



Addendum for Red Water Pond Areas Focused Feasibility Study for Soil FUDS Project No. G05OH001820 Updated Cost Tables

Former Plum Brook Ordnance Works Sandusky, Ohio

G05OH001820_04.09_1004_a
200-1e

**US Army Corps
of Engineers**
Nashville District





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November 13, 2014

U.S. Army Engineer District, Nashville
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Nashville, Tennessee 37203

**Subject: *Submittal of the Addendum to the Focused
Feasibility Study for the Red Water Pond Areas
DERP-FUDS Project No. G05OH001820
Final Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio
Contract No. W912QR-08-D-0013: Shaw Project Number 132458***

Dear Ms. Coleman:

In accordance with the requirements of Delivery Order No. DX03 of Contract No. W912QR-08-D-0013 awarded to CB&I Federal Services LLC, we are pleased to submit this Addendum to the Focused Feasibility Study for the Red Water Pond Areas at the Former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio. This addendum provides final 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 of this addendum. Copies have also been sent to those on the distribution list for their records.

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

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Distribution List

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

Project Description: Addendum to Red Water Pond Areas Focused Feasibility Study: Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract No. W 9 1 2 Q R - 0 8 - D - 0 0 1 3

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FS Addendum: Updated Cost Tables

Required Person

Signature

Date

	Required Person	Signature	Date
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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 for Red Water Pond Areas Focused Feasibility Study for Soil
FUDS Project No. G05OH001820
Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio**

This Addendum to the Final Red Water Pond Areas Focused Feasibility Study for Soil (FS) (IT Corporation, 2002) was prepared to update the costs and remedial durations for the remedial alternatives presented in the Addendum to the FS (Shaw Environmental & Infrastructure, Inc., 2013) 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 Addendum is unchanged. The remedial costs and durations were updated to capture the U.S. Army Corps of Engineers' recent experience in remedial operations using the various technologies evaluated in the document. 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 Further Action	\$0	0
2	Excavation and Off-Site Treatment/Disposal	\$8,600,000	25
3	Excavation, Windrow Composting, and Off-Site Disposal	\$9,400,000	30
4	Excavation, Alkaline Hydrolysis, and On-Site/Off-Site Disposal	\$8,100,000	30

References:

IT Corporation, 2002, *Red Water Pond Areas Focused Feasibility Study for Soil*, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, December.

Shaw Environmental & Infrastructure, Inc., 2013, *Addendum to Red Water Pond Areas Focused Feasibility Study for Soil, FUDS Project No. G05OH001820*, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, May.

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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Alternative 2 Excavation/Off-Site Disposal Cost Estimate		Site: Pentolite Road Red Water Pond Area Plum Brook Ordnance Works	
		Date: 10/8/2014	
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	\$5,000.00 /ea
			Subtotal
			\$95,000.00
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
	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
			\$6,000.00

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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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 in 100% of excavation area.			
5. Assumed mulch is not contaminated.			
6. Assumed mulch and vegetative debris to be placed adjacent to site to decompose.			
Assumptions and Calculations:			
1. Area to be cleared (acres) =		3.8 acres	
2. Daily output clearing crew (acres/day) =		1	
3. Days clearing contractor in field =		4 days	
4. Silt Fence to be installed (lf) =		5000	
5. Daily output silt fencing crew (LF/day) =		1000	
6. Days silt fence crew in field =		5 days	
7. Number of Hay Bales =		1000	
8. Work hours per day =		8 hrs	
Service/Materials	Unit	Unit Cost	Subtotal
Decontamination Pad	1	\$10,000.00 LS	\$10,000.00
Road Improvement	1	\$25,000.00 LS	\$25,000.00
Weigh Station	1	\$5,000.00 LS	\$5,000.00
Contractor:			
Site PM	72	\$120.00 /hr	\$8,640.00
Site Superintendent	72	\$115.00 /hr	\$8,280.00
QA (Sampling) Coordinator	72	\$80.00 /hr	\$5,760.00
H&S Coordinator	72	\$130.00 /hr	\$9,360.00
Equipment Operator	9	\$406.00 /day	\$3,654.00
Laborer	9	\$341.60 /day	\$3,074.40
Laborer	9	\$341.60 /day	\$3,074.40
Subcontractor:			
Surveying Crew	1	\$2,000.00 /day	\$2,000.00
Bushhog	3	\$500.00 /ac	\$1,500.00
Materials:			
Field Instruments	2	\$1,150.00 /wk	\$2,300.00
Silt Fencing	5,000	\$1.60 /ft	\$8,000.00
Hay Bales	1,000	\$5.00 /ea	\$5,000.00
Surface Water Controls	1	\$5,000.00 /ls	\$5,000.00
Subtotal			\$105,643.00

