-SB193	8/29/2010	N1	PBOW-10-SO-AA2-SB193-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	9.91	40.1	ug/Kg
AA2-SB193	8/29/2010	N1	PBOW-10-SO-AA2-SB193-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	9.91	40.1	ug/Kg
AA2-SB193	8/29/2010	N1	PBOW-10-SO-AA2-SB193-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	9.91	40.1	ug/Kg
AA2-SB193	8/29/2010	N1	PBOW-10-SO-AA2-SB193-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	9.91	40.1	ug/Kg
AA2-SB193	8/29/2010	N1	PBOW-10-SO-AA2-SB193-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	9.91	40.1	ug/Kg
AA2-SB193	8/29/2010	N1	PBOW-10-SO-AA2-SB193-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	1440	J	9.91	40.1	ug/Kg

Attachment 1
Table 4-7
Acid Area 2 Surrogate Recovery Exceedances

Location	Date Sampled	Type	Sample ID	Matrix	Test	Analyte	Result	Qualifier	Detection Limit	Reporting Limit	Units
AA2-SB193	8/29/2010	N1	PBOW-10-SO-AA2-SB193-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	571	J	9.91	40.1	ug/Kg
AA2-SB194	8/29/2010	N1	PBOW-10-SO-AA2-SB194-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	9.68	39.2	ug/Kg
AA2-SB194	8/29/2010	N1	PBOW-10-SO-AA2-SB194-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	9.68	39.2	ug/Kg
AA2-SB194	8/29/2010	N1	PBOW-10-SO-AA2-SB194-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	9.68	39.2	ug/Kg
AA2-SB194	8/29/2010	N1	PBOW-10-SO-AA2-SB194-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	9.68	39.2	ug/Kg
AA2-SB194	8/29/2010	N1	PBOW-10-SO-AA2-SB194-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	9.68	39.2	ug/Kg
AA2-SB194	8/29/2010	N1	PBOW-10-SO-AA2-SB194-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	960	J	9.68	39.2	ug/Kg
AA2-SB194	8/29/2010	N1	PBOW-10-SO-AA2-SB194-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	396	J	9.68	39.2	ug/Kg
AA2-SB195	8/29/2010	N1	PBOW-10-SO-AA2-SB195-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	9.95	40.3	ug/Kg
AA2-SB195	8/29/2010	N1	PBOW-10-SO-AA2-SB195-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	9.95	40.3	ug/Kg
AA2-SB195	8/29/2010	N1	PBOW-10-SO-AA2-SB195-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	9.95	40.3	ug/Kg
AA2-SB195	8/29/2010	N1	PBOW-10-SO-AA2-SB195-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	9.95	40.3	ug/Kg
AA2-SB195	8/29/2010	N1	PBOW-10-SO-AA2-SB195-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	9.95	40.3	ug/Kg
AA2-SB195	8/29/2010	N1	PBOW-10-SO-AA2-SB195-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	995	J	9.95	40.3	ug/Kg
AA2-SB195	8/29/2010	N1	PBOW-10-SO-AA2-SB195-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	476	J	9.95	40.3	ug/Kg
AA2-SB196	8/29/2010	N1	PBOW-10-SO-AA2-SB196-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	4.82	19.5	ug/Kg
AA2-SB196	8/29/2010	N1	PBOW-10-SO-AA2-SB196-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	4.82	19.5	ug/Kg
AA2-SB196	8/29/2010	N1	PBOW-10-SO-AA2-SB196-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	4.82	19.5	ug/Kg
AA2-SB196	8/29/2010	N1	PBOW-10-SO-AA2-SB196-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	4.82	19.5	ug/Kg
AA2-SB196	8/29/2010	N1	PBOW-10-SO-AA2-SB196-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	4.82	19.5	ug/Kg
AA2-SB196	8/29/2010	N1	PBOW-10-SO-AA2-SB196-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	475	J	4.82	19.5	ug/Kg
AA2-SB196	8/29/2010	N1	PBOW-10-SO-AA2-SB196-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	828	J	4.82	19.5	ug/Kg
AA2-SB197	8/29/2010	N1	PBOW-10-SO-AA2-SB197-A	SO	SW8082A	PCB-1016 (Aroclor 1016)	ND	UJ	10	40.5	ug/Kg
AA2-SB197	8/29/2010	N1	PBOW-10-SO-AA2-SB197-A	SO	SW8082A	PCB-1221 (Aroclor 1221)	ND	UJ	10	40.5	ug/Kg
AA2-SB197	8/29/2010	N1	PBOW-10-SO-AA2-SB197-A	SO	SW8082A	PCB-1232 (Aroclor 1232)	ND	UJ	10	40.5	ug/Kg
AA2-SB197	8/29/2010	N1	PBOW-10-SO-AA2-SB197-A	SO	SW8082A	PCB-1242 (Aroclor 1242)	ND	UJ	10	40.5	ug/Kg
AA2-SB197	8/29/2010	N1	PBOW-10-SO-AA2-SB197-A	SO	SW8082A	PCB-1248 (Aroclor 1248)	ND	UJ	10	40.5	ug/Kg
AA2-SB197	8/29/2010	N1	PBOW-10-SO-AA2-SB197-A	SO	SW8082A	PCB-1254 (Aroclor 1254)	699	J	10	40.5	ug/Kg
AA2-SB197	8/29/2010	N1	PBOW-10-SO-AA2-SB197-A	SO	SW8082A	PCB-1260 (Aroclor 1260)	1160	J	10	40.5	ug/Kg

Data Source: Jacobs, 30 March 2011, Plum Brook Site Environmental Evaluation (SEE) Database

ND = non-detect

N1 = primary environmental sample

PCB = polychlorinated biphenyl

Attachment 1
Table 4-7
Acid Area 2 Surrogate Recovery Exceedances

Location	Date Sampled	Type	Sample ID	Matrix	Test	Analyte	Result	Qualifier	Detection Limit	Reporting Limit	Units

SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram

Attachment 1
Table 1-1
Acid Area 2 Sample Summary

Location	Sample ID	SDG	Laboratory Sample ID	Date Sampled	Time Sampled	Type	Matrix	SW8082 (PCBs as Aroclors)
AA2-SB029	PBOW-08-SO-AA2-SB29-A	0811206	0811206-17	11/11/08	15:11	N1	SO	X
AA2-SB030	PBOW-08-SO-AA2-SB30-A	0811206	0811206-18	11/11/08	15:22	N1	SO	X
AA2-SB031	PBOW-08-SO-AA2-SB31-A	0811206	0811206-19	11/11/08	15:34	N1	SO	X
AA2-SB032	PBOW-08-SO-AA2-SB32-A	0811206	0811206-16	11/11/08	14:58	N1	SO	X
AA2-SB033	PBOW-08-SO-AA2-SB33-A	0811206	0811206-23	11/11/08	16:07	N1	SO	X
AA2-SB034	PBOW-08-SO-AA2-SB34-A	0811206	0811206-20	11/11/08	15:46	N1	SO	X
AA2-SB035	PBOW-08-SO-AA2-SB35-A	0811206	0811206-21	11/11/08	15:56	N1	SO	X
AA2-SB035	PBOW-08-SO-AA2-SB35-D	0811206	0811206-22	11/11/08	15:56	FD1	SO	X
AA2-SB036	PBOW-08-SO-AA2-SB36-A	0811206	0811206-24	11/11/08	16:20	N1	SO	X
AA2-SB037	PBOW-08-SO-AA2-SB37-A	0811206	0811206-04	11/11/08	10:58	N1	SO	X
AA2-SB038	PBOW-08-SO-AA2-SB38-A	0811206	0811206-01	11/11/08	10:05	N1	SO	X
AA2-SB039	PBOW-08-SO-AA2-SB39-A	0811206	0811206-03	11/11/08	10:41	N1	SO	X
AA2-SB040	PBOW-08-SO-AA2-SB40-A	0811206	0811206-02	11/11/08	10:24	N1	SO	X
AA2-SB041	PBOW-08-SO-AA2-SB41-A	0811206	0811206-12	11/11/08	13:53	N1	SO	X
AA2-SB042	PBOW-08-SO-AA2-SB42-A	0811206	0811206-15	11/11/08	14:33	N1	SO	X
AA2-SB043	PBOW-08-SO-AA2-SB43-A	0811206	0811206-14	11/11/08	14:21	N1	SO	X
AA2-SB044	PBOW-08-SO-AA2-SB44-A	0811206	0811206-13	11/11/08	14:08	N1	SO	X
AA2-SB045	PBOW-08-SO-AA2-SB45-A	0811206	0811206-10	11/11/08	13:37	N1	SO	X
AA2-SB045	PBOW-08-SO-AA2-SB45-D	0811206	0811206-11	11/11/08	13:37	FD1	SO	X
AA2-SB046	PBOW-08-SO-AA2-SB46-A	0811206	0811206-09	11/11/08	13:21	N1	SO	X
AA2-SB047	PBOW-08-SO-AA2-SB47-A	0811206	0811206-05	11/11/08	11:16	N1	SO	X
AA2-SB048	PBOW-08-SO-AA2-SB48-A	0811206	0811206-08	11/11/08	12:14	N1	SO	X
AA2-SB049	PBOW-08-SO-AA2-SB49-A	0811206	0811206-07	11/11/08	12:01	N1	SO	X
AA2-SB050	PBOW-08-SO-AA2-SB50-A	0811206	0811206-06	11/11/08	11:31	N1	SO	X
AA2-SB051	PBOW-08-SO-AA2-SB51-A	0811206	0811206-37	11/12/08	10:46	N1	SO	X
AA2-SB052	PBOW-08-SO-AA2-SB52-A	0811206	0811206-36	11/12/08	10:37	N1	SO	X
AA2-SB053	PBOW-08-SO-AA2-SB53-A	0811206	0811206-35	11/12/08	10:28	N1	SO	X
AA2-SB054	PBOW-08-SO-AA2-SB54-A	0811206	0811206-34	11/12/08	10:17	N1	SO	X
AA2-SB055	PBOW-08-SO-AA2-SB55-A	0811206	0811206-29	11/12/08	9:39	N1	SO	X
AA2-SB056	PBOW-08-SO-AA2-SB56-A	0811206	0811206-30	11/12/08	9:48	N1	SO	X
AA2-SB057	PBOW-08-SO-AA2-SB57-A	0811206	0811206-31	11/12/08	9:57	N1	SO	X
AA2-SB058	PBOW-08-SO-AA2-SB58-A	0811206	0811206-32	11/12/08	10:09	N1	SO	X
AA2-SB058	PBOW-08-SO-AA2-SB58-D	0811206	0811206-33	11/12/08	10:09	FD1	SO	X
AA2-SB059	PBOW-08-SO-AA2-SB59-A	0811206	0811206-25	11/12/08	8:55	N1	SO	X
AA2-SB060	PBOW-08-SO-AA2-SB60-A	0811206	0811206-28	11/12/08	9:31	N1	SO	X
AA2-SB061	PBOW-08-SO-AA2-SB61-A	0811206	0811206-27	11/12/08	9:21	N1	SO	X
AA2-SB062	PBOW-08-SO-AA2-SB62-A	0811206	0811206-26	11/12/08	9:08	N1	SO	X
AA2-SB63	PBOW-09-SO-AA2-SB63-A	0904132	0904132-20	4/14/09	15:55	N1	SO	X
AA2-SB64	PBOW-09-SO-AA2-SB64-A	0904132	0904132-21	4/14/09	16:00	N1	SO	X
AA2-SB65	PBOW-09-SO-AA2-SB65-A	0904132	0904132-22	4/14/09	16:10	N1	SO	X
AA2-SB66	PBOW-09-SO-AA2-SB66-A	0904132	0904132-23	4/14/09	16:15	N1	SO	X
AA2-SB67	PBOW-09-SO-AA2-SB67-A	0904132	0904132-24	4/14/09	16:25	N1	SO	X
AA2-SB68	PBOW-09-SO-AA2-SB68-A	0904132	0904132-25	4/14/09	16:30	N1	SO	X
AA2-SB69	PBOW-09-SO-AA2-SB69-A	0904149	0904149-01	4/15/09	9:00	N1	SO	X

Attachment 1
Table 1-1
Acid Area 2 Sample Summary

Location	Sample ID	SDG	Laboratory Sample ID	Date Sampled	Time Sampled	Type	Matrix	SW8082 (PCBs as Aroclors)
AA2-SB70	PBOW-09-SO-AA2-SB70-A	0904149	0904149-02	4/15/09	9:08	N1	SO	X
AA2-SB71	PBOW-09-SO-AA2-SB71-A	0904149	0904149-03	4/15/09	9:15	N1	SO	X
AA2-SB72	PBOW-09-SO-AA2-SB72-A	0904149	0904149-04	4/15/09	9:30	N1	SO	X
AA2-SB72	PBOW-09-SO-AA2-SB72-D	0904149	0904149-05	4/15/09	9:30	FD1	SO	X
AA2-SB73	PBOW-09-SO-AA2-SB73-A	0904149	0904149-06	4/15/09	9:38	N1	SO	X
AA2-SB74	PBOW-09-SO-AA2-SB74-A	0904149	0904149-07	4/15/09	9:45	N1	SO	X
AA2-SB75	PBOW-09-SO-AA2-SB75-A	0904149	0904149-08	4/15/09	9:50	N1	SO	X
AA2-SB76	PBOW-09-SO-AA2-SB76-A	0904149	0904149-09	4/15/09	10:00	N1	SO	X
AA2-SB77	PBOW-09-SO-AA2-SB77-A	0904149	0904149-10	4/15/09	10:08	N1	SO	X
AA2-SB78	PBOW-09-SO-AA2-SB78-A	0904149	0904149-11	4/15/09	10:15	N1	SO	X
AA2-SB79	PBOW-09-SO-AA2-SB79-A	0904149	0904149-12	4/15/09	10:25	N1	SO	X
AA2-SB80	PBOW-09-SO-AA2-SB80-A	0904149	0904149-13	4/15/09	10:30	N1	SO	X
AA2-SB81	PBOW-09-SO-AA2-SB81-A	0904149	0904149-14	4/15/09	13:55	N1	SO	X
AA2-SB82	PBOW-09-SO-AA2-SB82-A	0904149	0904149-15	4/15/09	14:05	N1	SO	X
AA2-SB83	PBOW-09-SO-AA2-SB83-A	0904149	0904149-16	4/15/09	14:15	N1	SO	X
AA2-SB83	PBOW-09-SO-AA2-SB83-D	0904149	0904149-17	4/15/09	14:15	FD1	SO	X
AA2-SB84	PBOW-09-SO-AA2-SB84-A	0904149	0904149-18	4/15/09	14:30	N1	SO	X
AA2-SB85	PBOW-09-SO-AA2-SB85-A	0904149	0904149-19	4/15/09	14:38	N1	SO	X
AA2-SB86	PBOW-09-SO-AA2-SB86-A	0904149	0904149-20	4/15/09	14:45	N1	SO	X
AA2-SB87	PBOW-09-SO-AA2-SB87-A	0904149	0904149-21	4/15/09	14:58	N1	SO	X
AA2-SB88	PBOW-09-SO-AA2-SB88-A	0904149	0904149-22	4/15/09	15:08	N1	SO	X
AA2-SB89	PBOW-09-SO-AA2-SB89-A	0904149	0904149-23	4/15/09	15:15	N1	SO	X
AA2-SB90	PBOW-09-SO-AA2-SB90-A	0904149	0904149-24	4/15/09	16:30	N1	SO	X
AA2-SB91	PBOW-09-SO-AA2-SB91-A	0904149	0904149-25	4/15/09	16:35	N1	SO	X
AA2-SB92	PBOW-09-SO-AA2-SB92-A	0904149	0904149-26	4/16/09	8:50	N1	SO	X
AA2-SB93	PBOW-09-SO-AA2-SB93-A	0904149	0904149-27	4/16/09	9:00	N1	SO	X
AA2-SB94	PBOW-09-SO-AA2-SB94-A	0904149	0904149-28	4/16/09	9:10	N1	SO	X
AA2-SB94	PBOW-09-SO-AA2-SB94-D	0904149	0904149-29	4/16/09	9:10	FD1	SO	X
AA2-SB95	PBOW-09-SO-AA2-SB95-A	0904149	0904149-30	4/16/09	9:20	N1	SO	X
AA2-SB96	PBOW-09-SO-AA2-SB96-A	0904149	0904149-31	4/16/09	9:30	N1	SO	X
AA2-SB97	PBOW-09-SO-AA2-SB97-A	0904149	0904149-32	4/16/09	9:40	N1	SO	X
AA2-SB98	PBOW-09-SO-AA2-SB98-A	0904149	0904149-33	4/16/09	9:50	N1	SO	X
AA2-SB99	PBOW-09-SO-AA2-SB99-A	0904149	0904149-34	4/16/09	11:20	N1	SO	X
AA2-SB99	PBOW-09-SO-AA2-SB99-D	0904149	0904149-35	4/16/09	11:20	FD1	SO	X
AA2-SB100	PBOW-09-SO-AA2-SB100-A	0904149	0904149-36	4/16/09	11:35	N1	SO	X
AA2-SB101	PBOW-09-SO-AA2-SB101-A	0904149	0904149-37	4/16/09	11:50	N1	SO	X
AA2-SB102	PBOW-09-SO-AA2-SB102-A	0904149	0904149-38	4/16/09	12:55	N1	SO	X
AA2-SB103	PBOW-09-SO-AA2-SB103-A	0904149	0904149-39	4/16/09	13:12	N1	SO	X
AA2-SB104	PBOW-09-SO-AA2-SB104-A	0904149	0904149-40	4/16/09	13:25	N1	SO	X
AA2-SB105	PBOW-09-SO-AA2-SB105-A	0904149	0904149-41	4/16/09	13:40	N1	SO	X
AA2-SB106	PBOW-09-SO-AA2-SB106-A	0905018	0905018-19	4/30/09	13:15	N1	SO	X
AA2-SB107	PBOW-09-SO-AA2-SB107-A	0905018	0905018-20	4/30/09	13:25	N1	SO	X
AA2-SB108	PBOW-09-SO-AA2-SB108-A	0905018	0905018-21	4/30/09	13:35	N1	SO	X
AA2-SB108	PBOW-09-SO-AA2-SB108-D	0905018	0905018-22	4/30/09	13:35	FD1	SO	X

Attachment 1
Table 1-1
Acid Area 2 Sample Summary

Location	Sample ID	SDG	Laboratory Sample ID	Date Sampled	Time Sampled	Type	Matrix	SW8082 (PCBs as Aroclors)
AA2-SB109	PBOW-09-SO-AA2-SB109-A	0905018	0905018-23	4/30/09	13:50	N1	SO	X
AA2-SB110	PBOW-09-SO-AA2-SB110-A	0905018	0905018-24	4/30/09	14:00	N1	SO	X
AA2-SB111	PBOW-09-SO-AA2-SB111-A	0905018	0905018-25	4/30/09	14:10	N1	SO	X
AA2-SB112	PBOW-09-SO-AA2-SB112-A	0905018	0905018-26	4/30/09	14:15	N1	SO	X
AA2-SB113	PBOW-09-SO-AA2-SB113-A	0905018	0905018-27	4/30/09	14:30	N1	SO	X
AA2-SB114	PBOW-09-SO-AA2-SB114-A	0905018	0905018-28	4/30/09	14:37	N1	SO	X
AA2-SB115	PBOW-09-SO-AA2-SB115-A	0905018	0905018-29	4/30/09	14:48	N1	SO	X
AA2-SB116	PBOW-09-SO-AA2-SB116-A	0905018	0905018-30	4/30/09	14:55	N1	SO	X
AA2-SB117	PBOW-09-SO-AA2-SB117-A	0905018	0905018-31	4/30/09	15:20	N1	SO	X
AA2-SB118	PBOW-09-SO-AA2-SB118-A	0905018	0905018-32	4/30/09	15:30	N1	SO	X
AA2-SB119	PBOW-09-SO-AA2-SB119-A	0905018	0905018-33	4/30/09	15:40	N1	SO	X
AA2-SB120	PBOW-09-SO-AA2-SB120-A	0905018	0905018-34	4/30/09	15:53	N1	SO	X
AA2-SB121	PBOW-09-SO-AA2-SB121-A	0905018	0905018-35	4/30/09	16:00	N1	SO	X
AA2-SB121	PBOW-09-SO-AA2-SB121-D	0905018	0905018-36	4/30/09	16:00	FD1	SO	X
AA2-SB122	PBOW-09-SO-AA2-SB122-A	0905018	0905018-37	4/30/09	16:10	N1	SO	X
AA2-SB123	PBOW-09-SO-AA2-SB123-A	0905018	0905018-38	4/30/09	16:20	N1	SO	X
AA2-SB124	PBOW-09-SO-AA2-SB124-A	0905018	0905018-39	4/30/09	16:35	N1	SO	X
AA2-SB125	PBOW-09-SO-AA2-SB125-A	0905018	0905018-40	4/30/09	16:45	N1	SO	X
AA2-SB126	PBOW-09-SO-AA2-SB126-A	0905018	0905018-41	4/30/09	16:58	N1	SO	X
AA2-SB127	PBOW-09-SO-AA2-SB127-A	0905018	0905018-42	4/30/09	17:05	N1	SO	X
AA2-SB128	PBOW-09-SO-AA2-SB128-A	0905018	0905018-43	4/30/09	17:15	N1	SO	X
AA2-SB128	PBOW-09-SO-AA2-SB128-D	0905018	0905018-44	4/30/09	17:15	FD1	SO	X
AA2-SB129	PBOW-09-SO-AA2-SB129-A	0905018	0905018-45	4/30/09	17:25	N1	SO	X
AA2-SB130	PBOW-09-SO-AA2-SB130-A	0905018	0905018-46	5/1/09	10:30	N1	SO	X
AA2-SB131	PBOW-09-SO-AA2-SB131-A	0905018	0905018-47	5/1/09	10:40	N1	SO	X
AA2-SB132	PBOW-09-SO-AA2-SB132-A	0905018	0905018-48	5/1/09	10:48	N1	SO	X
AA2-SB133	PBOW-09-SO-AA2-SB133-A	0905018	0905018-49	5/1/09	11:00	N1	SO	X
AA2-SB133	PBOW-09-SO-AA2-SB133-D	0905018	0905018-50	5/1/09	11:00	FD1	SO	X
AA2-SB134	PBOW-09-SO-AA2-SB134-A	0905018	0905018-51	5/1/09	11:08	N1	SO	X
AA2-SB135	PBOW-09-SO-AA2-SB135-A	0905018	0905018-52	5/1/09	11:15	N1	SO	X
AA2-SB136	PBOW-09-SO-AA2-SB136-A	0905018	0905018-53	5/1/09	11:25	N1	SO	X
AA2-SB137	PBOW-09-SO-AA2-SB137-A	0905018	0905018-54	5/1/09	11:35	N1	SO	X
AA2-SB138	PBOW-09-SO-AA2-SB138-A	0905018	0905018-55	5/1/09	11:45	N1	SO	X
AA2-SB138	PBOW-09-SO-AA2-SB138-D	0905018	0905018-56	5/1/09	11:45	FD1	SO	X
AA2-SB139	PBOW-09-SO-AA2-SB139-A	0905018	0905018-57	5/1/09	11:52	N1	SO	X
AA2-SB140	PBOW-09-SO-AA2-SB140-A	0905018	0905018-58	5/1/09	12:55	N1	SO	X
AA2-SB141	PBOW-09-SO-AA2-SB141-A	0905018	0905018-59	5/1/09	13:05	N1	SO	X
AA2-SB142	PBOW-09-SO-AA2-SB142-A	0905018	0905018-60	5/1/09	13:25	N1	SO	X
AA2-SB143	PBOW-09-SO-AA2-SB143-A	0905018	0905018-61	5/1/09	13:40	N1	SO	X
AA2-SB144	PBOW-09-SO-AA2-SB144-A	0905018	0905018-62	5/1/09	13:55	N1	SO	X
AA2-SB145	PBOW-09-SO-AA2-SB145-A	0905018	0905018-63	5/1/09	14:03	N1	SO	X
AA2-SB146	PBOW-09-SO-AA2-SB146-A	0905018	0905018-64	5/1/09	14:15	N1	SO	X
AA2-SB147	PBOW-09-SO-AA2-SB147-A	0906007	0906007-22	5/28/09	14:12	N1	SO	X
AA2-SB148	PBOW-09-SO-AA2-SB148-A	0906007	0906007-23	5/28/09	14:22	N1	SO	X

Attachment 1
Table 1-1
Acid Area 2 Sample Summary

Location	Sample ID	SDG	Laboratory Sample ID	Date Sampled	Time Sampled	Type	Matrix	SW8082 (PCBs as Aroclors)
AA2-SB149	PBOW-09-SO-AA2-SB149-A	0906007	0906007-24	5/28/09	14:29	N1	SO	X
AA2-SB150	PBOW-09-SO-AA2-SB150-A	0906007	0906007-25	5/28/09	14:45	N1	SO	X
AA2-SB151	PBOW-09-SO-AA2-SB151-A	0906007	0906007-26	5/28/09	14:52	N1	SO	X
AA2-SB152	PBOW-09-SO-AA2-SB152-A	0906007	0906007-27	5/28/09	15:05	N1	SO	X
AA2-SB153	PBOW-09-SO-AA2-SB153-A	0906007	0906007-28	5/28/09	15:20	N1	SO	X
AA2-SB154	PBOW-09-SO-AA2-SB154-A	0906007	0906007-29	5/28/09	15:25	N1	SO	X
AA2-SB155	PBOW-09-SO-AA2-SB155-A	0906007	0906007-30	5/28/09	15:35	N1	SO	X
AA2-SB156	PBOW-09-SO-AA2-SB156-A	0906007	0906007-31	5/28/09	15:57	N1	SO	X
AA2-SB157	PBOW-09-SO-AA2-SB157-A	0906007	0906007-32	5/28/09	16:07	N1	SO	X
AA2-SB158	PBOW-09-SO-AA2-SB158-A	0906007	0906007-33	5/28/09	16:15	N1	SO	X
AA2-SB159	PBOW-09-SO-AA2-SB159-A	0906007	0906007-34	5/28/09	16:20	N1	SO	X
AA2-SB160	PBOW-09-SO-AA2-SB160-A	0906007	0906007-35	5/28/09	16:30	N1	SO	X
AA2-SB161	PBOW-09-SO-AA2-SB161-A	0906007	0906007-36	5/28/09	16:40	N1	SO	X
AA2-SB162	PBOW-09-SO-AA2-SB162-A	0906007	0906007-37	5/29/09	11:45	N1	SO	X
AA2-SB163	PBOW-09-SO-AA2-SB163-A	0906007	0906007-38	5/29/09	11:50	N1	SO	X
AA2-SB164	PBOW-09-SO-AA2-SB164-A	0906007	0906007-39	5/29/09	11:57	N1	SO	X
AA2-SB165	PBOW-09-SO-AA2-SB165-A	0906007	0906007-40	5/29/09	12:05	N1	SO	X
AA2-SB166	PBOW-09-SO-AA2-SB166-A	0906007	0906007-41	5/29/09	10:34	N1	SO	X
AA2-SB167	PBOW-09-SO-AA2-SB167-A	0906007	0906007-42	5/29/09	10:45	N1	SO	X
AA2-SB168	PBOW-09-SO-AA2-SB168-A	0906007	0906007-43	5/29/09	11:00	N1	SO	X
AA2-SB169	PBOW-09-SO-AA2-SB169-A	0906007	0906007-44	5/29/09	11:15	N1	SO	X
AA2-SB170	PBOW-09-SO-AA2-SB170-A	0906007	0906007-45	5/29/09	11:25	N1	SO	X
AA2-SB171	PBOW-09-SO-AA2-SB171-A	0906007	0906007-46	5/29/09	11:35	N1	SO	X
AA2-SB172	PBOW-09-SO-AA2-SB172-A	0911185	0911185-16	11/17/09	11:35	N1	SO	X
AA2-SB173	PBOW-09-SO-AA2-SB173-A	0911185	0911185-17	11/17/09	11:45	N1	SO	X
AA2-SB174	PBOW-09-SO-AA2-SB174-A	0911185	0911185-18	11/17/09	11:50	N1	SO	X
AA2-SB175	PBOW-09-SO-AA2-SB175-A	0911185	0911185-19	11/17/09	11:55	N1	SO	X
AA2-SB176	PBOW-09-SO-AA2-SB176-A	0911185	0911185-20	11/17/09	12:00	N1	SO	X
AA2-SB177	PBOW-09-SO-AA2-SB177-A	0911185	0911185-21	11/17/09	12:07	N1	SO	X
AA2-SB178	PBOW-09-SO-AA2-SB178-A	0911185	0911185-22	11/17/09	12:15	N1	SO	X
AA2-SB179	PBOW-09-SO-AA2-SB179-A	0911185	0911185-23	11/17/09	14:25	N1	SO	X
AA2-SB180	PBOW-09-SO-AA2-SB180-A	0911185	0911185-24	11/17/09	14:30	N1	SO	X
AA2-SB181	PBOW-09-SO-AA2-SB181-A	0911185	0911185-25	11/17/09	14:35	N1	SO	X
AA2-SB182	PBOW-09-SO-AA2-SB182-A	0911185	0911185-26	11/17/09	14:45	N1	SO	X
AA2-SB183	PBOW-09-SO-AA2-SB183-A	0911185	0911185-27	11/17/09	16:50	N1	SO	X
AA2-SB184	PBOW-09-SO-AA2-SB184-A	0911185	0911185-28	11/17/09	16:55	N1	SO	X
AA2-SB185	PBOW-09-SO-AA2-SB185-A	0911185	0911185-29	11/17/09	17:00	N1	SO	X
AA2-SB186	PBOW-09-SO-AA2-SB186-A	0911185	0911185-30	11/17/09	17:10	N1	SO	X
AA2-SB187	PBOW-09-SO-AA2-SB187-A	0911185	0911185-31	11/17/09	17:15	N1	SO	X
AA2-SB188	PBOW-10-SO-AA2-SB188-A	1008273	1008273-28	8/29/10	10:40	N1	SO	X
AA2-SB189	PBOW-10-SO-AA2-SB189-A	1008273	1008273-29	8/29/10	10:55	N1	SO	X
AA2-SB190	PBOW-10-SO-AA2-SB190-A	1008273	1008273-30	8/29/10	11:00	N1	SO	X
AA2-SB191	PBOW-10-SO-AA2-SB191-A	1008273	1008273-31	8/29/10	11:15	N1	SO	X
AA2-SB192	PBOW-10-SO-AA2-SB192-A	1008273	1008273-32	8/29/10	11:30	N1	SO	X

Attachment 1
Table 1-1
Acid Area 2 Sample Summary

Location	Sample ID	SDG	Laboratory Sample ID	Date Sampled	Time Sampled	Type	Matrix	SW8082 (PCBs as Aroclors)
AA2-SB193	PBOW-10-SO-AA2-SB193-A	1008273	1008273-33	8/29/10	11:40	N1	SO	X
AA2-SB194	PBOW-10-SO-AA2-SB194-A	1008273	1008273-34	8/29/10	11:45	N1	SO	X
AA2-SB195	PBOW-10-SO-AA2-SB195-A	1008273	1008273-35	8/29/10	13:20	N1	SO	X
AA2-SB196	PBOW-10-SO-AA2-SB196-A	1008273	1008273-36	8/29/10	14:20	N1	SO	X
AA2-SB197	PBOW-10-SO-AA2-SB197-A	1008273	1008273-37	8/29/10	14:30	N1	SO	X
AA2-SB198	PBOW-10-SO-AA2-SB198-A	1008273	1008273-38	8/29/10	14:35	N1	SO	X
AA2-SB199	PBOW-10-SO-AA2-SB199-A	1008273	1008273-39	8/29/10	17:00	N1	SO	X
AA2-SB200	PBOW-10-SO-AA2-SB200-A	1008273	1008273-40	8/29/10	17:05	N1	SO	X
AA2-SB201	PBOW-10-SO-AA2-SB201-A	1008273	1008273-41	8/29/10	17:10	N1	SO	X
AA2-SB202	PBOW-10-SO-AA2-SB202-A	1008273	1008273-42	8/29/10	17:25	N1	SO	X

Data Source: Jacobs, 30 March 2011, Plum Brook Site Environmental Evaluation (SEE) Database

FD1 = field duplicate sample
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SDG = sample delivery group
SO = soil matrix

