



Addendum for Feasibility Study Acid Area 1 FUDS Project No. G05OH001823 Updated Cost Tables

Former Plum Brook Ordnance Works Sandusky, Ohio

G05OH001823_04.09_0503_a
200-1e

**US Army Corps
of Engineers**
Nashville District





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December 4, 2014

U.S. Army Engineer District, Nashville
ATTN: CELRN-EC-E (Ms. Paula Coleman)
110 Ninth Avenue South, Room 682
U.S. Court House Annex
Nashville, Tennessee 37203

**Subject: *Submittal of the Final Addendum to the Feasibility Study
Acid Area 1
DERP-FUDS Project No. G05OH001823
Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio
Contract No. W91278-10-D-0094: Shaw Project Number 141429***

Dear Ms. Coleman:

In accordance with the requirements of Delivery Order No. DX03 of Contract No. W91294-10-D-0094 awarded to CB&I Federal Services LLC, we are pleased to submit this Final Addendum to the Feasibility Study for Acid Area 1 at the Former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio. This addendum provides updated cost tables. The updates were prepared to capture the recent experience of the U.S. Army Corps of Engineers in remedial technologies that were evaluated as part of the feasibility study. The updates affect only the costs and durations of the remedial alternatives.

Enclosed are four copies for your records. Copies have also been sent to those on the distribution list for their review.

Should you have any questions or require additional information regarding this submittal, please do not hesitate to contact me at (865) 694-7496.

Sincerely,

Steven. T. Downey, PE, PMP
Project Manager

Please Reply To: Steven T. Downey

Phone: 865 694 7496

E-Mail Address: Steven.Downey@CBIFederalServices.com

Distribution List

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DISCIPLINE SIGN-OFF REVIEW

Client Name: U.S. Army Engineer District, Nashville; CELRN-EC-E

Project Description: Addendum to Feasibility Study, Acid Area 1: Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract No. W 9 1 2 7 8 - 1 0 - D - 0 0 9 4

Delivery Order No. D X 0 3

Project No. 1 4 1 4 2 9

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NOTICE: By signature above, parties certify that the subject document has been prepared by and/or reviewed by them (as appropriate), that all review comments have been resolved, and that the document is ready for submittal.

**Addendum to the Feasibility Study for Acid Area 1
FUDS Project No. G05OH001823
Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio**

This Addendum to the Final Feasibility (FS) for Acid Area 1 (Shaw Environmental & Infrastructure, Inc., 2013) was prepared to update the costs and remedial durations for the remedial alternatives presented in the FS for this Formerly Used Defense Sites (FUDS) project. Updated cost tables are attached. Other than the costs and durations, the remainder of the previous FS is unchanged. The remedial costs and durations were updated to capture the U.S. Army Corps of Engineers' recent experience in remedial operations. The updated remedial costs and durations will be used in the proposed plan and decision document for this FUDS project. These values are summarized in the following table.

Alternative No.	Description	Cost	Duration (Months)
1	No Action	\$0	0
2	Excavation and Off-Site Disposal	\$5,800,000	21
3	Excavation, Chemical Oxidation, and Off-Site Disposal	\$6,100,000	26
4	Excavation, Off-Site Incineration and Disposal	\$29,000,000	21

Additional soil samples were collected and analyzed for total lead and toxicity characteristic leaching procedure (TCLP) to verify that the soil was not hazardous with respect to lead for disposal purposes. The results of these TCLP samples indicate that the soil is not hazardous. The total lead and TCLP analytical results of these samples are provided in Attachment Table A-1. The sample locations are shown on Attachment Figure A-1. The sample collection logs are included as Appendix A-1, the data quality evaluations for these samples are provided as Appendix A-2, and the chain of custody is provided as Appendix A-3.

Reference:

Shaw Environmental & Infrastructure, Inc., 2013, *Feasibility Study, Acid Area 1, FUDS Project No. G05OH001823*, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, April.

**UPDATED COST TABLES FOR
ACID AREA 1 FEASIBILITY STUDY**

Table 4-1

**Alternative 2 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 1 of 6)

Alternative 2 Excavation and Off-Site Disposal		Site: Acid Area No. 1 Plum Brook Ordnance Works	
		Date: 10/20/2014	
Scope:			
1. Prepare work plan, H&S plan, materials list, and procurement along with the final report			
2. Mobilize/demobilize equipment and personnel.			
3. Prepare site for remedial activity.			
4. Excavate contaminated soil, perform confirmation sampling & characterize waste.			
5. Off-site disposal.			
6. Site restoration.			
7. Demobilize equipment and personnel.			
1.0 Work Plans and Procurement			
Includes:			
1. Labor to generate work plans, including engineering specifications and Health and Safety Plan, along with the Final Report.			
2. Procure equipment and materials.			
	Service	Unit	Unit Cost
	Work Plans and Final Report	1	\$90,000.00 /ls
	Procurement	1	\$10,000.00 /ea
			Subtotal
			\$90,000.00
			\$10,000.00
			Subtotal
			\$100,000
2.0 Mobilization/Demobilization of Equipment and Personnel			
Includes:			
1. Mobilization and demobilization of local equipment and personnel.			
2. Set-up/tear down office trailer.			
Assumptions:			
1. Labor and equipment are available locally.			
2. Pressure washer to be purchased for use during project.			
	Service/Materials	Unit	Unit Cost
			Subtotal
	Labor/Equipment:		
	Mobe/Demobe	1	\$5,000.00 /ls
	Office Trailer (set up/tear down)	1	\$500.00 /ls
	Pressure Washer	1	\$500.00 /ls
			Subtotal
			\$6,000

Table 4-1

**Alternative 2 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 2 of 6)

3.0 Site Preparation			
Includes:			
1. Survey and mark proposed remediation area			
2. Construction and maintenance of Erosion and Sediment Controls			
3. Install/improve access road for transport of equipment			
4. Clearing (medium brush without grubbing) will be performed.			
5. Assumed mulch is not contaminated and small volume generated to be disposed on-site or with soil.			
Assumptions and Calculations:			
1. Area to be cleared (acres) =		1.5	
2. Daily output clearing crew (acres/day) =		1	
3. Days clearing contractor in field =		2	
4. Silt Fence to be installed (lf) =		1000	
5. Daily output silt fencing crew (LF/day) =		500	
6. Days silt fence crew in field =		2	
7. Number of Hay Bales =		500	
Service/Materials			
Decontamination Pad	1	\$10,000.00 LS	\$10,000.00
Road Improvement/Repair	1	\$25,000.00 LS	\$25,000.00
Weigh Station	1	\$5,000.00 LS	\$5,000.00
Contractor:			
Site PM	4	\$120.00 /hr	\$480.00
Site Superintendent	4	\$115.00 /hr	\$460.00
QA (Sampling) Coordinator	4	\$80.00 /hr	\$320.00
H&S Coordinator	4	\$130.00 /hr	\$520.00
Equipment Operator	4	\$406.00 /day	\$1,624.00
Laborer	4	\$341.60 /day	\$1,366.40
Laborer	4	\$341.60 /day	\$1,366.40
H&S Coordinator	4	\$62.00 /hr	\$248.00
Subcontractor:			
Surveying Crew	2	\$2,000.00 /day	\$4,000.00
Bushhog	2	\$500.00 /ac	\$1,000.00
Materials:			
Field Instruments	1	\$1,150.00 /wk	\$1,150.00
Silt Fencing	1,000	\$1.60 /day	\$1,600.00
Hay Bales	500	\$5.00 /ea	\$2,500.00
Surface Water Controls	1	\$5,000.00 /ls	\$5,000.00
Subtotal			\$61,635

Table 4-1

**Alternative 2 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 3 of 6)

4.0 Excavation of Contaminated Soil			
Includes:			
1. Excavation of soil with contaminants exceeding remedial goals.			
2. Direct load soil into dump trucks.			
3. Collect confirmatory samples to verify extent of excavation.			
Assumptions and Calculations:			
1. Cubic yards of consolidated soil excavated (surf and sub) =	28,188		
2. Swell factor for soil upon excavation =	1.3		
3. Cubic yards of unconsolidated soil =	36,644		
4. Density of unconsolidated soil (tons/cy) =	1.1		
5. Mass of unconsolidated soil (tons) =	40,309		
6. Excavator: hydraulic backhoe, 1 cy bucket.			
7. Excavator production rate (cy/day) =	375		
8. Time to load dump truck =	29	min	
9. Disposal facility daily capacity =	200	Tons/day	
10. Excavation duration =	202	Days	
11. Load capacity of a 20 ton truck =	12	Tons	
12. Number of dump trucks loaded per day =	17		
13. Number of excavation crew =	5		
14. Lineal foot of excavation per sidewall confirmation sample =	20	FT	
15. Excavation area per floor confirmation sample =	400	SF	
16. Resampling factor for confirmation sampling =	1.1		
17. Number of excavation sidewall confirmation samples =	371		
18. Number of excavation floor confirmation samples =	688		
19. Number of confirmatory samples from excavated area =	1059		
20. Excavation area =	250,331	SF	
21. Perimeter of excavation area =	6,750	FT	
Service/Materials			
Labor:	Unit	Unit Cost	Subtotal
Site PM	1,616	\$120.00 /hr	\$193,920.00
Site Superintendent	1616	\$115.00 /hr	\$185,840.00
QA (Sampling) Coordinator	1616	\$80.00 /hr	\$129,280.00
H&S Coordinator	1616	\$130.00 /hr	\$210,080.00
Chemist (home office)	323	\$75.00 /hr	\$24,240.00
Equipment Operator	202	\$406.00 /day	\$82,012.00
Equipment Operator	202	\$406.00 /day	\$82,012.00
Laborer	202	\$341.60 /day	\$69,003.20
Equipment:			
Excavator	10	\$7,500.00 /mo	\$75,000.00
Wheel Loader	10	\$5,000.00 /mo	\$50,000.00
Water Tank	10	\$180.00 /mo	\$1,800.00
Office Trailer	10	\$800.00 /mo	\$8,000.00
Porta Jon	10	\$165.00 /mo	\$1,650.00
Generator	10	\$510.00 /mo	\$5,100.00
P/U Truck	10	\$750.00 /mo	\$7,500.00
Analytical:			
PCBs	1059	\$66.00 /ea	\$69,894.00
Shipping	71	\$40.00 /ea	\$2,824.00
Materials & Services:			
Level D PPE	5	\$10.00 /day	\$50.00
			Subtotal
			\$1,198,205