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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4.0 Excavation of Contaminated Soil				
Includes:				
1. Excavation of soil with contaminants exceeding RGs.				
2. Screen oversize material.				
3. Stockpile screened soil				
4. Confirmatory sampling and analysis to verify extent of excavation.				
Assumptions and Calculations:				
1a. Remedial area (including NTCRA area)				121,783 ft ²
1b. Cubic yards (bank) of soil within remedial area =				28,195 bcy
2. Total depth of excavation (feet) =				8 ft
3. Slope line (run/rise) in lieu of shoring				2 ft/ft
4. Perimeter of excavation				2,870 ft
4a. Cutback area for excavation slope				45,920 ft ²
5. Unit volume of excavated soil within slope line				2.37 bcy/ft
6. Volume of excavated soil within slope line				6,803 bcy
7. Total volume of soil excavated				34,998 bcy
8. Swell factor for soil upon excavation =				1.3 lcy/bcy
9. Cubic yards (loose) of unconsolidated soil =				45,497 lcy
10. Bulk density of loose soil =				1.1 tons/lcy
11. Mass of unconsolidated soil =				50,047 tons
12. Capacity of screening plant =				300 tons/hr
13. Hydraulic excavator, CAT 321D bucket size				1.31 bcy
13a. Excavator cycle time				0.42 min
13b. Excavator production, 100% efficiency, CAT p4-210				187 lcy/hr
13c. Excavator efficiency				75%
13d. Excavator production (tons/hr), (lcy/hr) =	39			36 lcy/hr
14. Excavator production (tons/day)/(bcy/day) =	315			286 lcy/day
15. Days to excavate soil =				160 days
16. Maximum distance to stockpile =				400 ft
17. Track loader CAT 963D bucket size				3.2 lcy
18. Track loader load and dump times =	0.07			0.04 min
19. Max. round trip travel time excavation to stockpile				1.8 min
20. Track load maneuver time =				0.2 min
21. Track loader max. cycle time =				2.11 min
22. Track loader cycles per hour, 100% efficiency				28.4 cycles/hr
23. Loader efficiency				83%
24. Track loader cycles per hour				23
25. Track loader production =				74 lcy/hr
26. No. of loaders required =				1 loaders
27. Number of excavation crew =				3 workers
28. Number of screening crew =				2 workers
29. Lineal foot of excavation per confirmation sample =				20 ft
30. Resampling factor for confirmation sampling =				110%
31. Number of confirmatory samples from excavated area =				420 samples
32. Excavation area =				95,157 ft ²
33. Fraction of excavation work performed in Level C PPE =				10%
35. Days excavation crew in Level C =				16 days
36. Days screening crew in Level C =				16 days
38. Work days per week				5 days
39. Work hours per day				8 hrs
	Service/Materials	Unit	Unit Cost	Subtotal
Labor:				
	Site PM	1,280	\$120.00 /hr	\$153,600.00
	Site Superintendent	1,280	\$115.00 /hr	\$147,200.00
	QA (Sampling) Coordinator	1,280	\$80.00 /hr	\$102,400.00
	H&S Coordinator	1,280	\$130.00 /hr	\$166,400.00
	Chemist (home office)	128	\$600.00 /day	\$76,800.00
	Excavator Operator	160	\$406.00 /day	\$64,960.00
	Track Loader Operator	160	\$406.00 /day	\$64,960.00
	Track Loader Operator	160	\$406.00 /day	\$64,960.00
	Screening Plant Operator	160	\$406.00 /day	\$64,960.00
	Laborer	160	\$341.60 /day	\$54,656.00

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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4.0 Excavation of Contaminated Soil (continued)				
Equipment:				
CAT 321D Excavator	7	\$6,500.00	/4-wks	\$45,500.00
300-ton/hr Screening Plant	7	\$9,000.00	/4-wks	\$63,000.00
CAT 953 Track Loader	7	\$8,800.00	/4-wks	\$61,600.00
2000 gal. Water Truck	7	\$3,800.00	/4-wks	\$26,600.00
Office Trailer	8	\$800.00	/mo	\$6,400.00
Generator	8	\$595.00	/mo	\$4,760.00
P/U Truck	8	\$1,200.00	/mo	\$9,600.00
Analytical:				
<i>Excavation Confirmation Sampling:</i>				
NACs (8330)	420	\$125.00	/ea	\$52,500.00
NAC field analyses	420	\$40.00	/ea	\$16,800.00
Shipping	28	\$40.00	/ea	\$1,120.00
Materials & Services:				
Level D PPE	720	\$10.00	/day	\$7,200.00
Level C PPE	80	\$35.00	/day	\$2,800.00
PID rental	8	\$974.00	/mo.	\$7,792.00
CGI rental	8	\$380.00	/mo.	\$3,040.00
Subtotal				\$1,269,608.00