ATTACHMENT 2

Test Result Tables with Review Qualifiers Applied

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-08-SO-AA2-SB29-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB30-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB31-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB32-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB33-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB34-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB35-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB35-D 11/11/2008 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	4.7 ND/U	4.8 ND/U	5.1 ND/U	4.8 ND/U	5.3 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1221 (Aroclor 1221)	4.7 ND/U	4.8 ND/U	5.1 ND/U	4.8 ND/U	5.3 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1232 (Aroclor 1232)	4.7 ND/U	4.8 ND/U	5.1 ND/U	4.8 ND/U	5.3 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1242 (Aroclor 1242)	4.7 ND/U	4.8 ND/U	5.1 ND/U	4.8 ND/U	5.3 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1248 (Aroclor 1248)	4.7 ND/U	4.8 ND/U	5.1 ND/U	4.8 ND/U	5.3 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1254 (Aroclor 1254)	4900/=/J	4700/=/J	2600/=/J	730/=	180/=	7600/=/J	4200/=/J	2800/=/J
SW8082	PCB-1260 (Aroclor 1260)	12000/=	12000/=	5900/=	1200/=	500/=	18000/=	9100/=	6900/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-08-SO-AA2-SB36-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB37-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB38-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB39-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB40-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB41-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB42-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB43-A 11/11/2008 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	4.9 ND/U	4.8 ND/U	5 ND/U	4.8 ND/U	4.6 ND/U	5.1 ND/U	5 ND/U	4.8 ND/U
SW8082	PCB-1221 (Aroclor 1221)	4.9 ND/U	4.8 ND/U	5 ND/U	4.8 ND/U	4.6 ND/U	5.1 ND/U	5 ND/U	4.8 ND/U
SW8082	PCB-1232 (Aroclor 1232)	4.9 ND/U	4.8 ND/U	5 ND/U	4.8 ND/U	4.6 ND/U	5.1 ND/U	5 ND/U	4.8 ND/U
SW8082	PCB-1242 (Aroclor 1242)	4.9 ND/U	4.8 ND/U	5 ND/U	4.8 ND/U	4.6 ND/U	5.1 ND/U	5 ND/U	4.8 ND/U
SW8082	PCB-1248 (Aroclor 1248)	4.9 ND/U	4.8 ND/U	5 ND/U	4.8 ND/U	4.6 ND/U	5.1 ND/U	5 ND/U	4.8 ND/U
SW8082	PCB-1254 (Aroclor 1254)	430/=	2200/=/J	3900/=/J	4600/=/J	3800/=/J	100/=	1600/=/J	3300/=/J
SW8082	PCB-1260 (Aroclor 1260)	1400/=	7000/=	10000/=	14000/=	12000/=	290/=	4500/=	11000/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL
TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-08-SO-AA2-SB44-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB45-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB45-D 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB46-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB47-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB48-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB49-A 11/11/2008 Result/Qualifier	PBOW-08-SO-AA2-SB50-A 11/11/2008 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	4.9 ND/U	5 ND/U	5 ND/U	4.9 ND/U	5.1 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1221 (Aroclor 1221)	4.9 ND/U	5 ND/U	5 ND/U	4.9 ND/U	5.1 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1232 (Aroclor 1232)	4.9 ND/U	5 ND/U	5 ND/U	4.9 ND/U	5.1 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1242 (Aroclor 1242)	4.9 ND/U	5 ND/U	5 ND/U	4.9 ND/U	5.1 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1248 (Aroclor 1248)	4.9 ND/U	5 ND/U	5 ND/U	4.9 ND/U	5.1 ND/U	4.9 ND/U	4.9 ND/U	4.9 ND/U
SW8082	PCB-1254 (Aroclor 1254)	3900/=/J	11000/=/J	6400/=/J	3700/=/J	120/=	780/=	180/=	210/=
SW8082	PCB-1260 (Aroclor 1260)	13000/=	36000/=	22000/=	11000/=	420/=	2800/=	540/=	540/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-08-SO-AA2-SB51-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB52-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB53-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB54-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB55-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB56-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB57-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB58-A 11/12/2008 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	5.1 ND/U	4.9 ND/U	5 ND/U	4.8 ND/U	4.9 ND/U	4.4 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1221 (Aroclor 1221)	5.1 ND/U	4.9 ND/U	5 ND/U	4.8 ND/U	4.9 ND/U	4.4 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1232 (Aroclor 1232)	5.1 ND/U	4.9 ND/U	5 ND/U	4.8 ND/U	4.9 ND/U	4.4 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1242 (Aroclor 1242)	5.1 ND/U	4.9 ND/U	5 ND/U	4.8 ND/U	4.9 ND/U	4.4 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1248 (Aroclor 1248)	5.1 ND/U	4.9 ND/U	5 ND/U	4.8 ND/U	4.9 ND/U	4.4 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1254 (Aroclor 1254)	2000/=/J	4.9 ND/U	1500/=/J	2600/=/J	4000/=/J	180/=	2200/=/J	11000/=/J
SW8082	PCB-1260 (Aroclor 1260)	5400/=	23/=/J	4200/=	13000/=	6500/=	310/=	5300/=	29000/=/J

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-08-SO-AA2-SB58-D 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB59-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB60-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB61-A 11/12/2008 Result/Qualifier	PBOW-08-SO-AA2-SB62-A 11/12/2008 Result/Qualifier	PBOW-09-SO-AA2-SB63-A 4/14/2009 Result/Qualifier	PBOW-09-SO-AA2-SB64-A 4/14/2009 Result/Qualifier	PBOW-09-SO-AA2-SB65-A 4/14/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	4.8 ND/U	4.8 ND/U	4.9 ND/U	4.8 ND/U	4.9 ND/U	50 ND/U	56 ND/U	51 ND/U
SW8082	PCB-1221 (Aroclor 1221)	4.8 ND/U	4.8 ND/U	4.9 ND/U	4.8 ND/U	4.9 ND/U	50 ND/U	56 ND/U	51 ND/U
SW8082	PCB-1232 (Aroclor 1232)	4.8 ND/U	4.8 ND/U	4.9 ND/U	4.8 ND/U	4.9 ND/U	50 ND/U	56 ND/U	51 ND/U
SW8082	PCB-1242 (Aroclor 1242)	4.8 ND/U	4.8 ND/U	4.9 ND/U	4.8 ND/U	4.9 ND/U	50 ND/U	56 ND/U	51 ND/U
SW8082	PCB-1248 (Aroclor 1248)	4.8 ND/U	4.8 ND/U	4.9 ND/U	4.8 ND/U	4.9 ND/U	50 ND/U	56 ND/U	51 ND/U
SW8082	PCB-1254 (Aroclor 1254)	4600/=/J	460/=	550/=	2300/=/J	1400/=/J	950/=	370 ND/U	290 ND/U
SW8082	PCB-1260 (Aroclor 1260)	13000/=/J	320/=	640/=	5000/=	2700/=	2800/=	940 ND/U	250 ND/U

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB66-A 4/14/2009 Result/Qualifier	PBOW-09-SO-AA2-SB67-A 4/14/2009 Result/Qualifier	PBOW-09-SO-AA2-SB68-A 4/14/2009 Result/Qualifier	PBOW-09-SO-AA2-SB69-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB70-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB71-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB72-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB72-D 4/15/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	53 ND/U	50 ND/U	51 ND/U	51 ND/U	50 ND/U	50 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1221 (Aroclor 1221)	53 ND/U	50 ND/U	51 ND/U	51 ND/U	50 ND/U	50 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1232 (Aroclor 1232)	53 ND/U	50 ND/U	51 ND/U	51 ND/U	50 ND/U	50 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1242 (Aroclor 1242)	53 ND/U	50 ND/U	51 ND/U	51 ND/U	50 ND/U	50 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1248 (Aroclor 1248)	53 ND/U	50 ND/U	51 ND/U	51 ND/U	50 ND/U	50 ND/U	5 ND/U	4.9 ND/U
SW8082	PCB-1254 (Aroclor 1254)	1600/=	680/=	1400/=	150 ND/U	2800/=	2000/=	28 ND/U	4.9 ND/U
SW8082	PCB-1260 (Aroclor 1260)	2800/=	1800/=	3000/=	320 ND/U	5900/=	5000/=	120 ND/U	27 ND/U

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB73-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB74-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB75-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB76-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB77-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB78-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB79-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB80-A 4/15/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	46 ND/U	52 ND/U	54 ND/U	55 ND/U	51 ND/U	52 ND/U	51 ND/U	4.9 ND/U
SW8082	PCB-1221 (Aroclor 1221)	46 ND/U	52 ND/U	54 ND/U	55 ND/U	51 ND/U	52 ND/U	51 ND/U	4.9 ND/U
SW8082	PCB-1232 (Aroclor 1232)	46 ND/U	52 ND/U	54 ND/U	55 ND/U	51 ND/U	52 ND/U	51 ND/U	4.9 ND/U
SW8082	PCB-1242 (Aroclor 1242)	46 ND/U	52 ND/U	54 ND/U	55 ND/U	51 ND/U	52 ND/U	51 ND/U	4.9 ND/U
SW8082	PCB-1248 (Aroclor 1248)	46 ND/U	52 ND/U	54 ND/U	55 ND/U	51 ND/U	52 ND/U	51 ND/U	4.9 ND/U
SW8082	PCB-1254 (Aroclor 1254)	490 ND/U	1300/=	680 ND/U	1900/=	2200/=	1300/=	590 ND/U	47/=
SW8082	PCB-1260 (Aroclor 1260)	1000 ND/U	3100/=	1600 ND/U	4500/=	5200/=	3000/=	1200 ND/U	56 ND/U

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL
TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB81-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB82-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB83-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB83-D 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB84-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB85-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB86-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB87-A 4/15/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	52 ND/U	52 ND/U	52 ND/U	51 ND/U	54 ND/U	50 ND/U	53 ND/U	51 ND/U
SW8082	PCB-1221 (Aroclor 1221)	52 ND/U	52 ND/U	52 ND/U	51 ND/U	54 ND/U	50 ND/U	53 ND/U	51 ND/U
SW8082	PCB-1232 (Aroclor 1232)	52 ND/U	52 ND/U	52 ND/U	51 ND/U	54 ND/U	50 ND/U	53 ND/U	51 ND/U
SW8082	PCB-1242 (Aroclor 1242)	52 ND/U	52 ND/U	52 ND/U	51 ND/U	54 ND/U	50 ND/U	53 ND/U	51 ND/U
SW8082	PCB-1248 (Aroclor 1248)	52 ND/U	52 ND/U	52 ND/U	51 ND/U	54 ND/U	50 ND/U	53 ND/U	51 ND/U
SW8082	PCB-1254 (Aroclor 1254)	1500/=/J	9000/=	170/TR/J	330/=	140/=/J	4700/=	1300/=	2200/=
SW8082	PCB-1260 (Aroclor 1260)	3500/=	22000/=	450/=/J	880/=/J	310/=	9700/=	2900/=	4700/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB88-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB89-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB90-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB91-A 4/15/2009 Result/Qualifier	PBOW-09-SO-AA2-SB92-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB93-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB94-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB94-D 4/16/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	50 ND/U	52 ND/U	52 ND/U	54 ND/U	53 ND/U	52 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1221 (Aroclor 1221)	50 ND/U	52 ND/U	52 ND/U	54 ND/U	53 ND/U	52 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1232 (Aroclor 1232)	50 ND/U	52 ND/U	52 ND/U	54 ND/U	53 ND/U	52 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1242 (Aroclor 1242)	50 ND/U	52 ND/U	52 ND/U	54 ND/U	53 ND/U	52 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1248 (Aroclor 1248)	50 ND/U	52 ND/U	52 ND/U	54 ND/U	53 ND/U	52 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1254 (Aroclor 1254)	4000/=	220/=	810/=	380/=	3700/=	4100/=	7100/=	5400/=
SW8082	PCB-1260 (Aroclor 1260)	8800/=	380/=	2300/=	1100/=	8900/=	14000/=	25000/=	16000/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB95-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB96-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB97-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB98-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB99-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB99-D 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB100-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB101-A 4/16/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	50 ND/U	44 ND/U	50 ND/U	51 ND/U	52 ND/U	52 ND/U	50 ND/U	52 ND/U
SW8082	PCB-1221 (Aroclor 1221)	50 ND/U	44 ND/U	50 ND/U	51 ND/U	52 ND/U	52 ND/U	50 ND/U	52 ND/U
SW8082	PCB-1232 (Aroclor 1232)	50 ND/U	44 ND/U	50 ND/U	51 ND/U	52 ND/U	52 ND/U	50 ND/U	52 ND/U
SW8082	PCB-1242 (Aroclor 1242)	50 ND/U	44 ND/U	50 ND/U	51 ND/U	52 ND/U	52 ND/U	50 ND/U	52 ND/U
SW8082	PCB-1248 (Aroclor 1248)	50 ND/U	44 ND/U	50 ND/U	51 ND/U	52 ND/U	52 ND/U	50 ND/U	52 ND/U
SW8082	PCB-1254 (Aroclor 1254)	3600/=	10000/=	800/=/J	4400/=	4100/=	3900/=	1900/=	600/=
SW8082	PCB-1260 (Aroclor 1260)	8500/=	39000/=	2100/=	16000/=	9000/=	9000/=	4500/=	1400/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB102-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB103-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB104-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB105-A 4/16/2009 Result/Qualifier	PBOW-09-SO-AA2-SB106-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB107-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB108-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB108-D 4/30/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	53 ND/U	51 ND/U	51 ND/U	52 ND/U	52 ND/U	53 ND/U	53 ND/U	52 ND/U
SW8082	PCB-1221 (Aroclor 1221)	53 ND/U	51 ND/U	51 ND/U	52 ND/U	52 ND/U	53 ND/U	53 ND/U	52 ND/U
SW8082	PCB-1232 (Aroclor 1232)	53 ND/U	51 ND/U	51 ND/U	52 ND/U	52 ND/U	53 ND/U	53 ND/U	52 ND/U
SW8082	PCB-1242 (Aroclor 1242)	53 ND/U	51 ND/U	51 ND/U	52 ND/U	52 ND/U	53 ND/U	53 ND/U	52 ND/U
SW8082	PCB-1248 (Aroclor 1248)	53 ND/U	51 ND/U	51 ND/U	52 ND/U	52 ND/U	53 ND/U	53 ND/U	52 ND/U
SW8082	PCB-1254 (Aroclor 1254)	770/=	2100/=	3200/=	5300/=	1200/=	1400/=	1200/=/J	2300/=/J
SW8082	PCB-1260 (Aroclor 1260)	2000/=	5000/=	7400/=	16000/=	3400/=/J	2300/=/J	3900/=/J	7400/=/J

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB109-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB110-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB111-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB112-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB113-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB114-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB115-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB116-A 4/30/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	52 ND/U	51 ND/U	54 ND/U	49 ND/U	52 ND/U	50 ND/U	46 ND/U	51 ND/U
SW8082	PCB-1221 (Aroclor 1221)	52 ND/U	51 ND/U	54 ND/U	49 ND/U	52 ND/U	50 ND/U	46 ND/U	51 ND/U
SW8082	PCB-1232 (Aroclor 1232)	52 ND/U	51 ND/U	54 ND/U	49 ND/U	52 ND/U	50 ND/U	46 ND/U	51 ND/U
SW8082	PCB-1242 (Aroclor 1242)	52 ND/U	51 ND/U	54 ND/U	49 ND/U	52 ND/U	50 ND/U	46 ND/U	51 ND/U
SW8082	PCB-1248 (Aroclor 1248)	52 ND/U	51 ND/U	54 ND/U	49 ND/U	52 ND/U	50 ND/U	46 ND/U	51 ND/U
SW8082	PCB-1254 (Aroclor 1254)	1500/=	1300/=	1300/=	1500/=	850/=	1500/=	390/=	500/=
SW8082	PCB-1260 (Aroclor 1260)	1800/=/J	3500/=/J	2900/=/J	3900/=/J	2100/=/J	2100/=/J	720/=/J	820/=/J

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB117-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB118-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB119-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB120-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB121-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB121-D 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB122-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB123-A 4/30/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	51 ND/U	51 ND/U	48 ND/U	52 ND/U	53 ND/U	52 ND/U	53 ND/U	54 ND/U
SW8082	PCB-1221 (Aroclor 1221)	51 ND/U	51 ND/U	48 ND/U	52 ND/U	53 ND/U	52 ND/U	53 ND/U	54 ND/U
SW8082	PCB-1232 (Aroclor 1232)	51 ND/U	51 ND/U	48 ND/U	52 ND/U	53 ND/U	52 ND/U	53 ND/U	54 ND/U
SW8082	PCB-1242 (Aroclor 1242)	51 ND/U	51 ND/U	48 ND/U	52 ND/U	53 ND/U	52 ND/U	53 ND/U	54 ND/U
SW8082	PCB-1248 (Aroclor 1248)	51 ND/U	51 ND/U	48 ND/U	52 ND/U	53 ND/U	52 ND/U	53 ND/U	54 ND/U
SW8082	PCB-1254 (Aroclor 1254)	620/=	4100/=	1800/=	1200/=	6300/=	5700/=	5400/=	3300/=
SW8082	PCB-1260 (Aroclor 1260)	1400/=/J	9400/=/J	3500/=/J	3000/=/J	15000/=/J	12000/=/J	12000/=/J	8500/=/J

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB124-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB125-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB126-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB127-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB128-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB128-D 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB129-A 4/30/2009 Result/Qualifier	PBOW-09-SO-AA2-SB130-A 5/1/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	53 ND/U	53 ND/U	51 ND/U	5.2 ND/U	54 ND/U	53 ND/U	57 ND/U	5.1 ND/U
SW8082	PCB-1221 (Aroclor 1221)	53 ND/U	53 ND/U	51 ND/U	5.2 ND/U	54 ND/U	53 ND/U	57 ND/U	5.1 ND/U
SW8082	PCB-1232 (Aroclor 1232)	53 ND/U	53 ND/U	51 ND/U	5.2 ND/U	54 ND/U	53 ND/U	57 ND/U	5.1 ND/U
SW8082	PCB-1242 (Aroclor 1242)	53 ND/U	53 ND/U	51 ND/U	5.2 ND/U	54 ND/U	53 ND/U	57 ND/U	5.1 ND/U
SW8082	PCB-1248 (Aroclor 1248)	53 ND/U	53 ND/U	51 ND/U	5.2 ND/U	54 ND/U	53 ND/U	57 ND/U	5.1 ND/U
SW8082	PCB-1254 (Aroclor 1254)	180/TR/J	270/=	1300/=	48/=	470/=	430/=	920/=	25/=
SW8082	PCB-1260 (Aroclor 1260)	500/=/J	680/=	2700/=	96/=	1000/=	990/=	1700/=	46/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB131-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB132-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB133-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB133-D 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB134-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB135-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB136-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB137-A 5/1/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	51 ND/U	47 ND/U	50 ND/U	49 ND/U	48 ND/U	5.2 ND/U	51 ND/U	51 ND/U
SW8082	PCB-1221 (Aroclor 1221)	51 ND/U	47 ND/U	50 ND/U	49 ND/U	48 ND/U	5.2 ND/U	51 ND/U	51 ND/U
SW8082	PCB-1232 (Aroclor 1232)	51 ND/U	47 ND/U	50 ND/U	49 ND/U	48 ND/U	5.2 ND/U	51 ND/U	51 ND/U
SW8082	PCB-1242 (Aroclor 1242)	51 ND/U	47 ND/U	50 ND/U	49 ND/U	48 ND/U	5.2 ND/U	51 ND/U	51 ND/U
SW8082	PCB-1248 (Aroclor 1248)	51 ND/U	47 ND/U	50 ND/U	49 ND/U	48 ND/U	5.2 ND/U	51 ND/U	51 ND/U
SW8082	PCB-1254 (Aroclor 1254)	940/=	4000/=	690/=	840/=	2600/=	54/=	680/=	630/=
SW8082	PCB-1260 (Aroclor 1260)	2300/=	8600/=	2200/=	2700/=	8500/=	160/=	2000/=	1700/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB138-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB138-D 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB139-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB140-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB141-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB142-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB143-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB144-A 5/1/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	52 ND/U	52 ND/U	5.2 ND/U	52 ND/U	51 ND/U	51 ND/U	51 ND/U	53 ND/U
SW8082	PCB-1221 (Aroclor 1221)	52 ND/U	52 ND/U	5.2 ND/U	52 ND/U	51 ND/U	51 ND/U	51 ND/U	53 ND/U
SW8082	PCB-1232 (Aroclor 1232)	52 ND/U	52 ND/U	5.2 ND/U	52 ND/U	51 ND/U	51 ND/U	51 ND/U	53 ND/U
SW8082	PCB-1242 (Aroclor 1242)	52 ND/U	52 ND/U	5.2 ND/U	52 ND/U	51 ND/U	51 ND/U	51 ND/U	53 ND/U
SW8082	PCB-1248 (Aroclor 1248)	52 ND/U	52 ND/U	5.2 ND/U	52 ND/U	51 ND/U	51 ND/U	51 ND/U	53 ND/U
SW8082	PCB-1254 (Aroclor 1254)	2200/=/J	3700/=/J	96/=	1200/=	1900/=	4000/=	2000/=	370/=
SW8082	PCB-1260 (Aroclor 1260)	6100/=	9800/=	260/=	2900/=	4800/=	9200/=	5100/=	940/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB145-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB146-A 5/1/2009 Result/Qualifier	PBOW-09-SO-AA2-SB147-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB148-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB149-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB150-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB151-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB152-A 5/28/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	52 ND/U	52 ND/U	52 ND/U	53 ND/U	49 ND/U	50 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1221 (Aroclor 1221)	52 ND/U	52 ND/U	52 ND/U	53 ND/U	49 ND/U	50 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1232 (Aroclor 1232)	52 ND/U	52 ND/U	52 ND/U	53 ND/U	49 ND/U	50 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1242 (Aroclor 1242)	52 ND/U	52 ND/U	52 ND/U	53 ND/U	49 ND/U	50 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1248 (Aroclor 1248)	52 ND/U	52 ND/U	52 ND/U	53 ND/U	49 ND/U	50 ND/U	51 ND/U	52 ND/U
SW8082	PCB-1254 (Aroclor 1254)	260/=	1700/=	780/=	1700/=	1400/=	580/=	670/=	1800/=
SW8082	PCB-1260 (Aroclor 1260)	670/=	4200/=	1100/=	2600/=	2300/=	1400/=	1800/=	4600/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB153-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB154-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB155-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB156-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB157-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB158-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB159-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB160-A 5/28/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	49 ND/U	52 ND/U	53 ND/U	50 ND/U	53 ND/U	51 ND/U	54 ND/U	50 ND/U
SW8082	PCB-1221 (Aroclor 1221)	49 ND/U	52 ND/U	53 ND/U	50 ND/U	53 ND/U	51 ND/U	54 ND/U	50 ND/U
SW8082	PCB-1232 (Aroclor 1232)	49 ND/U	52 ND/U	53 ND/U	50 ND/U	53 ND/U	51 ND/U	54 ND/U	50 ND/U
SW8082	PCB-1242 (Aroclor 1242)	49 ND/U	52 ND/U	53 ND/U	50 ND/U	53 ND/U	51 ND/U	54 ND/U	50 ND/U
SW8082	PCB-1248 (Aroclor 1248)	49 ND/U	52 ND/U	53 ND/U	50 ND/U	53 ND/U	51 ND/U	54 ND/U	50 ND/U
SW8082	PCB-1254 (Aroclor 1254)	550/=	3000/=	2700/=	5700/=	8400/=	1600/=	8800/=	330/=
SW8082	PCB-1260 (Aroclor 1260)	1300/=	4600/=	3900/=	10000/=	16000/=	3400/=	16000/=	780/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB161-A 5/28/2009 Result/Qualifier	PBOW-09-SO-AA2-SB162-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB163-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB164-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB165-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB166-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB167-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB168-A 5/29/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	52 ND/U	49 ND/U	51 ND/U	51 ND/U	53 ND/U	51 ND/U	52 ND/U	51 ND/U
SW8082	PCB-1221 (Aroclor 1221)	52 ND/U	49 ND/U	51 ND/U	51 ND/U	53 ND/U	51 ND/U	52 ND/U	51 ND/U
SW8082	PCB-1232 (Aroclor 1232)	52 ND/U	49 ND/U	51 ND/U	51 ND/U	53 ND/U	51 ND/U	52 ND/U	51 ND/U
SW8082	PCB-1242 (Aroclor 1242)	52 ND/U	49 ND/U	51 ND/U	51 ND/U	53 ND/U	51 ND/U	52 ND/U	51 ND/U
SW8082	PCB-1248 (Aroclor 1248)	52 ND/U	49 ND/U	51 ND/U	51 ND/U	53 ND/U	51 ND/U	52 ND/U	51 ND/U
SW8082	PCB-1254 (Aroclor 1254)	2900/=	1500/=	1100/=	2600/=	7900/=	240/=	660/=	2200/=
SW8082	PCB-1260 (Aroclor 1260)	6800/=	4400/=	1400/=	8600/=	16000/=	570/=	1600/=	5200/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB169-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB170-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB171-A 5/29/2009 Result/Qualifier	PBOW-09-SO-AA2-SB172-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB173-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB174-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB175-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB176-A 11/17/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	50 ND/U	49 ND/U	47 ND/U	5 ND/U	48.1 ND/U	4.54 ND/U	4.98 ND/U	49.9 ND/U
SW8082	PCB-1221 (Aroclor 1221)	50 ND/U	49 ND/U	47 ND/U	5 ND/U	48.1 ND/U	4.54 ND/U	4.98 ND/U	49.9 ND/U
SW8082	PCB-1232 (Aroclor 1232)	50 ND/U	49 ND/U	47 ND/U	5 ND/U	48.1 ND/U	4.54 ND/U	4.98 ND/U	49.9 ND/U
SW8082	PCB-1242 (Aroclor 1242)	50 ND/U	49 ND/U	47 ND/U	5 ND/U	48.1 ND/U	4.54 ND/U	4.98 ND/U	49.9 ND/U
SW8082	PCB-1248 (Aroclor 1248)	50 ND/U	49 ND/U	47 ND/U	5 ND/U	48.1 ND/U	4.54 ND/U	4.98 ND/U	49.9 ND/U
SW8082	PCB-1254 (Aroclor 1254)	2100/=	2200/=	2100/=	88.5/=	1350/=	4.54 ND/U	41.7/=	546/=
SW8082	PCB-1260 (Aroclor 1260)	5100/=	5600/=	5600/=	185/=	3200/=	19.2/=	77.7/=	1180/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB177-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB178-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB179-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB180-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB181-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB182-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB183-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB184-A 11/17/2009 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	44.8 ND/U	51.8 ND/U	5.19 ND/U	5.19 ND/U	49 ND/U	48.4 ND/U	52.2 ND/U	51.7 ND/U
SW8082	PCB-1221 (Aroclor 1221)	44.8 ND/U	51.8 ND/U	5.19 ND/U	5.19 ND/U	49 ND/U	48.4 ND/U	52.2 ND/U	51.7 ND/U
SW8082	PCB-1232 (Aroclor 1232)	44.8 ND/U	51.8 ND/U	5.19 ND/U	5.19 ND/U	49 ND/U	48.4 ND/U	52.2 ND/U	51.7 ND/U
SW8082	PCB-1242 (Aroclor 1242)	44.8 ND/U	51.8 ND/U	5.19 ND/U	5.19 ND/U	49 ND/U	48.4 ND/U	52.2 ND/U	51.7 ND/U
SW8082	PCB-1248 (Aroclor 1248)	44.8 ND/U	51.8 ND/U	5.19 ND/U	5.19 ND/U	49 ND/U	48.4 ND/U	52.2 ND/U	51.7 ND/U
SW8082	PCB-1254 (Aroclor 1254)	2270/=	1130/=	68.9/=	15.9/TR/J	1280/=	2590/=	979/=	352/=
SW8082	PCB-1260 (Aroclor 1260)	4590/=	2350/=	125/=	27/=	2640/=	4510/=	2560/=	942/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-09-SO-AA2-SB185-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB186-A 11/17/2009 Result/Qualifier	PBOW-09-SO-AA2-SB187-A 11/17/2009 Result/Qualifier	PBOW-10-SO-AA2-SB188-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB189-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB190-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB191-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB192-A 8/29/2010 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	50.5 ND/U	4.9 ND/U	4.82 ND/U	19.2 ND/UJ	9.34 ND/UJ	9.74 ND/UJ	10.7 ND/UJ	10.3 ND/U
SW8082	PCB-1221 (Aroclor 1221)	50.5 ND/U	4.9 ND/U	4.82 ND/U	19.2 ND/UJ	9.34 ND/UJ	9.74 ND/UJ	10.7 ND/UJ	10.3 ND/U
SW8082	PCB-1232 (Aroclor 1232)	50.5 ND/U	4.9 ND/U	4.82 ND/U	19.2 ND/UJ	9.34 ND/UJ	9.74 ND/UJ	10.7 ND/UJ	10.3 ND/U
SW8082	PCB-1242 (Aroclor 1242)	50.5 ND/U	4.9 ND/U	4.82 ND/U	19.2 ND/UJ	9.34 ND/UJ	9.74 ND/UJ	10.7 ND/UJ	10.3 ND/U
SW8082	PCB-1248 (Aroclor 1248)	50.5 ND/U	4.9 ND/U	4.82 ND/U	19.2 ND/UJ	9.34 ND/UJ	9.74 ND/UJ	10.7 ND/UJ	10.3 ND/U
SW8082	PCB-1254 (Aroclor 1254)	5870/=	140/=	161/=	444/=	991/=/J	328/=/J	1080/=/J	450/=
SW8082	PCB-1260 (Aroclor 1260)	11100/=	327/=	380/=	1190/=	383/=/J	980/=/J	452/=/J	1120/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated
"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-10-SO-AA2-SB193-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB194-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB195-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB196-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB197-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB198-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB199-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB200-A 8/29/2010 Result/Qualifier
	PCBs								
SW8082	PCB-1016 (Aroclor 1016)	9.91 ND/UJ	9.68 ND/UJ	9.95 ND/UJ	4.82 ND/UJ	10 ND/UJ	128 ND/U	255 ND/U	49.4 ND/U
SW8082	PCB-1221 (Aroclor 1221)	9.91 ND/UJ	9.68 ND/UJ	9.95 ND/UJ	4.82 ND/UJ	10 ND/UJ	128 ND/U	255 ND/U	49.4 ND/U
SW8082	PCB-1232 (Aroclor 1232)	9.91 ND/UJ	9.68 ND/UJ	9.95 ND/UJ	4.82 ND/UJ	10 ND/UJ	128 ND/U	255 ND/U	49.4 ND/U
SW8082	PCB-1242 (Aroclor 1242)	9.91 ND/UJ	9.68 ND/UJ	9.95 ND/UJ	4.82 ND/UJ	10 ND/UJ	128 ND/U	255 ND/U	49.4 ND/U
SW8082	PCB-1248 (Aroclor 1248)	9.91 ND/UJ	9.68 ND/UJ	9.95 ND/UJ	4.82 ND/UJ	10 ND/UJ	128 ND/U	255 ND/U	49.4 ND/U
SW8082	PCB-1254 (Aroclor 1254)	1440/=/J	960/=/J	995/=/J	475/=/J	699/=/J	9830/=	14000/=	1860/=
SW8082	PCB-1260 (Aroclor 1260)	571/=/J	396/=/J	476/=/J	828/=/J	1160/=/J	1970/=	6010/=	4990/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Attachment 2
Acid Area 2 Test Results with Validation Qualifiers Applied

Method	Analyte	PBOW-10-SO-AA2-SB201-A 8/29/2010 Result/Qualifier	PBOW-10-SO-AA2-SB202-A 8/29/2010 Result/Qualifier
	PCBs		
SW8082	PCB-1016 (Aroclor 1016)	49.7 ND/U	49.9 ND/U
SW8082	PCB-1221 (Aroclor 1221)	49.7 ND/U	49.9 ND/U
SW8082	PCB-1232 (Aroclor 1232)	49.7 ND/U	49.9 ND/U
SW8082	PCB-1242 (Aroclor 1242)	49.7 ND/U	49.9 ND/U
SW8082	PCB-1248 (Aroclor 1248)	49.7 ND/U	49.9 ND/U
SW8082	PCB-1254 (Aroclor 1254)	3810/=	1590/=
SW8082	PCB-1260 (Aroclor 1260)	1700/=	4660/=

Data Source: Jacobs, 30 March 2011,
Plum Brook Site Environmental Evaluation
(SEE) Database

FD1 = field duplicate sample
ND = non-detect
N1 = primary environmental sample
PCB = polychlorinated biphenyl
SO = soil matrix
U = non-detect
UJ = estimated non-detect
ug/Kg = micrograms per kilogram
J = estimated

"=" indicates that the result is greater than the RL and DL

TR indicates that the value is between the RL and DL at trace levels

Appendix B

Alternative 2 Capital Cost Sub-Element
Planning Documents

COST WORKSHEET B-1

Site: PBOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Prepare planning documents to include Remedial Action Work Plan (RAWP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP). Includes two review cycles with comment incorporation.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	30	Hr	$ 120	$3,600	All documents
Task Manager	70	Hr	$ 107	$7,490	All documents
QA Specialist	10	Hr	$ 85	$850	All documents
Geologist	30	Hr	$ 85	$2,550	RAWP only
Chemist	20	Hr	$ 85	$1,700	RAWP and QAPP
Project Engineer	140	Hr	$ 90	$12,600	All documents
Health and Safety	40	Hr	$ 85	$3,400	HASP only
GIS / CADD Specialist	40	Hr	$ 73	$2,920	RAWP only
SUBTOTAL				**$35,110**	
Materials / Service					
shipping	36	ea	$ 45.00	$1,620	includes 6 shipments per submittal, draft and final, 3 documents
SUBTOTAL				**$1,620**	
TOTAL				$36,730	
Prime Contractor Profit			10%	$3,673	
TOTAL UNIT COST				**$40,403**	

Alternative 2 Capital Cost Sub-Element
Mobilization

COST WORKSHEET B-2

Site:	PBOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)		
Base Year	2011		

Work Statement: Mobilize personnel and equipment to the site. This will include packing documents, small equipment items, and field office supplies. Procurement and field planning is included in this estimate. Travel to the site for contractor personnel. Set-up of site facilities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	10	Hr	$ 120	$1,200	subcontract SOWs, field planning
Task Manager	10	Hr	$ 107	$1,070	subcontract SOWs, field planning
Geologist	20	Hr	$ 85	$1,700	subcontract SOWs, field planning
Chemist	30	Hr	$ 85	$2,550	subcontract SOWs, field planning
Project Engineer	30	Hr	$ 90	$2,700	subcontract SOWs, field planning
Contracts Mgr	30	Hr	$ 95	$2,850	subcontract packages
Procurement Specialist	60	Hr	$ 55	$3,300	subcontract packages
Site Manager	80	Hr	$ 100	$8,000	field planning
Equipment Operator	27	Hr	$ 42	$1,134	equipment mobilization
SUBTOTAL				**$24,504**	
Materials / Service					
mobilize personnel	1	LS	$ 1,000	$1,000	
site office materials and supplies	1	LS	$ 1,000	$1,000	
Deliver & Set up trailer	1	LS	$ 2,825	$2,825	
Install Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$7,400**	
Equipment					
Mobilize Equipment	9	ea	$ 300.00	$2,700	2 dozers, 2 dump trucks, front end loader, water truck, compactor, tractor, portable toilet
SUBTOTAL				**$2,700**	
TOTAL				$34,604	
Prime Contractor Profit			10%	$3,460	
TOTAL UNIT COST				**$38,064**	

Alternative 2 Capital Cost Sub-Element
Site Clearing

COST WORKSHEET B-3

Site:	PBOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/26/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 3/12/2012	
Base Year	2011		

Work Statement: Clear site of brush and small trees, grub and remove stumps. Remove an occassional larger tree and stump.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Cut and chip light trees	2.57	Ac	$ 3,416	$8,779	$1400/acre equipment, 48 hrs/acre labor @ $42/hr
Grub and remove stumps	2.57	AC	$ 1,679	$4,315	$1175/acre equipment, 12 hrs/acre labor @ $42/hr
Brush hog	1.10	AC	$ 452	$497	$200/acre equipment, 6 hrs/acre labor @ $42/hr
Remove larger trees and stumps	1	LS	$ 1,988	$1,988	15 trees removed and left on sight lump sum cost
SUBTOTAL				**$15,579**	
TOTAL				**$15,579**	
Prime Contractor Profit			10%	$1,558	
TOTAL UNIT COST				**$17,137**	