Table 4-1

**Alternative 2 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 4 of 6)

5.0 Off-Site Disposal			
Includes:			
1. Dispose of non-TSCA PCB-contaminated (<50 ppm) soil at a municipal solid waste landfill.			
2. Dispose of PCB remediation waste (≥50 ppm) at a EPA approved PCB disposal facility.			
3. Analysis for off-site waste disposal.			
4. Volume of TSCA PCB-contaminated consolidated soil (CY) =	747		
5. Waste characterization and disposal sampling: 1 sample per		300 CY	
6. Disposal facility daily capacity (tons) =		200 tons	
Assumptions and Calculations:			
1. Volume of consolidated soil (cy) =	28,188		
2. Volume of unconsolidated soil (cy) =	36,644		
3. Tons of total soil for disposal =	40,309		
4. Quantity of non-TSCA PCB soil for disposal (BCY) =	27,441		
5. Quantity of TSCA PCB-contaminated soil for disposal (BCY) =	747		
6. Total volume of unconsolidated TSCA soil (LCY) =	971		
7. Non-haz waste transportation cost (\$/hr) =	72		
8. Non-haz waste disposal costs (\$/ton) =	52	Erie County Landfill	
9. Non-haz waste regulatory fees (\$/ton) =	0	included in disposal	
10. TSCA waste transportation and disposal cost (\$/ton) =	175	Wayne	
11. Number of crew =	3		
12. Load capacity of a 20 ton truck (tons) =	12		
13. Travel distance to municipal landfill	10	miles	
13. Dump truck cycle time (load, unload, round trip travel) =	1.33	hr	
14. Number of trips per driver per day =	6	trips	
15. Number of truck drivers =	3		
14. Loads of non-haz waste or trips =	3,360	trips	
15. Output of front-end loader (cy/day) =	550		
16. No. of wheel loaders =	1		
17. Field days based on excavation/loading constraints =	67	based on total soil/loaders	
18. Field days based on disposal facility daily capacity =	202		
19. Number field days =	202		
20. Standard work week is 5 days per week at 8 hours per day.			
21. All lead contaminated soil is non-RCRA			
	Service/Materials	Unit	Unit Cost
			Subtotal
Analytical:			
Waste Characterization Sampling (Soil):			
	PCBs	122	\$66.00 /ea
	TCLP metals	122	\$110.00 /ea
			\$8,061.77
			\$13,436.28
Off-Site Disposal Costs:			
	Transportation (Non-TSCA Waste)	4,469	\$72.00 /hr
	Disposal Cost (Non-TSCA waste)	39,241	\$52.00 /ton
	T&D (TSCA Waste)	1,068	\$175.00 /ton
			\$321,753.60 truck & driver
			\$2,040,512.76 Erie County Landfill
			\$186,936.75 Wayne
			Subtotal
			\$2,570,701

Table 4-1

**Alternative 2 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 5 of 6)

6.0 Site Restoration				
Includes:				
1. Backfill excavated areas with clean backfill.				
2. Re-seed site.				
3. Confirmation sampling of soil staging areas.				
Assumptions and Calculations:				
1. Volume of consolidated soil excavated (cy) = 28,188				
2. Compaction factor = 1.15				
3. Volume of soil required for backfill (cy) = 32,416				
4. Cost of clean backfill soil delivered to site (\$/cy) = 12				
5. Output of front-end loader (cy/day) = 1,735				
6. Field days required to backfill soil = 19				
7. Number of field crew = 3				
8. Upon completion of remedial action soil samples shall be taken within the laydown area to determine if any soil removal is required.				
9. The laydown area shall be divided into 4 quarters and a 5-point composite collected (4 samples total).				
10. Number of soil samples (ea) = 4				
11. Allow 1 week for reseeding site and road repair.				
12. Task duration (days) = 19				
13. Standard work week is 5 days per week at 8 hours per day.				
Service/Materials Unit Unit Cost Subtotal				
Labor:				
Site PM	152	\$120.00		\$18,240.00
Site Superintendent	152	\$115.00 /hr		\$17,480.00
QA Coordinator	152	\$80.00 /hr		\$12,160.00
H&S Coordinator	152	\$130.00 /hr		\$19,760.00
Equipment Operator	19	\$406.00 /day		\$7,714.00
Equipment Operator	19	\$406.00 /day		\$7,714.00
Laborer	19	\$341.60 /day		\$6,490.40
Reseeding	250	\$80.00 /1000 sf		\$20,026.48
Road Repair	1	\$50,000.00 /ls		\$50,000.00
Equipment:				
Dozer	1.0	\$3,500.00 /mo		\$3,500.00
Wheel Loader	1.0	\$5,000.00 /mo		\$5,000.00
Office Trailer	1.0	\$800.00 /mo		\$800.00
Porta Jon	1.0	\$175.22 /mo		\$175.22
Generator	1.0	\$170.35 /mo		\$170.35
P/U Truck	1.0	\$1,800.00 /mo		\$1,800.00
Material:				
Backfill	32,416	\$12.00 /cy		\$388,994.40 delivered to site
Level D PPE	57	\$10.00 /day		\$570.00
Analytical:				
PCBs	4	\$66.00 /ea		\$264.00
Shipping	4	\$40.00 /ea		\$160.00
Subtotal				\$561,019

Table 4-1

**Alternative 2 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 6 of 6)

7.0 Overall Cost		
	Total Capital Cost	\$4,497,600
	Contingency (25%)	\$1,124,400
	Contractor Oversight (5%)	\$224,880
	Total Cost	\$5,846,900

*This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

Table 4-2

**Alternative 3 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 1 of 7)

Alternative 3 Excavation, Chemical Oxidation, and Off-Site Disposal	Site: Acid Area No. 1 Plum Brook Ordnance Works Date: 10/20/2014																												
<p>Scope:</p> <ol style="list-style-type: none"> 1. Chemical oxidation treatability study, work plans, closeout report, and procurement. 2. Mobilize/demobilize equipment and personnel. 3. Prepare site for remedial activity. 4. Excavate contaminated soil, perform confirmation sampling & characterize waste. 5. Chemical oxidation of soil that contains PCBs ≥50 mg/kg using lime-activated sodium persulfate. 6. Off site disposal of excavated soil. 7. Site restoration. 																													
1.0 Treatability Study, Work Plans, and Procurement																													
<p>Includes:</p> <ol style="list-style-type: none"> 1. Labor to generate work plans, including engineering specifications and Health and Safety Plan, along with the Final Report. 2. Procure equipment and materials. 																													
<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Service</th> <th style="text-align: center;">Unit</th> <th style="text-align: left;">Unit Cost</th> <th style="text-align: right;">Subtotal</th> </tr> </thead> <tbody> <tr> <td>Treatability Study</td> <td style="text-align: center;">1</td> <td>\$80,000.00 /ls</td> <td style="text-align: right;">\$80,000.00</td> </tr> <tr> <td>Work Plans and Final Report</td> <td style="text-align: center;">1</td> <td>\$90,000.00 /ls</td> <td style="text-align: right;">\$90,000.00</td> </tr> <tr> <td>Procurement</td> <td style="text-align: center;">1</td> <td>\$20,000.00 /ea</td> <td style="text-align: right;">\$20,000.00</td> </tr> <tr> <td colspan="3"></td> <td style="text-align: right;">Subtotal</td> </tr> <tr> <td colspan="3"></td> <td style="text-align: right;">\$190,000</td> </tr> </tbody> </table>		Service	Unit	Unit Cost	Subtotal	Treatability Study	1	\$80,000.00 /ls	\$80,000.00	Work Plans and Final Report	1	\$90,000.00 /ls	\$90,000.00	Procurement	1	\$20,000.00 /ea	\$20,000.00				Subtotal				\$190,000				
Service	Unit	Unit Cost	Subtotal																										
Treatability Study	1	\$80,000.00 /ls	\$80,000.00																										
Work Plans and Final Report	1	\$90,000.00 /ls	\$90,000.00																										
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2.0 Mobilization/Demobilization of Equipment and Personnel																													
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Service/Materials	Unit	Unit Cost	Subtotal																										
Labor/Equipment:																													
Mobe/Demobe	1	\$5,000.00 /ls	\$5,000.00																										
Office Trailer (set up/tear down)	1	\$500.00 /ls	\$500.00																										
Pressure Washer	1	\$500.00 /ls	\$500.00																										
			Subtotal																										
			\$6,000																										