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
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Sandusky, Ohio**

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5.0 Off-Site Disposal

Includes:

1. Characterization of excavated soil for offsite disposal.
2. Characterization of stormwater runoff from soil staging area for offsite disposal.
3. Offsite disposal of non-hazardous soil at local municipal landfill.
4. Offsite disposal of soil hazardous for 2,4-DNT at a hazardous waste landfill.
5. Costs for characterization of uncontaminated excavated soil are in Section 6, Site Restoration.

Assumptions and Calculations:

1. Percent of contaminated soil within remedial area:	75%
2. Percent of excavated soil assumed to be hazardous.	20%
3. Waste characterization and disposal sampling: 1 sample per	300 lcy
4. Erie County Landfill daily capacity	200 tons
5. EQ Environmental TSDF daily capacity	300 tons
6. Bulk density of loose soil =	1.1 tons/lcy
7. Volume of soil within remedial area	36,654 lcy
8. Volume of contaminated soil	27,491 lcy
9. Volume of hazardous soil for disposal =	7,331 lcy
10. Volume of nonhazardous soil for disposal =	20,160 lcy
11. Mass of D030 soil for haz disposal =	8,064 tons
12. Mass of nonhazardous soil for disposal =	22,176 tons
13. Non-haz waste disposal costs (\$/ton) =	\$35 Erie County Landfill
14. D030 Haz waste disposal cost (\$/ton) =	\$250 EQ Environmental ^a
15. Haz waste transportation cost (without fuel surcharge)	\$704 per truck load
16. Haz waste transportation fuel surcharge	47% per truck load
17. Haz waste transportation cost (incl. fuel surcharge) =	\$1,035 per truck load
18. Truck loads to transport haz soil	448 truck loads
19. Number of workers in field crew =	3
20. Average load capacity of a 22 ton end dump truck =	18 tons
21. Round trip duration from site to non-haz landfill =	1.5 hrs
22. Truck loads to transport non-haz soil =	1,232 loads
23. Total transportation time to municipal landfill =	1,848 hrs
24. Daily haul cycles per truck	5 loads
25. Daily haul capacity per truck	90 tons
26. Number of trucks required	3 trucks
27. CAT 924K wheel loader bucket volume	2.5 lcy
28. Wheel loader cycle time, truck loading =	0.5 min
29. Cycles per hour, 100% efficiency =	120 cycles/hr
30. Wheel loader efficiency =	83%
31. Cycles per hour =	100 cycles/hr
32. Wheel loader production (lcy/day), (tons/day) =	1,992 2,191 tons/day
33. No. of wheel loaders =	1
34. No. of days to complete nonhazardous soil disposal =	111 days
35. No. of days to complete hazardous soil disposal =	27 days
36. Volume of stormwater requiring off-site disposal (gal) =	20,000
37. Truck loads of stormwater for disposal =	5 truck loads
38. Number of wastewater samples =	5 samples
39. Work days per week =	5 days
40. Work hours per day =	8 hours

	Service/Materials	Unit	Unit Cost	Subtotal
Labor:				
	Site PM	888	\$120.00 /hr	\$106,560.00
	Site Superintendent	888	\$115.00 /hr	\$102,120.00
	QA (Sampling) Coordinator	888	\$80.00 /hr	\$71,040.00
	H&S Coordinator	888	\$130.00 /hr	\$115,440.00
	Wheel Loader Operator	111	\$406.00 /day	\$45,066.00
	Truck Drivers (non haz soil)	333	\$406.00 /day	\$135,198.00
	Laborer	111	\$341.60 /day	\$37,917.60
Materials:				
	Level D PPE	333	\$10.00 /day	\$3,330.00