Assunptions

assumes clearing additional 25% beyond current delineation
assumes wooded area is 70% of area to be cleared
assumes brush hogging is 30% of area.
Assumes 5 larger trees per acre of wooded area

Alternative 2 Capital Cost Sub-Element
Waste Characterization

COST WORKSHEET B-4

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/26/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 3/12/2012	
Base Year	2011		

Work Statement: Collect waste characterization samples at a rate of 1 : 500 tons of soil. Each sample will be a composite of four samples collected on 30' grid centers. Samples will be analyzed off-site for PAH, TCLP Lead, and ph. One represenative sample from the site will be analyzed for ignitability, flashpoint, and reactivity for cyanide / sulfide.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Geologist	37	Hr	$ 85	$ 3,145	8 hrs grid set-up, 17 hours collect and ship samples, 12 hours travel
Environmental Scientist	37	Hr	$ 70	$ 2,590	8 hrs grid set-up, 17 hours collect and ship samples, 12 hours travel
Chemist	25	Hr	$ 85	$ 2,125	lab coordination, data validation
Data Mgmt	11	Hr	$ 75	$ 825	data management
SUBTOTAL				**$ 8,685**	
Materials / Service					
sampling materials	1	LS	$ 8,728	$8,728	see backup table
sample shipping	7	ea	$ 250	$1,750	
off-site analysis	34	ea	$ 165	$5,610	(PAH, TCLP Lead, ph)
off-site analysis (other)	1	ea	$ 100	$100	flashpoint, ignitability, reactivity
SUBTOTAL				**$16,188**	
Travel					
airfare	2	ea	$ 350.00	$700	geologist and env scientist
lodging	10	ea	$ 77.00	$770	8 days each
per diem	10	ea	$ 46.00	$460	8 days each
vehicle	1	wk	$ 600.00	$600	
SUBTOTAL				**$2,530**	
TOTAL				**$27,403**	
Prime Contractor Profit			10%	$2,740	
TOTAL UNIT COST				**$30,143**	

Assumptions

waste characterization samples will be collected from material in-place prior to excavation rather than from stockpiles
team of two can collect 48 hand augered samples per day
two of the 4 grabs per composite will be collected from 6" to 12" and 2 from 12" to 18"

Alternative 2 Capital Cost Sub-Element
Excavation and Disposal

COST WORKSHEET B-5

Site:	PBOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 3/13/2012	
Base Year	2011		

Work Statement: Excavate contaminated soil and transport to the local landfill for disposal. Soil will initially be excavated to a depth of 18". Additional 9" lifts will be removed in areas where verification samples show remaining contamination. Excavation will proceed as warranted by verification samples.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator	721	Hr	$ 42	$30,261	Dozer, .044 hrs per CY (RS Means)
Operator	721	Hr	$ 42	$30,261	Front end loader, .044 hrs per CY (RS Means)
Operator	802	Hr	$ 42	$33,700	18 CY Dump Truck, 0.049 hrs per CY (RS Means)
SUBTOTAL				**$94,222**	
Materials / Service					
waste disposal (landlill charges)	17240	ton	$ 30	$517,200	
SUBTOTAL				**$517,200**	
Equipment					
105 HP Dozer, 150' Haul	16375	CY	$ 2.45	$40,119	
Front end loader	16375	CY	$ 2.45	$40,119	
18 CY Dump truck, hauling	16375	CY	$ 5.20	$85,150	
SUBTOTAL				**$165,388**	
TOTAL				$776,809	
Prime Contractor Profit			10%	$77,681	
TOTAL UNIT COST				**$854,490**	

Alternative 2 Capital Cost Sub-Element
Excavation Verification Sampling

COST WORKSHEET B-6

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/26/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 7/30/2012	
Base Year	2011		

Work Statement: Collect excavation verification samples from the exacvation floor and side wall using the USACE incremental sampling guidance. Floor sample unit areas will be 400 sq ft and wall sample unit areas will be 20 linear feet. Samples will be analyzed on-site for PCBs using a potable GC unit. QA samples will be sent off-site for PCB analysis at a rate of 1:10 to verify the portable GC results.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Geologist	142	Hr	$ 85	$ 12,070	8 hrs grid set-up, 98 hours collect and ship samples, 36 hrs travel, 3 trips
Environmental Scientist	142	Hr	$ 70	$ 9,940	8 hrs grid set-up, 33 hours collect and ship samples, 36 hrs travel, 3 trips
Chemist	288	Hr	$ 85	$ 24,480	220 hrs on-site PCB analysis, 32 hrs data validation 36 hours travel, 3 trips
Data Mgmt	12	Hr	$ 75	$ 900	data mgmt
SUBTOTAL				**$ 46,490**	
Materials / Service					
sampling materials	1	LS	$ 3,980	$3,980	see backup table
Sample shipping	16	ea	$ 125	$2,000	
off-site analysis	78	ea	$ 88	$6,864	PCBs only
SUBTOTAL				**$12,844**	
Equipment					
Portable GC Unit and supplies				$9,545	
SUBTOTAL				**$9,545**	
Travel					
airfare	9	ea	$ 350.00	$3,150	geologist, env scientist and chemist, 3 trips
lodging	22	ea	$ 77.00	$1,694	3 days each trip (geo & env.), 4 days each (chem)
per diem	22	ea	$ 46.00	$1,012	3 days each trip (geo & env.), 4 days each (chem)
vehicle	3	wk	$ 600.00	$1,800	
SUBTOTAL				**$7,656**	
TOTAL				**$68,879**	
Prime Contractor Profit			10%	$6,888	
TOTAL UNIT COST				**$75,767**	

Assumptions

team of two can collect 16 grab samples per hr with hand shovel

Cost of portable GC unit split between AA2 and AA3 projects

Alternative 2 Capital Cost Sub-Element
Backfill and Site Restoration

COST WORKSHEET B-7

Site:	PBOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 3/13/2012	
Base Year	2011		

Work Statement: Backfill excavation with clean soil (local source), compact, grade site, and seed.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator	196.5	Hr	$ 42	$8,253	Dozer, .012 hrs per CY (RS Means)
Operator	147.38	Hr	$ 42	$6,190	Compactor, .009 hrs per CY (RS Means)
Operator & Crew	851	Hr	$ 27	$22,987	Grading, seeding, fertilizing, .048 hrs per SY (RSM)
SUBTOTAL				**$37,430**	
Materials / Service					
Backfill (delivered)	16375	CY	$ 10	$163,750	Quote from Barnes Nursery
Seed, straw, fertilizer	17737	SY	$ 0.2	$3,547	
SUBTOTAL				**$167,297**	
Equipment					
105 HP Dozer, spread soil	16375	CY	$ 1.19	$19,486	RS Means
Compactor	16375	CY	$ 0.96	$15,720	RS Means
Grader, seeder	17737	SY	$ 0.34	$6,031	RS Means
SUBTOTAL				**$41,237**	
TOTAL				$245,964	
Prime Contractor Profit			10%	$24,596	
TOTAL UNIT COST				**$270,561**	

Alternative 2 Capital Cost Sub-Element
Facilities

COST WORKSHEET B-8

Site:	PBOW, Acid Area 2	**Prepared By:**	RGH	**Checked By:**	AH
Location	Sandusky, Ohio	**Date:**	4/27/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	3/13/2012		
Base Year	2011				

Work Statement: Trailer rental, utilities, and office equipment

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Trailer rental	6	MO	$ 360	$2,160	RS means
Utilities	6	MO	$ 770.0	$4,620	RS Means
SUBTOTAL				**$6,780**	
Prime Contractor Profit			10%	$678	
TOTAL UNIT COST				**$7,458**	

Alternative 2 Capital Cost Sub-Element
Site Management

COST WORKSHEET B-9

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 3/13/2012	
Base Year	2011		

Work Statement: Coordination and oversight of field activities

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Site Manager	1300	Hr	$ 100	$130,000	50 hr per week, 6 months
SUBTOTAL				**$130,000**	
Travel					
airfare	6	ea	$ 350	$2,100	one trip per month
lodging	156	ea	$ 77	$12,012	26 days per month
per diem	156	ea	$ 46	$7,176	26 days per month
vehicle	6	mo	$ 2,000	$12,000	
SUBTOTAL				**$33,288**	
TOTAL				$163,288	
Prime Contractor Profit			10%	$16,329	
TOTAL UNIT COST				**$179,617**	

Alternative 2 Capital Cost Sub-Element
Demobilization

COST WORKSHEET B-10

Site: PBOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Demobilize personnel and equipment from the site. Disconnect utilities and demob trailer. Close procurements and document project activities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Geologist	10	Hr	$ 85	$850	project documentation
Chemist	20	Hr	$ 85	$1,700	project documentation
Project Engineer	20	Hr	$ 90	$1,800	project documentation
Contracts Mgr	20	Hr	$ 95	$1,900	close contacts
Procurement Specialist	40	Hr	$ 55	$2,200	close contracts
Site Manager	60	Hr	$ 100	$6,000	project documentation
Equipment Operator	27	Hr	$ 42	$1,134	equipment demobilization
SUBTOTAL				**$15,584**	
Materials / Service					
Demobilize personnel	1	LS	$ 1,000	$1,000	
Trailer Pick-up	1	LS	$ 2,825	$2,825	
Dissconnect Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$6,400**	
Equipment					
Demobilize Equipment	9	ea	$ 300.00	$2,700	2 dozers, 2 dump trucks, front end loader, water truck, compactor, tractor, portable toilet
SUBTOTAL				**$2,700**	
TOTAL				$24,684	
Prime Contractor Profit			10%	$2,468	
TOTAL UNIT COST				**$27,152**	

Alternative 3 Capital Cost Sub-Element
Planning Documents

COST WORKSHEET B-11

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Prepare planning documents to include Remedial Action Work Plan (RAWP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP). Includes two review cycles with comment incorporation.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	40	Hr	$ 120	$4,800	All documents
Task Manager	70	Hr	$ 107	$7,490	All documents
QA Specialist	10	Hr	$ 85	$850	All documents
Geologist	30	Hr	$ 85	$2,550	RAWP only
Chemist	20	Hr	$ 85	$1,700	RAWP and QAPP
Project Engineer	160	Hr	$ 90	$14,400	All documents
Health and Safety	40	Hr	$ 85	$3,400	HASP only
GIS / CADD Specialist	40	Hr	$ 73	$2,920	RAWP only
SUBTOTAL				**$38,110**	
Materials / Service					
shipping	36	ea	$ 45.00	$1,620	includes 6 shipments per submittal, draft and final, 3 documents
SUBTOTAL				**$1,620**	
TOTAL				$39,730	
Prime Contractor Profit			10%	$3,973	
TOTAL UNIT COST				**$43,703**	

Alternative 3 Capital Cost Sub-Element
Mobilization

COST WORKSHEET B-12

Site:	BPOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)		
Base Year	2011		

Work Statement: Mobilize personnel and equipment to the site. This will include packing documents, small equipment items, and field office supplies. Procurement and field planning is included in this estimate. Travel to the site for contractor personnel. Set-up of site facilities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	10	Hr	$ 120	$1,200	subcontract SOWs, field planning
Task Manager	10	Hr	$ 107	$1,070	subcontract SOWs, field planning
Geologist	20	Hr	$ 85	$1,700	subcontract SOWs, field planning
Chemist	30	Hr	$ 85	$2,550	subcontract SOWs, field planning
Project Engineer	30	Hr	$ 90	$2,700	subcontract SOWs, field planning
Contracts Mgr	30	Hr	$ 95	$2,850	subcontract packages
Procurement Specialist	60	Hr	$ 55	$3,300	subcontract packages
Site Manager	80	Hr	$ 100	$8,000	field planning
Equipment Operator	27	Hr	$ 42	$1,134	equipment mobilization
SUBTOTAL				**$24,504**	
Materials / Service					
mobilize personnel	1	LS	$ 1,000	$1,000	
site office materials and supplies	1	LS	$ 1,000	$1,000	
Deliver & Set up trailer	1	LS	$ 2,825	$2,825	
Install Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$7,400**	
Equipment					
Mobilize Equipment	8	ea	$ 300.00	$2,400	dozer, dump truck (8CY), front end loader, water truck, compactor, tractor, rototiller, portable toilet
SUBTOTAL				**$2,400**	
TOTAL				$34,304	
Prime Contractor Profit			10%	$3,430	
TOTAL UNIT COST				**$37,734**	

Alternative 3 Capital Cost Sub-Element
Site Clearing

COST WORKSHEET B-13

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/26/2011
Revised: 3/14/2012

Checked By: BL
Date: 4/27/2011

Work Statement: Clear site of brush and small trees, grub and remove stumps. Remove an occassional larger tree and stump.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Cut and chip light trees	2.54	Ac	$ 3,416	$8,668	$1400/acre equipment, 48 hrs/acre labor @ $42/hr
Grub and remove stumps	2.54	AC	$ 1,679	$4,260	$1175/acre equipment, 12 hrs/acre labor @ $42/hr
Brush hog	1.09	AC	$ 452	$492	$200/acre equipment, 6 hrs/acre labor @ $42/hr
Remove larger trees and stumps	1	LS	$ 1,725	$1,725	13 trees removed and left on sight lump sum cost
SUBTOTAL				**$15,145**	
TOTAL				**$15,145**	
Prime Contractor Profit			10%	$1,515	
TOTAL UNIT COST				**$16,660**	

Assunptions

assumes clearing additional 25% beyond current delineation
assumes wooded area is 70% of area to be cleared
assumes brush hogging is 30% of area.
Assumes 5 larger trees per acre of wooded area

Alternative 3 Capital Cost Sub-Element
In-situ Treatment

COST WORKSHEET B-14

Site: BPOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL	
Location Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011	
Phase FS (-30% to +50%)	**Revised:** 3/14/2012		
Base Year 2011			

Work Statement: Contaminated areas will be subdivided into 10 equal areas. Soil from areas 1 and 10 will be excavated and stockpiled adjacent to areas 5 and 6. Soil from the remaining areas will be excavted in 9" lifts, spread in an ajacent excavated area and treated with Munirem® powder using a rototiller. Treated soil will be compacted in place.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Install silt fence	74	ft	$ 27	$ 1,999	.02 hrs per linear ft
Operator (excavation)	721	Hr	$ 42	$ 30,261	Dozer, .044 hrs per CY (RS Means)
Operator (stockpile soil)	144	Hr	$ 42	$ 6,052	Front end loader, .044 hrs per CY (RS Means)
Operator (stockpile soil)	118	Hr	$ 42	$ 4,952	8 CY Dump Truck, 0.036 hrs per CY (RS Means)
Operator (return stockpiled soil)	144	Hr	$ 42	$ 6,052	Front end loader, .044 hrs per CY (RS Means)
Operator (return stockpiled soil)	118	Hr	$ 42	$ 4,952	8 CY Dump Truck, 0.036 hrs per CY (RS Means)
Operator (spreading)	197	Hr	$ 42	$ 8,253	Dozer, .012 hrs per CY (RS Means)
Operator (soil tilling)	46	Hr	$ 42	$ 1,931	0.03 Hrs per MSF per 9" lift, till three times per batch
Operator (compaction)	147	Hr	$ 42	$ 6,190	0.009 Hrs per CY
SUBTOTAL				**$ 70,642**	
Materials / Service					
Munirem® powder	17240	ton	$ 60	$ 1,034,400	quoted $60 of Munirem to treat one ton of soil
Silt Fence	3703	ft	$ 0.4	$ 1,481	includes cleared area increased by 25%
SUBTOTAL				**$ 1,035,881**	
Equipment					
105 HP Dozer, 150' Haul	16375	CY	$ 2.45	$ 40,119	
Front end loader (stockpile soil)	3275	CY	$ 2.45	$ 8,024	
8 CY Dump truck, hauling	3275	CY	$ 1.79	$ 5,862	
Front end loader (stockpile soil)	3275	CY	$ 2.45	$ 8,024	
8 CY Dump truck, hauling	3275	CY	$ 1.79	$ 5,862	
Dozer, Spreading	16375	CY	$ 1.19	$ 19,486	
Rototiller	511	MSF	$ 0.70	$ 358	127.7 MSF contaminated area x (4) 9" lifts
Compactor	16375	CY	$ 0.96	$ 15,720	
SUBTOTAL				**$ 103,455**	
TOTAL				$ 1,209,978	
Prime Contractor Profit			10%	$ 120,998	
TOTAL UNIT COST				**$ 1,330,975**	

Alternative 3 Capital Cost Sub-Element
Verification Sampling

COST WORKSHEET B-15

Site:	BPOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/26/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 7/28/2012	
Base Year	2011		

Work Statement:

Collect excavation verification samples from the exacvation floor and walls consistent with the procedure outlined in Alternative 2. Collect verification samples from the treated soil. Analyze samples on-site for PCBs. Samples will be analyzed at a rate of 2 samples per batch or 1 per 205 tons of treated soil. Each sample will consit of 10 individaul grab samples evenly distrubuted from the treatment area. QA samples will be sent off-site for PCB analysis at a rate of 1:10 to verify the portable GC results.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Chemist	40	Hr	$ 85	$ 3,400	data validation
Data Mgmt	18	Hr	$ 75	$ 1,350	data mgmt
SUBTOTAL				**$ 4,750**	
Materials / Service					
sampling materials	1	LS	$ 3,980	$3,980	See table B-4
Sample shipping	11	ea	$ 125	$1,344	
off-site analysis	86	ea	$ 88	$7,568	78 delineation and 8 treatment (PCBs only)
SUBTOTAL				**$12,892**	
Equipment					
Portable GC Unit and supplies				$9,545	
SUBTOTAL				**$9,545**	
TOTAL				**$27,187**	
Prime Contractor Profit			10%	$2,719	
TOTAL UNIT COST				**$29,905**	

Assumptions

sampling and analysis duties will be handled by the site manager, site manager will need to be of a technical background

Cost of portable GC unit split between AA2 and AA3 projects

Alternative 3 Capital Cost Sub-Element
Site Restoration

COST WORKSHEET B-16

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011
Revised: 3/14/2012

Checked By: BL
Date: 4/27/2011

Work Statement: Grade site, and seed.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator & Crew	681	Hr	$ 27	$18,389	Grading, seeding, fertilizing, .048 hrs per SY (RSM)
SUBTOTAL				**$18,389**	
Materials / Service					
Seed, straw, fertilizer	14189	SY	$ 0.2	$2,838	
SUBTOTAL				**$2,838**	
Equipment					
Grader, seeder	14189	SY	$ 0.34	$4,824	RS Means
SUBTOTAL				**$4,824**	
TOTAL				$26,051	
Prime Contractor Profit			10%	$2,605	
TOTAL UNIT COST				**$28,656**	

Alternative 3 Capital Cost Sub-Element
Facilities

COST WORKSHEET B-17

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011
Revised: 3/14/2012

Checked By: AH
Date: 4/27/2011

Work Statement: Trailer rental, storage, utilities, and office equipment

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Trailer rental	8	MO	$ 360	$2,880	RS means
Storage	8	MO	$ 105	$840	RS means
Utilities	8	MO	$ 770.0	$6,160	RS Means
SUBTOTAL				**$9,880**	
Prime Contractor Profit			10%	$988	
TOTAL UNIT COST				**$10,868**	

Alternative 3 Capital Cost Sub-Element
Site Management

COST WORKSHEET B-18

Site:	BPOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 3/14/2012	
Base Year	2011		

Work Statement: Coordination and oversight of field activities

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Site Manager	1733	Hr	$ 105	$182,000	50 hr per week, 8 months
SUBTOTAL				**$182,000**	
Travel					
airfare	7	ea	$ 350	$2,450	one trip per month
lodging	208	ea	$ 77	$16,016	26 days per month
per diem	208	ea	$ 46	$9,568	26 days per month
vehicle	8	mo	$ 2,000	$16,000	
SUBTOTAL				**$44,034**	
TOTAL				$226,034	
Prime Contractor Profit			10%	$22,603	
TOTAL UNIT COST				**$248,637**	

Alternative 3 Capital Cost Sub-Element
Demobilization

COST WORKSHEET B-19

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Demobilize personnel and equipment from the site. Disconnect utilities and demob trailer. Close procurements and document project activities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Chemist	20	Hr	$ 85	$1,700	project documentation
Project Engineer	20	Hr	$ 90	$1,800	project documentation
Contracts Mgr	20	Hr	$ 95	$1,900	close contracts
Procurement Speciaslist	40	Hr	$ 55	$2,200	close contracts
Site Manager	60	Hr	$ 100	$6,000	project documentation
Equipment Operator	27	Hr	$ 42	$1,134	equipment Demob
SUBTOTAL				**$14,734**	
Materials / Service					
Demobilize personnel	1	LS	$ 1,000	$1,000	
Trailer Pick-up	1	LS	$ 2,825	$2,825	
Disconnect Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$6,400**	
Equipment					
Demobilize Equipment	8	ea	$ 300.00	$2,400	2 dozers, 2 dump trucks, front-end loader, water truck, compactor, tractor, portable toilet
SUBTOTAL				**$2,400**	
TOTAL				$23,534	
Prime Contractor Profit			10%	$2,353	
TOTAL UNIT COST				**$25,887**	

Alternative 4 Capital Cost Sub-Element
Planning Documents

COST WORKSHEET B-20

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Prepare planning documents to include Remedial Action Work Plan (RAWP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP). Includes two review cycles with comment incorporation.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	40	Hr	$ 120	$4,800	All documents
Task Manager	70	Hr	$ 107	$7,490	All documents
QA Specialist	10	Hr	$ 85	$850	All documents
Geologist	30	Hr	$ 85	$2,550	RAWP only
Chemist	40	Hr	$ 85	$3,400	RAWP and QAPP
Project Engineer	200	Hr	$ 90	$18,000	All documents
Health and Safety	40	Hr	$ 85	$3,400	HASP only
GIS / CADD Specialist	40	Hr	$ 73	$2,920	RAWP only
SUBTOTAL				**$43,410**	
Materials / Service					
shipping	36	ea	$ 45.00	$1,620	includes 6 shipments per submittal, draft and final, 3 documents
SUBTOTAL				**$1,620**	
TOTAL				$45,030	
Prime Contractor Profit			10%	$4,503	
TOTAL UNIT COST				**$49,533**	

Alternative 4 Capital Cost Sub-Element
Mobilization

COST WORKSHEET B-21

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Mobilize personnel and equipment to the site. This will include packing documents, small equipment items, and field office supplies. Procurement and field planning is included in this estimate. Travel to the site for contractor personnel. Set-up of site facilities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	10	Hr	$ 120	$1,200	subcontract SOWs, field planning
Task Manager	10	Hr	$ 107	$1,070	subcontract SOWs, field planning
Geologist	20	Hr	$ 85	$1,700	subcontract SOWs, field planning
Chemist	30	Hr	$ 85	$2,550	subcontract SOWs, field planning
Project Engineer	30	Hr	$ 90	$2,700	subcontract SOWs, field planning
Contracts Mgr	30	Hr	$ 95	$2,850	subcontract packages
Procurement Specialist	60	Hr	$ 55	$3,300	subcontract packages
Site Manager	80	Hr	$ 100	$8,000	field planning
Equipment Operator	27	Hr	$ 42	$1,134	equipment mobilization
SUBTOTAL				**$24,504**	
Materials / Service					
mobilize personnel	1	LS	$ 1,000	$1,000	
site office materials and supplies	1	LS	$ 1,000	$1,000	
Deliver & Set up trailer	1	LS	$ 2,825	$2,825	
Install Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$7,400**	
Equipment					
Mobilize Equipment	13	ea	$ 300.00	$3,900	2 dozers, 4 dump trucks (18CY), 2 front end loader, water truck, compactor, tractor, windrow turner, portable toilet
SUBTOTAL				**$3,900**	
TOTAL				$35,804	
Prime Contractor Profit			10%	$3,580	
TOTAL UNIT COST				**$39,384**	

Alternative 4 Capital Cost Sub-Element
Site Clearing

COST WORKSHEET B-22

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/26/2011
Revised: 5/26/2012

Checked By: BL
Date: 4/27/2011

Work Statement: Clear site of brush and small trees, grub and remove stumps. Remove an occassional larger tree and stump.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Cut and chip light trees	3.25	Ac	$ 3,416	$11,102	$1400/acre equipment, 48 hrs/acre labor @ $42/hr
Grub and remove stumps	3.25	AC	$ 1,679	$5,457	$1175/acre equipment, 12 hrs/acre labor @ $42/hr
Brush hog	1.40	AC	$ 452	$633	$200/acre equipment, 6 hrs/acre labor @ $42/hr
Remove larger trees and stumps	1	LS	$ 2,120	$2,120	16 trees removed and left on sight lump sum cost
SUBTOTAL				**$19,312**	
TOTAL				**$19,312**	
Prime Contractor Profit			10%	$1,931	
TOTAL UNIT COST				**$21,243**	

Assunptions

includes additional 1.75 acres for construction of 2nd treatment pad. Assumes pentolite Rd treatment area will be available
assumes wooded area is 70% of area to be cleared
assumes brush hogging is 30% of area.
Assumes 5 larger trees per acre of wooded area

Alternative 4 Capital Cost Sub-Element
Ex-situ Treatment

COST WORKSHEET B-23

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011
Revised: 3/26/2012

Checked By: BL
Date: 4/27/2011

Work Statement: Construct additional treatment pad at AA2. Excavate soil and transport to Pentolite Rd treatment pad and new pad. Use manure and molasses for treatment of soil in windrows. Turn rows three times per week or as windrow monitoring warrants. Maintain a consistant cycle of areobic and anareobic conditions every few days.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Install silt fence	70	Hr	$ 27	$1,900	.02 hrs per linear ft (RS Means)
Consruct pad (geotextile)	5	Hr	$ 27	$135	(1/2) of .002 hrs/SY lay geotextile (RS Means)
Consruct pad (gravel)	26	Hr	$ 42	$1,092	(1/2) of .01 hrs/SY lay gravel (RS Means)
Operator (excavation)	624	Hr	$ 42	$26,221	Dozer, .044 hrs per CY (RS Means)
Operator (load trucks)	624	Hr	$ 42	$26,221	Front end loader, .044 hrs per CY (RS Means)
Operator (soil to treatment pad)	255	Hr	$ 42	$10,727	18 CY Dump Truck, 0.018 hrs per CY (RS Means)
Operator (windrow turner)	439	Hr	$ 42	$18,438	Windrow turner, see Table B-6 for hours est
SUBTOTAL				**$84,734**	
Materials / Service					
Silt Fence	3518	ft	$ 0.4	$1,407	RS Means, permiter of new pad split with AA3
Geotextile	2542	SY	$ 1.5	$3,813	RS Means, quantity split with AA3 project
Crushed stone	2542	SY	$ 3.4	$8,592	RS Means, quantity split with AA3 project
Manure	8187	CY	$ 20	$163,740	horse manure 166 baled CY per load, shipped from Ky, quote from Barnes Nursery
Molasses	242	ton	$ 249	$60,265	tanker truck, quote local farm coop supplier
Service windrow turner	2	ea	$ 5,000	$10,000	replace flails
SUBTOTAL				**$247,817**	
Equipment					
18 CY Truck (Gravel)	2542	SY	$ 0.71	$1,805	quantity split with AA3 project
105 HP Dozer, 150' Haul	16375	CY	$ 2.45	$40,119	
Front end loader	16375	CY	$ 2.45	$40,119	
18 CY Dump truck, hauling	16375	CY	$ 1.86	$30,458	
Windrow turner	1	ea	$ 76,500	$76,500	purchase new $253,000, re-sell at $100,000, cost split with AA3 project
SUBTOTAL				**$189,000**	
TOTAL				$521,551	
Prime Contractor Profit			10%	$52,155	
TOTAL UNIT COST				**$573,707**	

Alternative 4 Capital Cost Sub-Element
Verification Sampling

COST WORKSHEET B-24

Site:	BPOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/26/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 7/28/2012	
Base Year	2011		

Work Statement:

Collect excavation verification samples from the exacvation floor and side wall in accordance with procedures used for Alternative 2. Collect verification samples from the treated soil. Analyze samples on-site for PCBs. Samples will be analyzed at a rate of 2 samples per windrow or 1 per 140 tons of treated soil. Each sample will consit of 10 individaul grab samples evenly distrubuted from the windrow. QA samples will be sent off-site for PCB analysis at a rate of 1:10 to verify the portable GC results.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Chemist	40	Hr	$ 85	$ 3,400	data validation
Data Mgmt	18	Hr	$ 75	$ 1,350	data mgmt
SUBTOTAL				**$ 4,750**	
Materials / Service					
sampling materials	1	LS	$ 3,980	$3,980	See table B-4
Sample shipping	4	ea	$ 125	$500	
off-site analysis	90	ea	$ 88	$7,920	78 delineation and 12 treatment (PCBs only)
SUBTOTAL				**$12,400**	
Equipment					
Portable GC Unit and supplies				$9,545	
SUBTOTAL				**$9,545**	
TOTAL				**$26,695**	
Prime Contractor Profit			10%	$2,670	
TOTAL UNIT COST				**$29,365**	

Assumptions

sampling and analysis duties will be handled by the site manager, site manager will need to be of a technical background

Cost of portable GC unit split between AA2 and AA3 projects

Alternative 4 Capital Cost Sub-Element
Backfill and Site Restoration

COST WORKSHEET B-25

Site:	BPOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 5/27/2012	
Base Year	2011		

Work Statement: Backfill excavation with treated soil, compact, grade site, and seed.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator (load trucks)	1081	Hr	$ 42	$45,391	Front end loader, .044 hrs per CY (RS Means)
Operator (soil back to excavation)	442	Hr	$ 42	$18,569	18 CY Dump Truck, 0.018 hrs per CY (RS Means)
Operator (spread backfill)	295	Hr	$ 42	$12,379	Dozer, .012 hrs per CY (RS Means)
Operator	221	Hr	$ 42	$9,284	Compactor, .009 hrs per CY (RS Means)
Operator & Crew	886	Hr	$ 27	$23,929	Grading, seeding, fertilizing, .048 hrs per SY (RSM)
SUBTOTAL				**$109,552**	
Materials / Service					
Seed, straw, fertilizer	18464	SY	$ 0.2	$3,693	includes 2nd treatment area (split with AA3)
SUBTOTAL				**$3,693**	
Equipment					
Front end loader	24562	CY	$ 2.45	$60,177	
18 CY Dump truck, hauling	24562	CY	$ 1.86	$45,685	
105 HP Dozer, spread soil	24562	CY	$ 1.19	$29,229	RS Means
Compactor	24562	CY	$ 0.96	$23,580	RS Means
Grader, seeder	18464	SY	$ 0.34	$6,278	RS Means
SUBTOTAL				**$164,948**	
TOTAL				$278,194	
Prime Contractor Profit			10%	$27,819	
TOTAL UNIT COST				**$306,013**	

Alternative 4 Capital Cost Sub-Element
Facilities

COST WORKSHEET B-26

Site:	BPOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** AH
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 5/27/2012	
Base Year	2011		

Work Statement: Trailer rental, storage, utilities, and office equipment

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Trailer rental	15	MO	$ 360	$5,400	RS means
Storage	15	MO	$ 105	$1,575	RS means
Utilities	15	MO	$ 770.0	$11,550	RS Means
SUBTOTAL				**$18,525**	
Prime Contractor Profit			10%	$1,853	
TOTAL UNIT COST				**$20,378**	

Alternative 4 Capital Cost Sub-Element
Site Management

COST WORKSHEET B-27

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 4/27/2011
Revised: 5/27/2012

Checked By: BL
Date: 4/27/2011

Work Statement: Coordination and oversight of field activities

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Site Manager	3250	Hr	$ 105	$341,250	50 hr per week, 15 months
SUBTOTAL				**$341,250**	
Travel					
airfare	15	ea	$ 350	$5,250	one trip per month
lodging	390	ea	$ 77	$30,030	26 days per month
per diem	390	ea	$ 46	$17,940	26 days per month
vehicle	15	mo	$ 2,000	$30,000	
SUBTOTAL				**$83,220**	
TOTAL				$424,470	
Prime Contractor Profit			10%	$42,447	
TOTAL UNIT COST				**$466,917**	

Alternative 4 Capital Cost Sub-Element
Demobilization

COST WORKSHEET B-28

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Demobilize personnel and equipment from the site. Disconnect utilities and demob trailer. Close procurements and document project activities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Chemist	20	Hr	$ 85	$1,700	project documentation
Project Engineer	20	Hr	$ 90	$1,800	project documentation
Contracts Mgr	20	Hr	$ 95	$1,900	close contacts
Procurement Specialist	40	Hr	$ 55	$2,200	close contracts
Site Manager	60	Hr	$ 100	$6,000	project documentation
Equipment Operator	27	Hr	$ 42	$1,134	equipment demobilization
SUBTOTAL				**$14,734**	
Materials / Service					
Demobilize personnel	1	LS	$ 1,000	$1,000	
Trailer Pick-up	1	LS	$ 2,825	$2,825	
Dissconnect Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$6,400**	
Equipment					
Demobilize Equipment	13	ea	$ 300.00	$3,900	2 dozers, 4 dump trucks (18CY), 2 front end loader, water truck, compactor, tractor, windrow turner, portable toilet
SUBTOTAL				**$3,900**	
TOTAL				$25,034	
Prime Contractor Profit			10%	$2,503	
TOTAL UNIT COST				**$27,537**	

Alternative 5 Capital Cost Sub-Element
Planning Documents

COST WORKSHEET B-29

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** SL
Location	Sandusky, Ohio	**Date:** 8/5/2011	**Date:** 8/15/2011
Phase	FS (-30% to +50%)		
Base Year	2011		

Work Statement: Prepare planning documents to include Remedial Action Work Plan (RAWP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP). Includes two review cycles with comment incorporation.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	30	Hr	$ 120	$3,600	All documents
Task Manager	70	Hr	$ 107	$7,490	All documents
QA Specialist	10	Hr	$ 85	$850	All documents
Geologist	30	Hr	$ 85	$2,550	RAWP only
Chemist	20	Hr	$ 85	$1,700	RAWP and QAPP
Project Engineer	140	Hr	$ 90	$12,600	All documents
Health and Safety	40	Hr	$ 85	$3,400	HASP only
GIS / CADD Specialist	40	Hr	$ 73	$2,920	RAWP only
SUBTOTAL				**$35,110**	
Materials / Service					
shipping	36	ea	$ 45.00	$1,620	includes 6 shipments per submittal, draft and final, 3 documents
SUBTOTAL				**$1,620**	
TOTAL				$36,730	
Prime Contractor Profit			10%	$3,673	
TOTAL UNIT COST				**$40,403**	