Table 4-2

**Alternative 3 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 2 of 7)

3.0 Site Preparation				
Includes:				
1. Survey and mark proposed remediation area				
2. Construction and maintenance of Erosion and Sediment Controls				
3. Install/improve access road for transport of equipment				
4. Clearing (medium brush without grubbing) will be performed.				
5. Assumed mulch is not contaminated and small volume generated to be disposed on-site or with soil.				
Assumptions and Calculations:				
1. Area to be cleared (acres) =				1.5
2. Daily output clearing crew (acres/day) =				1
3. Days clearing contractor in field =				2
4. Silt Fence to be installed (lf) =				1000
5. Daily output silt fencing crew (LF/day) =				500
6. Days silt fence crew in field =				2
7. Number of Hay Bales =				500
Service/Materials				
Decontamination Pad	1		\$10,000.00 LS	\$10,000.00
Road Improvement/Repair	1		\$25,000.00 LS	\$25,000.00
Weigh Station	1		\$5,000.00 LS	\$5,000.00
Contractor:				
Site PM	4		\$120.00 /hr	\$480.00
Site Superintendent	4		\$115.00 /hr	\$460.00
QA (Sampling) Coordinator	4		\$80.00 /hr	\$320.00
H&S Coordinator	4		\$130.00 /hr	\$520.00
Equipment Operator	4		\$406.00 /day	\$1,624.00
Laborer	4		\$341.60 /day	\$1,366.40
Laborer	4		\$341.60 /day	\$1,366.40
H&S Coordinator	4		\$62.00 /hr	\$248.00
Subcontractor:				
Surveying Crew	2		\$2,000.00 /day	\$4,000.00
Bushhog	2		\$500.00 /ac	\$1,000.00
Materials:				
Field Instruments	1		\$1,150.00 /wk	\$1,150.00
Silt Fencing	1,000		\$1.60 /day	\$1,600.00
Hay Bales	500		\$5.00 /ea	\$2,500.00
Surface Water Controls	1		\$5,000.00 /ls	\$5,000.00
Subtotal				\$61,635

Table 4-2

**Alternative 3 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 3 of 7)

4.0 Excavation of Contaminated Soil

Includes:

1. Excavation of soil with contaminants exceeding remedial goals.
2. Direct load soil into dump trucks, except for soil to be via chemical oxidation.
3. Collect confirmatory samples to verify extent of excavation.

Assumptions and Calculations:

1. Cubic yards of consolidated soil excavated (surf and sub) = 28,188
2. Swell factor for soil upon excavation = 1.3
3. Cubic yards of unconsolidated soil = 36,644
4. Density of unconsolidated soil (tons/cy) = 1.1
5. Mass of unconsolidated soil (tons) = 40,309
6. Excavator: hydraulic backhoe, 1 cy bucket.
7. Excavator production rate (cy/day) = 375
8. Time to load dump truck = 29 min
9. Disposal facility daily capacity = 200 Tons/day
10. Excavation duration = 202 Days
11. Load capacity of a 20 ton truck = 12 Tons
12. Number of dump trucks loaded per day = 17
13. Number of excavation crew = 5
14. Lineal foot of excavation per sidewall confirmation sample = 20 FT
15. Excavation area per floor confirmation sample = 400 SF
16. Resampling factor for confirmation sampling = 1.1
17. Number of excavation sidewall confirmation samples = 371
18. Number of excavation floor confirmation samples = 688
19. Number of confirmatory samples from excavated area = 1059
20. Excavation area = 250,331 SF
21. Perimeter of excavation area = 6,750 FT

Service/Materials	Unit	Unit Cost	Subtotal
Labor:			
Site PM	1,616	\$120.00 /hr	\$193,920.00
Site Superintendent	1616	\$115.00 /hr	\$185,840.00
QA (Sampling) Coordinator	1616	\$80.00 /hr	\$129,280.00
H&S Coordinator	1616	\$130.00 /hr	\$210,080.00
Chemist (home office)	323	\$75.00 /hr	\$24,240.00
Equipment Operator	202	\$406.00 /day	\$82,012.00
Equipment Operator	202	\$406.00 /day	\$82,012.00
Laborers	202	\$341.60 /day	\$69,003.20
Equipment:			
Excavator	10	\$7,500.00 /mo	\$75,000.00
Wheel Loader	10	\$5,000.00 /mo	\$50,000.00
Water Tank	10	\$180.00 /mo	\$1,800.00
Office Trailer	10	\$800.00 /mo	\$8,000.00
Porta Jon	10	\$165.00 /mo	\$1,650.00
Generator	10	\$510.00 /mo	\$5,100.00
P/U Truck	10	\$750.00 /mo	\$7,500.00
Analytical:			
PCBs	1059	\$66.00 /ea	\$69,894.00
Shipping	71	\$40.00 /ea	\$2,824.00
Materials & Services:			
Level D PPE	5	\$10.00 /day	\$50.00
			Subtotal
			\$1,198,205

Table 4-2

**Alternative 3 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 4 of 7)

5.0 Ex Situ Chemical Oxidation

Includes:

1. Treat the PCB-contaminated soil with lime (calcium hydroxide) activated persulfate.
2. Field tests (persulfate, pH) during treatment. Cost for post-treatment sampling in off-site disposal task.

Assumptions and Calculations:

1. Volume of consolidated TSCA PCB-contaminated soil (cy) = 747
2. Swell factor for soil upon excavation = 1.3
3. Cubic yards of unconsolidated soil (LCY) = 971
4. Density of unconsolidated soil = 1.1 tons/CY
5. Mass of unconsolidated soil = 1,068 tons
6. Concentration of PCBs in treated soil = 60 mg/kg
7. Mass of PCBs in soil = 128 lb
8. Batch size = 250 CY
9. Assume temporary storage for persulfate and lime (calcium hydroxide) will not be required.
10. Persulfate dosage rate for PCBs = 17.1 lb/lb PCBs
11. Persulfate dosage for soil oxidand demand= 2.0 lb/ton soil
12. Persulfate demand for PCBs = 2195 lb
13. Persulfate demand for soil = 2136 lb
14. Persulfate required to treat contaminant and SOD (lb) = 4331 lb
15. Lime (CaOH) dosage rate = 0.2 lb/lb persulfate
16. Lime required to activate persulfate = 866 lb
17. Number of batches = 3.9
18. Number of batches during one treatment cycle = 4
19. Number of treatment cycles = 1
20. 5 days for setup, chemical addition, and mixing in treatment area, 1 day/week sampling thereafter.
21. Treatment duration (wks) = 8
22. Number of field days = 40

Service/Materials	Unit	Unit Cost	Subtotal
Labor:			
Site PM	320	\$120.00 /hr	\$38,400.00
Site Superintendent	320	\$115.00 /hr	\$36,800.00
QA (Sampling) Coordinator	320	\$80.00 /hr	\$25,600.00
H&S Coordinator	320	\$130.00 /hr	\$41,600.00
Equipment Operator	40	\$406.00 /day	\$16,240.00
Equipment Operator	40	\$406.00 /day	\$16,240.00
Laborer	40	\$341.60 /day	\$13,664.00
Equipment:			
Excavator	2	\$7,500.00 /mo	\$15,000.00
Wheel Loader	2	\$5,000.00 /mo	\$10,000.00
Office Trailer	2	\$800.00 /mo	\$1,600.00
Porta Jon	2	\$165.00 /mo	\$330.00
Generator	2	\$510.00 /mo	\$1,020.00
P/U Truck	2	\$750.00 /mo	\$1,500.00
Materials:			
Persulfate	4,331	\$1.41 /lb	\$6,106.71
Calcium Hydroxide	866	\$0.30 /lb	\$259.80
Level C PPE	240	\$35.00 /day	\$8,400.00
Analytical:			
<i>Tests During Treatment</i>			
pH meter	1	\$1,800.00 /ea	\$1,800.00
persulfate field test kits	8	\$125.00 /ea	\$1,000.00 1/wk
Subtotal			\$235,561