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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5.0 Off-Site Disposal (continued)					
Equipment:					
CAT 924K Wheel Loader	6	\$4,000.00	/4-wks	\$24,000.00	
Dump Truck	18	\$4,000.00	/4-wks	\$72,000.00	
Office Trailer	6	\$800.00	/mo	\$4,800.00	
Generator	6	\$595.00	/mo	\$3,570.00	
P/U Truck	6	\$1,200.00	/mo	\$7,200.00	
Analytical:					
<i>Waste Characterization Soil Sampling:</i>					
TCLP 2,4-DNT	92	\$125.00	/ea	\$11,500.00	
NACs (8330)	92	\$125.00	/ea	\$11,500.00	
<i>Stormwater Sampling:</i>					
TCLP 2,4-DNT	5	\$125.00	/ea	\$625.00	
NACs (8330)	5	\$125.00	/ea	\$625.00	
Off-Site Disposal Costs:					
Disposal Cost (Non-Haz waste)	22,176	\$52.00	/ton	\$1,153,152.00	Erie County Landfill
Transportation (Haz Waste)	448	\$1,035	/load	\$463,680.00	
Disposal Cost (D030 haz waste)	8,064	\$250.00	/ton	\$2,016,000.00	Chemical oxidation
Disposal Cost (D030 haz waste)	0	\$500.00	/ton	\$0.00	Incineration
Stormwater Disposal	20,000	\$0.25	/gal	\$5,000.00	Enviro-Tank Clean
				Subtotal	\$4,390,324.00

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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6.0 Site Restoration				
Includes:				
1. Sample and analyze soil believed to be uncontaminated.				
2. Backfill excavated areas with uncontaminated excavated soil and clean backfill.				
3. Re-seed site.				
Assumptions and Calculations:				
1. Volume of consolidated soil excavated (bcy) =				34,998 bcy
2. Soil compaction factor =				1.15 lcy/bcy
3. Volume of soil required for backfill =				40,248 lcy
4. Vol. of stockpiled uncontaminated soil used to slope excavation				6,803 bcy
5. Volume of soil within remedial area that is uncontaminated				7,049 bcy
6. Vol. of excavated soil used for backfill =				18,008 lcy
7. Volume of offsite backfill required =				22,240 lcy
8. Track loader production =				589 lcy/day
9. No. of track loaders				2 loaders
10. Total track loader output =				1,178 lcy/day
11. Field days required to backfill soil =				35 days
12. CAT 815F2 soil compactor wheel drum width =				3.25 ft
13. Soil compactor ground speed, 10% rolling (total) resistance =				5 mph
14. Compacted lift thickness =				6 in
15. No. of soil compactor passes =				6 passes/lift
16. Soil compactor production, 100% efficiency =				529 bcy/hr
17. Soil compactor efficiency =				83%
18. Soil compactor production =				4,039 lcy/day
19. Number of field crew =				3 workers
20. Reseeding time =				5 days
21. Task duration (days) =				40
22. Days per work week =				5 days/week
23. Hours per work day =				8 hrs/day
24. Characterization sampling for onsite backfill: 1 sample per				300 lcy
25. No. of onsite backfill samples				60 samples
	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 Coordinator	320	\$80.00 /hr	\$25,600.00
	H&S Coordinator	320	\$130.00 /hr	\$41,600.00
	Track Loader Operator	35	\$406.00 /day	\$14,210.00
	Soil Compactor Operator	35	\$406.00 /day	\$14,210.00
	Laborer	35	\$341.60 /day	\$11,956.00
	Reseeding	122	\$80.00 /1000 ft ²	\$9,760.00
	Road Repair	1	\$175,000.00 /ls	\$175,000.00
				Erie Blacktop
Equipment:				
	CAT 953 Track Loader	4	\$8,800.00 /4-wks	\$35,200.00
	CAT 815F2 Soil Compactor	2	\$12,600.00 /4-wks	\$25,200.00
	Office Trailer	2	\$800.00 /mo	\$1,600.00
	Generator	2	\$595.00 /mo	\$1,190.00
	P/U Truck	2	\$1,200.00 /mo	\$2,400.00
Material:				
	Backfill	22,240	\$12.00 /cy	\$266,880.00
	PID rental	2	\$974.00 /mo.	\$1,948.00
	CGI rental	2	\$380.00 /mo.	\$760.00
	Level D PPE	120	\$10.00 /day	\$1,200.00
				delivered to site
Analytical:				
	NACs (8330)	60	\$125.00 /ea	\$7,500.00
	Shipping	10	\$40.00 /ea	\$400.00
				Subtotal
				\$711,814.00

Table 4-1

**Alternative 2 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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7.0 Overall Cost		
	Total Capital Cost	\$6,578,400.00
	Contingency (25%)	\$1,644,600.00
	Contractor Oversight (5%)	\$328,920.00
	Total Cost	\$8,551,900.00

^a EQ Environmental, Wayne, MI. Treatment of soil using chemical oxidation at TSDF to lower DNT concentrations to comply with LDRs followed by disposal in RCRA C cell.