Alternative 5 Capital Cost Sub-Element
Mobilization

COST WORKSHEET B-30

Site: PBOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 8/5/2011

Checked By: SL
Date: 8/15/2011

Work Statement: Mobilize personnel and equipment to the site. This will include packing documents, small equipment items, and field office supplies. Procurement and field planning is included in this estimate. Travel to the site for contractor personnel. Set-up of site facilities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	10	Hr	$ 120	$1,200	subcontract SOWs, field planning
Task Manager	10	Hr	$ 107	$1,070	subcontract SOWs, field planning
Geologist	20	Hr	$ 85	$1,700	subcontract SOWs, field planning
Chemist	30	Hr	$ 85	$2,550	subcontract SOWs, field planning
Project Engineer	30	Hr	$ 90	$2,700	subcontract SOWs, field planning
Contracts Mgr	30	Hr	$ 95	$2,850	subcontract packages
Procurement Specialist	60	Hr	$ 55	$3,300	subcontract packages
Site Manager	80	Hr	$ 100	$8,000	field planning
Equipment Operator	27	Hr	$ 42	$1,134	equipment mobilization
SUBTOTAL				**$24,504**	
Materials / Service					
mobilize personnel	1	LS	$ 1,000	$1,000	
site office materials and supplies	1	LS	$ 1,000	$1,000	
Deliver & Set up trailer	1	LS	$ 2,825	$2,825	
Install Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$7,400**	
Equipment					
Mobilize Equipment	9	ea	$ 300.00	$2,700	2 dozers, 2 dump trucks, front end loader, water truck, compactor, tractor, portable toilet
SUBTOTAL				**$2,700**	
TOTAL				$34,604	
Prime Contractor Profit			10%	$3,460	
TOTAL UNIT COST				**$38,064**	

Alternative 5 Capital Cost Sub-Element
Site Clearing

COST WORKSHEET B-31

Site: PBOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 8/5/2011
Revised: 3/27/2012

Checked By: SL
Date: 8/15/2011

Work Statement: Clear site of brush and small trees, grub and remove stumps. Remove an occassional larger tree and stump.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Cut and chip light trees	2.54	Ac	$ 3,416	$8,668	$1400/acre equipment, 48 hrs/acre labor @ $42/hr
Grub and remove stumps	2.54	AC	$ 1,679	$4,260	$1175/acre equipment, 12 hrs/acre labor @ $42/hr
Brush hog	1.11	AC	$ 452	$500	$200/acre equipment, 6 hrs/acre labor @ $42/hr
Remove larger trees and stumps	1	LS	$ 1,723	$1,723	13 trees removed and left on sight lump sum cost
SUBTOTAL				**$15,152**	
TOTAL				**$15,152**	
Prime Contractor Profit			10%	$1,515	
TOTAL UNIT COST				**$16,667**	

Assunptions

assumes clearing additional 25% beyond current delineation
assumes wooded area is 70% of area to be cleared
assumes brush hogging is 30% of area.
Assumes 5 larger trees per acre of wooded area

Alternative 5 Capital Cost Sub-Element
Waste Characterization

COST WORKSHEET B-32

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** SL
Location	Sandusky, Ohio	**Date:** 8/5/2011	**Date:** 8/15/2011
Phase	FS (-30% to +50%)	**Revised:** 3/27/2012	
Base Year	2011		

Work Statement: Collect waste characterization samples at a rate of 1 : 500 tons of soil. Each sample will be a composite of four samples collected on 30' grid centers. Samples will be analyzed off-site for PAH, TCLP Lead, and ph. One represenative sample from the site will be analyzed for ignitability, flashpoint, and reactivity for cyanide / sulfide.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Geologist	37	Hr	$ 85	$ 3,145	8 hrs grid set-up, 17 hours collect and ship samples, 12 hours travel
Environmental Scientist	37	Hr	$ 70	$ 2,590	8 hrs grid set-up, 17 hours collect and ship samples, 12 hours travel
Chemist	25	Hr	$ 85	$ 2,125	lab coordination, data validation
Data Mgmt	11	Hr	$ 75	$ 825	data management
SUBTOTAL				**$ 8,685**	
Materials / Service					
sampling materials	1	LS	$ 8,728	$8,728	see backup table
Sample shipping	7	ea	$ 250	$1,750	
off-site analysis	34	ea	$ 165	$5,610	(PAH, TCLP Lead, ph)
off-sit analysis (other)	1	ea	$ 100	$100	flashpoint, ignitability, reactivity
SUBTOTAL				**$16,188**	
Travel					
airfare	2	ea	$ 350.00	$700	geologist and env scientist
lodging	10	ea	$ 77.00	$770	8 days each
per diem	10	ea	$ 46.00	$460	8 days each
vehicle	1	wk	$ 600.00	$600	
SUBTOTAL				**$2,530**	
TOTAL				**$27,403**	
Prime Contractor Profit			10%	$2,740	
TOTAL UNIT COST				**$30,143**	

Assumptions

waste characterization samples will be collected from material in-place prior to excavation rather than from stockpiles

team of two can collect 48 hand augered samples per day

two of the 4 grabs per composite will be collected from 6" to 12" and 2 from 12" to 18"

Alternative 5 Capital Cost Sub-Element
Excavation and Incineration

COST WORKSHEET B-33

Site:	PBOW, Acid Area 2	**Prepared By:**	AFH	**Checked By:**	SL
Location	Sandusky, Ohio	**Date:**	8/5/2011	**Date:**	8/15/2011
Phase	FS (-30% to +50%)	**Revised:**	3/27/2012		
Base Year	2011				

Work Statement:

Excavate contaminated soil and transport to a TSCA permitted facility for incineration. Soil will initially be excavated to a depth of 18". Additional 9" lifts will be removed in areas where verification samples show remaining contamination. Excavation will proceed as warranted by verification samples.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator	721	Hr	$ 42	$30,261	Dozer, .044 hrs per CY (RS Means)
Operator	721	Hr	$ 42	$30,261	Front end loader, .044 hrs per CY (RS Means)
Operator	2046	Hr	$ 42	$85,932	tractor with lowboy, 2 hrs per roll-off (RS Means)
Operator	341	Hr	$ 42	$14,322	Front end loader to load railcars, 2 hours per car
Laborer	128	Hr	$ 28	$3,581	secure roll-offs on rail car, .75 hours per car
Operator	256	Hr	$ 42	$10,742	Front end loader to unload railcars, 1.5 hrs per railcar
Laborer	128	Hr	$ 28	$3,581	support roll-offs unload, .75 hours per car
SUBTOTAL				**$178,679**	
Materials / Service					
Mobilize rail cars and roll-offs	8	ea	$ 4,360.00	$34,880	
(60) 20 yd roll-off rental	24	mo	$ 18,000.00	$432,000	12 per week 5 weeks roundtrip = 60
(8) railcar rental	24	mo	$ 11,880.00	$285,120	2 per week 4 weeks round trip = 8
roll-off liners	1023	ea	$ 35.00	$35,805	
roundtrip rail transportation per railcar	171	ea	$ 13,465.00	$2,295,783	6 roll-offs per railcar = 170, MHF Services
off-loading and transport to incinerator	1023	ea	$ 1,050	$1,074,150	Triad Transport
waste incineration	17240	ton	$ 480	$8,275,200	Veolia environmental services
SUBTOTAL				**$12,432,938**	
Equipment					
105 HP Dozer, 150' Haul	16375	CY	$ 2.45	$40,119	
Front end loader	16375	CY	$ 2.45	$40,119	
Tractor & lowboy, hauling	1023	ea	$ 160.00	$163,680	total roll-offs from Table B-7
SUBTOTAL				**$243,918**	
TOTAL				$12,855,534	
Prime Contractor Profit			10%	$1,285,553	
TOTAL UNIT COST				**$14,141,087**	

Alternative 5 Capital Cost Sub-Element
Excavation Verification Sampling

COST WORKSHEET B-34

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** SL
Location	Sandusky, Ohio	**Date:** 8/1/2012	**Date:** 8/18/2011
Phase	FS (-30% to +50%)		
Base Year	2011		

Work Statement: Collect excavation verification samples from the exacvation floor and side wall using the USACE incremental sampling guidance. Floor sample unit areas will be 400 sq ft and wall sample unit areas will be 20 linear feet of wall. Samples will be analyzed on-site for PCBs using a potable GC unit. QA samples will be sent off-site for PCB analysis at a rate of 1:10 to verify the portable GC results.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Geologist	142	Hr	$ 85	$ 12,070	8 hrs grid set-up, 98 hours collect and ship samples, 36 hrs travel, 3 trips
Environmental Scientist	142	Hr	$ 70	$ 9,940	8 hrs grid set-up, 98 hours collect and ship samples, 36 hrs travel, 3 trips
Chemist	288	Hr	$ 85	$ 24,480	220 hrs on-site PCB analysis, 9 hrs data validation 36 hours travel, 3 trips
Data Mgmt	12	Hr	$ 75	$ 900	data mgmt
SUBTOTAL				**$ 47,390**	
Materials / Service					
sampling materials	1	LS	$ 3,980	$3,980	see backup table
Sample shipping	16	ea	$ 125	$2,000	
off-site analysis	78	ea	$ 88	$6,864	PCBs only
SUBTOTAL				**$12,844**	
Equipment					
Portable GC Unit and supplies				$9,545	
SUBTOTAL				**$9,545**	
Travel					
airfare	9	ea	$ 350.00	$3,150	geologist, env scientist and chemist, 3 trips
lodging	22	ea	$ 77.00	$1,694	4 days each trip (geo & env.), 5 days each (chem)
per diem	22	ea	$ 46.00	$1,012	4 days each trip (geo & env.), 5 days each (chem)
vehicle	3	wk	$ 600.00	$1,800	
SUBTOTAL				**$7,656**	
TOTAL				**$69,779**	
Prime Contractor Profit			10%	$6,978	
TOTAL UNIT COST				**$76,757**	

Assumptions

team of two can collect 16 grab samples per hr with hand shovel

Cost of portable GC unit split between AA2 and AA3 projects

Alternative 5 Capital Cost Sub-Element
Backfill and Site Restoration

COST WORKSHEET B-35

Site: PBOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 8/7/2011
Revised: 3/27/2012

Checked By: SL
Date: 8/18/2011

Work Statement: Backfill excavation with clean soil (local source), compact, grade site, and seed.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator	197	Hr	$ 42	$8,253	Dozer, .012 hrs per CY (RS Means)
Operator	147	Hr	$ 42	$6,190	Compactor, .009 hrs per CY (RS Means)
Operator & Crew	851	Hr	$ 27	$22,977	Grading, seeding, fertilizing, .048 hrs per SY (RSM)
SUBTOTAL				**$37,420**	
Materials / Service					
Backfill (delivered)	16375	CY	$ 10	$163,750	Quote from Barnes Nursery
Seed, straw, fertilizer	17737	SY	$ 0.2	$3,547	
SUBTOTAL				**$167,297**	
Equipment					
105 HP Dozer, spread soil	16375	CY	$ 1.19	$19,486	RS Means
Compactor	16375	CY	$ 0.96	$15,720	RS Means
Grader, seeder	17737	SY	$ 0.34	$6,031	RS Means
SUBTOTAL				**$41,237**	
TOTAL				$245,954	
Prime Contractor Profit			10%	$24,595	
TOTAL UNIT COST				**$270,550**	

Alternative 5 Capital Cost Sub-Element
Facilities

COST WORKSHEET B-36

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** SL
Location	Sandusky, Ohio	**Date:** 8/8/2011	**Date:** 8/18/2011
Phase	FS (-30% to +50%)	**Revised:** 3/27/2012	
Base Year	2011		

Work Statement: Trailer rental, utilities, and office equipment

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Trailer rental	24	MO	$ 360	$8,640	RS means
Utilities	24	MO	$ 770.0	$18,480	RS Means
SUBTOTAL				**$27,120**	
Prime Contractor Profit			10%	$2,712	
TOTAL UNIT COST				**$29,832**	

Alternative 5 Capital Cost Sub-Element
Site Management

COST WORKSHEET B-37

Site: PBOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 8/8/2011
Revised: 3/27/2012

Checked By: SL
Date: 8/18/2011

Work Statement: Coordination and oversight of field activities

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Site Manager	740	Hr	$ 100	$74,025	50 hr per week, 3.5 months
Site Manager	1692	Hr	$ 100	$169,200	20 hours per week, 20 months during hauling
SUBTOTAL				**$243,225**	
Travel					
airfare	4	ea	$ 350	$1,400	one trip per month
airfare	85	ea	$ 350	$29,610	one trip per week, during hauling
lodging	260	ea	$ 77	$20,035	26 days per month, 2 days per week during hauling
per diem	260	ea	$ 46	$11,969	26 days per month, 2 days per week during hauling
vehicle	3.5	mo	$ 2,000	$7,000	5 months
vehicle	169	day	$ 65	$10,998	2 days per week during hauling
SUBTOTAL				**$81,013**	
TOTAL				$324,238	
Prime Contractor Profit			10%	$32,424	
TOTAL UNIT COST				**$356,661**	

Alternative 5 Capital Cost Sub-Element
Demobilization

COST WORKSHEET B-38

Site:	PBOW, Acid Area 2	**Prepared By:** AFH	**Checked By:** SL
Location	Sandusky, Ohio	**Date:** 8/8/2011	**Date:** 8/18/2011
Phase	FS (-30% to +50%)		
Base Year	2011		

Work Statement: Demobilize personnel and equipment from the site. Disconnect utilities and demob trailer. Close procurements and document project activities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Geologist	10	Hr	$ 85	$850	project documentation
Chemist	20	Hr	$ 85	$1,700	project documentation
Project Engineer	20	Hr	$ 90	$1,800	project documentation
Contracts Mgr	20	Hr	$ 95	$1,900	close contacts
Procurement Specialist	40	Hr	$ 55	$2,200	close contracts
Site Manager	60	Hr	$ 100	$6,000	project documentation
Equipment Operator	27	Hr	$ 42	$1,134	equipment demobilization
SUBTOTAL				**$15,584**	
Materials / Service					
Demobilize personnel	1	LS	$ 1,000	$1,000	
Trailer Pick-up	1	LS	$ 2,825	$2,825	
Dissconnect Utilities	1	LS	$ 2,575	$2,575	
SUBTOTAL				**$6,400**	
Equipment					
Demobilize Equipment	9	ea	$ 300.00	$2,700	2 dozers, 2 dump trucks, front end loader, water truck, compactor, tractor, portable toilet
SUBTOTAL				**$2,700**	
TOTAL				$24,684	
Prime Contractor Profit			10%	$2,468	
TOTAL UNIT COST				**$27,152**	

Table B-1 Unit Rates for Estimating Costs

JACOBS						RGH
ESTIMATE DETAILS						
PROJECT NO:			PROJECT LOCATION:			APRIL 14. 2011
ACC'T. NO.	DESCRIPTION	UNIT	LABOR UNIT	MAT'L. $/UNIT	EQUIP $/UNIT	NOTES
	CUT & CHIP LIGHT TREES TO 6"	AC	48.00		1400	RATES FROM RS MEANS 2011
	GRUB STUMPS & REMOVE TO 6"	AC	12.00		1175	
	TREE REMOVAL TO 12", 300HP DOZER	EA	0.12		15.90	
	STUMP REMOVAL, 12" HYD BACKHOE	EA	0.727		71.50	
	CLEARING BRUSH WITH DOZER, BALL & CHAIN, MEDIUM	AC	10.667		795.00	
	CLEARING BRUSH WITH DOZER & BRUSH RAKE, MEDIUM	AC	2.000		149.00	
	BRUSH HOG, MEDIUM	AC	5.333		201.00	
	EXCAVATE, BULK, DOZER, 105HP, 150' HAUL	CY	0.044		2.45	COMMON EARTH
	EXCAVATE, BULK, SCRAPER	CY	0.023		2.64	COMMON EARTH
	EXCAVATOR, BULK, HYD, CRAWLER, 1.5CY	CY	0.016		1.02	COMMON EARTH
	FOR LOADING ONTO TRUCKS, ADD 15% OF TOTAL					
	HAULING, 8 CY TRUCK, 1/2 MI CYCLE	CY	0.036		1.79	
	HAULING, 18 CY TRUCK, 1 MI CYCLE	CY	0.018		1.86	
	HAULING, 12 CY TRUCK, 20 MI CYCLE	CY	0.067		5.55	
	HAULING, 18 CY TRUCK, 20 MI CYCLE	CY	0.049		5.20	
	HAULING, 12 CY TRUCK, 50 MI CYCLE	CY	0.133		11.15	
	HAULING, 18 CY TRUCK, 50 MI CYCLE	CY	0.089		9.30	
	FILL, SPREAD BY DOZER	CY	0.012		1.19	DUMPED
	FILL, SPREAD BY FE LOADER, 1.5 CY	CY	0.06		1.84	FROM PILE
	FILL, HAUL, 20 MI	CY	0.067		5.55	
	COMPACTION, SHEEPSFOOT, COMMON FILL	CY	0.009		0.96	8" LIFTS
	COMPACTION, VIBRATORY PLATE, COMMON FILL	CY	0.040		0.17	8" LIFTS
	WATER TRUCK	MO			7200	
	FINE GRADING & SEEDING, INCL LIME, FERT & SEED	SY	0.05	0.20	0.34	
	TILLING TOPSOIL, 6" DEEP, TRACTOR 20HP	MSF	0.030		0.70	
	TILLING TOPSOIL, 6" DEEP, ROTOTILLER, 26"	SY	0.011		0.11	
	GEOTEXTILE	SY	0.002	1.50	0.03	
	SILT FENCE	LF	0.02	0.40		
	CRUSHED STONE BASE, 3"	SY	0.01	3.38	0.71	
	HAULING, 1 MILE	CY	0.027		2.23	
	MOBILIZE EARTHWORK EQUIPMENT TO 25 MI	EA	2		200.00	DOZER, LOADER, BACKHOE,
	EACH ADDITIONAL 5 MI, ADD	EA	10%		10%	EXCAVATOR, GRADER, ROLLER
	DEMOB = MOB					
	SET UP OFFICE TRAILER	EA		2825.00		INCL DELIVERY & REMOVAL
	OFFICE TRAILER RENTAL, FURNISHED, 50' X 12'	MO			360	
	INSTALL UTILITIES TO TRAILER	EA		2575.00		
	UTILITIES FOR OFFICE TRAILER	MO		770.00		
	SIGNAGE	SF	0.071	25.50		

Table B-2 Alternative 2 Estimates

DESCRIPTION	UNIT	QTY	ASSUMPTIONS
contamination area	sq ft	127705	from delineation report
contamination area	SY	14189	
contaminated soil volume in-place	cu yd	14189	assumed 36 inches deep
contaminated soil volume excavated	cu yds	16375	in place yds to ex yds = 1.154
contaminated soil weight	tons	17240	tons per yard in place = 1.215
contamination area perimeter	ft	**2962**	
waste characterization samples	ea	34	one sample per 500 tons
floor verification samples @ 18"	ea	319	one sample per 400 sq ft
floor verification samples @ 27"	ea	160	assume half as many as at 18"
floor verification samples@ 36"	ea	80	assume half as many as at 27"
side wall samples	ea	148	one sample every 20 linear feet
side wall step-outs	ea	74	assume 50% total stepouts
total verification grab samples	ea	**781**	
grab samples per hour	ea	8	
total hours sample collection	hr	98	
on-site PCB analysis per day	ea	32	4 PCB analsis per hour
total hours PCB analysis	hr	220	
10% off-site verification	ea	78	
soil weight per truckload	ton	19	tons per yd excavated = 1.053
excavated soil volume per load	yd	18	18 cy tandem truck
toatl truckloads	each	910	200 tons per day
truckloads per day	each	18	700 tons on Saturday
hauling hours per yard	hrs	0.049	loading, unloading, round trip
hauling hours per load	hrs	0.882	
loads per day per truck	each	9	
Most efficient means			
daily production per truck	tons	171	1 Dozer and 1 truck Tuesday through Saturday
project duration	weeks	20	
daily production	**tons**	**341**	**2 Dozers and 2 trucks Tuesday through Saturday**
project duration	weeks	10.1	

Table B-2 Alternative 2 Estimates

Erie County Landfill Daily Waste Quota	tons	800	
Average daily summer waste received	tons	500-600	
Average daily fall/winter/spring waste	tons	300-400	**work will be performed fall / winter/ spring**
Schedule / Durations			
Mobilization/ Site Set-up	weeks	2	
Clearing and grubbing	weeks	2.2	30 hours per acre, 2 dozers, 2.9 acres
Waste Characterization Sampling	weeks	3.3	51 hours sampling, 2 weeks analysis results
Excavation/Disposal	weeks	10.1	
Backfill/Compaction	weeks	3.9	Hrs from dozer hrs worksheet B-7
Grading / Seeding	weeks	2.8	1000 SY per day
Total Duration	weeks	24.3	
Total Duration	MO	6	

Table B-3 Aternative 2 Equipment Costs - Waste Characterization Sampling

Item	Unit	Price Unit	Qty	Extended Cost
Logbooks	each	$ 16.61	1	$ 16.61
Nitrile Gloves box - specify ct. - med	case	$ 15.00	3	$ 45.00
Nitrile Gloves box - specify ct. - large	case	$ 15.00	3	$ 45.00
Nitrile Gloves box - specify ct. - x large	case	$ 15.00	5	$ 75.00
Glove Liners - specify ct	case	$ 6.00	2	$ 12.00
Paper Towels (per case)	case	$ 36.00	0.5	$ 18.00
Safety Glasses	each	$ 2.88	4	$ 11.50
Caution Tape - Roll	roll	$ 11.50	4	$ 46.00
Aluminum Foil 18" x 500' (per roll)	roll	$ 36.00	1	$ 36.00
Arrow Shipping Labels (per roll)	roll	$ 18.00	1	$ 18.00
Fragile Shipping Labels (per roll)	roll	$ 18.00	1	$ 18.00
Strapping Tape - roll	roll	$ 2.20	5	$ 11.00
Clear Tape - roll	roll	$ 2.20	5	$ 11.00
Ziplock Bags 10 x 12 (per case)	box	$ 77.00	1	$ 77.00
Garbage Bags (per case)	box	$ 41.00	0.5	$ 20.50
Ziplock Bags 6 x 9 (per case)	box	$ 60.00	1	$ 60.00
5 Gallon Bucket with lid	each	$ 6.25	4	$ 25.00
DI Water ASTM Type 2 - 5 Gallons	20 L	$ 40.00	2	$ 80.00
Wooden Stakes - 4 ft - specify ct - 50	bundle	$ 45.50	5	$ 227.50
Flagging Tape - roll	roll	$ 1.52	2	$ 3.04
Decon Brushes	each	$ 6.50	2	$ 13.00
Folding tables	each	$ 53.00	1	$ 53.00
coolers large (4GL80)	each	$ 43.07	2	$ 86.14
Ice	bag	$ 3.89	10	$ 38.90
bubble bags (case 500)	case	$ 58.00	1	$ 58.00
Whirl Pak sample Bags	box	$ 28.00	1	$ 28.00
Stainless steel liners for hand auger	each	$ 27.00	208	$ 5,616.00
Rentals				
GPS - Trimble Pro	daily	$ 220.00	5	$ 1,100.00

TOTAL COST PURCHASES AND RENTALS	$ 7,508.08
SHIPPING COSTS (7%)	$ 525.57
TAX (9.25%)	$ 694.50
TOTAL COST, ALL ITEMS	**$ 8,728.14**

Table B-4 Aternative 2 Equipment Costs - Excavation Verifcation Sampling

Item	Unit	Price Unit	Qty	Extended Cost
Logbooks	each	$ 16.61	1	$ 16.61
Nitrile Gloves box - specify ct. - med	case	$ 15.00	3	$ 45.00
Nitrile Gloves box - specify ct. - large	case	$ 15.00	3	$ 45.00
Nitrile Gloves box - specify ct. - x large	case	$ 15.00	5	$ 75.00
Glove Liners - specify ct	case	$ 6.00	2	$ 12.00
Paper Towels (per case)	case	$ 36.00	0.5	$ 18.00
Safety Glasses	each	$ 2.88	4	$ 11.50
Caution Tape - Roll	roll	$ 11.50		$ -
Aluminum Foil 18" x 500' (per roll)	roll	$ 36.00		$ -
Arrow Shipping Labels (per roll)	roll	$ 18.00	1	$ 18.00
Fragile Shipping Labels (per roll)	roll	$ 18.00	1	$ 18.00
Strapping Tape - roll	roll	$ 2.20	5	$ 11.00
Clear Tape - roll	roll	$ 2.20	5	$ 11.00
Ziplock Bags 10 x 12 (per case)	box	$ 77.00	0.25	$ 19.25
Garbage Bags (per case)	box	$ 41.00	0.25	$ 10.25
5 Gallon Bucket with lid	each	$ 6.25	4	$ 25.00
DI Water ASTM Type 2 - 5 Gallons	20 L	$ 40.00	2	$ 80.00
Wooden Stakes - 4 ft - specify ct - 50	bundle	$ 45.50	8	$ 364.00
Flagging Tape - roll	roll	$ 1.52	2	$ 3.04
Decon Brushes	each	$ 6.50	2	$ 13.00
Folding tables	each	$ 53.00	1	$ 53.00
coolers large (4GL80)	each	$ 43.07	2	$ 86.14
Ice	bag	$ 3.89	10	$ 38.90
bubble bags (case 500)	case	$ 58.00	0.25	$ 14.50
Whirl Pak sample Bags	box	$ 28.00	1	$ 28.00
Stainless steel shovel	each	$ 27.00	1	$ 27.00
Rentals				
GPS - Trimble Pro	daily	$ 220.00	12	$ 2,640.00

TOTAL COST PURCHASES AND RENTALS	$ 3,424.08
SHIPPING COSTS (7%)	$ 239.69
TAX (9.25%)	$ 316.73
TOTAL COST, ALL ITEMS	**$ 3,980.49**

Table B-5 Alternative 3 Estimates

DESCRIPTION	UNIT	QTY	ASSUMPTIONS
contamination area	sq ft	127705	from delineation report
contaminantion area	Ac	2.9	
contaminantion area	SY	14189.4	
contaminated soil volume in-place	cu yd	14189	assumed 36 inches deep
contaminated soil volume excavated	cu yds	16375	in place yds to ex yds = 1.154
contaminated soil weight	tons	17240	tons per yard in place = 1.215
contamination area perimeter	ft	**2962**	
floor verification samples @ 18"	ea	319	one sample per 400 sq ft
floor verification samples @ 27"	ea	160	assume half as many as at 18"
floor verification samples@ 36"	ea	80	assume half as many as at 27"
side wall samples	ea	148	one sample every 20 linear feet
side wall step-outs	ea	74	assume 50% total stepouts
total verification grab samples	ea	**781**	
grab samples per hour	ea	8	
total hours sample collection	hr	98	
on-site PCB analysis per day	ea	32	4 PCB analsis per hour
total hours PCB analysis	hr	220	
10% off-site verification	ea	78	
No of remediation areas	ea	10	
number of 9" lifts (batches) per area	ea	4	based on 36" depth of contamination
total remediation batches	ea	40	
volume of batch	CY	409	
excavation time per batch	Hr	9	0.044 hrs per CY, assume two dozers
soil spreading time per batch	Hr	2	0.012 hrs per CY, assume 2 dozers
remediation time per batch	days	3	
compaction time per batch	Hr	4	0.009 hrs per CY
total time per batch	days	6	
Total time in-situ remediation	days	120	2 remediation areas will be operated simultaneously
Total time in-situ remediation	weeks	24	
Remediation Verification Samples	ea	80	two samples per batch = 1 sample per 205 tons soil

Table B-5 Alternative 3 Estimates

Stockpile area 1 and 10			
volume of stockpiled soil	CY	3275	
time to load in trucks	CY	144	0.044 hrs per CY
Time to stockpile	weeks	3.6	
Schedule / Durations			
Mobilization/ Site Set-up	weeks	2	
Clearing and grubbing	weeks	2.2	30 hours per acre, 2 dozers, 2.9 acres
Stockpile soil	weeks	3.6	
In-situ remediation	weeks	24.0	
Grading / Seeding	weeks	2.8	1000 SY per day
Total Duration	weeks	34.6	
Total Duration	Mo	8	

Table B-6 Alternative 4 Estimates

DESCRIPTION	UNIT	QTY	ASSUMPTIONS
contamination area	sq ft	127705	from delineation report
contamination area	ac	2.9	
contamination area	SY	14189	
contaminated soil volume in-place	cu yd	14189	assumed 36 inches deep
contaminated soil volume excavated	cu yds	16375	in place yds to ex yds = 1.154
contaminated soil weight	tons	17240	tons per yard in place = 1.215
contamination area perimeter	ft	2962	
excavation / transportation duration	hrs	624	0.044 hrs per CY, RS Means
excavation / transportation duration	weeks	16	
excavate/transport duration per batch	weeks	1.7	
waste characterization samples	ea	34	one sample per 500 tons
floor verification samples @ 18"	ea	319	one sample per 400 sq ft
floor verification samples @ 27"	ea	160	assume half as many as at 18"
floor verification samples@ 36"	ea	80	assume half as many as at 27"
side wall samples	ea	148	one sample every 20 linear feet
side wall step-outs	ea	74	assume 50% total stepouts
total verification grab samples	ea	**781**	
grab samples per hour	ea	8	
total hours sample collection	hr	98	
on-site PCB analysis per day	ea	32	
total hours PCB analysis	hr	220	4 PCB analsis per hour
10% off-site verification	ea	78	
construction of 2nd remediation pad	Ac	1.75	13 rows - 200' long
2nd remediation pad length	ft	260	
2nd remediation pad width	ft	296	
area second remediation pad	sq ft	76960	
area second remediation pad	SY	8551	
gravel area alleys	sq ft	28000	14 alleys 10" x 200'
gravel area turning ends	sq ft	17760	60' x 296'
total graveled area	sq ft	45760	
total graveled area	SY	5084	
perimeter	ft	1112	

Table B-6 Alternative 4 Estimates

molasses volume	yd	205	1.25 % molassess to soil volume
molasses weight	ton	242	1.25 % molassess to soil volume
manure volume	yd	8187	50% manure to soil ratio
volume of soil/ manure for remediation	yd	24562	includes soil and manure
volume of one windrow	yd	400	6' high, 9' wide, 200' long
number of total windrows	ea	61	
number of windrows in processing area	ea	23	
number of process batches	ea	3	
processing time per windrow	weeks	12	
total remediation duration	weeks	36	
Remediation verification samples	ea	122	two final samples per windrow
manure needed every 3 months	yd	3067	
molasses needed every 3 months	tons	91	
remediation area (width)	ft	516	23 windrows, 12 ft wide, (24) 10 ft wide alleys
remediation area (length)	ft	260	30 feet buffer at ends for turning radius
remediation area	sq ft	134160	
remediation area	Ac	3.1	
windrow length	ft	12200	61 windrows 200' long
time to turn total windrow length	hr	12	1000' per hour
total windrow turning	hr	439	3 turnings per week, 12 weeks
Schedule / Durations			
Mobilization/ Site Set-up	weeks	2	
Clearing and grubbing	weeks	2.2	30 hours per acre, 2 dozers, 2.9 acres
Excavation/Transportation	weeks	7.8	2 dozers, 2 front-end loaders
Remediation	weeks	36	
Transportation	weeks	7.8	2 front-end loaders
Backfill/Compaction	weeks	3.9	Hrs from dozer hrs worksheet B-7
Grading / Seeding	weeks	2.8	1000 SY per day
Total Duration	weeks	62.5	
Total Duration	MO	15	

Table B-7 Alternative 5 Estimates

DESCRIPTION	UNIT	QTY	ASSUMPTIONS
contamination area	sq ft	127705	from delineation report
contamination area	SY	14189	
contamination area	Ac	2.9	
contaminated soil volume in-place	cu yd	14189	assumed 36 inches deep
contaminated soil volume excavated	cu yds	16375	in place yds to ex yds = 1.154
contaminated soil weight	tons	17240	tons per yard in place = 1.215
contamination area perimeter	ft	2962	
waste characterization samples	ea	34	one sample per 500 tons
floor verification samples @ 18"	ea	319	one sample per 400 sq ft
floor verification samples @ 27"	ea	160	assume half as many as at 18"
floor verification samples@ 36"	ea	80	assume half as many as at 27"
side wall samples	ea	148	one sample every 20 linear feet
side wall step-outs	ea	74	assume 50% total stepouts
total verification grab samples	ea	**781**	
grab samples per hour	ea	8	
total hours sample collection	hr	98	
on-site PCB analysis per day	ea	32	
total hours PCB analysis	hr	220	4 PCB analsis per hour
10% off-site verification	ea	78	
excavated soil volume per load	yd	16	20 yd roll-off, 16 yd max on highway
total roll-offs	each	1023	
roll-offs per week	each	12	15 max capacity at TSCA facility and 6 max per rail car
total duration	weeks	85	
total duration	months	20	
Number of rail cars needed		8	plan for 4 weeks round trip, 2 per week
Number of roll-off boxes		60	plan for 5 weeks round trip, 12 per week
Schedule / Durations			
Mobilization/ Site Set-up	weeks	2	
Clearing and grubbing	weeks	2.2	30 hours per acre, 2 dozers, 2.9 acres
Waste Characterization Sampling	weeks	3.3	51 hours sampling, 2 weeks analysis results
Excavation/Incineration	weeks	85.3	
Backfill/Compaction	weeks	3.9	Hr from dozer hrs worksheet B-35
Grading / Seeding	weeks	2.8	1000 SY per day
Total Duration	weeks	99.5	
Total Duration	MO	24	

Cost Estimate

Alternative 3 Pilot Study

Table 5-2(b) Cost Estimate Summary - Alternative 3
(Cost for pilot test)

Alternative 3
In-Situ Remediation, MuniRem®

COST ESTIMATE SUMMARY

Site: PBOW, Acid Area 2
Location: Sandusky, Ohio
Phase: Feasibility Study (-30% to +50%)
Base Year: 2011
Date: April