Table 4-2

**Alternative 3 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 5 of 7)

6.0 Off-Site Disposal			
Includes:			
1. Disposal of non-TSCA PCB-contaminated (<50 ppm) soil at a municipal solid waste landfill.			
2. Post treatment compliance sampling (PCBs, TAL metals, pH).			
3. Analysis for off-site waste disposal.			
4. Waste characterization and disposal sampling: 1 sample per	300	CY	
5. Disposal facility daily capacity (tons) =	200	tons	
6. Labor for disposal is included under excavation (concurrent operations)			
Assumptions and Calculations:			
1. Mass of untreated soil for disposal =	39,241	tons	
1a. Bulk density of treated soil =	1.47	tons/LCY	
1b. Mass of treated soil =	1,428	tons	
1c. Tons of total soil for disposal =	40,669	tons	incl. trt chemicals
2. Ca(OH) ₂ and persulfate added for soil treatment (tons) =	3		
3. Total weight of soil and treatment chemicals for disposal (lb) =	40,672		
4. Non-haz waste transportation cost (\$/hr) =	72		
5. Non-haz waste disposal costs (\$/ton) =	52	Erie County Landfill	
6. Non-haz waste regulatory fees (\$/ton) =	0	included in disposal	
7. Number of crew =	3		
8. Load capacity of a 20 ton truck (tons) =	12		
9. Travel duration (round trip) to non-haz landfill =	1.33	hrs	
10. Loads of non-haz waste or trips =	3,390	trips	
11. Output of front-end loader (cy/day) =	550		
12. No. of wheel loaders =	1		
13. Field days based on excavation/loading constraints =	74	based on total soil/loaders	
16. Field days based on disposal facility daily capacity =	204		
17. Number field days =	204		
18. Volume of stormwater requiring off-site disposal (gal) =	20,000		
19. Stormwater shall be analyzed for PCBs prior to transport.			
20. At one sample per truckload, number of samples (ea) =	5		
21. Standard work week is 5 days per week at 8 hours per day.			
22. All lead contaminated soil is non-RCRA			
Analytical:			
Waste Characterization Sampling (Soil):			
PCBs	122	\$66.00 /ea	\$8,061.77
TCLP Metals	122	\$110.00 /ea	\$13,436.28
pH	122	\$10.00 /ea	\$1,221.48
Off-Site Disposal Costs:			
Transportation (Non-TSCA Waste)	4,509	\$72.00 /hr	\$324,626.40 truck & driver
Disposal Cost (Non-TSCA waste)	40,672	\$52.00 /ton	\$2,114,924.76 Erie County Landfill
Subtotal			\$2,462,271

Table 4-2

**Alternative 3 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 6 of 7)

7.0 Site Restoration

Includes:

1. Backfill excavated areas with clean backfill.
2. Re-seed site.
3. Confirmation sampling of soil staging areas.

Assumptions and Calculations:

1. Volume of consolidated soil excavated (cy) = 28,188
2. Compaction factor = 1.15
3. Volume of soil required for backfill (cy) = 32,416
4. Cost of clean backfill soil delivered to site (\$/cy) = 12
5. Output of front-end loader (cy/day) = 1,735
6. Field days required to backfill soil = 19
7. Number of field crew = 3
8. Upon completion of remedial action soil samples shall be taken within the laydown area to determine if any soil removal is required.
9. The laydown area shall be divided into 4 quarters and a 5-point composite collected (4 samples total).
10. Number of soil samples (ea) = 4
11. Allow 1 week for reseeded site and road repair.
12. Task duration (days) = 19
13. Standard work week is 5 days per week at 8 hours per day.

Service/Materials	Unit	Unit Cost	Subtotal
Labor:			
Site PM	152	\$120.00 /hr	\$18,240.00
Site Superintendent	152	\$115.00 /hr	\$17,480.00
QA Coordinator	152	\$80.00 /hr	\$12,160.00
H&S Coordinator	152	\$130.00 /hr	\$19,760.00
Equipment Operator	19	\$406.00 /day	\$7,714.00
Equipment Operator	19	\$406.00 /day	\$7,714.00
Laborer	19	\$341.60 /day	\$6,490.40
Reseeding	250	\$80.00 /1000 sf	\$20,026.48
Road Repair	1	\$50,000.00 /ls	\$50,000.00
Equipment:			
Dozer	1.0	\$3,500.00 /mo	\$3,500.00
Wheel Loader	1.0	\$5,000.00 /mo	\$5,000.00
Office Trailer	1.0	\$800.00 /mo	\$800.00
Porta Jon	1.0	\$175.22 /mo	\$175.22
Generator	1.0	\$170.35 /mo	\$170.35
P/U Truck	1.0	\$1,800.00 /mo	\$1,800.00
Material:			
Backfill	32,416	\$12.00 /cy	\$388,994.40 delivered to site
Level D PPE	57	\$10.00 /day	\$570.00
Analytical:			
PCBs	4	\$66.00 /ea	\$264.00
Shipping	4	\$40.00 /ea	\$160.00
			Subtotal
			\$561,019

Table 4-2

**Alternative 3 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 7 of 7)

8.0 Overall Cost		
	Total Capital Cost	\$4,714,700
	Contingency (25%)	\$1,178,675
	Contractor Oversight (5%)	\$235,735
	Total Cost	\$6,129,100

*This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

Table 4-3

**Alternative 4 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 1 of 6)

Alternative 4		Site: Acid Area No. 1	
Excavation, Off-Site Incineration and Disposal		Plum Brook Ordnance Works	
		Date: 10/20/2014	
Scope:			
1. Prepare work plan, H&S plan, materials list, and procurement along with the final report			
2. Mobilize/demobilize equipment and personnel.			
3. Prepare site for remedial activity.			
4. Excavate contaminated soil, perform confirmation sampling & characterize waste.			
5. Off-site disposal.			
6. Site restoration.			
7. Demobilize equipment and personnel.			
1.0 Work Plans and Procurement			
Includes:			
1. Labor to generate work plans, including engineering specifications and Health and Safety Plan, along with the Final Report.			
2. Procure equipment and materials.			
Service	Unit	Unit Cost	Subtotal
Work Plans and Final Report	1	\$90,000.00 /ls	\$90,000.00
Procurement	1	\$10,000.00 /ea	\$10,000.00
		Subtotal	\$100,000
2.0 Mobilization/Demobilization of Equipment and Personnel			
Includes:			
1. Mobilization and demobilization of local equipment and personnel.			
2. Set-up/tear down office trailer.			
Assumptions:			
1. Labor and equipment are available locally.			
2. Pressure washer to be purchased for use during project.			
Service/Materials	Unit	Unit Cost	Subtotal
Labor/Equipment:			
Mobe/Demobe	1	\$5,000.00 /ls	\$5,000.00
Office Trailer (set up/tear down)	1	\$500.00 /ls	\$500.00
Pressure Washer	1	\$500.00 /ls	\$500.00
		Subtotal	\$6,000

Table 4-3

**Alternative 4 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 2 of 6)

3.0 Site Preparation

Includes:

1. Survey and mark proposed remediation area
2. Construction and maintenance of Erosion and Sediment Controls
3. Install/improve access road for transport of equipment
4. Clearing (medium brush without grubbing) will be performed.
5. Assumed mulch is not contaminated and small volume generated to be disposed on-site or with soil.

Assumptions and Calculations:

- | | |
|----------------------------------------------|------|
| 1. Area to be cleared (acres) = | 1.5 |
| 2. Daily output clearing crew (acres/day) = | 1 |
| 3. Days clearing contractor in field = | 2 |
| 4. Silt Fence to be installed (lf) = | 1000 |
| 5. Daily output silt fencing crew (LF/day) = | 500 |
| 6. Days silt fence crew in field = | 2 |
| 7. Number of Hay Bales = | 500 |

Service/Materials	Unit	Unit Cost	Subtotal
Decontamination Pad	1	\$10,000.00 LS	\$10,000.00
Road Improvement/Repair	1	\$25,000.00 LS	\$25,000.00
Weigh Station	1	\$5,000.00 LS	\$5,000.00

Contractor:

Site PM	4	\$120.00 /hr	\$480.00
Site Superintendent	4	\$115.00 /hr	\$460.00
QA (Sampling) Coordinator	4	\$80.00 /hr	\$320.00
H&S Coordinator	4	\$130.00 /hr	\$520.00
Equipment Operator	4	\$406.00 /day	\$1,624.00
Laborer	4	\$341.60 /day	\$1,366.40
Laborer	4	\$341.60 /day	\$1,366.40
H&S Coordinator	4	\$62.00 /hr	\$248.00

Subcontractor:

Surveying Crew	2	\$2,000.00 /day	\$4,000.00
Bushhog	2	\$500.00 /ac	\$1,000.00

Materials:

Field Instruments	1	\$1,150.00 /wk	\$1,150.00
Silt Fencing	1,000	\$1.60 /day	\$1,600.00
Hay Bales	500	\$5.00 /ea	\$2,500.00
Surface Water Controls	1	\$5,000.00 /ls	\$5,000.00

Subtotal	\$61,635
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Table 4-3

**Alternative 4 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 3 of 6)

4.0 Excavation of Contaminated Soil

Includes:

1. Excavation of soil with contaminants exceeding remedial goals.
2. Direct load soil into intermodal rolloff containers
3. Collect confirmatory samples to verify extent of excavation.