^b CAT equip rental prices from Ohio CAT Rental, Toledo, <http://www.ohiocat.com/en/EQUIPMENT%20DIVISION/Rentals.aspx>

*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
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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Alternative 3 Excavation/Composting/Off-Site Disposal Cost Estimate		Site: Pentolite Road Red Water Pond Area Plum Brook Ordnance Works		
		Date: 10/8/2014		
Scope:				
1. Prepare composting work plan, H&S plan, materials list, and procurement along with the final report				
2. Mobilize equipment and personnel.				
3. Prepare site for remedial activity.				
4. Excavate contaminated soil, perform confirmation sampling & characterize waste.				
5. Treatment of soil contaminated with nitroaromatic compounds via windrow composting.				
6. Off-site disposal.				
7. Site restoration.				
8. 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	\$100,000.00
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	\$6,000.00

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 2 of 10)

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 in 100% of excavation area.				
5. Assumed mulch is not contaminated.				
6. Assumed mulch and vegetative debris to be placed adjacent to site to decompose.				
Assumptions and Calculations:				
1. Area to be cleared (acres) =				3.8 acres
2. Daily output clearing crew (acres/day) =				1
3. Days clearing contractor in field =				4 days
4. Silt Fence to be installed (lf) =				5000
5. Daily output silt fencing crew (LF/day) =				1000
6. Days silt fence crew in field =				5 days
7. Number of Hay Bales =				1,000
8. Work hours per day =				8 hrs
	Service/Materials	Unit	Unit Cost	Subtotal
	Decontamination Pad	1	\$10,000.00 LS	\$10,000.00
	Road Improvement	1	\$25,000.00 LS	\$25,000.00
	Weigh Station	1	\$5,000.00 LS	\$5,000.00
	Contractor:			
	Site PM	72	\$120.00 /hr	\$8,640.00
	Site Superintendent	72	\$115.00 /hr	\$8,280.00
	QA (Sampling) Coordinator	72	\$80.00 /hr	\$5,760.00
	H&S Coordinator	72	\$130.00 /hr	\$9,360.00
	Equipment Operator	9	\$406.00 /day	\$3,654.00
	Laborer	9	\$341.60 /day	\$3,074.40
	Laborer	9	\$341.60 /day	\$3,074.40
	Subcontractor:			
	Surveying Crew	1	\$2,000.00 /day	\$2,000.00
	Bushhog	3	\$500.00 /ac	\$1,500.00
	Materials:			
	Field Instruments	2	\$1,150.00 /wk	\$2,300.00
	Silt Fencing	5,000	\$1.60 /ft	\$8,000.00
	Hay Bales	1,000	\$5.00 /ea	\$5,000.00
	Surface Water Controls	1	\$5,000.00 /ls	\$5,000.00
			Subtotal	\$105,643.00

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 3 of 10)