Description: Conduct pilot test of in-situ remediation. 120' x 100' area will be tilled and treated in-place over a period of 2 weeks. Treatment performance sampling will be collected daily.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST	NOTES
Mobilize equipment and personnel	1	LS	$ 11,545	see cost worksheet B-12(b), App B back-up
In-situ remediation	1	LS	$ 33,330	see cost worksheet B-14(b), App B back-up
Verification sampling	1	LS	$ 11,546	see cost worksheet B-15(b), App B back-up
Demobilization	1	LS	$ 5,610	see cost worksheet B-19(b), App B back-up
Performance Evaluation Report	1	LS	$ 24,981	see cost worksheet B-20(b), App B back-up
SUBTOTAL			$ 87,012	
Project Management	5%		4,351	
TOTAL CAPITAL COST			**$ 91,363**	

Alternative 3 Capital Cost Sub-Element
Mobilization

COST WORKSHEET B-12(b)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Mobilize personnel and equipment to the site. This will include packing documents, small equipment items, and field office supplies. Procurement and field planning is included in this estimate. Travel to the site for contractor personnel. Set-up of site facilities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	10	Hr	$ 120	$1,200	subcontract SOWs, field planning
Task Manager	10	Hr	$ 107	$1,070	subcontract SOWs, field planning
Geologist	20	Hr	$ 85	$1,700	subcontract SOWs, field planning
Chemist	15	Hr	$ 85	$1,275	subcontract SOWs, field planning
Contracts Mgr	10	Hr	$ 95	$950	subcontract packages
Procurement Specialist	20	Hr	$ 55	$1,100	subcontract packages
SUBTOTAL				**$7,295**	
Materials / Service					
mobilize personnel	2	LS	$ 1,000	$2,000	
SUBTOTAL				**$2,000**	
Equipment					
Mobilize Equipment	4	ea	$ 300.00	$1,200	water truck, tractor, rototiller, portable toilet
SUBTOTAL				**$1,200**	
TOTAL				$10,495	
Prime Contractor Profit			10%	$1,050	
TOTAL UNIT COST				**$11,545**	

Alternative 3 Capital Cost Sub-Element
In-situ Treatment

COST WORKSHEET B-14(b)

Site:	BPOW, Acid Area 2	**Prepared By:**	RGH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/27/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	3/14/2012		
Base Year	2011				

Work Statement: Treat soil down to 9" over a 20' x 100' area.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator (soil tilling)	20	Hr	$ 42	$ 840	
Site Mgr	80	Hr	$ 100	$ 8,000	
Project Engineer	80	Hr	$ 90	$ 7,200	
SUBTOTAL				**$ 16,040**	
Materials / Service					
Munirem® powder	66	ton	$ 60	$ 3,960	quoted $60 of Munirem to treat one ton of soil
SUBTOTAL				**$ 3,960**	
Equipment					
tractor	2	wk	$ 1,200	$ 2,400	
Rototiller	2	wk	$ 600	$ 1,200	
water truck	2	wk	$ 1,550	$ 3,100	
SUBTOTAL				**$ 6,700**	
Travel					
Site Mgr	12	day	$150	$ 1,800	
Project Engineer	12	day	$150	$ 1,800	
SUBTOTAL				**$ 3,600**	
TOTAL				$ 30,300	
Prime Contractor Profit			10%	$ 3,030	
TOTAL UNIT COST				**$ 33,330**	

Alternative 3 Capital Cost Sub-Element
Verification Sampling

COST WORKSHEET B-15(b)

Site:	BPOW, Acid Area 2	**Prepared By:**	AFH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/26/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	7/28/2012		
Base Year	2011				

Work Statement: Collect verification samples from the treated soil. Analyze samples off-site for PCBs. Samples will be analyzed at a rate of 2 samples per batch or 1 per 205 tons of treated soil. Each sample will consit of 10 individaul grab samples evenly distrubuted from the treatment area. QA samples will be sent off-site for PCB analysis at a rate of 1:10 to verify the portable GC results.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Chemist	20	Hr	$ 85	$ 1,700	data validation
Data Mgmt	10	Hr	$ 75	$ 750	data mgmt
SUBTOTAL				**$ 2,450**	
Materials / Service					
sampling materials	1	LS	$ 3,980	$3,980	See table B-4
Sample shipping	10	ea	$ 125	$1,250	
off-site analysis	32	ea	$ 88	$2,816	4 samples per day, 8 days
SUBTOTAL				**$8,046**	
TOTAL				**$10,496**	
Prime Contractor Profit			10%	$1,050	
TOTAL UNIT COST				**$11,546**	

Assumptions

sampling and analysis duties will be handled by the site manager, site manager will need to be of a technical background

Cost of portable GC unit split between AA2 and AA3 projects

Alternative 3 Capital Cost Sub-Element
Demobilization

COST WORKSHEET B-19(b)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Demobilize personnel and equipment from the site. Disconnect utilities and demob trailer. Close procurements and document project activities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Project Engineer	10	Hr	$ 90	$900	project documentation
Site Manager	10	Hr	$ 100	$1,000	project documentation
SUBTOTAL				**$1,900**	
Materials / Service					
Demobilize personnel	2	LS	$ 1,000	$2,000	
SUBTOTAL				**$2,000**	
Equipment					
Demobilize Equipment	4	ea	$ 300.00	$1,200	water truck, tractor, rototiller, portable toilet
SUBTOTAL				**$1,200**	
TOTAL				$5,100	
Prime Contractor Profit			10%	$510	
TOTAL UNIT COST				**$5,610**	

Alternative 3 Capital Cost Sub-Element
Performance Report

COST WORKSHEET B-20(b)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Prepare pilot test results and performance evaluation report

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	40	Hr	$ 120	$4,800	
Task Manager	10	Hr	$ 107	$1,070	
QA Specialist	10	Hr	$ 85	$850	
Geologist	30	Hr	$ 85	$2,550	
Chemist	20	Hr	$ 85	$1,700	
Project Engineer	80	Hr	$ 90	$7,200	
GIS / CADD Specialist	40	Hr	$ 73	$2,920	
SUBTOTAL				**$21,090**	
Materials / Service					
shipping	36	ea	$ 45.00	$1,620	includes 6 shipments per submittal, draft and final, 3 documents
SUBTOTAL				**$1,620**	
TOTAL				$22,710	
Prime Contractor Profit			10%	$2,271	
TOTAL UNIT COST				**$24,981**	

Cost Estimate

Alternative 4 Pilot Study

Table 5-3(b) Cost Estimate Summary - Alternative 4
(pilot test)

Alternative 4
Ex-situ Remediation, Enhanced Bioremediation

COST ESTIMATE SUMMARY

Site: PBOW, Acid Area 2
Location: Sandusky, Ohio
Phase: Feasibility Study (-30% to +50%)
Base Year: 2011
Date: April

Description: This alternative would involve excavation of the contaminated soil, transportation to an on-site facility for remediation using enhanced bioremediation in windrows, and backfill of the excavation using the remediated soil.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST	NOTES
Mobilize equipment and personnel	1	LS	$ 11,435	see cost worksheet B-21(b), App B back-up
Ex-situ Remediation	1	LS	$ 187,957	see cost worksheet B-23(b), App B back-up
Verification sampling	1	LS	$ 14,419	see cost worksheet B-24(b), App B back-up
Backfill excavation, grade site, seed	1	LS	$ 2,461	see cost worksheet B-25(b), App B back-up
De-mobilization	1	LS	$ 4,510	see cost worksheet B-28(b), App B back-up
Performance Report	1	LS	$ 24,981	see cost worksheet B-29(b), App B back-up
SUBTOTAL			$ 245,763	
Project Management	5%		12,288	
TOTAL CAPITAL COST			**$ 258,051**	

Alternative 4 Capital Cost Sub-Element
Mobilization

COST WORKSHEET B-21(b)

Site: BPOW, Acid Area 2 **Prepared By:** RGH **Checked By:** BL
Location Sandusky, Ohio **Date:** 4/27/2011 **Date:** 4/27/2011
Phase FS (-30% to +50%)
Base Year 2011

Work Statement: Mobilize personnel and equipment to the site. This will include packing documents, small equipment items, and field office supplies. Procurement and field planning is included in this estimate. Travel to the site for contractor personnel. Set-up of site facilities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	10	Hr	$ 120	$1,200	subcontract SOWs, field planning
Task Manager	10	Hr	$ 107	$1,070	subcontract SOWs, field planning
Geologist	20	Hr	$ 85	$1,700	subcontract SOWs, field planning
Chemist	15	Hr	$ 85	$1,275	subcontract SOWs, field planning
Contracts Mgr	10	Hr	$ 95	$950	subcontract packages
Procurement Specialist	20	Hr	$ 55	$1,100	subcontract packages
SUBTOTAL				**$7,295**	
Materials / Service					
mobilize personnel	1	LS	$ 1,000	$1,000	
SUBTOTAL				**$1,000**	
Equipment					
Mobilize Equipment	7	ea	$ 300.00	$2,100	1 dozers, 1 dump trucks (18CY), 1 front end loader, water truck, tractor, windrow turner, portable toilet
SUBTOTAL				**$2,100**	
TOTAL				$10,395	
Prime Contractor Profit			10%	$1,040	
TOTAL UNIT COST				**$11,435**	

Alternative 4 Capital Cost Sub-Element
Ex-situ Treatment

COST WORKSHEET B-23(b)

Site:	BPOW, Acid Area 2	**Prepared By:**	RGH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/27/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	3/26/2012		
Base Year	2011				

Work Statement: Construct additional treatment pad at AA2. Excavate soil and transport to Pentolite Rd treatment pad and new pad. Use manure and molasses for treatment of soil in windrows. Turn rows three times per week or as windrow monitoring warrants. Maintain a consistant cycle of areobic and anareobic conditions every few days.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator (excavation)	9	Hr	$ 42	$370	Dozer, .044 hrs per CY (RS Means)
Operator (load trucks)	9	Hr	$ 42	$378	Front end loader, .044 hrs per CY (RS Means)
Operator (soil to treatment pad)	4	Hr	$ 42	$151	18 CY Dump Truck, 0.018 hrs per CY (RS Means)
Operator (windrow turner)	78	Hr	$ 42	$3,276	Windrow turner, see Table B-6 for hours est
Site Mgr	520	Hr	$ 105	$54,600	
SUBTOTAL				**$58,775**	
Materials / Service					
Manure	200	yd	$ 20	$4,000	horse manure 166 baled CY per load, shipped from Ky, quote from Barnes Nursery
Molasses	7	ton	$ 249	$1,743	tanker truck, quote local farm coop supplier
SUBTOTAL				**$5,743**	
Equipment					
105 HP Dozer, 150' Haul	200	CY	$ 2.45	$490	
Front end loader	200	CY	$ 2.45	$490	
18 CY Dump truck, hauling	200	CY	$ 1.86	$372	
Windrow turner	3	mo	$ 35,000	$105,000	
SUBTOTAL				**$106,352**	
TOTAL				$170,870	
Prime Contractor Profit			10%	$17,087	
TOTAL UNIT COST				**$187,957**	

Alternative 4 Capital Cost Sub-Element
Verification Sampling

COST WORKSHEET B-24(b)

Site:	BPOW, Acid Area 2	**Prepared By:**	AFH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/26/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	7/28/2012		
Base Year	2011				

Work Statement: Collect one set of samples to charaterize the starting concentration. Collect one set of samples once each week during test. Each set will consist of 4 samples.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Chemist	20	Hr	$ 85	$ 1,700	data validation
Data Mgmt	10	Hr	$ 75	$ 750	data mgmt
SUBTOTAL				**$ 2,450**	
Materials / Service					
sampling materials	1	LS	$ 3,980	$3,980	See table B-4
Sample shipping	14	ea	$ 125	$1,750	
off-site analysis	56	ea	$ 88	$4,928	78 delineation and 12 treatment (PCBs only)
SUBTOTAL				**$10,658**	
TOTAL				**$13,108**	
Prime Contractor Profit			10%	$1,311	
TOTAL UNIT COST				**$14,419**	

Assumptions

sampling and analysis duties will be handled by the site manager, site manager will need to be of a technical background

Cost of portable GC unit split between AA2 and AA3 projects

Alternative 4 Capital Cost Sub-Element
Backfill and Site Restoration

COST WORKSHEET B-25(b)

Site:	BPOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** BL
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 5/27/2012	
Base Year	2011		

Work Statement: Backfill excavation with treated soil, compact, grade site, and seed.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator (load trucks)	9	Hr	$ 42	$378	Front end loader, .044 hrs per CY (RS Means)
Operator (soil back to excavation)	4	Hr	$ 42	$168	18 CY Dump Truck, 0.018 hrs per CY (RS Means)
Operator (spread backfill)	3	Hr	$ 42	$126	Dozer, .012 hrs per CY (RS Means)
Operator	2	Hr	$ 42	$84	Compactor, .009 hrs per CY (RS Means)
Operator & Crew	3	Hr	$ 27	$81	Grading, seeding, fertilizing, .048 hrs per SY (RSM)
SUBTOTAL				**$837**	
Materials / Service					
Seed, straw, fertilizer	200	SY	$ 0.2	$40	includes 2nd treatment area (split with AA3)
SUBTOTAL				**$40**	
Equipment					
Front end loader	200	CY	$ 2.45	$490	
18 CY Dump truck, hauling	200	CY	$ 1.86	$372	
105 HP Dozer, spread soil	200	CY	$ 1.19	$238	RS Means
Compactor	200	CY	$ 0.96	$192	RS Means
Grader, seeder	200	SY	$ 0.34	$68	RS Means
SUBTOTAL				**$1,360**	
TOTAL				$2,237	
Prime Contractor Profit			10%	$224	
TOTAL UNIT COST				**$2,461**	

Alternative 4 Capital Cost Sub-Element
Demobilization

COST WORKSHEET B-28(b)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Demobilize personnel and equipment from the site. Disconnect utilities and demob trailer. Close procurements and document project activities.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Site Manager	10	Hr	$ 100	$1,000	project documentation
SUBTOTAL				**$1,000**	
Materials / Service					
Demobilize personnel	1	LS	$ 1,000	$1,000	
SUBTOTAL				**$1,000**	
Equipment					
Demobilize Equipment	7	ea	$ 300.00	$2,100	2 dozers, 4 dump trucks (18CY), 2 front end loader, water truck, compactor, tractor, windrow turner, portable toilet
SUBTOTAL				**$2,100**	
TOTAL				$4,100	
Prime Contractor Profit			10%	$410	
TOTAL UNIT COST				**$4,510**	

Alternative 3 Capital Cost Sub-Element
Performance Report

COST WORKSHEET B-29(b)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 4/27/2011

Checked By: BL
Date: 4/27/2011

Work Statement: Prepare pilot test results and performance evaluation report

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Senior Engineer	40	Hr	$ 120	$4,800	
Task Manager	10	Hr	$ 107	$1,070	
QA Specialist	10	Hr	$ 85	$850	
Geologist	30	Hr	$ 85	$2,550	
Chemist	20	Hr	$ 85	$1,700	
Project Engineer	80	Hr	$ 90	$7,200	
GIS / CADD Specialist	40	Hr	$ 73	$2,920	
SUBTOTAL				**$21,090**	
Materials / Service					
shipping	36	ea	$ 45.00	$1,620	includes 6 shipments per submittal, draft and final, 3 documents
SUBTOTAL				**$1,620**	
TOTAL				$22,710	
Prime Contractor Profit			10%	$2,271	
TOTAL UNIT COST				**$24,981**	

Cost Estimate

Alternative 4: Enhanced Bioremediation

(Based on increasing unknown variables by a factor of two)

Table 5-3(a) Cost Estimate Summary - Alternative 4 (increasing variables by a factor of 2)

Alternative 4
Ex-situ Remediation, Enhanced Bioremediation

COST ESTIMATE SUMMARY

Site: PBOW, Acid Area 2
Location: Sandusky, Ohio
Phase: Feasibility Study (-30% to +50%)
Base Year: 2011
Date: April

Description: This alternative would involve excavation of the contaminated soil, transportation to an on-site facility for remediation using enhanced bioremediation in windrows, and backfill of the excavation using the remediated soil.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST	NOTES
Submittals/Implemenation Plans	1	LS	$ 49,533	see cost worksheet B-20, Appendix B
Mobilize equipment and personnel	1	LS	$ 39,384	see cost worksheet B-21, Appendix B
Clearing & Grubbing	1	LS	$ 21,243	see cost worksheet B-22, Appendix B
Ex-situ Remediation	1	LS	$854,322	see cost worksheet B-23(a), App B
Verification sampling	1	LS	$ 29,365	see cost worksheet B-24, Appendix B
Backfill excavation, grade site, seed	1	LS	$ 395,595	see cost worksheet B-25, Appendix B
Monthly Facilities Charges	1	LS	$ 35,321	see cost worksheet B-26(a), App B
Site Management	1	LS	$793,807	see cost worksheet B-27(a), App B
De-mobilization	1	LS	$ 27,537	see cost worksheet B-28, Appendix B
SUBTOTAL			$ 2,246,107	
Contingency	25%		$ 561,527	10% scope, 15% bid
SUBTOTAL			$ 2,807,634	
Project Management	5%		140,382	
TOTAL CAPITAL COST			**$ 2,948,016**	

Alternative 4 Capital Cost Sub-Element
Ex-situ Treatment

COST WORKSHEET B-23(a)

Site:	BPOW, Acid Area 2	**Prepared By:**	RGH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/27/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	3/26/2012		
Base Year	2011				

Work Statement: Construct additional treatment pad at AA2. Excavate soil and transport to Pentolite Rd treatment pad and new pad. Use manure and molasses for treatment of soil in windrows. Turn rows three times per week or as windrow monitoring warrants. Maintain a consistant cycle of areobic and anareobic conditions every few days.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Install silt fence	70	Hr	$ 27	$1,900	.02 hrs per linear ft (RS Means)
Consruct pad (geotextile)	5	Hr	$ 27	$135	(1/2) of .002 hrs/SY lay geotextile (RS Means)
Consruct pad (gravel)	26	Hr	$ 42	$1,092	(1/2) of .01 hrs/SY lay gravel (RS Means)
Operator (excavation)	624	Hr	$ 42	$26,221	Dozer, .044 hrs per CY (RS Means)
Operator (load trucks)	624	Hr	$ 42	$26,221	Front end loader, .044 hrs per CY (RS Means)
Operator (soil to treatment pad)	255	Hr	$ 42	$10,727	18 CY Dump Truck, 0.018 hrs per CY (RS Means)
Operator (windrow turner)	1179	Hr	$ 42	$49,518	Windrow turner, see Table B-6 for hours est
SUBTOTAL				**$115,814**	
Materials / Service					
Silt Fence	3518	ft	$ 0.4	$1,407	RS Means, permiter of new pad split with AA3
Geotextile	2542	SY	$ 1.5	$3,813	RS Means, quantity split with AA3 project
Crushed stone	2542	SY	$ 3.4	$8,592	RS Means, quantity split with AA3 project
Manure	16375	CY	$ 20	$327,500	horse manure 166 baled CY per load, shipped from Ky, quote from Barnes Nursery
Molasses	484	ton	$ 249	$120,531	tanker truck, quote local farm coop supplier
Service windrow turner	2	ea	$ 5,000	$10,000	replace flails
SUBTOTAL				**$471,843**	
Equipment					
18 CY Truck (Gravel)	2542	SY	$ 0.71	$1,805	quantity split with AA3 project
105 HP Dozer, 150' Haul	16375	CY	$ 2.45	$40,119	
Front end loader	16375	CY	$ 2.45	$40,119	
18 CY Dump truck, hauling	16375	CY	$ 1.86	$30,458	
Windrow turner	1	ea	$ 76,500	$76,500	purchase new $253,000, re-sell at $100,000, cost split with AA3 project
SUBTOTAL				**$189,000**	
TOTAL				$776,657	
Prime Contractor Profit			10%	$77,666	
TOTAL UNIT COST				**$854,322**	

Alternative 4 Capital Cost Sub-Element
Backfill and Site Restoration

COST WORKSHEET B-25(a)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011
Revised: 5/27/2012

Checked By: BL
Date: 4/27/2011

Work Statement: Backfill excavation with treated soil, compact, grade site, and seed.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Operator (load trucks)	1441	Hr	$ 42	$60,522	Front end loader, .044 hrs per CY (RS Means)
Operator (soil back to excavation)	590	Hr	$ 42	$24,759	18 CY Dump Truck, 0.018 hrs per CY (RS Means)
Operator (spread backfill)	393	Hr	$ 42	$16,506	Dozer, .012 hrs per CY (RS Means)
Operator	295	Hr	$ 42	$12,380	Compactor, .009 hrs per CY (RS Means)
Operator & Crew	886	Hr	$ 27	$23,929	Grading, seeding, fertilizing, .048 hrs per SY (RSM)
SUBTOTAL				**$138,096**	
Materials / Service					
Seed, straw, fertilizer	18464	SY	$ 0.2	$3,693	includes 2nd treatment area (split with AA3)
SUBTOTAL				**$3,693**	
Equipment					
Front end loader	32750	CY	$ 2.45	$80,238	
18 CY Dump truck, hauling	32750	CY	$ 1.86	$60,915	
105 HP Dozer, spread soil	32750	CY	$ 1.19	$38,973	RS Means
Compactor	32750	CY	$ 0.96	$31,440	RS Means
Grader, seeder	18464	SY	$ 0.34	$6,278	RS Means
SUBTOTAL				**$217,843**	
TOTAL				$359,631	
Prime Contractor Profit			10%	$35,963	
TOTAL UNIT COST				**$395,595**	

Alternative 4 Capital Cost Sub-Element
Facilities

COST WORKSHEET B-26(a)

Site:	BPOW, Acid Area 2	**Prepared By:** RGH	**Checked By:** AH
Location	Sandusky, Ohio	**Date:** 4/27/2011	**Date:** 4/27/2011
Phase	FS (-30% to +50%)	**Revised:** 5/27/2012	
Base Year	2011		

Work Statement: Trailer rental, storage, utilities, and office equipment

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Trailer rental	26	MO	$ 360	$9,360	RS means
Storage	26	MO	$ 105	$2,730	RS means
Utilities	26	MO	$ 770.0	$20,020	RS Means
SUBTOTAL				**$32,110**	
Prime Contractor Profit			10%	$3,211	
TOTAL UNIT COST				**$35,321**	

Alternative 4 Capital Cost Sub-Element
Site Management

COST WORKSHEET B-27(a)

Site:	BPOW, Acid Area 2	**Prepared By:**	AFH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/27/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	5/27/2012		
Base Year	2011				

Work Statement: Coordination and oversight of field activities

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Site Manager	5499	Hr	$ 105	$577,395	50 hr per week, 26 months
SUBTOTAL				**$577,395**	
Travel					
airfare	26	ea	$ 350	$9,100	one trip per month
lodging	676	ea	$ 77	$52,052	26 days per month
per diem	676	ea	$ 46	$31,096	26 days per month
vehicle	26	mo	$ 2,000	$52,000	
SUBTOTAL				**$144,248**	
TOTAL				$721,643	
Prime Contractor Profit			10%	$72,164	
TOTAL UNIT COST				**$793,807**	

Table B-6(a) Alternative 4 Estimates
(increasing variables by a factor of 2)

DESCRIPTION	UNIT	QTY	ASSUMPTIONS
contamination area	sq ft	127705	from delineation report
contamination area	ac	2.9	
contamination area	SY	14189	
contaminated soil volume in-place	cu yd	14189	assumed 36 inches deep
contaminated soil volume excavated	cu yds	16375	in place yds to ex yds = 1.154
contaminated soil weight	tons	17240	tons per yard in place = 1.215
contamination area perimeter	ft	2962	
excavation / transportation duration	hrs	624	0.044 hrs per CY, RS Means
excavation / transportation duration	weeks	16	
excavate/transport duration per batch	weeks	1.7	
waste characterization samples	ea	34	one sample per 500 tons
floor verification samples @ 18"	ea	319	one sample per 400 sq ft
floor verification samples @ 27"	ea	160	assume half as many as at 18"
floor verification samples@ 36"	ea	80	assume half as many as at 27"
side wall samples	ea	148	one sample every 20 linear feet
side wall step-outs	ea	74	assume 50% total stepouts
total verification grab samples	ea	**781**	
grab samples per hour	ea	8	
total hours sample collection	hr	98	
on-site PCB analysis per day	ea	32	
total hours PCB analysis	hr	220	4 PCB analsis per hour
10% off-site verification	ea	78	
construction of 2nd remediation pad	Ac	1.75	13 rows - 200' long
2nd remediation pad length	ft	260	
2nd remediation pad width	ft	296	
area second remediation pad	sq ft	76960	
area second remediation pad	SY	8551	
gravel area alleys	sq ft	28000	14 alleys 10" x 200'
gravel area turning ends	sq ft	17760	60' x 296'
total graveled area	sq ft	45760	
total graveled area	SY	5084	
perimeter	ft	1112	

(increasing variables by a factor of 2)

molasses volume	yd	409	2.5 % molassess to soil volume
molasses weight	ton	484	1.25 % molassess to soil volume
manure volume	yd	16375	100% manure to soil ratio
volume of soil/ manure for remediation	yd	32749	includes soil and manure
volume of one windrow	yd	400	6' high, 9' wide, 200' long
number of total windrows	ea	82	
number of windrows in processing area	ea	23	
number of process batches	ea	4	
processing time per windrow	weeks	24	
total remediation duration	weeks	85	
Remediation verification samples	ea	122	two final samples per windrow
manure needed every 6 months	yd	4600	
molasses needed every 6 months	tons	136	
remediation area (width)	ft	516	23 windrows, 12 ft wide, (24) 10 ft wide alleys
remediation area (length)	ft	260	30 feet buffer at ends for turning radius
remediation area	sq ft	134160	
remediation area	Ac	3.1	
windrow length	ft	16375	82 windrows 200' long
time to turn total windrow length	hr	16	1000' per hour
total windrow turning	hr	1179	3 turnings per week, 24 weeks
Schedule / Durations			
Mobilization/ Site Set-up	weeks	2	
Clearing and grubbing	weeks	2.2	30 hours per acre, 2 dozers, 2.9 acres
Excavation/Transportation	weeks	7.8	2 dozers, 2 front-end loaders
Remediation	weeks	85	
Transportation	weeks	7.8	2 front-end loaders
Backfill/Compaction	weeks	3.9	Hrs from dozer hrs worksheet B-7
Grading / Seeding	weeks	2.8	1000 SY per day
Total Duration	weeks	112.0	
Total Duration	MO	26	

Cost Estimate

Alternative 3: Chemical Reduction - Munirem®

(Based on increasing unknown variables by a factor of two)

Table 5-2(a) Cost Estimate Summary - Alternative 3
(increasing all variables by a factor of 2)

Alternative 3
In-Situ Remediation, MuniRem®

COST ESTIMATE SUMMARY

Site: PBOW, Acid Area 2
Location: Sandusky, Ohio
Phase: Feasibility Study (-30% to +50%)
Base Year: 2011
Date: April

Description: This alternative would involve in-situ remediation. Soil will be excavted in 4.5" lifts, spread in an ajacent area within the excavtion and remediated with Munirem® powder using a rototiller. Remediated soil will be compacted in place. After remediation of all soil, the site will be graded and seeded.

Capital Costs:

DESCRIPTION	QTY	UNIT	UNIT COST	NOTES
Submittals/Implemenation Plans	1	LS	$ 43,703	see cost worksheet B-11, Appendix B
Mobilize equipment and personnel	1	LS	$ 37,734	see cost worksheet B-12, Appendix B
Clearing & Grubbing	1	LS	$ 16,660	see cost worksheet B-13, Appendix B
In-situ remediation	1	LS	$ 2,479,472	see cost worksheet B-14(a), App B
Verification sampling	1	LS	$ 29,905	see cost worksheet B-15(a), App B
Site Restoration	1	LS	$ 30,817	see cost worksheet B-16, Appendix B
Monthly Facilities Charges	1	LS	$ 27,170	see cost worksheet B-17(a), App B
Site Management	1	LS	$ 610,236	see cost worksheet B-18(a), App B
Demobilization	1	LS	$ 25,887	see cost worksheet B-19, Appendix B
SUBTOTAL			$ 3,301,584	
Contingency	25%		$ 825,396	10% scope, 15% bid
SUBTOTAL			$ 4,126,980	
Project Management	5%		206,349	
TOTAL CAPITAL COST			**$ 4,333,329**	

Alternative 3 Capital Cost Sub-Element
In-situ Treatment

COST WORKSHEET B-14(a)

Site:	BPOW, Acid Area 2	**Prepared By:**	RGH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/27/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	3/14/2012		
Base Year	2011				

Work Statement: Contaminated areas will be subdivided into 10 equal areas. Soil from areas 1 and 10 will be excavated and stockpiled adjacent to areas 5 and 6. Soil from the remaining areas will be excavted in 9" lifts, spread in an ajacent excavated area and treated with Munirem® powder using a rototiller. Treated soil will be compacted in place.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Install silt fence	74	ft	$ 27	$ 1,999	.02 hrs per linear ft
Operator (excavation)	721	Hr	$ 42	$ 30,261	Dozer, .044 hrs per CY (RS Means)
Operator (stockpile soil)	144	Hr	$ 42	$ 6,052	Front end loader, .044 hrs per CY (RS Means)
Operator (stockpile soil)	118	Hr	$ 42	$ 4,952	8 CY Dump Truck, 0.036 hrs per CY (RS Means)
Operator (return stockpiled soil)	144	Hr	$ 42	$ 6,052	Front end loader, .044 hrs per CY (RS Means)
Operator (return stockpiled soil)	118	Hr	$ 42	$ 4,952	8 CY Dump Truck, 0.036 hrs per CY (RS Means)
Operator (spreading)	197	Hr	$ 42	$ 8,253	Dozer, .012 hrs per CY (RS Means)
Operator (soil tilling)	183	Hr	$ 42	$ 7,686	0.03 Hrs per MSF per 4.5" lift, till six times per batch
Operator (compaction)	147	Hr	$ 42	$ 6,190	0.009 Hrs per CY
SUBTOTAL				**$ 76,397**	
Materials / Service					
Munirem® powder	17240	ton	$ 120	$ 2,068,800	quoted $60 of Munirem to treat one ton of soil
Silt Fence	3703	ft	$ 0.4	$ 1,481	includes cleared area increased by 25%
SUBTOTAL				**$ 2,070,281**	
Equipment					
105 HP Dozer, 150' Haul	16375	CY	$ 2.45	$ 40,119	
Front end loader (stockpile soil)	3275	CY	$ 2.45	$ 8,024	
8 CY Dump truck, hauling	3275	CY	$ 1.79	$ 5,862	
Front end loader (stockpile soil)	3275	CY	$ 2.45	$ 8,024	
8 CY Dump truck, hauling	3275	CY	$ 1.79	$ 5,862	
Dozer, Spreading	16375	CY	$ 1.19	$ 19,486	
Rototiller	6129	MSF	$ 0.70	$ 4,290	127.7 MSF contaminated area x (8) 4.5" lifts x 6 times
Compactor	16375	CY	$ 0.96	$ 15,720	
SUBTOTAL				**$ 107,387**	
TOTAL				$ 2,254,065	
Prime Contractor Profit			10%	$ 225,407	
TOTAL UNIT COST				**$ 2,479,472**	

Alternative 3 Capital Cost Sub-Element
Verification Sampling

COST WORKSHEET B-15(a)

Site:	BPOW, Acid Area 2	**Prepared By:**	AFH	**Checked By:**	BL
Location	Sandusky, Ohio	**Date:**	4/26/2011	**Date:**	4/27/2011
Phase	FS (-30% to +50%)	**Revised:**	7/28/2012		
Base Year	2011				

Work Statement: Collect excavation verification samples from the exacvation floor and walls consistent with the procedure outlined in Alternative 2. Collect verification samples from the treated soil. Analyze samples on-site for PCBs. Collect verification samples from the treated soil. Samples will be analyzed at a rate of 2 samples per batch or 1 per 205 tons of treated soil. Each sample will consit of 10 individaul grab samples evenly distrubuted from the treatment area. QA samples will be sent off-site for PCB analysis at a rate of 1:10 to verify the portable GC results.