Assumptions and Calculations:

1. Cubic yards of consolidated soil excavated (surf and sub) =	28,188	
2. Swell factor for soil upon excavation =	1.3	
3. Cubic yards of unconsolidated soil =	36,644	
4. Density of unconsolidated soil (tons/cy) =	1.1	
5. Mass of unconsolidated soil (tons) =	40,309	
6. Excavator: hydraulic backhoe, 1 cy bucket.		
7. Excavator production rate (cy/day) =	375	
8. Days to excavate soil =	75	
9. Rolloff capacity (cy) =	12	
10. Number of rolloffs loaded per day =	31.25	
11. Number of excavation crew =	5	
12. Lineal foot of excavation per sidewall confirmation sample =	20	FT
13. Excavation area per floor confirmation sample =	400	SF
14. Resampling factor for confirmation sampling =	1.1	
15. Number of excavation sidewall confirmation samples =	371	
16. Number of excavation floor confirmation samples =	688	
17. Number of confirmatory samples from excavated area =	1059	
18. Excavation area =	250,331	SF
19. Perimeter of excavation area =	6,750	FT

Service/Materials	Unit	Unit Cost	Subtotal	
Labor:				
Site PM	600	\$120.00 /hr	\$72,000.00	
Site Superintendent	600	\$115.00 /hr	\$69,000.00	
QA (Sampling) Coordinator	600	\$80.00 /hr	\$48,000.00	
H&S Coordinator	600	\$130.00 /hr	\$78,000.00	
Chemist (home office)	120	\$75.00 /hr	\$9,000.00	
Equipment Operator	75	\$406.00 /day	\$30,450.00	
Equipment Operator	75	\$406.00 /day	\$30,450.00	
Equipment Operator	75	\$406.00 /day	\$30,450.00	
Laborer	75	\$341.60 /day	\$25,620.00	
Laborer	75	\$341.60 /day	\$25,620.00	
Equipment:				
Excavator	4	\$7,500.00 /mo	\$30,000.00	
Wheel Loader	4	\$4,000.00 /mo	\$16,000.00	load rail cars
Wheel Loader	4	\$4,000.00 /mo	\$16,000.00	unload rail cars
Water Tank	4	\$180.00 /mo	\$720.00	
Office Trailer	4	\$800.00 /mo	\$3,200.00	
Porta Jon	4	\$165.00 /mo	\$660.00	
Generator	4	\$510.00 /mo	\$2,040.00	
P/U Truck	4	\$750.00 /mo	\$3,000.00	
Analytical:				
PCBs	1059	\$66.00 /ea	\$69,894.00	
Shipping	71	\$40.00 /ea	\$2,824.00	
Materials & Services:				
Level D PPE	5	\$10.00 /day	\$50.00	
Subtotal			\$562,978	

Table 4-3

**Alternative 4 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 4 of 6)

5.0 Off-Site Incineration and Disposal

Includes:

1. Highway transport of rolloff containers to CSX intermodal terminal in North Baltimore, OH.
2. Rail transport of intermodal containers via CSX/NS from N. Baltimore, OH to Port Arthur, TX.
3. Unload rolloffs and deliver to TSCA facility for incineration.
4. Incinerate PCB-contaminated soil at Veolia TSCA facility in Port Arthur, TX.
5. Analysis for off-site waste disposal.
6. Waste characterization and disposal sampling: 1 sample per 300 CY

Assumptions and Calculations:

1. Volume of consolidated soil = 28,188 CY
2. Volume of unconsolidated soil = 36,644 CY
3. Weight of total soil for incineration = 40,309 Tons
4. Weight capacity of 20CY intermodal rolloff = 20 Tons
5. Number of 20CY rolloffs required = 2,016
6. Number of 20CY intermodal rolloffs per doublestack railcar = 6
7. Number of railcars needed = 336
8. Roundtrip duration for rolloffs = 5 weeks
9. Rolloff rental = 2,326 months
10. Roundtrip duration for rail cars = 4 weeks
11. Rail car rental duration = 310 months
12. Truck haul distance (round trip) = 140 miles 3 hr drive time RT
13. Round trips per truck driver per day = 2 trips
14. Number of truck drivers = 16
15. Incineration at Veolia Environmental Services (\$/ton) 480 Port Arthur, TX
16. Standard work week is 5 days per week at 8 hours per day.
17. All lead contaminated soil is non-RCRA

Service/Materials	Unit	Unit Cost	Subtotal
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Labor:

Truck Drivers	1200	\$293.00 /day	\$351,600.00
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Equipment:

Truck Rental	64	\$1,800.00 /mo	\$115,200.00
20-CY Roll-Off Rental	2326	\$300.00 /mo	\$697,800.00
Railcar Rental	310	\$1,485.00 /mo	\$460,350.00

Materials:

Rolloff Liners	2016	\$35.00 /ea	\$70,560.00
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Analytical:

Waste Characterization Sampling (Soil):

PCBs	122	\$66.00 /ea	\$8,061.77
TCLP metals	122	\$110.00 /ea	\$13,436.28

Off-Site Disposal Costs:

Offloading & Transport to TSCA Facility	2,016	\$125.00 /rolloff	\$252,000.00	truck & driver
Incineration	40,309	\$480.00 /ton	\$19,348,243.20	Veolia

Subtotal \$21,317,251

Table 4-3

**Alternative 4 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 5 of 6)

6.0 Site Restoration

Includes:

1. Backfill excavated areas with clean backfill.
2. Re-seed site.
3. Confirmation sampling of soil staging areas.

Assumptions and Calculations:

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------|--------|
| 1. Volume of consolidated soil excavated (cy) = | 28,188 |
| 2. Compaction factor = | 1.15 |
| 3. Volume of soil required for backfill (cy) = | 32,416 |
| 4. Cost of clean backfill soil delivered to site (\$/cy) = | 12 |
| 5. Output of front-end loader (cy/day) = | 1,735 |
| 6. Field days required to backfill soil = | 19 |
| 7. Number of field crew = | 3 |
| 8. Upon completion of remedial action soil samples shall be taken within the laydown area to determine if any soil removal is required. | |
| 9. The laydown area shall be divided into 4 quarters and a 5-point composite collected (4 samples total). | |
| 10. Number of soil samples (ea) = | 4 |
| 11. Allow 1 week for reseeding site and road repair. | |
| 12. Task duration (days) = | 19 |
| 13. Standard work week is 5 days per week at 8 hours per day. | |

Service/Materials	Unit	Unit Cost	Subtotal
Labor:			
Site PM	152	\$120.00	\$18,240.00
Site Superintendent	152	\$115.00 /hr	\$17,480.00
QA Coordinator	152	\$80.00 /hr	\$12,160.00
H&S Coordinator	152	\$130.00 /hr	\$19,760.00
Equipment Operator	19	\$406.00 /day	\$7,714.00
Equipment Operator	19	\$406.00 /day	\$7,714.00
Laborer	19	\$341.60 /day	\$6,490.40
Reseeding	250	\$80.00 /1000 sf	\$20,026.48
Road Repair	1	\$50,000.00 /ls	\$50,000.00
Equipment:			
Dozer	0.9	\$3,500.00 /mo	\$3,150.00
Wheel Loader	0.9	\$5,000.00 /mo	\$4,500.00
Office Trailer	0.9	\$800.00 /mo	\$720.00
Porta Jon	0.9	\$175.22 /mo	\$157.70
Generator	0.9	\$170.35 /mo	\$153.32
P/U Truck	0.9	\$1,800.00 /mo	\$1,620.00
Material:			
Backfill	32,416	\$12.00 /cy	\$388,994.40 delivered to site
Level D PPE	57	\$10.00 /day	\$570.00
Analytical:			
PCBs	4	\$66.00 /ea	\$264.00
Shipping	4	\$40.00 /ea	\$160.00
Subtotal			\$559,874

Table 4-3

**Alternative 4 Cost Estimate
Acid Area No. 1 Feasibility Study
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 6 of 6)

7.0 Overall Cost		
	Total Capital Cost	\$22,607,700
	Contingency (25%)	\$5,651,925
	Contractor Oversight (5%)	\$1,130,385
	Total Cost	\$29,390,000

*This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

**ATTACHMENT A
LOCATIONS AND ANALYTICAL RESULTS
FOR ACID AREA 1 CHARACTERIZATION SAMPLES**

SEL_TEXTSUB_ONL_Y.TBL
pdf_with_levels.plt
2:42:46 PM
11/18/2014
cbentley
aaf_fs_add_001.dgn



NOTES:

1. REMEDIAL GOALS:
AROCOR 1254 - 1 mg/kg
TOTAL PCBs - 2 mg/kg
2. BUILDINGS 302, 308, 310, AND THE INCINERATOR/STORAGE BUILDING WERE USED BY NASA. BUILDING 302 IS THE ONLY BUILDING STILL REMAINING AT THE SITE.
3. A SINGLE SURFACE SOIL COMPOSITE SAMPLE WAS COLLECTED IN EACH OF THE FOLLOWING AREAS: 1, 2, 3, AND 5. FOUR COMPOSITE SAMPLES WERE COLLECTED IN AREA 4 (i.e. 4a, 4b, 4c, AND 4d).
4. A PLANNED GRAB SAMPLE WAS COLLECTED AT SB-09 FOR LABORATORY ANALYSIS AND VERIFICATION, BECAUSE THE X-RAY FLUORESCENCE (XRF) RESULTS FOR THIS LOCATION SHOWED A FAR HIGHER LEAD CONCENTRATION THAN FOR ANY OTHER LOCATION SAMPLED WITH XRF.