4.0 Excavation of Contaminated Soil			
Includes:			
1. Excavation of soil with contaminants exceeding RGs.			
2. Screen oversize material.			
3. Stockpile screened soil			
4. Collect confirmatory samples to verify extent of excavation.			
Assumptions and Calculations:			
1a. Remedial area			121,783 ft ²
1b. Total cubic yards of consolidated soil excavated =			28,195 bcy
2. Total depth of excavation (feet) =			8 ft
3. Slope line (run/rise) in lieu of shoring			2 ft/ft
4. Perimeter of excavation			2,870 ft
4a. Cutback area for excavation slope			45,920 ft ²
5. Unit volume of excavated soil within slope line			2.37 bcy/ft
6. Volume of excavated soil within slope line			6,803 bcy
7. Total volume of soil excavated			34,998 bcy
8. Swell factor for soil upon excavation =			1.3 lcy/bcy
9. Cubic yards (loose) of unconsolidated soil =			45,497 lcy
10. Bulk density of loose soil =			1.1 tons/lcy
11. Mass of unconsolidated soil =			50,047 tons
12. Capacity of screening plant =			300 tons/hr
13. Hydraulic excavator, CAT 321D bucket size			1.31 bcy
13a. Excavator cycle time			0.42 min
13b. Excavator production, 100% efficiency, CAT p4-210			187 lcy/hr
13c. Excavator efficiency			75%
13d. Excavator production (tons/hr), (lcy/hr) =	39		36 lcy/hr
14. Excavator production (tons/day)/(bcy/day) =	315		286 lcy/day
15. Days to excavate soil =			160 days
16. Maximum distance to stockpile =			400 ft
17. Track loader CAT 963D bucket size			3.2 lcy
18. Track loader load and dump times =	0.07		0.04 min
19. Max. round trip travel time excavation to stockpile			1.8 min
20. Track load maneuver time =			0.2 min
21. Track loader max. cycle time =			2.11 min
22. Track loader cycles per hour, 100% efficiency			28.4 cycles/hr
23. Loader efficiency			83%
24. Track loader cycles per hour			23
25. Track loader production =			74 lcy/hr
26. No. of loaders required =			1 loaders
27. Number of excavation crew =			3 workers
28. Number of screening crew =			2 workers
29. Lineal foot of excavation per confirmation sample =			20 ft
30. Resampling factor for confirmation sampling =			110%
31. Number of confirmatory samples from excavated area =			420 samples
32. Excavation area =			95,157 ft ²
33. Fraction of excavation work performed in Level C PPE =			10%
35. Days excavation crew in Level C =			16 days
36. Days screening crew in Level C =			16 days
38. Work days per week			5 days
39. Work hours per day			8 hrs
Service/Materials Unit Unit Cost Subtotal			
Labor:			
Site PM	1,280	\$120.00 /hr	\$153,600.00
Site Superintendent	1,280	\$115.00 /hr	\$147,200.00
QA (Sampling) Coordinator	1,280	\$80.00 /hr	\$102,400.00
H&S Coordinator	1,280	\$130.00 /hr	\$166,400.00
Chemist (home office)	128	\$600.00 /day	\$76,800.00
Excavator Operator	160	\$406.00 /day	\$64,960.00
Track Loader Operator	160	\$406.00 /day	\$64,960.00
Track Loader Operator	160	\$406.00 /day	\$64,960.00
Screening Plant Operator	160	\$406.00 /day	\$64,960.00
Laborer	160	\$341.60 /day	\$54,656.00

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

(Page 4 of 10)

4.0 Excavation of Contaminated Soil (continued)				
Equipment:				
CAT 321D Excavator	7	\$6,500.00	/4-wks	\$45,500.00
300-ton/hr Screening Plant	7	\$9,000.00	/4-wks	\$63,000.00
CAT 953 Track Loader	7	\$8,800.00	/4-wks	\$61,600.00
2000 gal. Water Truck	7	\$3,800.00	/4-wks	\$26,600.00
Office Trailer	8	\$800.00	/mo	\$6,400.00
Generator	8	\$595.00	/mo	\$4,760.00
P/U Truck	8	\$1,200.00	/mo	\$9,600.00
Analytical:				
<i>Excavation Confirmation Sampling:</i>				
NACs (8330)	420	\$125.00	/ea	\$52,500.00
NAC field analyses	420	\$40.00	/ea	\$16,800.00
Shipping	28	\$40.00	/ea	\$1,120.00
Materials & Services:				
Level D PPE	720	\$10.00	/day	\$7,200.00
Level C PPE	80	\$35.00	/day	\$2,800.00
PID rental	8	\$974.00	/mo.	\$7,792.00
CGI rental	8	\$380.00	/mo.	\$3,040.00
Subtotal				\$1,269,608.00