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Chemist	40	Hr	$ 85	$ 3,400	data validation
Data Mgmt	18	Hr	$ 75	$ 1,350	data mgmt
SUBTOTAL				**$ 4,750**	
Materials / Service					
sampling materials	1	LS	$ 3,980	$3,980	See table B-4
Sample shipping	12	ea	$ 125	$1,469	
off-site analysis	94	ea	$ 88	$8,272	78 delineation and 16 treatment (PCBs only)
SUBTOTAL				**$13,721**	
Equipment					
Portable GC Unit and supplies				$9,545	
SUBTOTAL				**$9,545**	
TOTAL				**$28,016**	
Prime Contractor Profit			10%	$2,802	
TOTAL UNIT COST				**$30,817**	

Assumptions

sampling and analysis duties will be handled by the site manager, site manager will need to be of a technical background

Cost of portable GC unit split between AA2 and AA3 projects

Alternative 3 Capital Cost Sub-Element
Facilities

COST WORKSHEET B-17(a)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: RGH
Date: 4/27/2011
Revised: 3/14/2012

Checked By: AH
Date: 4/27/2011

Work Statement: Trailer rental, storage, utilities, and office equipment

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Materials / Service					
Trailer rental	20	MO	$ 360	$7,200	RS means
Storage	20	MO	$ 105	$2,100	RS means
Utilities	20	MO	$ 770.0	$15,400	RS Means
SUBTOTAL				**$24,700**	
Prime Contractor Profit			10%	$2,470	
TOTAL UNIT COST				**$27,170**	

Alternative 3 Capital Cost Sub-Element
Site Management

COST WORKSHEET B-18(a)

Site: BPOW, Acid Area 2
Location Sandusky, Ohio
Phase FS (-30% to +50%)
Base Year 2011

Prepared By: AFH
Date: 4/27/2011
Revised: 3/14/2012

Checked By: BL
Date: 4/27/2011

Work Statement: Coordination and oversight of field activities

Cost Analysis:

DESCRIPTION	QTY	UNIT	UNIT RATE	UNIT TOTAL	NOTES
Labor					
Site Manager	4230	Hr	$ 105	$444,150	50 hr per week, 20 months
SUBTOTAL				**$444,150**	
Travel					
airfare	19	ea	$ 350	$6,650	one trip per month
lodging	520	ea	$ 77	$40,040	26 days per month
per diem	520	ea	$ 46	$23,920	26 days per month
vehicle	20	mo	$ 2,000	$40,000	
SUBTOTAL				**$110,610**	
TOTAL				$554,760	
Prime Contractor Profit			10%	$55,476	
TOTAL UNIT COST				**$610,236**	

Table B-5(a) Alternative 3 Estimates
(increasing all variables by a factor of 2)

DESCRIPTION	UNIT	QTY	ASSUMPTIONS
contamination area	sq ft	127705	from delineation report
contaminantion area	Ac	2.9	
contaminantion area	SY	14189.4	
contaminated soil volume in-place	cu yd	14189	assumed 36 inches deep
contaminated soil volume excavated	cu yds	16375	in place yds to ex yds = 1.154
contaminated soil weight	tons	17240	tons per yard in place = 1.215
contamination area perimeter	ft	**2962**	
floor verification samples @ 18"	ea	319	one sample per 400 sq ft
floor verification samples @ 27"	ea	160	assume half as many as at 18"
floor verification samples@ 36"	ea	80	assume half as many as at 27"
side wall samples	ea	148	one sample every 20 linear feet
side wall step-outs	ea	74	assume 50% total stepouts
total verification grab samples	ea	**781**	
grab samples per hour	ea	8	
total hours sample collection	hr	98	
on-site PCB analysis per day	ea	32	4 PCB analsis per hour
total hours PCB analysis	hr	220	
10% off-site verification	ea	78	
No of remediation areas	ea	10	
number of 4.5" lifts (batches) per area	ea	8	based on 36" depth of contamination
total remediation batches	ea	80	
volume of batch	CY	205	
excavation time per batch	Hr	5	0.044 hrs per CY, assume two dozers
soil spreading time per batch	Hr	1	0.012 hrs per CY, assume 2 dozers
remediation time per batch	days	6	
compaction time per batch	Hr	2	0.009 hrs per CY
total time per batch	days	9	
Total time in-situ remediation	days	360	2 remediation areas will be operated simultaneously
Total time in-situ remediation	weeks	72	
Remediation Verification Samples	ea	160	two samples per batch = 1 sample per 100 tons soil

(increasing all variables by a factor of 2)

Stockpile area 1 and 10			
volume of stockpiled soil	CY	3275	
time to load in trucks	CY	144	0.044 hrs per CY
Time to stockpile	weeks	3.6	
Schedule / Durations			
Mobilization/ Site Set-up	weeks	2	
Clearing and grubbing	weeks	2.2	30 hours per acre, 2 dozers, 2.9 acres
Stockpile soil	weeks	3.6	
In-situ remediation	weeks	72.0	
Grading / Seeding	weeks	2.8	1000 SY per day
Total Duration	weeks	82.6	
Total Duration	Mo	20	

Cost Estimate Quotes

McCourt & Sons Equipment, Inc.
P. O. Box 247 / 5141 W Hwy 71
La Grange, Texas 78945

Office 979-242-5298
Fax 979-242-5292
Toll Free 888-838-9252

www.portablescreen.com

May 2, 2011

Jacobs Engineering

Attn: Al Hardesty

Dear Sir,

McCourt & Sons Equipment, Inc. will provide the following equipment as proposed below.

Equipment	Price
2011 Scarab Model 12E-200-RT Compost Turner	$239,000.00
Capable of processing a 12W X 5T Windrow	
Cummins QSB 6.7L 200HP T3 Diesel Engine	
75 Gallon Hydraulic Tank c/w 12V Heater & Filter	
Panoramic Cab c/w all instrumentation & C/D Radio	
DTAC A/C & Heat Unit rated at 22,200 btu	
SCARAB Digital Load Controller System	
AM/FM/CD Radio	
Sundstrand Wheel & Drum Hydraulic Pumps	
Rineer Hydraulic Drum Motor	
Auxiliary Fuel/Water Separator Filter	
Hydraulic charge filters & In tank return filter	
Firestone Drive Tires 13.6 X 28" & 11L X 15" Caster Wheels	
150 US Gallon Diesel Tank	
Cold Start Package: Engine Block Heater & Hyd Tank Heater	
DRUM – SC3200 1/2" X 32" X 12'	
'Low' Hydraulic Oil, engine shut down c/w light & buzzer	
Hydraulic Rear Flap	
SCARAB & Cummins Operations Manuals	
Option: Case 450A 14" Triple Grouser Track	$14,000.00

McCourt & Sons Equipment appreciates the opportunity to supply your project with the best equipment and service in the industry today. Our goal is to reduce your operating costs, maintain competitive rates and continually provide the highest quality of service, equipment and personnel, to make your project an accomplishment of your highest expectations.

We look forward to working with you on this and any future projects. If you have any questions or thoughts, please do not hesitate to call.

Sincerely,

McCourt & Sons Equipment Inc.

Ryan Kays
979-220-8746
ryan@portablescreen.com

"We supply the BEST and service the rest."

Hardesty, Al

To: Fallin, Lonnie
Subject: RE: Analytical Pricing

-----Original Message-----
From: Fallin, Lonnie
Sent: Tuesday, April 26, 2011 3:18 PM
To: Hardesty, Al
Subject: RE: Analytical Pricing

Pricing is as follows:

PAH – 100 soil samples – please provide pricing for both regular 8270C and 8270CSIM.
8270C - $100.00/ea
8270C low level full scan (method equivalent to SIM) - $110.00/ea
TCLP Lead – 100 soil samples
$60.00/ea
pH – 100 soil samples
$5.00/ea
Flashpoint/Ignitability/Reactivity (for cyanide/sulfide) – 1 sample
$100.00/sample

Please provide normal TAT (21 calendar days) prices and rush pricing (even if it is just a multiplier), including the quickest TAT for the TCLP Pb analyses (72 hr TAT; 80% up charge).

Assume a 5 day TAT would be a 75% surcharge.

Let me know if you need anything else.

Thanks,

Lonnie

The SRI Instruments PCB GC system will provide rugged utility and quick turnaround capability for analyzing soils during remediation. The instrument can detect down to and below the action limit of 1 mg/Kg (ppm) and provide accurate results for both Aroclor 1254 and Aroclor 1260 through use of multipoint standard calibrations. The instrument can analyze 3 – 4 samples per hour, and can accurately quantitate results in difficult matrices such as clay, silt, and fuel impacted soils. No additional sample preparation, such as solvent extraction, is necessary.

The ability to quickly and accurately analyze PCB samples will provide cost savings through reduced analytical costs and little to no yellow-iron down time. Samples can be analyzed in real time and results can be had in as little to 15 – 20 minutes, helping to direct further excavation without delays. Typical cost for a 24 hour rush PCB analysis ranges from $160 - $200 dollars, and does not take into account shipping delays and waiting for the fixed laboratory to provide preliminary results or down time waiting results. The unit cost for the analyzer is:

$15,495	PCB GC System
$3,495	Thermal Desorber
$100	Additional Desorber tubes

$19,090

Analyzing 120 rush TAT PCB samples at $160 each would cost the same, and could result in substantial delays waiting for results.

Hardesty, Al

To: David Barrett
Subject: RE: bulk molasses site

-----Original Message-----
From: David Barrett [mailto:dbarrett@ourcoop.com]
Sent: Friday, April 29, 2011 2:43 PM
To: Hardesty, Al
Subject: RE: bulk molasses site

This is a note I got from the supplier.
No, it is standard molasses. There is no sulphur added, what is there is naturally occurring and there would be approximately .5 % sulphur.

Your price delivered in will be $249.03 per ton delivered in.

Thanks,
David

From: Hardesty, Al [mailto:Al.Hardesty@jacobs.com]
Sent: Friday, April 29, 2011 1:30 PM
To: David Barrett
Subject: RE: bulk molasses site

Standard unsulphered molasses. Reducing the solids would reduce the nutrient content accordingly and just cause us to have to buy more diluted molasses.

-----Original Message-----
From: David Barrett [mailto:dbarrett@ourcoop.com]
Sent: Friday, April 29, 2011 2:23 PM
To: Hardesty, Al
Subject: RE: bulk molasses site

Al,

Do you know how much solids you want in these molasses? In talking to one of our suppliers I was told some people are using some low solid molasses for this purpose. In other words the molasses have water added to them. This would lower the price.

VEOLIA
ENVIRONMENTAL SERVICES

TECHNICAL SOLUTIONS
NORTH AMERICA

Preliminary Price Quotation

July 14, 2011

Mr. Al Hardesty
Jacobs Engineering
Via email: al.hardesty@jacobs.com

Dear Mr. Hardesty:

Veolia ES Technical Solutions, LLC (VESTS) is pleased to respond to your request for preliminary pricing with the following quotation.

Job Location: Plum Brook, NY

Waste Material Description and Volume: Approximately 20,000-30,000 cubic yards of TSCA contaminated soil, <50 ppm PCB and <500ppm PCB and unknown volume of TSCA contaminated debris.

Waste Code(s): No RCRA Codes

Services Provided: Disposal via high temperature incineration

Disposal Facilities:

Veolia ES Technical Solutions-PTA
Post Office Box 2563
Highway 73, 3.5 miles west of Taylor's Bayou
Port Arthur, TX 77643 (mail) 77640 (overnight mail)
Phone: (409) 736-2821
USEPA ID# TXD000838896
Receiving Hours: 7:00 AM – 4:00 PM, Monday through Friday
RCRA and TSCA approved, in compliance with CERCLA off-site rule (40CFR 300.440)

Estimated Job Start: 2012

Pricing:

DISPOSAL

TSCA Contaminated Soil	$0.24 per pound, $4200.00 minimum per load
Stream Qualifications: <2000 Btu, must pass paint filter test, flash point >140°F, total mercury <5ppm, total arsenic <100 ppm, chlorine <5%, fluorine <1%, sulfur <5%, Br/I <1% (combined), Na/K/Li <0.5% (combined), boron <5ppm, pH 4-10, debris must be <2% and meet the debris size specifications outlined below.	

Cement, Cinder Blocks, etc. **No Rebar**	6"x6"x6" Max
Rocks, stones	2"x2"x2" Max
Glass	
Bottles, jars, insulators, etc.	No Restrictions
Metal	
Metal Powders	NO
Brand Iron, Flat Iron, Angle Iron, etc.	1/8" max. total thickness 3' max length <2" cross section
Filters, Thin Metal Casing (Stainless Steel-cbc), Light Weight Fiber Media, No Heavy Metal	1/16" max thickness 3' max diameter 4' max length
Thin Wall Aluminum Conduit, Tubing, etc.	1/8 " max wall thickness 4' max length
Sheet Metal, Ductwork, etc.	1/8" max thickness 3' x 3' max piece size
Drums, Pails, Cans, etc.	No restrictions(must fit on a 48"x48" pallet)
Wire, Cable, etc.	2' max length ½" max diameter
Rebar	**NONE**
Miscellaneous	
Hoses, etc. (**No Flanges, No Stainless Steel**)	4' max length 8" max diameter
Rope, Line, String, etc.	4' max length ½" max diameter
Supersacks	No restriction
Plastic Liners, Tarps, Visqueen, etc.	No restrictions
Labpacks	NO
Plastic (rigid) Sheets	3' x 3' max
Plastic Drums	No restrictions

Scheduling:

Scheduling is subject to site availability. Your VESTS Customer Service Representative will assist you with scheduling this waste stream into VESTS-PTA once waste stream approval is completed. VESTS-PTA is not directly rail served but we have had customers deliver gondola cars and IMC to the Triad Transport Rail Spur in Houston, TX for transfer into roll-off boxes and shipment into our VESTS-PTA facility. VESTS-PTA would be able to accept 10-25 roll-off boxes of TSCA contaminated soil and 5-10 roll-off boxes of TSCA contaminated debris per week.
Thank you for the opportunity to submit this proposal. Please call me at (225) 293-4635 if you have any questions.

Sincerely,

Allison T. Wisener
Thermal Event Manager
Thermal Operation

Cc: Scott Hilton-Thermal Product Manager

TSCA Contaminated Debris	$0.45 per pound, $4200.00 minimum per load
Stream Qualifications: must pass paint filter test, flash point >140°F, total mercury <5ppm, total arsenic <100ppm, chlorine <10%, fluorine <1%, sulfur <5%, Br/I <1% (combined), Na/K/Li <0.5% (combined), boron <5ppm, pH 4-10, debris must meet the debris size specifications outlined below.	

ENERGY & SECURITY SURCHARGE

The Energy & Security surcharge is currently 10%.

TRANSPORTATION

Jacobs Engineering will provide transportation of these waste streams to VESTS-PTA in lined roll-off boxes.

TAXES

Texas; $4.00 per ton TSCA or non-hazardous

Qualifications:

This is a preliminary, budgetary quote. A final acceptance quote will be issued by the designated facility upon the submittal and approval of a waste profile and representative sample. This quotation is valid for thirty (30) days. Veolia ES Technical Solutions will invoice upon receipt of the waste. Terms are net thirty (30) days.

Waste Approval Fees: $500.00 per waste stream; Waived if waste is shipped to a Veolia facility

VESTS-PTA: A completed waste profile and representative sample/metals constituent addendum must be submitted to and approved by VESTS-PTA prior to waste scheduling. All samples and paper work should be submitted to:

Veolia ES Technical Solutions, LLC
Hwy 73, 3.5 miles west of Taylor's Bayou
Port Arthur, TX 77640
Attn: Waste Approval
Ph: 409.736.2821

Waste Criteria:

All bulk solid waste must pass the paint filter test, be non-tacky and exhibit negative flammability potential. Debris requirements follow for PTA.

DEBRIS GRID-PTA	
Material	**Regular Waste Pit**
	Bulk & Drums
Flash Point	>140°F
pH	>4
Water/Air Reactives	NO
Wood	
Boards, Poles, Logs, Stumps, etc., No spikes	6"x6"x3' Max.
Plywood, Paneling, Chip Board, etc.	4' x 4' Max
Concrete	

FW: soil handling from Sandusky Oh to Pt Aurthur

Bob Fischer [robertf@triadtransport.com]

Sent: Thursday, August 11, 2011 4:51 AM

To: Hardesty, Al

Attachments: Credit App 2011.doc (62 KB)

Al,

The trip charge from the Triad Terminal in Houston, TX to Port Arthur, TX is $630.00/ld plus local FSC (currently 18%). The charge to return the empty boxes from Port Arthur, TX to Triad in Houston is $175.00 per box plus local FSC. The charge to take the loaded boxes off the railcar is $75.00 per box and there is a $25.00 per box charge to put the empty back on the rail car. There are no charges for storage and we will take care of handling the paperwork and tracking and coordinating the boxes. You will have to Fed Ex the manifests to us here at the terminal when they are completed and the railcars are shipped.

Attached is the Triad credit application, please complete it and send it back to me and I will get it in process.

Thanks,

Bob

RE: Plum Brook job

Larry Cannon [Larry_Cannon@mhfservices.com]

Sent: Thursday, August 18, 2011 6:44 AM
To: Hardesty, Al
Cc: Kirk Collingwood [Kirk_Collingwood@mhfservices.com]
Attachments: 25 CY Intermodal Spec Sheet.pdf (196 KB) ; ABC Car Spec Sheet.pdf (861 KB)

Al,

Per your price estimate request.

- 25.4 CY IP-1 Intermodal Container - $10.00/Day

- 177 Ton MHF ABC Rail Car - $1485/Month
- Mobe Car with 8 IMs to Sandusky - $4360/Car
- Standard 6 mil poly IM liner - $35/Each
- Roundtrip ABC Car Trans from Willard, OH to Houston, TX - $13,465 (6 IMs per car)
- First 2 Days Free – No Charge! On-site Tech Services thereafter - $660/Day/Person

Please see attached spec sheets.

These are the kinds of projects MHF successfully supports for private industry as well as State and US Government on a routine basis, let me know when the time gets closer and I can provide associated references, etc. if you wish.

MHF is very familiar with the Plum Brook site and would very much like to support Jacobs on this project.

Just let me know if you have any other questions and/or need any additional information.

Thanks for the opportunity.

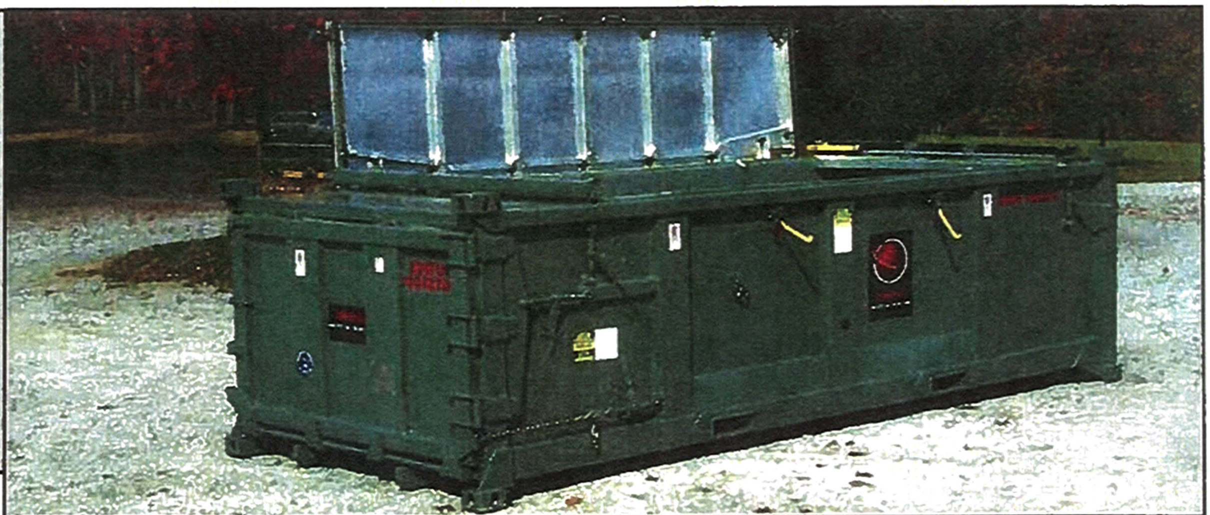
Larry Cannon
MHF SERVICES
Business Development Manager
Nuclear Services Group
685 Emory Valley Road, Suite B
Oak Ridge, TN 37830
Office 865.220.0102 Ext.103
Fax 865.220.0506
Cell 865.207.8764
larry_cannon@mhfservices.com

MHF SERVICES

Penguin Logistics LLC, d/b/a MHF Services, acquired the assets of MHF Logistical Solutions, Inc. on 6/19/09.

800 Cranberry Woods Drive, Suite 450, Cranberry Township, PA 16066
Phone: 1.877.452.9300 Fax: 724.772.9850 Web: www.mhfls.com

PRODUCT INFORMATION



● **Intermodal Container** with Rolling Aluminum Lid

Specifications

- 25.4 cubic yard capacity
- 59,800 lbs. maximum net weight capacity (actual weight will vary per transportation method)
- 7,400 lb. tare weight
- Outside dimension 238 1/2" L x 96" W x 78" H
- Inside dimension 230" L x 85" W x 61" H
- Lid opening 167" x 85"

Equipment Features

- Easily closed in minutes by one person
- MHFU Reporting Marks
- Containers are certified for international transport by container ship as well as barge, rail flatcar, flatbed truck, intermodal chassis or roll-off truck
- MHF-LS containers are uniform in construction and operation
- The containers can be double-stacked on our ABC railcar
- Container can be lifted by crane, sidelifter, forklift, roll-off truck or container handler
- Rear door can be side or top-hinged
- Watertight design and construction

Equipment Advantages

- Reduces time loading container; lid is easily opened and closed by one person in less than seven minutes
- All containers are equipped with bottom flapper secondary tailgate closure system, the most secure closure for rail transport in the industry
- Solid lid provides higher level of assurance that container will not release its contents under the rigors of transportation and extreme weather
- Ideal for soils, sludges, rubble, metals and construction/demolition debris
- Watertight gasket system ensures that no water will enter or exit the container if properly closed
- Lease or purchase options

Certifications

Container is manufactured under a Nuclear Quality Assurance (NQA-1) Program, which provides assurance of conformity to the following certifications:

49 CFR 173.427 & 49 CFR 173.410 Industrial Package 1 (IP-1), also ABS and AAR approved.

Light, Hydrostatic & Water Penetration Testing

- Internally water tested: The containers are completely filled with water to determine that all welds and seals are watertight. The test is documented with a water test certificate.
- Light test: All containers with lids must pass an internal light test. Under procedure, an inspector is placed into a closed container to verify that container is light tight. The test is documented with a light test certificate.
- External spray test: All containers with lids must pass an external "weather tightness" test in accordance with procedures. The test is documented with an external spray test certificate.

Security & Safety

Security seals are available for purchase in various styles that deter unauthorized access. Many safety features are engineered into our equipment, containers and packages and are referenced in the specifications, equipment features and advantages.

MHF SERVICES

Where Complex Challenges Meet Smart Solutions
Transportation ▶ Packaging ▶ Technical Services

PRODUCT INFORMATION

Articulated Bulk Container (ABC) Flatcars

Specifications

- 177 ton carrying capacity
- 89' 11 1/2" overall length
- "F" Plate clearance allows for double-stacking of containers to 17' extreme height above rail
- Railcar can transport up to eight 20' containers or two 40' containers
- Railcar consists of two 40' sections with an articulating middle truck set

Equipment Features

- MHFX Rail Reporting Marks
- Articulated design and the car's maneuvering capability allow it to be used on any rail siding or restricted rail track curvature
- Allows for double-stacking of 78" height bulk containers for a total height of 17' from rail

Equipment Advantages

- Increased weight capacity allows for greater amounts of material to be transported with each shipment, versus typical railroad supplied flatcars
- Heavy weight carrying capacity of the railcars allows for overweight containers to be transported long distances economically, versus trucking that requires expensive overweight permits
- Private railcar configuration that is not available from the railroads

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.

THE USE OF ENHANCED BIOREMEDIATION AT THE SAVANNAH RIVER SITE TO REMEDIATE PESTICIDES AND PCBS.

ABSTRACT

Enhanced bioremediation is quickly developing into an economical and viable technology for the remediation of contaminated soils. Until recently, chlorinated organic compounds have proven difficult to bioremediate. Environmentally recalcitrant compounds, such as polychlorinated biphenyls (PCBs) and persistent organic pesticides (POPs) such as dichlorodiphenyl trichloroethane (DDT), have shown to be especially arduous to bioremediate. Recent advances in field-scale bioremedial applications have indicated that biodegradation of these compounds may be possible. Engineers and scientists at the Savannah River Site (SRS), a major DOE installation near Aiken, SC, are using enhanced bioremediation to remediate soils contaminated with pesticides (DDT and its metabolites, heptachlor epoxide, dieldrin, and endrin) and PCBs. This article reviews the ongoing remediation occurring at the Chemicals, Metals, and Pesticides (CMP) Pits using windrow turners to facilitate microbial degradation of certain pesticides and PCBs.

BACKGROUND

The Savannah River Site (SRS) is a 310-square-mile facility owned by the United States Department of Energy (USDOE) near Aiken, South Carolina (Exhibit 1). The SRS has operated since 1950 with the mission to produce nuclear materials for national defense, medical research, and space exploration. Over the last 50 years, five production nuclear reactors have been built and operated. Large amounts of solid and liquid wastes were generated in the course of construction and operation of the reactors and associated fuel fabrication, processing, and waste handling operations. Up until 1970, most of this waste was burned, buried, or dumped in "rubble pits" near the reactor areas or other major facilities.

The Chemicals, Metals, and Pesticides (CMP) Pits are located in the central portion of the Savannah River Site (SRS) (Exhibit 1). The waste unit consists of seven unlined pits that occupy the top of a knoll at an elevation of 310 ft above mean sea level. The pits were constructed in 1971 to dispose of solvents, pesticides, and lighting ballast components; it received waste until 1979. Subsequent monitoring detected solvents in the groundwater. In 1984, the contents of the pits were excavated, the pits were then back-filled, and an infiltration cover was installed. During excavation of the drums, an area to the west of the pits was used for material staging. This area, which later became known as the ballast area, contains surface soils that are contaminated with low levels of pesticides and polychlorinated biphenyls (PCBs). A maintenance action was conducted in 1996 to minimize erosion by placing six inches of soil over the ballast area, thus improving the perimeter drainage and erosion control. Remediation of the residual subsurface solvent contamination in the vadose zone beneath the pits began in 2000 with the deployment of a soil vapor extraction (SVE) system.

Surface soils in the ballast area are contaminated with pesticides and PCBs that exceed risk-based remediation goals (RG) or clean up levels. The majority of the contamination is confined to the top two feet of soil with a limited amount detected down to 5 ft below land surface. The soil consists of hardpan sandy clay with cobbles, and is lacking organic materials and most normal soil nutrients. Characterization of the site indicates that the soils are only sparsely populated with natural microbial concentrations and are not suitable for bioremediation without substantial amendment additions.

TECHNOLOGY DESCRIPTION

Initial project cost estimates indicated that offsite disposition of the ballast area soils to a permitted facility would be prohibitively expensive. In addition, a subsequent investigation revealed the sporadic presence of 2,4,5-trichlorophenoxypropionic acid (Silvex), which at one time was sold commercially as a herbicide. Silvex is a listed Resource Conservation and Recovery Act (RCRA) waste (code FO27) and has restrictions for off-site disposal, thus severely limiting disposal options for the ballast area soils. Some degree of success in degrading chlorinated organic compounds, including pesticides, have been achieved commercially with in-situ bioremediation. Deploying an on-site remediation technology at the ballast area would be a more practical and cost-effective solution, provided the technology could be improved upon to degrade PCBs and Silvex to acceptable levels. Due to these factors, a treatability study was performed to determine if enhanced bioremediation would be a viable alternative in remediation the ballast area soils.

Therefore, the objectives for the treatability study of enhanced bioremediation were to 1) reduce contaminant concentrations to levels below the RGs that were established with the regulators for the contaminants of concern (COCs); 2) determine if bioremediation could achieve the RGs within an acceptable time frame; 3) identify the most effective combination of soil amendments and operating conditions that would achieve remediation of the ballast area and also determine any associated factors that might affect the process; and 4) determine the cost of the technology.

Up until recently, one of the limitations with large-scale bioremediation of soils has been the difficulty of achieving adequate homogenization of the correct balance of amendments into the soils to encourage the appropriate microbial reactions to occur. To overcome this limitation, SRS employed a windrow turner known as the Microenfractionator® to mechanically improve the effectiveness of homogenizing large quantities of soil with organic composting materials and amendments. The organic materials and amendments encourage the proliferation of microbial communities capable of degrading chlorinated organic compounds.

The Microenfractionator® developed by H&H Eco Systems Inc., is designed for bioremediation of petroleum contaminated soils and is a modification of commercial and municipal composting operations. It is manufactured with a counter-rotating drum supporting a set of fan-knife blades. The drum is powered hydraulically by a diesel engine and is driven through the soil pile by self-propelled, four-wheel drive power. The fan-knife blade design causes the soil particles to be thrown sideways into each other and against the stainless steel lining of the Microenfractionation chamber at high velocities. This physical action causes the soil particles to fracture into microscopic sizes, exposing more contaminant surface area for treatment.

Although soil particles are thrown aggressively around in the chamber, little potential for fugitive dust to escape exists. The windrow turner enhances the bioremediation process and suppresses fugitive dust in four ways: 1) water is added to the soil to maintain the correct moisture content in the windrows; 2) the physical blending action breaks the soil particles into smaller pieces, thus exposing fresh surfaces and the interior of the previously larger particle; 3) the rubber shields contain dust and airborne particles to the area under the chamber; and 4) the windrows are covered between mixing cycles allowing the retention of moisture and heat from the biochemical reactions.

The windrows are constructed from contaminated soil, organic/agricultural by-products, chemical nutrients, soil amendments, and water. The windrows are trapezoidal in cross-section with the following dimensions: the base is approximately 16 ft wide, the top of the windrows are approximately 5 ft wide, and the height is approximately 5 ft. The windrows vary in length, but are generally longer than 100 ft. The width and height dimensions for the windrows are based on the geometry of the windrow turner. The length of the windrows is based on the available flat test area within the boundaries of the CMP Pits.

Primary Contaminants

Many pesticides and PCBs are complex chlorinated compounds derived from the chemical benzene. Pesticides, particularly insecticides (such as DDT) and herbicides are an integral part of modern agricultural production (Manahan 1994). Due to DDT's ability to control mosquitoes and malarial infection, an exponential increase in the use and production of and use of pesticides became a worldwide phenomenon after World War II. While the public health and economic benefits of synthetic pesticide use of the past 50 years are indisputable, these benefits have not been without costs (Wexler 1998).

Widespread environmental contamination by DDT and other organochlorine pesticides, and their associated deleterious effects on some members of the foodweb heralded the end of an era for their extensive use.

Generally, persistent organic pollutants (POPs), such as DDT and its metabolites, are considered recalcitrant to biological degradation. However, under certain conditions, chlorine atoms on the diphenylethane structure are capable of replacement with hydrogen atoms or hydroxyl groups by microbial action. If the biological reactions are allowed to proceed for a certain time period, eventually the double benzene ring structure can be cleaved, producing a metabolite of the parent compound or some other similar organic compound.

DDT and its metabolites are highly lipophilic and bind strongly to soil particles. Due to their hydrophobic nature, DDT, DDE, and DDD have a tendency to also accumulate in plant tissues and fatty tissues of fish, birds, and mammals (including humans). They have a low acute toxicity to mammals, although there is some evidence that they might be carcinogenic (Manahan 1994).

Other organochlorine pesticides, including dieldrin, endrin, and heptachlor, are structurally similar, are all now banned for application in the United States, and share common characteristics of high persistence and suspicions of potential carcinogenicity (Manahan 1994).

PCBs are considered to be very recalcitrant in the environment. A PCB can contain 1 to 10 chlorine atoms in various positions around the biphenyl rings. With all of the possible combinations of chlorine arrangements on the biphenyl structure, 209 different PCB compounds, or congeners, are likely. The high molecular symmetry and high bond strength between the chlorine and carbon atoms gives PCBs the property of high chemical stability. This property led to widespread industrial application, including coolant-insulation fluids in transformers and capacitors, plasticizers, additives to some epoxy paints, and lighting ballasts. However, the stability of PCBs is also responsible for their bioaccumulation in the environment and their eventual ban in 1977.

Studies have identified that microbial processes are capable of biodegrading PCBs through aerobic oxidative processes and anaerobic reductive processes. The aerobic dechlorination occurs on the lower chlorinated congeners. Anaerobic dechlorination degrades the highly chlorinated congeners to lightly chlorinated congeners. Aerobic transformation of many congeners has been demonstrated in culture, but evidence for effectiveness in soil is lacking (Focht 1995). In contrast, reductive dehalogenation of Aroclors in incubated sediment has been considerable (Tiedje et al. 1993).

Although highly resistant to biological attack, laboratory research has indicated that limited microbial degradation of PCBs is possible under very specific conditions (Michel et al. 2001). Laboratory evidence suggests that the PCB congeners with 4 or more chlorine atoms can only be degraded under highly anaerobic conditions at very low redox potentials, which must be sustained for protracted periods. These are conditions that are very difficult to replicate in the field. Congeners with 3 or fewer chlorine atoms are believed to be more easily degraded under aerobic conditions, which must be maintained over many months, and the limited number of field trials that have been implemented under this scenario, have met with some degree of success (Michel et al. 2001).

Because of the complexity in measuring PCB degradation in the field, it was decided to take a two-pronged approach to verification for the treatability study (TS) results. Ongoing soil samples would be analyzed for total Aroclor concentrations by a commercial laboratory using EPA Standard Method 8082. Additional verification would be obtained by a supplementary analysis of the congener distribution in samples taken at the beginning and end of the TS. Support for this aspect of the TS has been provided by the Department of Environmental Engineering and Science at Clemson University. Clemson has conducted research over a number of years into the degradation of PCBs in the sediments found in Lake Hartwell, South Carolina, and has developed a substantial capability in PCB remediation and analytical techniques for complex chlorinated organic compounds.

Windrow soil samples were taken at the start and at the end of the aerobic period and also at the end of the anaerobic period during Phase 1, and sent to Clemson for investigation. This was repeated with sampling at the beginning and end of Phase 2. Clemson adopted a dual approach to providing independent verification of biological degradation of the pesticides and PCBs. In addition to the PCB congener speciation, microcosm experiments were performed on the windrow soils under ideal anaerobic and aerobic conditions to determine if the microbes that are known to dechlorinate PCBs were in fact present, and to confirm that PCB dechlorination was feasible under ideal conditions.

Site Preparation

Windrows were constructed with approximately 600 yds^3 of the ballast area soils at a location adjacent to the CMP Pits ballast area, on a sand pad base, during early October 2001 (Exhibit 1). The treatment area was constructed on a lower level just to the north of the actual pits but still within the waste unit. A berm was constructed around the perimeter of the treatment area out of railroad ties for erosion control. An 80-ml thick polyethylene sheet was then placed over the ground surface and overlapped the railroad ties to form a containment zone. A 6-inch deep layer of sand was then placed on top of the polyethylene to act as a base for the machine. The windrows were constructed on top of the sand by first placing horse manure in four rows, in a layer approximately 1 ft thick by 15 ft wide for the length of the windrows (Exhibit 2). The contaminated soil (including debris less than 3 inches in diameter) was deposited over the manure layer and constitutes the remainder of the windrow. The ballast area soil was then placed on top of the manure by dumping the dump trucks. The total volume of horse manure and stable sweepings amounted to approximately 240 yds^3 or about 40% of the volume of soil. A proprietary mixture of soil micronutrients developed by H&H Eco Systems, Inc. was placed on top of the windrows. Water was added from the machine during windrow mixing. The last turning event was completed in May 2002 after 6 months of operation, which effectively terminated the process.

Throughout the process, the soil samples were examined for three groups of microbial populations: culturable heterotrophic aerobes, culturable anaerobes, and culturable pseudomonades (Appendices B, C, and D). Microbial plate counts in the ballast area soils were typically low in the unblended soils. Initial plate counts were in the ranges of 10^6 colony forming units per gram dry weight (CFU/gdw) for heterotrophs, 10^3 CFU/gdw for anaerobes, and 10^4 CFU/gdw for pseudomonads. The microbial counts increased by several orders of magnitude by the end of the TS (10^8 CFU/gdw, 10^7 CFU/gdw, and 10^5 CFU/gdw, respectively).

Phase 1 of the Treatability Study

To encourage proliferation of the widest range of microbe and fungi species, the composting process was controlled to operate under mesophilic conditions, thus increasing the likelihood that chlorinated organic compound destroying microbe species would be present. The microbial activity generates sufficient heat to significantly raise windrow temperatures, and the population of mesophilic bacteria is most numerous below 105 ^{o}F. Above 125 ^{o}F the mesophilic microbes begin to die off and thermophilic microbe populations begin to take over. Throughout the process, the soil samples were examined for three groups of microbial populations: culturable heterotrophic aerobes, culturable anaerobes, and culturable pseudomonades.