LEGEND:

- POND
- CREEK, DITCH, CONVEYANCE
- RAILROAD (REMOVED)
- ROAD
- FENCE
- APPROXIMATE LOCATION OF FORMER ACID AREA No. 1 BUILDINGS
- APPROXIMATE LOCATION OF FORMER ACID AREA No. 1 STORAGE TANKS
- EXISTING BUILDINGS
- PCB REMEDIATION WASTE - TOTAL PCB CONCENTRATION ≥50 mg/kg
- REMEDIAL AREA - PCB CONCENTRATION >REMEDIAL GOALS
- COMPOSITE SOIL SAMPLE AREA FOR LEAD TCLP ANALYSIS
- COMPOSITE SOIL SAMPLE AREA DESIGNATION
- SEPTEMBER 2014 GRAB SAMPLE

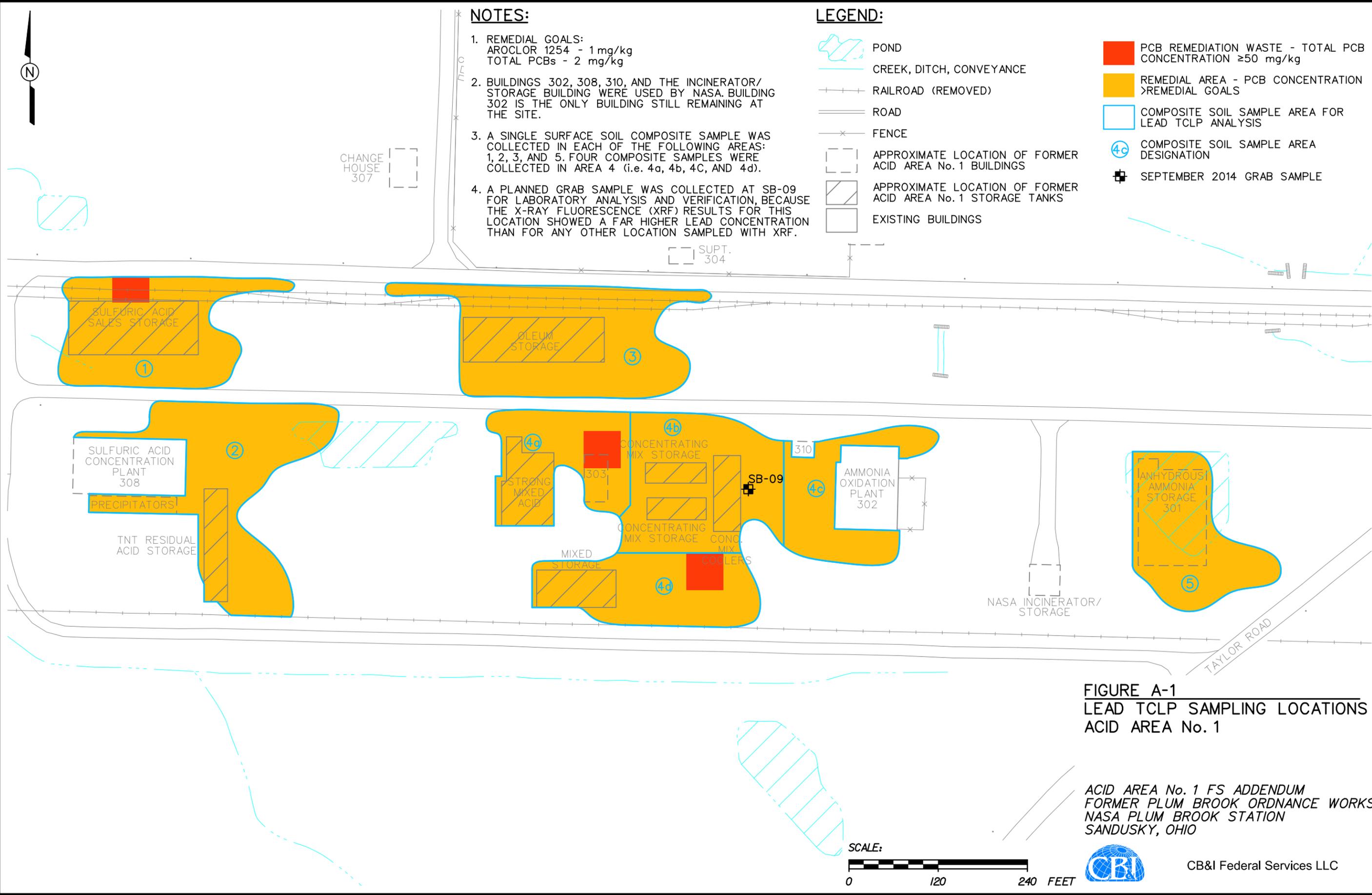


FIGURE A-1
LEAD TCLP SAMPLING LOCATIONS
ACID AREA No. 1

ACID AREA No. 1 FS ADDENDUM
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO



CB&I Federal Services LLC

Table A-1
Lead Characterization of Acid Area 1 Soil for Disposal
Former Plum Brook Ordnance Works, Sandusky, Ohio

		LOCATION_CODE	AA1-1	AA1-2	AA1-3	AA1-4a	AA1-4b	AA1-4c	AA1-4d	AA1-5								
		SAMPLE_NO	AA1-1	AA1-2	AA1-3	AA1-4a	AA1-4b	AA1-4c	AA1-4d	AA1-5								
		SAMPLE_DATE	19-Sep-14															
		DEPTH	0 - 0 Ft															
		SAMPLE_PURPOSE	REG															
Parameter	Units	TCLP Limit	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ		
METALS																		
Lead	mg/kg	NA	38.5		521		119		780		365		159		293		34.8	2630
TCLP																		
Lead TCLP	mg/L	5.0	0.011	U	0.18		0.011	U	0.47		2.1		0.018	J	0.052		0.02	J
GENERAL CHEMISTRY																		
% Solids	Percent	NA	77.9		61.1		72.2		72.8		79.6		75.8		76.4		80.2	65.8

TCLP - Toxicity Characteristic Leaching Procedure.
VQ - Validation qualifier.
NA - Not applicable.
mg/kg - Milligram(s) per kilogram.
mg/L - Milligram(s) per liter.
U - Not detected.
J - Analyte is positively identified; the reported value is estimated.

APPENDIX A-1
SAMPLE COLLECTION LOGS



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-1

Sample Number: AA1-1

Sample Name: PB-AA1-1-SS-AA1-1-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914 Acct

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1608

Start Depth: 0

End Depth: 0.5'

Sample Team: EW / JB

Sample Matrix: Soil

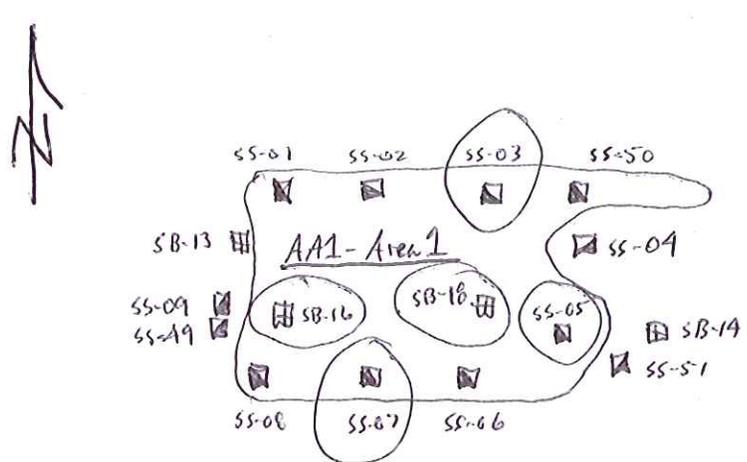
QC Associations: ---

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-1 is a composite sample comprised of soil from 5 locations within Area 1.

Sketch Location:

Sample Locations



- SS-03
- SS-05
- SS-07
- SB-16
- SB-18

Logged BY / Date: E. W. Weaver 9-19-14 Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-2

Sample Number: AA1-2

Sample Name: PB-AA1-2-SS-AA1-2-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914A Acc+

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1616

Start Depth: 0

End Depth: 0.5'

Sample Team: EW / JB

Sample Matrix: Soil

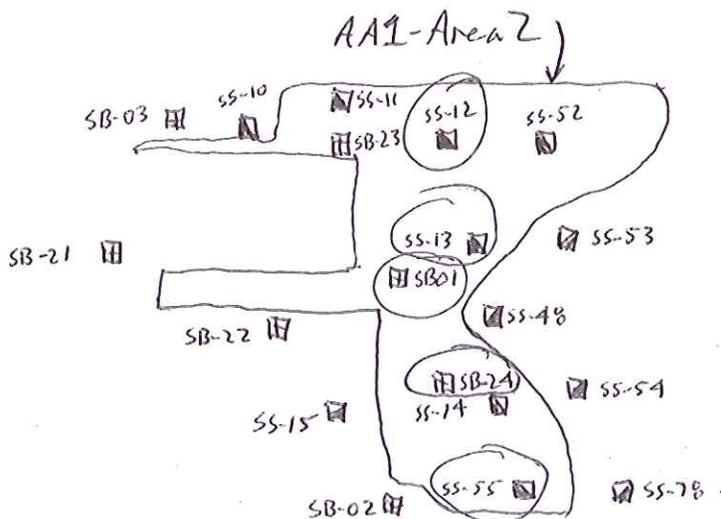
QC Associations: _____

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-2 is a composite sample comprised of soil from 5 locations with Area 2.