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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5.0 Windrow Composting of Contaminated of Soil			
Includes:			
1. Rental of composting equipment.			
2. Procurement & stockpiling of composting amendments.			
3. Mix and compost soil and amendments.			
4. Composting of soil hazardous due to leachable concentrations of 2,4-DNT			
5. Pre-compliance testing: after compost formation & at end of treatment.			
6. Pre-compliance testing using definitive field analysis for NAC.			
Assumptions:			
1. Percent of excavated soil in remedial area that is contaminated:	75%		
2. Percent of contaminated soil hazardous for 2,4-DNT:	20%		
3. Width of treatment area ^a	156 ft		
4. Length of treatment area ^a	323 ft		
5. Volume of excavated soil in remedial area	28,195 bcy		
6. Swell factor for soil upon excavation =	1.3 lcy/bcy		
7. Volume of excavated soil in remedial area =	36,654 lcy		
8. Volume of hazardous soil to be treated	7,331 lcy		
9. Bulk density of loose soil	1.1 tons/lcy		
10. Mass of hazardous soil to be treated	8,064 tons		
13. Wt % and Vol % of soil in compost	85.74%	25.0% ^a	
14. Wt % and Vol % of manure in compost	6.69%	2.9% ^a	
15. Wt % and Vol % of straw in compost	7.58%	72.1% ^a	
16. Total mass of compost	18,811,155 lbs		
17. Mass of soil in compost	16,128,000 lbs		
18. Mass of manure in compost	1,257,720 lbs		
19. Mass of straw in compost	1,425,435 lbs		
20. Volume (lcy) and bulk density (lb/cy) of soil	7,331	2,200 lb/cy	
21. Volume (cy) and bulk density (lb/cy) of manure	850	1,479 lb/cy ^e	
22. Volume (lcy) and bulk density (lb/cy) of straw	21,142	67 lb/lcy ^c	
23. Volume (cy) and bulk density of compost ^b	25,559	642 lb/cy	
24. Bulk density of baled straw	169 lb/cy ^c		
25. Windrow width ^a	24 ft		
26. Windrow height ^a	9 ft		
27. Windrow length ^a	300 ft		
28. Volume of compost per windrow	1,500 cy		
29. Mass of windrow	481 tons		
30. Mass of soil per windrow ^a	413 tons		
31. Soil volume per windrow	375 cy		
32. Number of windrows per treatment cycle ^a	4 windrows/cycle		
33. Number of treatment cycles =	5 cycles		
34. Number of windrows =	19.5 windrows		
35. Treatment duration per batch	6 weeks		
36. Compliance analytical TAT	2 weeks		
37. Erie County Landfill waste capacity per day	200 tons/day		
38. Treatment delay due to offsite disposal ^d	38 workdays		
40. Total treatment duration (days) =	318 workdays		
40. Total treatment duration (weeks) =	46 weeks		
41. Work hours per day	8 hrs		
42. Work days per week	7 days		
43. Number of field crew =	6		
44. Tractor and straw blower are in-use 1 day/week and on stand-by the rest of the week.			
45. Pre-compliance testing shall weekly per windrow and consist of:			
- EnSys TNT 20, one per batch. Number of samples =	120		
- EnSys TNT 20, no. of samples per kit =	20		
- Total NAC, one per batch. Number of samples =	100		
46. Compliance testing:			
- Composite samples per windrow =	3		
- Total NACs. Number of samples =	60		
- TCLP 2,4-DNT. Number of samples =	60		
47. Unit cost for straw	\$200 per ton		Meyer Hatchery
48. Unit cost for chicken manure	\$100 per ton		Meyer Hatchery

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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5.0 Windrow Composting of Contaminated of Soil (continued)				
Service/Materials	Unit	Unit Cost	Subtotal	
Labor:				
Site PM	2,548	\$120.00 /hr	\$305,750.48	
Site Superintendent	2,548	\$115.00 /hr	\$293,010.88	
QA (Sampling) Coordinator	2,548	\$80.00 /hr	\$203,833.66	
H&S Coordinator	2,548	\$130.00 /hr	\$331,229.69	
Equipment Operator	318	\$567.20 /day	\$180,647.58	
Equipment Operator	318	\$406.00 /day	\$129,306.98	
Equipment Operator	318	\$406.00 /day	\$129,306.98	
Laborer	318	\$341.60 /day	\$108,796.21	
Equipment:				
Windrow Turner (Allu 38H-24'x9')	12	\$45,000.00 /mo	\$540,000.00	
CAT 321D Excavator	12	\$6,150.00 /mo	\$73,800.00	
CAT 924K Wheel Loader	12	\$4,000.00 /mo	\$48,000.00	
2000 gal. Water Truck	12	\$4,200.00 /mo	\$50,400.00	
CAT 725 Articulated Truck	12	\$9,100.00 /mo	\$109,200.00	
CAT 725 Articulated Truck	12	\$9,100.00 /mo	\$109,200.00	
Tractor	12	\$5,500.00 /mo	\$66,000.00	
Straw Blower	12	\$4,000.00 /mo	\$48,000.00	
21000 gallon Frac Tank	12	\$1,400.00 /mo	\$16,800.00	
21000 gallon Frac Tank	12	\$1,400.00 /mo	\$16,800.00	
2-in Trash Pump	12	\$345.00 /mo	\$4,140.00	
3-in Trash Pump	12	\$435.00 /mo	\$5,220.00	
Office Trailer	12	\$800.00 /mo	\$9,600.00	
Generator	12	\$595.00 /mo	\$7,140.00	
P/U Truck	12	\$1,200.00 /mo	\$14,400.00	
Spectrophotometer	0	\$3,012.00 /ls	\$0.00	Previously purchased
Materials:				
Straw (baled)	713	\$200.00 /ton	\$142,543.50	
Manure	629	\$100.00 /ton	\$62,886.00	
Water	1,932	\$9.40 /kgal	\$18,160.80	
Level C PPE	318	\$35.00 /day	\$11,147.15	
Air Monitoring Screening Kits	1	\$2,500.00 /ls	\$2,500.00	
Moisture/Temp Probes	1	\$700.00 /ea	\$700.00	
Analytical:				
Pre-Compliance Sampling:				
EnSys Kit (TNT 20) - 20 samples per kit	6	\$693.00 /ea	\$4,158.00	Modern Water
Compliance Sampling:				
Total NACs	60	\$105.00 /ea	\$6,300.00	
TCLP 2,4-DNT	60	\$135.00 /ea	\$8,100.00	
			Subtotal	\$2,751,327.00