Initial COC sampling and analysis of the windrows was conducted at eight discrete locations along each windrow both before and after the first pass of the windrow turner. This sampling schedule was conducted to obtain good baseline information on the distribution of contaminants in the four windrows and to establish the effectiveness of the windrow turner in material homogenization. Each sample was taken by coring the windrows to a depth of about 2 feet with a plastic tube and then placing several smaller samples from along the soil core into a plastic bag. Discrete samples were taken on weeks 0, 1, 3, 6, 7, 14, 19, and 28; while composite samples were taken on weeks 15, 19, 21, 24, 25, 26, and 27. All the discrete samples, including the final regulatory compliance analyses, were analyzed by utilizing EPA Method 3540 for extraction of semi-volatiles from soils, Method 8081A for pesticide chromatographic analysis and Method 8082 for PCB chromatographic analysis.

In addition, windrow temperatures were monitored to follow the level of microbial activity throughout the winter months. In February, oxygen content measurements in the windrows began in conjunction with the temperature measurements.

Baseline windrow soil moisture levels started out at 13%. Water was added progressively throughout the anaerobic period to levels of 18%. A moisture level of 18% is close to the saturation level for the ballast area soils. Soil pH levels were maintained in the neutral 5 to 8 range, with the occasional addition of lime to neutralize the acids generated by microbial action. Occasional additions of fertilizer were made to maintain an appropriate carbon:nitrogen ratio. Periodically, H&H Ecosystems, Inc. proprietary micronutrient amendments were added to maintain the correct concentrations of standard agricultural elements i.e. potassium, phosphorous, calcium, magnesium, cobalt, copper, iron, boron, molybdenum, sulfur and zinc.

By the end of January 2002, although a general decrease in all contaminant concentrations had been observed under aerobic conditions, the rate of decrease appeared to be leveling off, and would not reach the remedial goals within the contract time frame (Exhibit 3). To accelerate the degradation process, the strategy for the enhanced bioremediation was modified from aerobic conditions, which had been prevalent since start up, to cyclic anaerobic conditions. To promote the necessary anaerobic conditions, molasses and small amounts of manure were added. Molasses, a carbohydrate source that is rapidly consumed along with residual oxygen by aerobic microbes, thus causing a decline in the oxygen content of the windrows which promotes activity within the dormant anaerobic microbial community.

Significant anaerobic microbial activity generally requires a 1 to 2 weeks incubation time to become really effective and anaerobic conditions must be sustained within the windrows for at least this period and longer. However, from the beginning of February, the general level of microbial activity in the windrows had begun to decline indicating that most of the organic material had been consumed. This was indicated by a gradual drop in windrow temperatures from 90 - 100 ^{o}F range to the 75 - 85 ^{o}F range throughout February/March.

During the February/March time frame, measurements of the oxygen content within the windrows were taken in order to gauge the effectiveness of the anaerobic process. In general terms, the transition from aerobic and anaerobic conditions, takes place at around 5% oxygen. Typically within 24 hours of turning the windrows after the molasses additions, the oxygen content would drop sharply to the 1-8% range coupled with a corresponding temperature rise of 5-10 ^{o}F. This trend is indicative of a rapid burst of activity within the anaerobic microbial community. However within the following 2-3 days, the oxygen content would increase to the 12-18% range, and the windrow temperatures would decrease, These conditions are indicative of a rapid return to aerobic conditions. Furthermore, visual inspections based of the windrow soils characteristics indicated that the organic material had been consumed. Thus, insufficient organic material remained in the windrows to sustain anaerobic microbial activity for more than 2-3 days.

A more intensive effort to sustain anaerobic conditions began in April in three out of the four windrows. Contaminant concentrations in windrow 3 were already below the RGs, therefore no further work was conducted with this windrow. To determine if repeated windrow turnings were more effective after molasses additions verses non-turning, two of the windrows were turned twice per week throughout April with molasses additions at each turning event, while the remaining windrow was turned with its molasses additions once, and then left undisturbed. Fresh manure, consisting of 50% horse stable sweepings and 50% cow manure (to increase the nitrogen content in the compost mixture), was added to the two active windrows at two intervals, Oxygen content and temperature were measure daily. Weekly composite sampling, pH, and moisture content measurements were conducted, as well.

Following the initial windrow turning in April, the two windrows rapidly became anaerobic, with a corresponding evolution of reducing gases such as methane, ammonia, and hydrogen sulfide. The reducing gas concentrations were measured using Draeger tubes to measure gas concentrations. These concentrations were therefore only indicative of the types of biochemical reactions that were occurring, and were not quantified to formulate a mass balance.

Phase 2 of the Treatability Study

The objective of Phase 2 was to redesign the process in order to achieve faster biodegradation rates for the contaminants. Based on the results obtained from Phase 1, the bioremediation process was modified as discussed below.

The windrows were turned at least twice per week, during both aerobic and anaerobic cycles, to improve contaminant/microbe/nutrient interaction. Anaerobic conditions were difficult to sustain for a prolonged period of time without multiple turnings possibly due to accumulation of by-products (i.e. alcohols) within the windrows, which effectively hinders the bioremediation processes. In order to overcome this buildup, windrow operations were cycled from anaerobic to aerobic conditions depending on the oxygen and temperature measurements for the windrows. Aerobic and anaerobic parts of the cycle were each expected to last several weeks, with the caveat that multiple cycles might be necessary. Furthermore, the increase in mixing allowed the windrows to achieve anaerobic conditions. Although this statement seems contradictory, the additional mixing and amendments provides the aerobic microbes with abundant food sources causing an increase in aerobic microbial activity. This increase in activity forces the piles anaerobic due to the consumption of oxygen by the aerobic microbes.

In addition, increased and continuous monitoring of the principal parameters was completed in order to make the necessary adjustments for optimum windrow conditions. Measurements included temperature and oxygen (daily), pH and moisture (weekly), COC concentrations (weekly under anaerobic conditions), PCB congener analysis (start and end of phase 2), and soil nutrients (monthly).

Similar to Phase 1, 600 yds^3 of contaminated soil was used for Phase 2. Phase 2 commenced August 2002 with the first mixing event. Following the initial mixing, molasses and additional manure were mixed into the windrows. Operations continued in the anaerobic mode with twice-weekly turnings of the windrows and molasses additions. Cottonseed hulls and manure were added to supplement the organic material content. Additional inorganic soil amendments were added in October to balance the pH, nutrient and nitrogen depletion.

During mid-October, windrow temperatures began to decline signifying the end of the composting process (Exhibit 4). Minor manure additions were mixed into the windrows in an attempt to continue the bioremediation process.

PHASE 1 RESULTS

Mean DDT concentrations decreased by 95% in windrow (WR)1 over the 28-week duration of the TS. Mean DDT concentrations in WR2, WR3, and WR4 could not be calculated due to questionable data associated with the initial (WR4) and final (WR2 and WR3) data, therefore, specific results cannot be discussed. However, over the 28-week period, the concentrations of DDT generally decreased. A significant portion of the DDT reduction occurred during the period of anaerobic operation in April in WR1 and WR2. During the intensive anaerobic period, oxygen and temperature measurements were taken twice daily. Temperatures during this period averaged 100 °F with a standard deviation of 8 °F. During the third week, windrow temperatures peaked at an average of 106 °F, with a standard deviation of 8 °F. The twice weekly turning of windrows 1 and 2 kept their window oxygen contents in the <5% range and many readings were <1%. Additional water elevated moisture levels to 25%. DDT concentrations decreased rapidly until the third and fourth weeks, when the biochemical reactions appeared to slow, ammonia production decreased and the rate of DDT reduction slowed dramatically. Several reasons have been postulated for this apparent process slowdown namely, formulation of alcohols and phenols generated from the fermentation process which would poison the anaerobic microbes, poisoning of the anaerobic microbes by the ammonia and also the rapid depletion of nitrogen from the compost process by the ammonia generation. Activity in WR4, which had minimal amounts of DDT throughout Phase 1 (400 ug/kg) and was not mixed during the aggressive period, was minimally affected by the anaerobic period. These results imply that DDT concentrations were not significantly decreased. Mean DDE concentrations decreased by 76% in WR1 and WR2, 60% in WR3, but slightly increased in WR4. The DDD results indicate that levels remained above the RG. Concentrations of DDD increased over time in WR1 and WR2, especially during the April anaerobic period. These results suggest that as the microbes degrade DDT into its anaerobic daughter product, an increase in DDD concentrations is occurring. The increase in DDD levels was not in direct proportion to the decrease in DDT concentrations. In addition, concentrations of chlorodiphenylchloroethylene (DDMU), a degradation product of DDD, were detected. The presence of DDMU suggests that the bioremediation continued the biodegradation process past the daughter product of DDT.

Reductions in mean dieldrin concentrations of 73%, 62%, and 89% were achieved for WR1, WR2, and WR3, respectively. Initial concentrations of dieldrin in WR4 slightly increased throughout Phase 1. Final concentrations of dieldrin in all four windrows, including WR4, were below the RG.

Reductions in mean endrin concentrations of 76%, 88%, and 72% were achieved for WR1, WR2, and WR3, respectively. Concentrations of endrin in WR4 were non-detects throughout Phase 1. Final concentrations of endrin in WR2, WR3, and WR4 were below the RG (60 ug/kg) at the end of Phase 1. The concentration in WR1 was only slightly higher than the RG at the end of Phase 1 (70 ug/kg).

Reductions in mean heptachlor epoxide concentrations of 93% and 42% were achieved for WR2, and WR4, respectively. Concentrations of heptachlor epoxide increased in WR1 (25 to 67 ug/kg) and WR3 (4 to 11 ug/kg) throughout Phase 1. The only Phase 1 windrow not to meet the RG at the end of the 28-week period was WR1.

Based on comparisons between initial and final concentrations, slight reductions in the mean concentrations of PCBs occurred in all four windrows (Table 6). WR2, WR3, and WR4 were below the RG (1000 ug/kg) at the end of Phase 1 with final concentrations of 996, 736, and 290 ug/kg, respectively. The final mean WR1 concentration (1605 ug/kg) was somewhat below the initial concentration of 1614 ug/kg. The mechanism for degradation of PCBs is more complex and less easily understood than the chlorinated pesticides. Based on visual observations, PCBs appeared to exist in the form of hard pea sized 'pellets' in the ballast area soils. During the first 5-7 weeks of Phase 1, it is possible that these 'pellets' were fractured in the aggressive mixing environment of the windrow turner allowing the PCBs to be more bioavailable for sampling and remediation. Furthermore during the first few turning events, a number of lighting ballasts and electrical capacitor cans were ejected from the windrows via the rotating action of the fan blades. Enough of the electrical components from Phase 1 were collected to nearly fill a 55-gallon drum. This rationale provides one explanation for the initial rise in PCB concentrations. The PCB congener analysis for samples taken at 4, 22 and 28 weeks indicate that the average number of chlorine atoms per biphenyl molecule remained unchanged in the range of 3.2 to 3.8. These results suggest that anaerobic dechlorination for Phase 1 was minimal, perhaps due to the low redox conditions, short duration of the anaerobic environment, and/or an absence/latency of the appropriate dechlorinating microorganisms in the windrows. The distribution of di-, tri-, tetra-, penta-, hexa-, and heptachlorobiphenyls in Phase 1 soil samples suggests a decrease in the percentage of dichlorobiphenyls relative to the other higher chlorinated congeners. In the December 2001 soil samples, dichlorobiphenyls comprised a 10-52 mole percent of the total congener distribution; whereas, the April 2002 soil samples consisted of 15-19 mole percent of dichlorobiphenyls. It is possible that the apparent decrease in the mole percentage of dichlorobiphenyls is due to oxidative biodegradation, presumably under aerobic conditions (which predominated during operation of the Phase 1 windrows). Approximately 5-29 mole percent of the dichlorobiphenyls in the December 2001 samples consisted of a non-chlorinated ring. Under aerobic conditions, these non-chlorinated rings are typically hydroxylated causing the non-chlorinated ring to break (dichlorobenzoates). Therefore the potential for aerobic oxidation does exist. Dichlorobenzoates are less hydrophobic than PCBs and are amenable to aerobic oxidation, making them less likely to persist in the windrows.

Silvex, which is not a COC for the CMP Pits OU (WSRC 2003), was considered for this TS due to its RCRA listing (F027 waste). Results from Phase 1 data indicate non-detects for Silvex within weeks of beginning Phase 1. These results suggest that Silvex is bioremediated through aerobic processes

PHASE 2 RESULTS

Reductions in mean DDT concentrations were 96%, 83%, 96%, and 90% for windrows 1, 2 and 4N and 4S, respectively, over 12-week period of operation. These Phase 2 results, when compared to the Phase 1 results (95% reduction in WR1), validates the theory that the bioremediation can be accelerated by frequent windrow turning. The Phase 2 results for DDT concentrations are below the RG of 1620 ug/kg. The mean concentrations of DDT for all of the windrows are below the RG. The degradation of DDT that occurred during weeks 2-6, produced a corresponding increase in concentrations of DDE in all four windrows. Mean concentrations of DDE increased slightly in WR1 and WR2, and decreased slightly in WR4N & S between the initial and final concentrations. However, the mean concentrations do not portray the increases and decreases in concentrations of DDE as DDT was degraded. In addition, DDE concentrations are below the RG of 554 ug/kg in all four windrows. Likewise for DDD, the degradation of DDT that occurred during weeks 2 through 6, produced a corresponding increase in concentrations of DDD in all four windrows. Mean concentrations of DDD increased in all four windrows between the initial and final concentrations. Concentrations in WR1 were 37 to 266 ug/kg; WR2 were 67 to 468 ug/kg; WR4N were 95 to 149 ug/kg; and WR4S were 39 to 94 ug/kg. Despite the increases in DDD concentrations at the end of Phase 2, final concentrations were below the RG of 287 ug/kg, except in WR2. It is conjectured that WR2 concentrations would also have decreased had Phase 2 operated for a longer time period.

Overall mean concentrations of dieldrin increased very slightly in WR1 and WR2; and decreased slightly in WR4N and S throughout Phase 2. However, a more sporadic degradation nature seems to correlate with mixing and amendment additions. Despite this erratic nature, windrow concentrations for dieldrin are at or below the RG of 68.4 ug/kg.

Mean concentrations of endrin decreased in all four windrow to below detection limits. In addition, endrin concentrations were non-detects before the end of Phase 2. The RG for endrin is 40 ug/kg.

A situation similar to that of endrin exists for heptachlor epoxide. Mean concentrations of heptachlor epoxide have degraded to levels at or below 1 ug/kg. The RG for heptachlor epoxide is 21 ug/kg.

Mean concentrations of total PCBs were below the RG (1000 ug/kg) in all four windrows. In addition, total PCB concentrations in the soil were at or below the RG. However, soil samples collected for congener analysis showed no significant difference in the average number of chlorine atoms per biphenyl molecule detected in samples taken at the beginning and end of Phase 2 for all windrows. Nonetheless, a change in the mole percent and weight distribution of specific congeners throughout Phase 2 was detected. It appears that the average mole percentage of dichlorobiphenyls decreased which is indicative of some degree of aerobic biodegradation. In addition the mole percentage of penta-, hexa- and heptachlorobiphenyls decreased with a corresponding increase in the mole percentage of tri- and tetrachlorobiphenyls, which is indicative of a degree of anaerobic activity. However the changes were relatively small and somewhat inconsistent between windrows.

Because Silvex results from Phase 1 showed successful degradation during the aerobic portion of Phase 1, Silvex was not analyzed for in Phase 2 and will not be discussed as part of Phase 2.

CONCLUSIONS

With the discrete samples for individual windrows, COC concentrations were reduced to less than the new RG levels in nearly all cases (Exhibit 5). In a few discrete sample cases, the COC levels did not quite achieve the RG levels, but would almost certainly get below RG levels with additional time.

Enhanced bioremediation based on horse manure, molasses, appropriate soil amendments and moisture is a process that can be duplicated to give reproducible results within an acceptable time frame.

Contract costs for Phase 1 were $690,000 to remediate 600 yd^3 of soil or $1,150/$yd^3$. Because of the increased efficiencies achieved in Phase 2, the same quantity of soil was remediated in three months instead of six for $350,000 or $585/ yd^3. These unit costs are relatively high for enhanced bioremediation and are principally due to two factors. The quantities of soil involved in Phase 1 and Phase 2 are relatively low. Full-scale bioremediation is normally conducted on soil quantities much higher than deployed in this TS, which would reduce the unit cost. In addition, the largest individual component of the cost of this process is the rental or capitalization of the Microenfractionator® machine itself.

ACKNOWLEDGMENTS

SRS would like to thank Clemson University's Department of Environmental Engineering and Sciences (Dr. Cindy Lee and Dr. David Freedman) for their work on the

PCB congener analyses and microbial microcosm experiments. We would also like to thank H&H Ecosystems, Inc. for the use of their Microenfractionator® and proprietary soil amendments.

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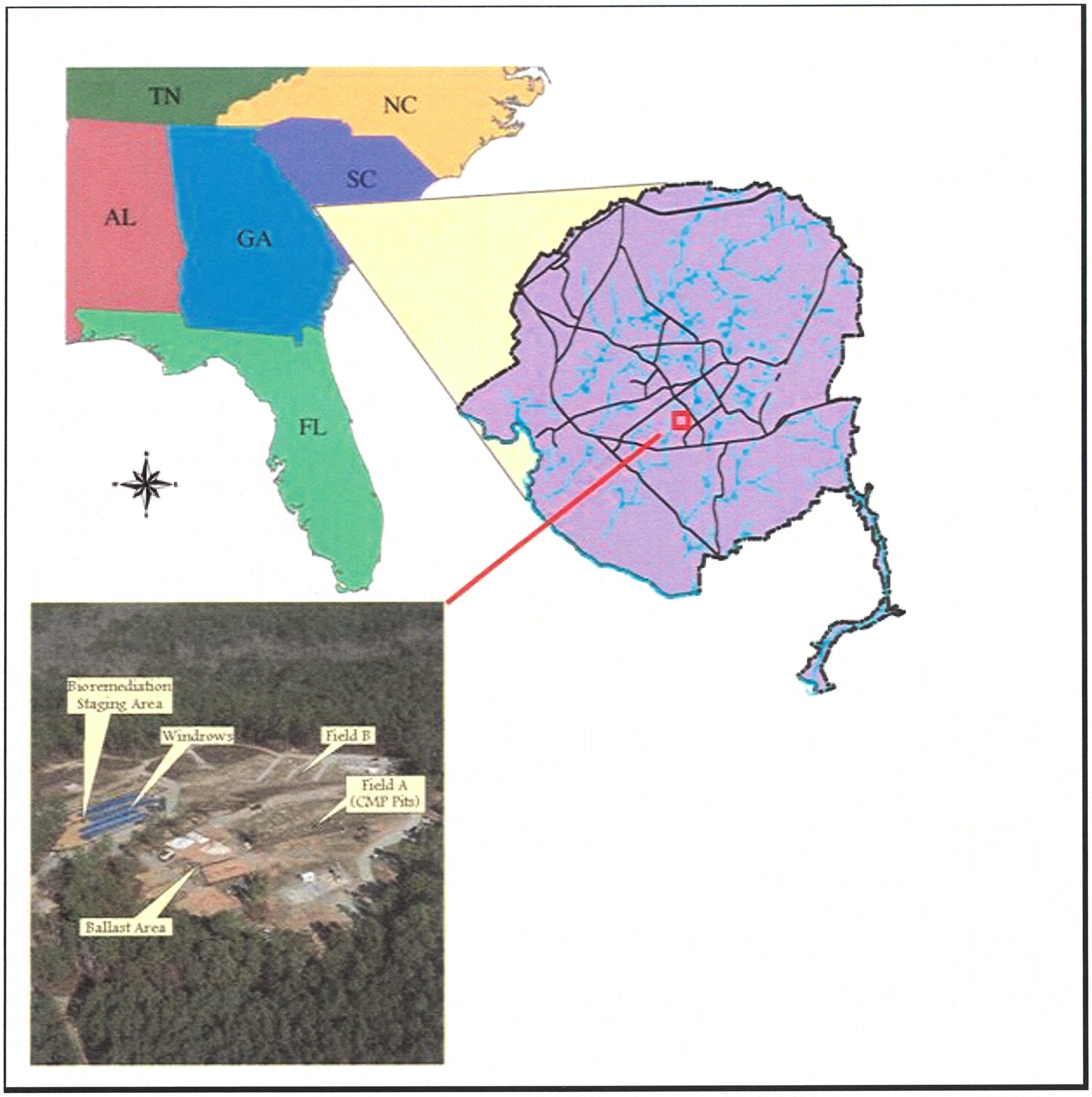

Exhibit 1. Location of CMP Pits at the SRS.

Exhibit 2. Windrows located on the treatment pad near the CMP Pits.

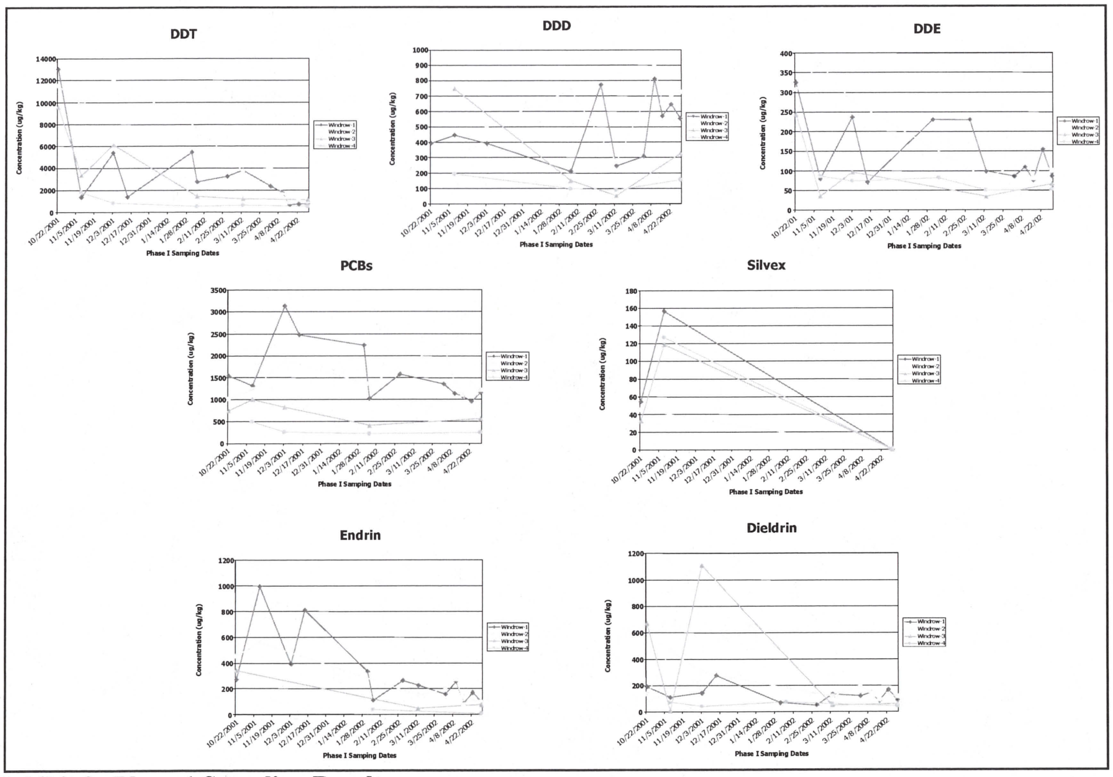

Exhibit 3. Phase 1 Sampling Results.

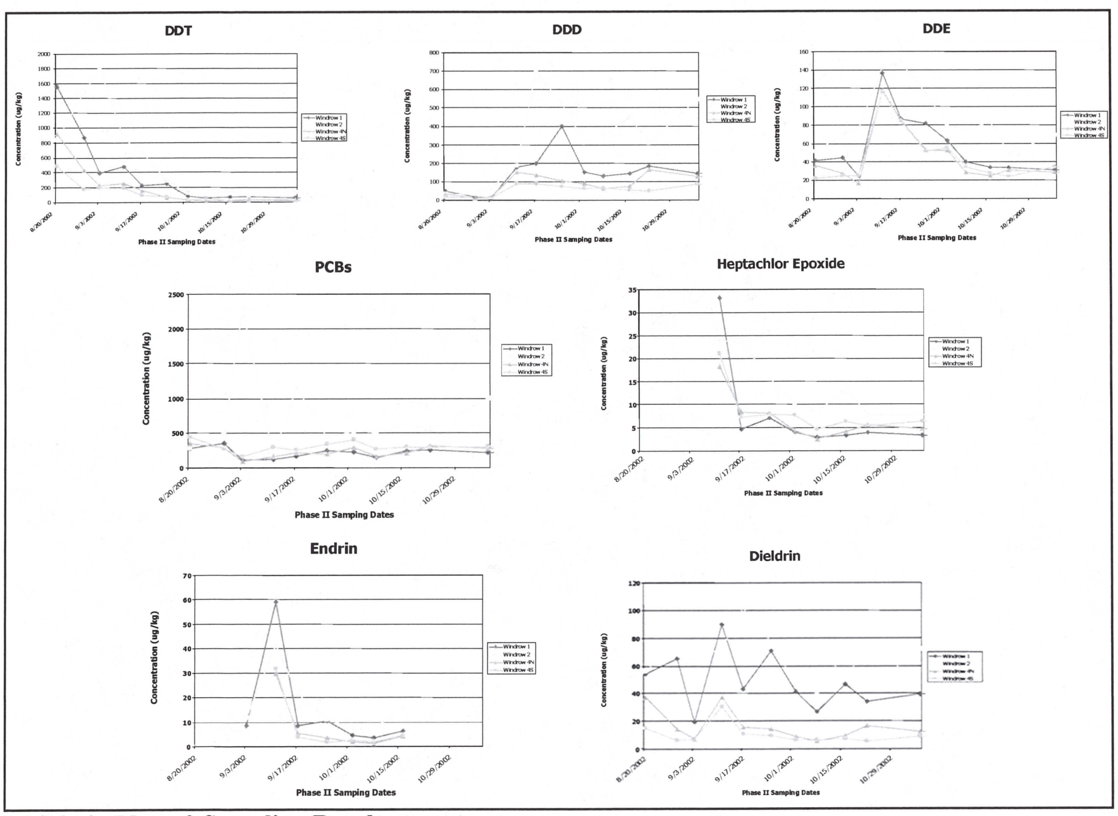

Exhibit 4. Phase 2 Sampling Results.

Exhibit 5. Summary of Overall Treatability Study Results

COC	Remedial Goals (ug/kg)	Mean Phase 1 results (ug/kg)	Mean Phase 2 results (ug/kg)	Type of COC
PCBs	1,000	857.6	384.3	ARAR
DDT	1,620	1330.8	78.3	Eco
DDD	287	559.8	223.3	Eco
DDE	554	84.6	47.3	Eco
Dieldrin	68.4	69.6	46.7	Eco
Endrin	40	63.8	8.7	Eco
Heptachlor Epoxide	21	10.0	7.0	HH

COC – Constituent of Concern
ARAR – Applicable or Relevant and Appropriate Requirements
Eco – Ecological
HH – Human Health

Response to Comments
Draft Focused Feasibility Study, Acid Area 2
Former Plum Brook Ordnance Works, Sandusky, Ohio

Reviewer: Carol Lee Dona, USACE CX, Process Engineering

Comment 1: General: Agree with the evaluation of the alternatives and conclusions but recommend a different arrangement of some of the evaluation material, see Comment 2.

Response: The evaluation sections have been reorganized as suggested in comment 2.

Comment 2: General, Short Term and Long Term Effectiveness and Implementability Criteria: The reviewer found the FFS to be inconsistent within the FFS and incomplete with respect to EPA FS guidance with respect to these criteria. The following comments and recommendation apply:

a. **Section 5.4.6, Alternative 3, discusses the uncertainties in the effectiveness of the treatment under Implementability whereas Section 5.5.5, Alternative 4, discusses the uncertainties in the effectiveness of the treatment under Short-Term Effectiveness. Section 6.6, Comparative Analysis, discusses the uncertainties in the effectiveness in the treatments in Alternatives 3 and 4 under Implementability.**

Response: The uncertainties discussion has been placed in the "Short-Term Effectiveness" sections for all alternatives discussions

b. **Sections 5.5.3, 5.6.3, and 6.3, the Long Term Effectiveness and Permanence section for Alternatives 3 and 4, and the Comparative Analysis, do not include any discussion of the uncertainty in the effectiveness of the Alternatives 3 and 4 treatment technologies.**

Response: The uncertainty discussions have been included in sections 5.4.3 and 5.5.3 for alternatives 3 and 4.

c. **Relevant information from the EPA RI-FS guidance includes that under Long Term Effectiveness and Permanence the magnitude of residual risk is indicated, under Short Term Effectiveness, the time until remedial action objectives are achieved is indicated, and under Implementability, the technical difficulties and unknowns associated with the technology are indicated.**

Response: A risk magnitude discussion was added to section 5.3.3 for alternative 2 and it was verified that a risk magnitude discussion was provided in sections 5.4.3, 5.5.3, and 5.6.3. It was verified that the "Short-term Effectiveness" sections included time frames to complete remediation. It was verified that the "Implementability" sections included appropriate discussions on technical difficulties and unknowns.

d. **It is recommended that revision of the FFS be considered, with the uncertainties in the treatments in Alternatives 3 and 4 both covered in the individual Alternative sections under Implementability but the uncertainty in reaching remedial action objectives also indicated in the Short Term Effectiveness sections, and the uncertainties of potential residuals above cleanup levels (because of the uncertainties in the effectiveness of treatments) mentioned in**

the Long Term Effectiveness sections (the reviewer recommends a discussion similar to that included in Section 6.3 in the Draft Acid 3 FFS, also recently reviewed). It is noted that the FFS already includes a discussion of the increased cost that would be associated with any unexpected remediation effort required to reach remedial action objectives because of treatment effectiveness uncertainty.

Response: The uncertainties discussion in section 6.3 of the AA3 report has been included in the short term effectiveness section of the AA2 report.

Reviewer: Mary Johansen, USACE CX, Regulatory Compliance

Comment # 1: ES-1. Region 9 PRGs are from 2004. The current screening criteria should be utilized – EPA Regional Screening Levels, November 2011.

Response: The text has been changed to reference EPA Regional Screening Levels.

Comment # 2: Section 1.5.1 and 1.5.2 Correct the text. The CERCLA process for the identification of State ARARs is: The lead agency (USACE) formally requests potential ARARs from the support agency (the State) no later than the time at which site characterization data is available (completion of the RI). The support agencies are required to provide potential ARARs in writing to the lead agency within 30 working days of receipt of the request for ARARs. (See 40 CFR 300.400(g)(6). 40 CFR 300.515 (d) the 30 day requirement is in CFR 300.515 (d)(2) which leads to 40 CFR 300.515(h)(2).) By definition, only those state standards that are "identified by a state in a timely manner and that are more stringent than federal requirements" are ARARs. When identifying ARARs, the citation to the statute or regulation from which the requirement is derived must be included. The citation should specifically address "a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site". During the FS, the lead and support agencies must identify their ARARs related to specific actions no later than the early stages of the comparative analysis.

NOTE: It is recommended that USACE (with support from a knowledgeable regulatory compliance personnel and Office of Counsel) review the ARARs that are submitted and determine which ARARs are truly ARARs for this site. The USACE team will review and confirm the final list of ARARs and provide them to the contractor for inclusion in the proposed plan and the ROD. As the lead agency on non-NPL FUDS sites, USACE has the final decision on ARARs.

Response: The process described above has been included in the text.

Comment #3: Section 2.2 Correct the text. RAOs development needs to be consistent with EPA Guidance; not *Final TNT Areas A and C Remedial Investigation, Former Plum Brook Ordnance Works, Sandusky, Ohio, Volume 4 -Focused Feasibility Study for Soil and Sediment* (Shaw, 2003).

Response: The text has been revised to include EPA guidance, but the reference to the TNT Areas A&C RI will remain per direction from USACE LRN and LRH in order to remain consistent with prior negotiations with the OEPA.

Comment #4: Section 2.2 RAOs are medium- or operable unit-specific goals for protecting human health and the environment. RAOs should, at a minimum, specify

- **Contaminants of concern**
- **Exposure route(s) and receptor(s)**
- **Acceptable contaminant level or range of levels for each exposure route (i.e., a PRG)**

Add the numerical value to the RAO. This appears to be 2 mg/kg for Aroclor 1254/1260.

Response: The value is provided in section 2.2.3

Comment # 5: Section 2.2.3. Revisit this analysis. For Acid Area 2, the highest concentration of PCBs is 49 ppm. Acid Area 3 has PCB contamination above 50 ppm (at 55 ppm per the SI 1998, RI 2004-2006and FS 2008-2020). Are the sources for PCB contamination different from Acid Area 2 verses Acid Area 3? Was the PCB contamination released prior to April 18, 1978? If so, has the EPA Regional Administrator directed USACE to clean up this site because it poses an unreasonable risk? If not, then the site would be assumed not to present an unreasonable risk of injury to health or the environment. The regulatory rationale for cleaning up the site needs to be clearly laid out. When identifying potential ARARs for each remedial alternative, remember they are specific to the site, the contamination and the action. Separate the ARARs by alternative. They are not all the same. For each potential ARAR ask the following questions:

1. **Is the requirement "promulgated"?**
   a. **No guidance**
   b. **Legally enforceable (created by process set in law)**
   c. **Generally applicable (Not directed towards government cleanups)**
   d. **Not discretionary**
2. **Is the requirement related to a Fed/State environmental law or State siting law?**
3. **Is the requirement**
   a. **a cleanup standard,**
   b. **standard of control, or**
   c. **other requirement that specifically addresses a**
   - **CERCLA hazardous substance, pollutant, or contaminant**
   - **Remedial action**
   - **Remedial location**

4. **Is the requirement "substantive" rather than administrative/procedural?**
   - Substantive – Is it a numerical clean up standard or standard of control?
   - Admin/procedural – Is the requirement only for tracking, record-keeping, or regulatory use only?
5. ***a.* Is the requirement "applicable" to the project?, or**
   ***b.* Is the requirement similar to what is going on with the project (relevant and appropriate)?**

General issues with the current text – TSCA will be an ARAR if the concentration is above 50 ppm, or you make the argument that since Acid Area 3 is above 50 ppm and the sites are sufficiently similar: the source of PCB contamination is likely the same at both sites, etc. The PCB contamination is a result of an activity prior to April 18, 1978. The EPA

Regional Administrator has determined that the site poses an unreasonable risk and therefore requires clean up. Or, you have made a determination that (if) since TSCA applies at this site your waste meets the definition of PCB remediation waste – (does it?) and you are going to implement ONE of the THREE options discussed in the TSCA regulations for addressing PCB remediation waste. These are found in 40 CFR 761.61 (a), (b), and (c) as discussed below. Of these, (a) and (b) are potential ARARs, but (c) is not because it is strictly procedural, not substantive. It is important that the decision document should only identify only one of these subsections as the ARAR or a TBC.