Sketch Location:

Sample Locations



- SS-12 SB-01
- SS-13 SB-24
- SS-55

Logged BY / Date: E.W. Weaver 9-19-14

Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-3

Sample Number: AA1-3

Sample Name: PB-AA1-3-SS-AA1-3-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914Acct

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1610

Start Depth: 0

End Depth: 0.5'

Sample Team: EW/JB

Sample Matrix: Soil

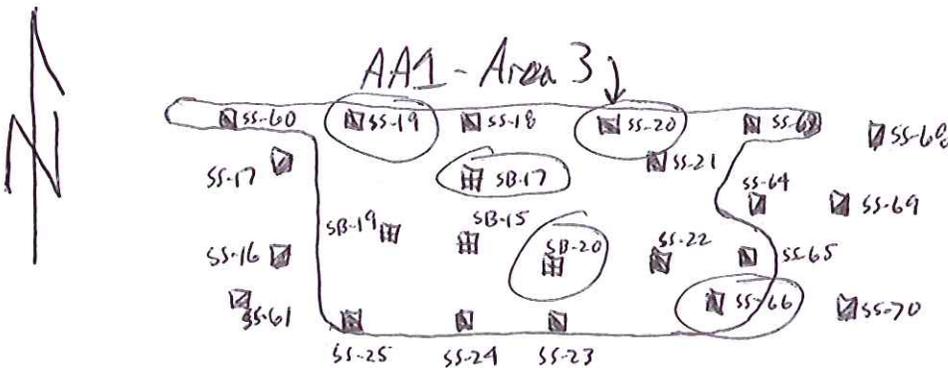
QC Associations: _____

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-3 is a composite sample comprised of soil from 5 locations within Area 3.

Sketch Location:

Sample Locations



- SS-19 SB-17
- SS-20 SB-20
- SS-66

Logged BY / Date: E.W. Weaver 9-19-14

Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-4a

Sample Number: AA1-4a

Sample Name: PB-AA1-4a-SS-AA1-4a-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914Acct

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1600

Start Depth: 0

End Depth: 0.5'

Sample Team: EW / JB

Sample Matrix: Soil

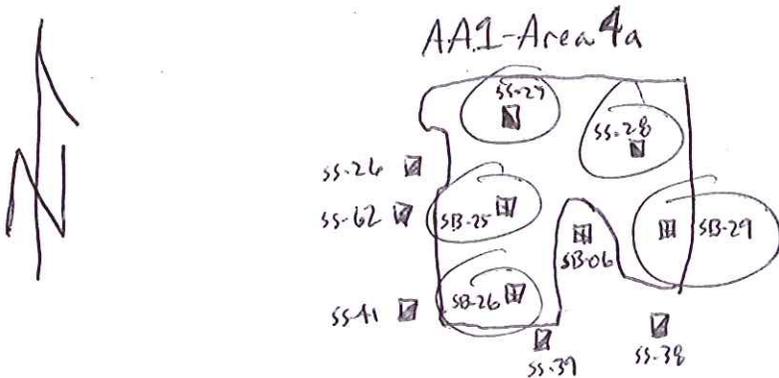
QC Associations: _____

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-4a is a composite sample comprised of soil from 5 locations within Area 4a.

Sketch Location:

Sample Locations



- SS-27
- SB-25
- SB-26
- SB-28
- SB-29

Logged BY / Date: E.W. Weaver 9-19-14

Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-4b

Sample Number: AA1-4b

Sample Name: PB-AA1-4b-SS-AA1-4b-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914 Acct

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1612

Start Depth: 0

End Depth: 0.5'

Sample Team: EW/JB

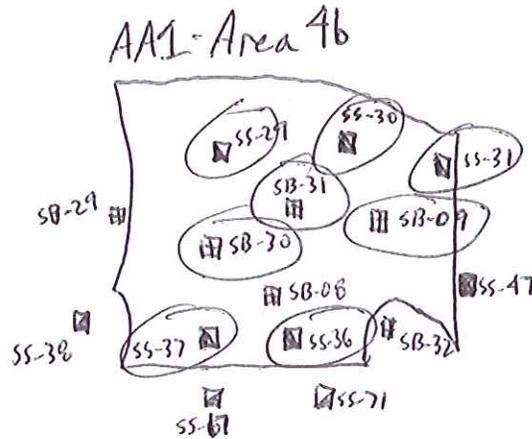
Sample Matrix: Soil

QC Associations: —

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-4b is a composite sample comprised of soil from 6 locations within Area 4b.

Sketch Location:



Sample Locations

SS-29	SB-09
SS-30	SB-30
SS-31	SB-31
SS-36	
SS-37	

Logged BY / Date: E-W Weaver

Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-4c

Sample Number: AA1-4c

Sample Name: PB-AA1-4c-SS-AA1-4c-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914 Acct

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1614

Start Depth: 0

End Depth: 0.5'

Sample Team: EW/JB

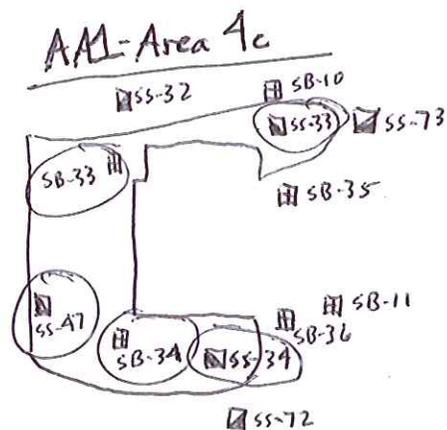
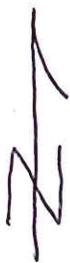
Sample Matrix: Soil

QC Associations: _____

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-4c is a composite sample comprised of soil from 5 locations within Area 4c.

Sketch Location:



Sample Locations

- SS-33 SB-33
- SS-34 SB-34
- SS-47

Logged BY / Date: Eric W. Weaver 9-19-14

Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-4d

Sample Number: AA1-4d

Sample Name: PB-AA1-4d-SS-AA1-4d-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914A_{ect}

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1609

Start Depth: 0

End Depth: 0.5'

Sample Team: EW/JB

Sample Matrix: Soil

QC Associations: _____

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-4d is a composite sample comprised of soil from 6 locations within Area 4d.

Sketch Location:

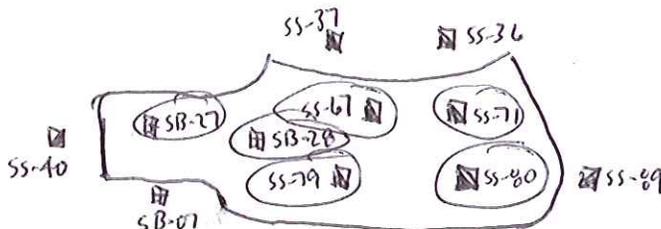
Sample Locations

SS-67 SB-27

SS-71 SB-28

SS-79

SS-80



AA1-Area 4d

Logged BY / Date: Eric W. Weaver

Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-5

Sample Number: AA1-5

Sample Name: PB-AA1-5-SS-AA1-5-REG

Sampling Method: Composite

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914 Acct

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1606

Start Depth: 0

End Depth: 0.5'

Sample Team: EW/JB

Sample Matrix: Soil

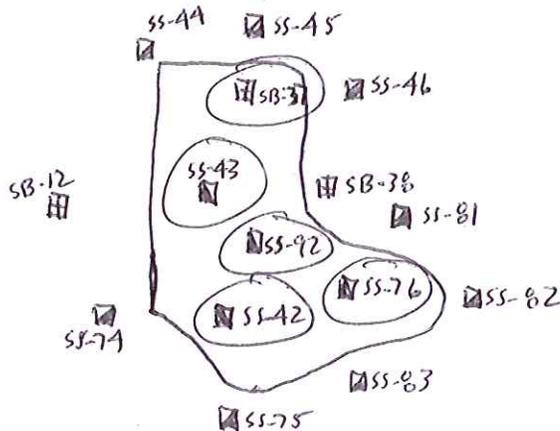
QC Associations: _____

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-5 is a composite sample comprised of soil from 5 locations within Area 5.

Sketch Location:

Sample Locations



- SS-42
- SS-43
- SS-76
- SS-92
- SB-37

Logged BY / Date: E.W. Weaver 9-19-14 Reviewed BY / Date: _____



Sample Collection Log

Project: Former Plum Brook Ordnance Works

Project No. 140606.19000000

Project Manager: Steven Downey

Location Code: AA1-SB09

Sample Number: AA1-SB09

Sample Name: PB-AA1-SB09-SS-AA1-SB09-REG

Sampling Method: ~~Composite~~ ^{EW} Grab

Sampling Type: SS Sample Purpose: REG

Sampling Equipment: Stainless Steel Trowel

RFA / COC Number: PB091914 Acct

Task: AA1_Soil

Collection Date: 9-19-14

Collection Time: 1602

Start Depth: 0

End Depth: 0.5'

Sample Team: EW / JB

Sample Matrix: Soil

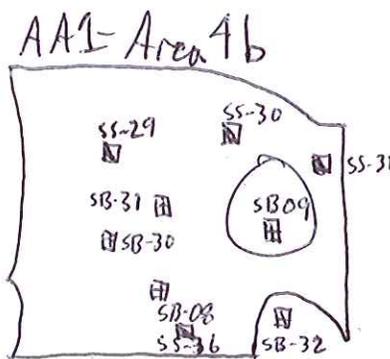
QC Associations: _____

Analytical Suite	Containers				Units	Type
	Flt	Frtn	Qty	Size		
Total Lead	N	A	1	4	oz	CWM
TCLP Lead	N	B	1	4	oz	CWM

Comments: Sample AA1-SB09 is a grab sample from location SB-09 located within AA1-Area 4b.

Sketch Location:

Sample Location



SB-09

Logged BY / Date: E.W. Werner 9-19-14 Reviewed BY / Date: _____

**APPENDIX A-2
DATA QUALITY EVALUATIONS**

Table 1
Sample Cross-Reference
Acid Area 1
Former Plum Brook Ordnance Works
Sandusky, Ohio

Sample Type	Sample Location	Sample Number	Sample Date	Sample Purpose	SDG Number	Laboratory
SS	AA1-1	AA1-1	9/19/2014	REG	FA18525	Accutest
SS	AA1-2	AA1-2	9/19/2014	REG	FA18525	Accutest
SS	AA1-3	AA1-3	9/19/2014	REG	FA18525	Accutest
SS	AA1-4a	AA1-4A	9/19/2014	REG	FA18525	Accutest
SS	AA1-4b	AA1-4B	9/19/2014	REG	FA18525	Accutest
SS	AA1-4c	AA1-4C	9/19/2014	REG	FA18525	Accutest
SS	AA1-4d	AA1-4D	9/19/2014	REG	FA18525	Accutest
SS	AA1-5	AA1-5	9/19/2014	REG	FA18525	Accutest
SS	AA1-SB-09	AA1-SB-09	9/19/2014	REG	FA18525	Accutest

SS - Surface soil.

REG - Regular field sample.

Table 2
Summary of Data Validation Reason Codes
Former Plum Brook Ordnance Works
Sandusky, Ohio

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

Table 3
Summary of Data Validation Qualifiers Assigned and Reason Codes for Qualification
Acid Area 1
Former Plum Brook Ordnance Works
Sandusky, Ohio

Work Order	Sample Number	Analysis	Parameter	Reason Codes				
				VQ	R1	R2	R3	R4
FA18525	AA1-4C	TCLP Lead	Lead	J	15			
FA18525	AA1-5	TCLP Lead	Lead	J	15			

VQ - Validation Qualifier
R1 - First Reason Code
R2 - Second Reason Code
R3 - Third Reason Code
R4 - Fourth Reason Code

Table 4
Qualifier Definitions
Former Plum Brook Ordnance Works
Sandusky, Ohio

Qualifier	Definition
Laboratory	
B	Indicates the analyte is found in associated method blank.
U	Not detected. The compound/analyte was analyzed for, but not detected above the
Validation	
J	The compound/analyte was positively identified; the reported value is an estimated concentration.
U	Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

**APPENDIX A-3
CHAIN OF CUSTODY**



CHAIN OF CUSTODY FA18525

Ref. Document # PB091914 AccT
Page 1 of 14171 Essen Lane, Baton Rouge, LA 70809
Phone: 225-987-7679Project Number: 140606.19000000
Project Name / Location: PBOW/Sandusky, OH
Purchase Order #: 140606.19000000Project Manager: Steve Dunsney 265-621-8495
(Name & phone #)Shipment Date: 9-19-14
Waybill Number: _____
Lab Destination: Accutest
Lab Contact Name / ph. #: Sue Bell 912-741-3338Send Report To: Eddie Weaver
Phone/Fax Number: 865-560-5274/865-679-3628
Address: 312 Directors Drive
City: Knoxville, TN 37923

Analysis Requested			
TCLP Lead	Total Lead		Cooler Temperature

Sampler's Name(s):		Collection Information				Matrix	# of containers	Preservative		Container		TCLP Lead	Total Lead	Cooler Temperature
Sample ID Number	Sample Description	Date	Time	Method	Beginning depth (ft)			Ending depth (ft)						
9	AA1-4a	Soil	9-19-14	1600	C	SO	2					X	X	
10	AA1-4b	Soil	9-19-14	1602	C	SO	2					X	X	
11	AA1-4d	Soil	9-19-14	1604	C	SO	2					X	X	
12	AA1-5	Soil	9-19-14	1606	C	SO	2					X	X	
13	AA1-7	Soil	9-19-14	1608	C	SO	2					X	X	
14	AA1-3	Soil	9-19-14	1610	C	SO	2					X	X	
15	AA1-4b ^{11/18/14}	Soil	9-19-14	1612	C	SO	2					X	X	
16	AA1-4c	Soil	9-19-14	1614	C	SO	2					X	X	
17	AA1-2	Soil	9-19-14	1616	C	SO	2					X	X	
Temperature Blank														X

Special Instructions:

Turnaround Time: Standard 10 Day	<input type="checkbox"/> 24-hr	<input type="checkbox"/> 48-hr	Level Of QC Required:	I	II	III	Project Specific
	<input type="checkbox"/> 3-day	<input type="checkbox"/> 5-day					
Relinquished By: <u>E. W. Weaver</u>	Date: <u>9-19-14</u>	Time: <u>17:10</u>	Received By: <u>LPS</u>	Date:	Time:	Method Codes	
Relinquished By: <u>LPS</u>	Date:	Time:	Received By: <u>J. Coone (AUSA)</u>	Date: <u>9-20-14</u>	Time: <u>10:00</u>	Matrix Codes	
						DW = Drinking Water	BO = Soil
						GW = Ground Water	
						WW = Wastewater	
						V = Vapor	

AA1-SB-09

5.1
5

Sample number AA1-4b was inadvertently recorded on the COC twice with a collection time of 16:02 and 16:12. The correct sample number for the sample collected on 9-19-14 at 16:12 is AA1-SB-09.

Eddie Weaver
11/18/14

ACCUTEST LABORATORIES SAMPLE RECEIPT CONFIRMATION

ACCUTEST'S JOB NUMBER: FA 18525 CLIENT: CB21 PROJECT: 14606.19000000
 DATE/TIME RECEIVED: 9.30.14 10:00 (MM/DD/YY 24:00) NUMBER OF COOLERS RECEIVED: 3
 METHOD OF DELIVERY: FEDEX UPS ACCUTEST COURIER GREYHOUND DELIVERY OTHER
 AIRBILL NUMBERS: 452 397 927 5

COOLER INFORMATION

- CUSTODY SEAL NOT PRESENT OR NOT INTACT
- CHAIN OF CUSTODY NOT RECEIVED (COC)
- ANALYSIS REQUESTED IS UNCLEAR OR MISSING
- SAMPLE DATES OR TIMES UNCLEAR OR MISSING
- TEMPERATURE CRITERIA NOT MET

TRIP BLANK INFORMATION

- TRIP BLANK PROVIDED
- TRIP BLANK NOT PROVIDED
- TRIP BLANK NOT ON COC
- TRIP BLANK INTACT
- TRIP BLANK NOT INTACT
- RECEIVED WATER TRIP BLANK
- RECEIVED SOIL TRIP BLANK

MISC. INFORMATION

NUMBER OF ENCORES? 25-GRAM 5-GRAM
 NUMBER OF 5035 FIELD KITS? _____
 NUMBER OF LAB FILTERED METALS? _____

TEMPERATURE INFORMATION

- IR THERM ID 1 CORR. FACTOR +0.4
- OBSERVED TEMPS: 2.8 2.6 3.2
- CORRECTED TEMPS: 3.2 3.0 3.6

SAMPLE INFORMATION

- INCORRECT NUMBER OF CONTAINERS USED
- SAMPLE RECEIVED IMPROPERLY PRESERVED
- INSUFFICIENT VOLUME FOR ANALYSIS
- DATES/TIMES ON COC DO NOT MATCH SAMPLE LABEL
- ID'S ON COC DO NOT MATCH LABEL
- VOC VIALS HAVE HEADSPACE (MACRO BUBBLES)
- BOTTLES RECEIVED BUT ANALYSIS NOT REQUESTED
- NO BOTTLES RECEIVED FOR ANALYSIS REQUESTED
- UNCLEAR FILTERING OR COMPOSITING INSTRUCTIONS
- SAMPLE CONTAINER(S) RECEIVED BROKEN
- 5035 FIELD KITS NOT RECEIVED WITHIN 48 HOURS
- BULK VOA SOIL JARS NOT RECEIVED WITHIN 48 HOURS
- % SOLIDS JAR NOT RECEIVED
- RESIDUAL CHLORINE PRESENT

(APPLICABLE TO EPA 600 SERIES OR NORTH CAROLINA ORGANICS)

SUMMARY OF COMMENTS: FOR SAMPLE # 27, 1 LB RECEIVED 1 AM B22 W/P. WE PRESERVED WITH 2 ml HNO3 ON 2 250 ml BOTTLES (P 951)

TECHNICIAN SIGNATURE/DATE: [Signature] 9-30-14 REVIEWER SIGNATURE/DATE: [Signature] 09-30-14

RS 04/14

receipt confirmation 041514.xls

5.1
5