Be sure you understand what an on-site requirement is and what an off-site requirement is. Unless you are storing hazardous waste on-site, 40 CFR 268 will be an off-site requirement and therefore, by definition, not be an ARAR.

Be sure you understand what is administrative and what is substantive. The majority of 40 CFR 262 are administrative requirements.

Since you have more than 3-5 ARARs in Tables 1-2, you have probably done the analysis incorrectly.

Response: The ARAR's tables have been removed and replaced by the following text insert in section 1.5.2: "The only ARAR identified is 40 CFR 761.61, identifying and properly managing soil that is a bulk PCB remediation waste."

Comment #6: Compliance with ARARs sections: 5.3.2, 5.4.2, 5.5.2, 5.6.2, 6.2 and Tables 1-1 and 1-2. Reevaluate the ARARs with a team familiar with ARARs (Counsel should be included). The ARARs should be specific to each alternative. The majority of ARARs listed in the tables are not actually ARARs for this site. One key misunderstanding seems to be on-site requirements verses off-site requirements. ARARs apply on-site; they are not identified for off-site requirements. Many of the ARARs listed are procedural and not substantive. To be an ARAR, the requirement must be substantive.

Response: The ARAR's tables have been removed and replaced by the following text insert in section 1.5.2: "The only ARAR identified is 40 CFR 761.61, identifying and properly managing soil that is a bulk PCB remediation waste."

Comment #7: Tables 1-1 and 1-2. ARARs should be identified for each alternative; not grouped together.

The ARAR's tables have been removed and replaced by the following text insert in section 1.5.2: "The only ARAR identified is 40 CFR 761.61, identifying and properly managing soil that is a bulk PCB remediation waste."

Comment #8: Tables 1-1 and 1-2. Also, this reviewer disagrees with the footnote. The table citation should clearly define the requirements, criteria, or limitations under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site.

Response: The tables have been removed since there was only one ARAR

Reviewer: Chung-Rei Mao, USACE CX, Chemistry

Comment 1: Page 3, Section 1.3, last paragraph: Suggest that discussions of PAHs and metals contamination similar to that of PCBs contamination presented in Section 1.3 be provided and also the rationales for not further considering them as described in the fourth paragraph of the Executive Summary be provided.

Response: The requested summary has been added.

Comment 2: Page 5, 2nd to the last paragraph: Please provide the reference for the potential source of bromomethane from off-gassing of o-rings.

Response: The reference to SW846/5030B, Section 3.1 has been added to the text. Section 6.2.5 of method 5030C also describes some potential trap decomposition leading to the formation of bromomethane and chloromethane, which can be caused by salt contamination. Additionally, bromomethane and chloromethane contamination in lab blanks (for no reason) is a common occurrence. As is often the case with low level contamination, it is inconsistent and may not show up in a blank but will show up at low levels in sample. This is also true with Methylene Chloride.

Comment 3: Page 16, Section 3.2.2, 1st paragraph, 2nd sentence: Please check if the "high surface energies" is a mistake of "high surface area".

Response: High surface energy is correct. This refers to the intermolecular bonds that occur on the surface of a substance. High surface energy means that the molecules on the surface have more energy compared with the molecules in the bulk material.

Comment 4: Page 17, Section 3.2.3, 2nd paragraph, 2nd sentence: The chemical symbol for sulfate free radical should be "$SO_4^{-\bullet}$".

Response: The symbol has been revised.

Comment 5: CDQR (4/2011), Page 1-2, Section 1.2.1: The information regarding the approval of project analytical laboratory is way out of date. Please reference for the DoD Environmental Laboratory Accreditation Program in the future (http://www.denix.osd.mil/edqw/Accreditation/index.cfm).

Response: Empirical Laboratories is ELAP certified. The first paragraph of Section 1.2.1 has been updated as follows: "The analytical laboratory employed on this project was originally evaluated by the USACE Hazardous, Toxic, and Radioactive Waste - Center of Expertise (HTRW-CX) and held a current letter of validation from HTRW-CX to perform sample analyses in support of the USACE HTRW Program. Subsequent to this certification, the laboratory has since received and maintains current Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) certification. These validations confirm their ability to produce reliable and defensible data."

Comment 6: CDQR (4/2011), Page 1-3, Section 1.2.3, 2nd bullet and Page 1-4, Section 1.2.4: USACE ME 200-1-3 has be rescinded and "Shell for Analytical Chemistry Requirements" has long been replaced with DoD "Quality Systems Manual for Environmental Laboratories (QSM)", Version 4.2 (http://www.denix.osd.mil/edqw/upload/QSM-V4-2-Final-102510.pdf). This project needs to update all Chemical Data quality Management Requirements and documents for future works accordingly.

Response: Comment noted. All future work done on this project will be performed following the latest version of the QSM. Note that the samples were collected and analyzed before QSM Version 4.2 was promulgated; results from November 2009 forward follow QC limits outlined in QSM Version 4.1 (which for PCBs are essentially the same as Version 4.2). Work performed prior to that date followed QC limits outlined in the 2004 Plum Brook QAPP.

Comment 7: CDQR (4/2011), Page 1-3, Section 1.2.3.1: Empirical Laboratories, Nashville, TN is currently validated for Methods 3546 and 3550, but not Method 3541or 3540C and should not be allowed for preparation of soil PCB samples with Method 3540C. Also, this report should include detailed discussions of the modifications of Method 3540C and impacts on data precision, bias, and sensitivity, and a copy of the written approval of the modification from the Nashville District. A DoD Environmental Laboratory Accreditation Program (ELAP) accredited lab that is accredited for all project-required analytical methods should be used in the future.

Response: Method 3540C (Soxhlet Extraction) was the extraction method listed in the approved 2004 Plum Brook QAPP. In 2010, the laboratory changed the extraction method from the Soxhlet Method to microwave digestion (3546), which was approved by the USACE on 7 September 2010. If Empirical is used for future work, they will extract the PCB samples using the approved microwave digestion method 3546. Empirical Laboratories is currently DoD ELAP accredited for Microwave Digestion (SW846/3546). As any future work at Plum Brook will require updating the QAPP, the ELAP approved microwave digestion procedure will be added in lieu of the Soxhlet Extraction listed in the current QAPP. As noted, the lab is currently using the microwave digestion procedure.

Comment 8: CDQR (4/2011), Page 1-4, Section 1.2.4, Data Verification Process, Data Quality Parameters: The acceptance criteria for field and laboratory QC samples should comply with the DoD QSM, Version 4.2. Because the specified QC acceptance criteria for QC samples did not comply with the DoD QSM, Version 4.2, detailed review comments on QC samples will not be prepared here. In addition, if this report addresses both data quality and data usability, a section dedicated on Data Validation should also be included.

Response: These samples were collected and analyzed before the promulgation of the DoD QSM V 4.2. The QC criteria for these samples were originally listed in the Plum Brook QAPP, and were updated to follow the limits in the DoD QSM V 4.1 with the November 2009 sampling event (recovery limits and RPD values are not different for PCBs between the two versions).

The data validation procedures are described in Section 1.2.4 under the title "Data Evaluation Procedure". The first paragraph has been updated as follows: "The quality of this data has been evaluated following the "data verification/data validation" procedure included in the QAPP as Step 2 of the five-step USACE DQA process. The procedure was derived from the USACE "Shell for Analytical Chemistry Requirements" and the USACE Engineering Manual EM 200-1-10 "Guidance for Evaluating Performance-Based Chemical Data" and considers the project DQOs, project QAPP guidance, DoD Quality Systems Manual Version 4.1 guidance, QC requirements of the analytical methods, and informed professional judgment of the evaluator. Qualified Jacobs' personnel, experienced in the evaluation of analytical data quality, performed data evaluation."

Comment 9: CDQR (4/2011), Page 4-1, Sections 4.1.1.1 & 4.1.1.2: The acceptance criteria and control limits of all QC samples should be clearly stated in the CDQR and listed in associated Tables. For example, what were the acceptance criteria and control limits on the RPDs of field duplicates of PCB soil samples and laboratory duplicates of LCS/LCSD and MS/MSD? Similar comments apply to the assessments of data accuracy (bias) in Section 4.1.2.

Response: Prior to the November 2009 sampling event, acceptance limits are listed in the 2004 Plum Brook QAPP or default to the laboratory limits; for the November 2009 sampling event going forward, QSM limits (Version 4.1) were followed. Therefore, explicit acceptance ranges are not listed in the CDQR; however in the case of high LCS and MS/MSD recoveries, the text does state that the recoveries are greater than the upper control limit of 125 percent. Recovery limits for MS/MSD and LCS samples have been added to the appropriate tables.

The RPD value for the field duplicate samples is 50 percent. This value is listed in Section 4.1.1.1, and the calculated RPD values are listed in the table. As noted above, the laboratory was using Plum Brook specific QAPP approved limits until November 2009, when they began using the QAPP V 4.1 limits. The QAPP V4.1 limits were, in general, tighter than the original QAPP limits. For instance the surrogate recovery for DCB in 8082 soil samples was 35 – 140 prior to the adoption of the QSM limits, and 60 – 125 subsequent to the adoption of the limits. As requested above, the QAPP and associated limits will be updated to comply with QSM V 4.2 for any future work done at Plum Brook, which will involve a reevaluation of limits vs the QAPP and project specific limits.

Comment 10: CDQR (4/2011), Table 4-3: The number of days exceeding the sample holding times should be listed for individual samples in the future. Also see Comment 9 above.

Response: A column for the number of days exceeding the extraction hold time has been added to Table 4-3, as requested.

Reviewer: Sam Bass, USACE CX, Geology

Comment # 1: Page 3, Section 1.3, General comment. To be consistent with EPA guidance on completing a Feasibility Study, recommend the document include a brief discussion of contaminant fate and transport for PCBs. The discussion does not need to be detailed but should give some context to the difficulty of remediating PCBs. The discussion could include generic information such as PCBs are not mobile, generally don't dissolve, tend to sorb to soils, etc. If PCBs need to be in dissolved phase for effective remediation this point should be noted also.

Response: The requested summary of fate and transport has been added.

Comment # 2: Page 9, Section 2.1. The description of risk-based remediation levels (RBRLs) sounds remarkably similar to a remediation goal. The use of the term is confusing. Consider eliminating the term and using the more commonly-used term of remediation goal (RG). If the term RBRL is unique to Plum Brook Ordnance Works sites then say that in the document and attempt to more clearly explain the term "RBRL", e.g., are RBRLs a subset of RGs, or are RBRLs only derived in the absence of ARARs? The public is not going to understand the current discussion.

Response: The text has been revised to address RBRLs as a subset of the RGs.

Comment # 3: Page 12, Section 2.3, second paragraph, third sentence. This sentence states the remediation goal for PCBs is 1 mg/kg. However, according to text in the previous section the cleanup goal for combined PCBs is 2 mg/kg. Please clarify the document or avoid using the generic term "PCBs" when only one PCB (Aroclor 1254 or 1260) is intended.

Response: The referenced RG was corrected to reflect 2 mg/kg.

Comment # 4: Page 15, Section 3.2, last paragraph. Dewatering, trenching, and shoring costs are not a factor for a remedy that excavates the upper 18 – 36" of soil. Consider deleting these additional costs from ex-situ remediation.

Response: The referenced criteria has been removed

Comment # 5: Pages 17 and 18, Section 3.2.4, General comment. Zero-valent magnesium (ZVMg) has been shown to be successful at reductively dechlorinating PCBs, at least from PCBs found in caulk and in paints/coatings. ZVMg is marketed under license from NASA as the Activated Metal Treatment System (AMTS). RemQuest holds a license for AMTS and may be working on developing the technology for use in soils. Recommend you contact RemQuest or other license holders to determine if the technology has been implemented in soils contaminated with PCBs.

Response: Information obtained from RemQuest has been included in this section. Unfortunately this technology is not economical or practical and may not effectively reduce PCB concentrations below 2 mg/kg in soil at Plum Brook.

Comment # 6: Page 19, Section 3.2.6, second sentence on page. This sentence is speculative and assumes that high metals concentrations are an issue at the Plum Brook site, which we know is not the case based on previous discussion in the FS. Rather than make a blanket statement that may not apply to site conditions and may eliminate a technology from further consideration, recommend the statement be deleted or at least made site-specific. The same comment applies to the statement regarding availability of water and electricity at Plum Brook, found in Section 3.2.8 on the same page.

Response: The reference to high metals concentrations has been removed, however cost and complexity of the process was the discriminating factor in not considering this technology.

Comment # 7: Section 4, General comment. While enhanced bioremediation or chemical reduction may not be capable of remediating all PCBs present at the site by themselves, it may be possible for lower PCB concentrations to be successfully treated. Recommend a hybrid alternative be developed that considers a combination of in-situ treatment of lower concentrations of PCBs along with excavation and off-site disposal of higher concentrations of PCBs.

Response: A combination alternative is not warranted. The rationale for not including a hybrid of alternative 2 with either alternative 3 or 4 is based on cost. Alternative 2 has a lower cost than alternatives 3 and 4 for Acid Area 3 and a lower cost than alternative 3 at Acid Area 2. Alternative 4 is $9,000 less expensive than Alternative 2 at Acid Area 2. Given the uncertainties discussions and the associated costs with these uncertainties the cost benefit of alternative 2 could be significantly greater. If a combination of alternatives were considered the cost per ton of soil would increase significantly for the alternatives 3 and 4 components because of the set-up and equipment costs would remain the same for a smaller amount of soil. It is clear that the overall cost for a combination alternative would be significantly higher than Alternative 2.

Comment # 8: **Section 4, General comment re: verification sampling to be performed at all sites. The text defines a grid sampling approach for verification samples (samples would be collected from the excavation floor on 50 ft grid centers with increments collected on 25 ft grid centers; excavation wall samples would be collected every 25 linear ft of excavation wall), then states incremental sampling methodology will be incorporated. In order for incremental sampling to be used there must be an equal probability that all soil particles will be included in a sample, i.e., using a fixed sample spacing automatically means that soils found at distances other than 25' from an increment will be excluded. Also, use of only 4 increments to comprise a single incremental sample will most likely result in an underestimation of the mean. You cannot do both incremental sampling and fixed-grid sampling. If you need more information on incremental sampling please call me at 402-697-2654 or work with the USACE representative to obtain additional information on incremental sampling. This comment applies to all discussions of incremental sampling found in the FS.**

Response: The text has been revised to indicate 30 – 100 incremental samples be collected per unit area as described in the USACE, Interim Guidance 09-02, published by the CX. The unit area for floor sampling has been revised to a 20' x 20' area, and the unit area for wall sampling has been revised to 20 linear feet, as currently being used elsewhere at the site, based on prior negotiations with OEPA. The cost estimate sheets for verification sampling have been revised accordingly.

Comment # 9: **Page 31, Section 5.4.3. Please include a discussion of the expected permanence of the remedy.**

Response: Text discussing permanence has been added.

Comment # 10: **Page 32, Section 5.4.7. It is unclear why increased application time would result in increased cost. Are you talking about time for <u>application</u> of the MuniRem or treatment time AFTER application? If the former, then yes I see extra cost. If the latter, extra cost would be minimal as there would be other things to do on site while waiting for treatment to complete (such as working at Acid Area 3 with similar technology). Please clarify the document.**

Response: This is referring to extra treatment time. The text has been changed from "application" to "treatment".

Comment # 11: **Page 33, Section 5.5.4. I don't believe enhanced bioremediation is a chemical oxidation process as discussed in this section. Please clarify the document.**

Response: The text has been revised to reference enhanced bio-remediation

Comment # 12: **Page 33, Section 5.5.5. For Muni-Rem (Alternative 3) it was recommended that the pilot study be done prior to the Proposed Plan. Why is a pilot study not recommended for enhanced bioremediation prior to the Proposed Plan? Recommend a similar process be used for bioremediation as for MuniRem.**

Response: The same recommendation has been made for the bioremediation alternative.

Comment # 13: **Page 35, Section 5.6.5. There are also inherent hazards associated with operation of an incinerator that should be recognized. These would not necessarily be covered by a site-specific Health and Safety Plan as the risks exist off-site at the incinerator.**

Response: Agree

Comment # 14: Page 36, Section 6.4. "Destroy" would be a better word than "remediate" in this context, as dig-and-haul also permanently remediates PCBs relative to the site.

Response: The suggested change has been made.

Comment # 15: Page 37, Section 6.6. I think field-scale pilot studies would be more appropriate to address concerns regarding reagent distribution, mixing, etc., in the field rather than a bench-scale study. This would apply to both Alternatives 3 and 4.

Response: The text has been revised as suggested.

Reviewer: Larry Tannenbaum, US Army, Health Risk

1. **Page 6, Section 1.4.2, L. Tannenbaum**
   Ecological Risk Assessment
   Comment: The text provides too brief an account of the site reconnaissance effort that allowed for a conclusion of "no definitive absence of biota or animal life in areas expected to support these ecological components."
   Recommendation: Please ensure that the document revision indicates: a) over how many days the reconnaissance extended, b) what animal forms were expected to reside at or occupy the site, c) how the 'no definitive absence' determination was made, and d) how much less of a biota presence from the anticipated arrangement (or from the arrangement at a nearby habitat-matched reference location) signifies a stress or impact condition.

Response: The requested information is available in the Acid Area 2 Screening Level Ecological Risk Assessment.

2. **Page 6, Section 1.4.2, L. Tannenbaum**
   Ecological Risk Assessment
   Comment: The section's fourth paragraph is problematic for several reasons. In the third sentence, was "NOAEL" intended as opposed to "NOEL"? The text is correct that hazard quotients (HQs) above 1,000 are "considered unrealistic and toxicologically impossible", but a reference should be supplied for that (specific) language. Finally, the paragraph's last sentence (about HQs), true as it is, is redundant; the previous sentence makes the same point and in a more accurate and pronounced way.
   Recommendation: Please replace "NOEL" with "NOAEL" if indeed there is a text error. Please supply the reference that is provided below to embellish the comment's highlighted quotation re high HQs. Please delete the fourth paragraph's last sentence. See next comment.

Reference: Tannenbaum, L.V., Johnson, M.S., and Bazar, M., 2003. Application of the Hazard Quotient Method in Remedial Decisions: A Comparison of Human and Ecological Risk Assessments. Human and Ecological Risk Assessment, Volume 9 (1): 387-401.

Response: The text has been revised as requested and the reference has been added.

3. **Page 7, Section 1.4.2, L. Tannenbaum**
Ecological Risk Assessment
__Comment__: A modification is needed for the last sentence of the page's carry-over paragraph (which mimics the last sentence of an earlier paragraph). Also, the text of the page's first full paragraph is quite problematic for the screening level ecological risk assessment (SLERA) that was done. In acknowledging the many uncertainties associated with the Hazard Quotient (HQ)-based ERA process, the text is communicating that there was no point in following it. By way of example, the HQs above 100 for the mallard are simply dismissed. With this kind of reporting, the document is effectively saying that there is no point in applying the HQ process because however large the computed HQ values might be, these can and will be overlooked. We agree that the HQ methodology is fundamentally flawed (see previous comment and the necessary reference to supply). If it was known *a priori*, that HQs above 1 will be dismissed (which is the case here), and that other arguments will be used instead to decide the health risk questions concerning site biota (such as the site offering poor quality habitat), then HQs should have never been computed. The text has the effect of letting readers know that they have been deceived, and this is unacceptable.
__Recommendation__: Please reword the identified sentence as: "As indicated earlier, estimated HQs . . ." Ensure that all references to HQ computation are removed from the SLERA reporting. Endeavor to have the subject document openly state that the site doesn't truly submit to ecological risk assessment because it has only limited and poor quality habitat to afford ecological receptors.

Response: The text has been revised as requested.

4. **Page 10, Section 2.2.2, L. Tannenbaum**
Methods for Derivation of AA2 Cleanup Goals
__Comment__: There is a problem in having set the target risk level ("TR") to 1E-5, i.e., a risk of one-in-100,000. This arrangement suggests that the trigger level for cancer risk-based remedial action is 1E-5, when for the Army it is 1E-4. Note that in the first sentence of Section 2.2.3 (page 11), the text makes clear that it only wanted to consider a target risk level of 1E-5.
__Recommendation__: For the document revision effort, please generate risk-based remediation levels that correspond to 1E-4, 1E-5, and 1E-6 as is traditionally done.

Response: The PBOW ILCR goal of 1E-5 ILCR has been used at PBOW by the Project Delivery Team (PDT) to guide remediation for approximately 10 years. To date, three signed decision documents have been based on this goal, each of which has received a letter of State concurrence with the remedy. Each of the these decision documents have received multiple reviews by USACE legal counsel, including counsel from the Huntington District, Louisville District, and the USACE Center of Expertise in Omaha. The use of this goal in the current document is thus consistent with site management practices employed by DOD at PBOW. Please note that mention of the NCP range is used throughout the document, along with the 1E-5 ILCR goal.

This 1E-5 cancer risk value was selected based on State of Ohio guidance (OEPA, 2009), which states "Many Divisions and Programs within Ohio EPA are currently operating using a fixed human health risk goal, rather than the risk range provided in the NCP. The Division of Hazardous Waste Management and the Division of Surface Water have adopted a fixed carcinogenic risk goal of 1E-5... The DERR Remedial Response program has adopted a human health cumulative excess lifetime carcinogenic risk goal of 1E-5 and a cumulative non-cancer hazard goal equal to a hazard index (HI) of 1, for all receptors and land uses. These goals are to be used as both the level of acceptable excess cancer risk or non-cancer hazard and for the development of remediation goals for a site. ... The adoption of a single risk goal will help ensure consistency in site evaluation, remedy selection, and site cleanup, and is within the NCP acceptable risk range." In addition, the 1E-5 criterion is a requirement in the Ohio Voluntary Action Program (VAP) which is codified in Ohio Administrative Code 3745-300-09(B)(1) for property-specific risk assessments.

Reviewer: Walter Roberts, CX, Counsel

Comment # 1: This review incorporates and is subject to the reviews by the following CX reviewer: Mary Johanson.

Response: Comment Noted

Comment # 2: The DERP Management Guide, DODM4715.20, 9 March 2012, 4.b.(5)(b)1. requires that an alternative be considered where the site is brought to a safe condition through the use of land use controls, either alone or in conjunction with other remedies.

Response: Land use controls were considered and would have been part of an alternate for the groundwater component, but there is no groundwater risk present. Land use controls for the soil were considered but were screened out as not being effective and implementable as the property is owned by GSA and under control of NASA. Likewise, tracts of the property are being considered for access back to GSA and the overall goal is to return the property to unrestricted use. This is also consistent with NASA's plan and actions for other remedial sites at Plum Brook, such as the Reactor Area.

Comment # 3: ES-3, 2nd para, 1st line – Change "inexpensive" to "expensive"

Response: The text has been corrected

Comment # 4: 1.5.1., 2nd para, last word – Change "wastes" to "substances"

Response: The text has been revised

Comment # 5: 1.5.2., 1st para, 1st line – Delete "and State of Ohio" State requirements proposed as ARARs must be proposed by the state – not USACE or its contractors.

Response: The State of Ohio did provide proposed ARARs which were reviewed. The text has been revised to reflect the state provided ARARs

Comment # 6: 1.5.2., 1st para, 2nd sentence – Delete.

Response: The sentence has been removed.

Comment # 7: 2.2., bullet – Add "adverse" before "residential"

Response: The qualifier “adverse” has been added.

Comment # 8: 4.2., page 23, last para – Delete except for last sentence. Why say this when you could have a similar paragraph for a 100 other laws (e.g. Even though there are no known endangered species at the site, every animal seen or impacted will be documented as to its endangered status and if on the endangered list will be protected to the maximum extent.)

Response: The paragraph has been removed.

Comment # 9: 4.2., page 24, last para - Delete last sentence. ARARs are not “potential” at this point. ARARs must be specifically identified to ensure transparency and mutuality of review. Some of these are applicable only to general construction projects rather than specifically to this remedial process or to this contaminant. Some are clearly not relevant.

Response: The sentence has been removed.

Comment # 10: 4.3., page 25, last sentence – Delete. ARARs are not “potential” at this point. ARARs must be specifically identified to ensure transparency and mutuality of review. Some of these are applicable only to general construction projects rather than specifically to this remedial process or to this contaminant. Some are clearly not relevant.

Response: The sentence has been removed.

Comment # 11: 4.4., last sentence – Delete. ARARs are not “potential” at this point. ARARs must be specifically identified to ensure transparency and mutuality of review. Some of these are applicable only to general construction projects rather than specifically to this remedial process or to this contaminant. Some are clearly not relevant.

Response: The sentence has been removed.

Comment # 12: 4.5., last sentence – Delete. ARARs are not “potential” at this point. ARARs must be specifically identified to ensure transparency and mutuality of review. Some of these are applicable only to general construction projects rather than specifically to this remedial process or to this contaminant. Some are clearly not relevant.

Response: The sentence has been removed.

Comment # 13: 5.1.1., 1st bullet, 3rd line – Change “the extent to which” to “whether”

Response: The suggested change has been made

Comment # 14: 5.1.1., 2nd bullet, 5th line – Delete “or circumstances”

Response: The text has been deleted

Comment # 15: 5.2.2. – Delete present sentence, which relates to the first criteria, and substitute a statement as to whether the NAA meets ARARs, which is the criteria identified as the subject of this section.

Response: The section has been revised

Comment # 16: **5.3.2. – Delete everything after “1-1 and 1-2”**

Response: The text has been deleted.

Comment # 17: **5.3.6. , last para – Delete.**

Response: The text has been deleted.

Comment # 18: **5.4.1. – This says that it is unknown whether this alternative would be protective. Why are we wasting time looking at an alternative that does not meet the mandatory threshold requirement? Either delete 5.4. as an alternative or revise it so as to make it protective.**

Response: This is an emerging technology with some hopeful promise of being successful, however it must be field tested. This alternative has been chosen based on potential. The uncertainty must be addressed here.

Comment # 19: **5.4.2. – Delete everything after “1-1 and 1-2”**

Response: The text has been deleted.

Comment # 20: **5.5.2. – Delete everything after “1-1 and 1-2”**

Response: The text has been deleted.

Comment # 21: **5.6.2. - Delete everything after “1-1 and 1-2”**

Response: The text has been deleted.

Comment # 22: **6.2. – Delete 1st sentence after “ARARs”**

Response: The text has been deleted

Comment # 23: **6.1. – The write-up does not address the question here. Rewrite as follows:**

Alternative 1 does not employ removal, containment, or remediation actions and therefore would retain the unsafe levels of PCBs that would endanger residential receptors in the future. It fails to provide protection of human health. It does not present a danger to the environment. Alternative 2, Excavation and Off-Site Disposal, would remove the contaminated soil from AA2 and dispose of this soil at a local permitted off-site disposal facility. This would make the site protective for human health and the environment. Alternatives 3 and 4, by treatment of the contamination to reduce the contamination to safe levels, would leave the site protective of human health and the environment. Alternative 5, Incineration, would remove the contaminated soil from AA2 and burn away the unsafe levels of PCBs, which would protect human health and the environment and permanently reduce the risk through contaminant destruction.

Response: The text has been revised as suggested.

Comment # 24: **6.4., 5th line – Delete "if successfully implemented" If we have significant doubts about the effectiveness of these alternatives to the point they will not be considered protective we need to discuss that up front and exclude them as alternatives for consideration. If we include them as alternatives, we cannot constantly call their validity into question.**

Response: Please see response to comment 18.

Comment # 25: **6.6. - We are confusing the separate CERCLA criteria here. Need to keep discussion focused on implementability. If there are issues with effectiveness, that should be discussed in that section. Change as follows:**

There is no implementation involved with Alternative 1. There are no appreciable technical, operational, or administrative difficulties anticipated for implementation of Alternatives 2 and 5. Because of uncertainties associated with an emerging technology as well as site-specific implementation challenges at AA2, implementation of Alternative 3 may be difficult . While Alternative 4 has been demonstrated at another site, it is not certain if the enhanced bioremediation technology would be easily implemented at AA2. Both Alternatives 3 and 4 may also require specific soil handling procedures. Alternative 3 may require the use of smaller lifts, additional tilling, additional residence time, and soil wetting. Alternative 4 may require an increase of amendments, additional residence time, and stop-work conditions during the winter months. In order to manage this uncertainty, a bench-scale study is recommended prior to finalizing the proposed plan to determine the most effective process parameters.

Response: The text has been revised as requested; however, the uncertainties discussion was moved to Section 6.5 based on other reviewer comments.

Comment # 26: **6.7., 2nd para, 3rd line – What is "R.S."?**

Response: R.S. Means is the name of a cost estimating book.

Comment # 27: **General – I cannot find anywhere in this document which discusses the evidence we have of DOD actions that led to the contamination of PCBs at this site. Identify that language or modify the document to provide.**

Response: Additional text was added at the end of section 1.2.1 to indicate that NASA has not used the Acid Area facilities since the Army dismantled the facilities in 1962.

Comment # 28: **Table 1-1 ARARs - In addition to the comments Mary Johanson has made, please consider these observations.**

a. Wetlands – There was no information in the FS to indicate that jurisdictional wetlands were on-site. Delete as an ARAR or justify the relevance.

Response: The ARARs tables have been deleted and wetlands issues are no longer addressed

Comment # 29: **Table 1-2 ARARs - In addition to the comments Mary Johanson has made, please consider these observations.**

a. OAC 3745-15-07– There was no information in the FS to establish the relevance of this requirement. Specifically discuss the facts of the particular alternative that would make this provision applicable or relevant. (or Delete)

b. OAC 3745-17-08(B) - There was no information in the FS to establish the relevance of this requirement. Specifically discuss the facts of the particular alternative that would make this provision applicable or relevant. (or Delete)

c. OAC 3745-17-08(B)(1) to (9) – Delete. These would never be ARARs as they are merely options an entity can take to appropriately comply with OAC 3745-17-08(B). They do not include a standard or other requirement.

d. All other requirements in Table 1-2 unless mentioned specifically otherwise. These requirements deal with solid and hazardous wastes. However, PCBs would not constitute a hazardous waste under RCRA but a substance regulated under TSCA. As such, these requirements do not seem relevant to this FS. Further, determination of waste or hazardous waste requirements are never ARARs as they do not provide a standard of control.

e. 40 CFR 261.1 and 40 CFR 261.4 and 40 CFR 761.79 and equivalent state provisions all deal with the discharge of wastewater. There was no information in the FS to establish the relevance of this requirement. Specifically discuss the facts of the particular alternative that would make this provision applicable or relevant. (or Delete)

f. 40 CFR 761.61 seems to be appropriate and relevant from a cursory review (at least a portion of it)

g. 40 CFR 761.79(b)(3)(i)(B) - There was no information in the FS to establish the relevance of this requirement. Specifically discuss the facts of the particular alternative that would make this provision applicable or relevant. (or Delete)

h. 40 CFR 761.61 (b)(1) or (b)(2)(ii) or (c) all seem to be relevant only to off-site disposals. ARARs only apply on-site. There was no information in the FS to establish the relevance of this requirement on-site. Specifically discuss the facts of the particular alternative that would make this provision applicable or relevant on-site. (or Delete)

Response: The ARARs tables have been deleted

REVIEWER: Dr. Janusz Z. Byczkowski, OEPA, Risk Assessment

Comment 1, S.2.2.3, P. 12, L# 3, <u>This document states:</u> "*...the RG for Aroclor 1254, the cancer-based cancer based effect of Aroclor 1254 contribute to...*" <u>Comment:</u> There seems to be a typo in this line.

Response: The typo has been removed.

Comment 2, S. 7.0, P. R-1, L# 32 <u>This document states:</u> "*...ITRC, 2005. Technical and Regulatory Guidance for In-situ Chemical Oxidation* [...] <u>http://www.itrcweb.org</u>. *71 p ...*" <u>Comment:</u> There is no such a document at this URL. It is also not clear, what is the meaning of quote "71 p". The page # 71 of actual 2005 ITRC guidance contains only several Internet addresses, including the URL "<u>http://www.itrcweb.org</u>", which would make this reference circular.

Response: The web address has been revised and is working. The document is in PDF format and is 71 pages not including appendices.

Comment 3, S. 7.0, P. R-2, L# 19 <u>This document states: </u>"…*Myers, T.E. and Bowman, D.W., 2000.* […] *http://www.erdc.army.mil/el/dots/doer/ …"* and then "*Meyers, T.E., and Horner, P., 2003.* […] *http://www.erdc.army.mil/el/dots/doer/* …" <u>Comment: </u>This URL returns "server not found" error message.

Response: The web addresses have been revised and verified to connect to the referenced documents.

Comment 4, S. 7.0, P. R-2, L# 25 <u>This document states: </u>"…*Mikszewski A., 2004* […] *www.clu-in.org , 30 p…*"
<u>Comment: </u>There is no such a document at this URL. It is also not clear, what is the meaning of quote "30 p". There is no page # 30 in *Mikszewski 2004* publication (available at URL http://www.clu-in.org/download/studentpapers/bio_of_pcbs_paper.pdf). The text is only 26

Response: The PDF is 30 pages but the actual document is 26 pages, page count has been revised. The web address has been removed from the reference. A google search of the document title provides a successful link to the PDF, however typing in the actual address provided by the link does not work.

Comment 5, S, 7.0, P. R-3, L# 14 <u>This document states: </u>"…*USDHHS and ATSDR, 1993.* […] *http://www.atsdr.cdc.gov/HAC/PCB/b_pcb_to.html#foreword* …" <u>Comment: </u>This URL returns "**The page cannot be found**" error message.

Response: The web address has been revised and verified to access the referenced material

Comment 6, S.7.0, P. R-3, L# 31 <u>This document states:</u>
"…USEPA, 2000. […]http://www.epa.gov/region4/waste/ots/healtbul.htm …" <u>Comment: </u>This URL returns "**The requested item was not found on the EPA'**

Response: The web address has been removed from the reference. A google search of the document title provides a successful link to the PDF, however typing in the actual address provided by the link does not work.