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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6.0 Off-Site Disposal	
Includes:	
1. Waste characterization of untreated soil for offsite disposal.	
2. Compost characterization included in Section 5, Windrow Composting	
3. Characterization of uncontaminated excavated soil included in Section 8, Site Restoration	
4. Offsite disposal of compost and untreated soil at local municipal landfill.	
5. Characterization of collected stormwater runoff from treatment area.	
6. Offsite disposal of stormwater as a nonhazardous waste.	
7. This task excludes costs for site PM, site superintendent, QA coordinator, and H&S coordinator that are covered under Section 5.0, Windrow Composting, that is ongoing for 318 work days (longest duration task) and runs concurrently with off-site disposal of untreated soil.	
8. This task excludes costs for wheel loader and wheel loader operator for loading of compost that is accounted for in Section 5, Windrow Composting.	
9. This task includes trucks and truck drivers for offsite transport of compost and untreated soil.	
Assumptions and Calculations:	
1. Percent of contaminated soil within remedial area:	75%
2. Percent of excavated soil assumed to be hazardous.	20%
3. Waste characterization and disposal sampling: 1 sample per	300 lcy
4. Erie County Landfill daily capacity	200 tons
5. Total volume of compost for nonhazardous disposal =	25,559 cy
6. Bulk density of compost (tons/cy) =	0.321 tons/cy
7. Mass of treated soil =	8,064 tons
8. Mass of compost amendments =	1,342 tons
9. Mass of compost for off-site disposal =	9,406 tons
10. Volume of untreated soil for off-site non-haz disposal =	20,160 lcy
11. Bulk density of loose soil =	1.1 tons/lcy
12. Mass of untreated soil for off-site non-haz disposal =	22,176 tons
13. Total mass of material for offsite nonhazardous disposal	31,582 tons
14. Average load capacity of a dump truck =	12 tons
15. Distance to municipal landfill	10 mi
16. Round trip duration from site to non-haz landfill =	1 hrs
17. Truck loads to transport non-haz soil =	2,632 loads
18. Total transportation time to municipal landfill =	2,632 hrs
19. Daily haul cycles per truck	8 loads
20. Daily haul capacity per truck	96 tons
21. Number of trucks required	3 trucks
22. CAT 924K wheel loader bucket volume	2.5 lcy
23. Wheel loader cycle time, truck loading =	0.5 min
24. Cycles per hour, 100% efficiency =	120 cycles/hr
25. Wheel loader efficiency =	83%
26. Cycles per hour =	100 cycles/hr
27. Wheel loader production (lcy/day), (tons/day) =	1,992 2,191 tons/day
28. No. of wheel loaders =	1 loader
29. No. of days to complete compost disposal =	47 days
30. No. of days to complete untreated soil disposal =	111 days
31. No. of days to complete nonhazardous waste disposal =	158 days
32. No. of days to complete hazardous soil disposal =	0 days
33. Volume of stormwater requiring off-site disposal (gal) =	20,000 gal
34. Truck loads of stormwater for disposal =	5 truck loads
35. Number of wastewater samples =	5 samples
36. Work days per week =	5 days
37. Work hours per day =	8 hours

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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7.0 Off-Site Disposal (continued)				
Service/Materials	Unit	Unit Cost	Subtotal	
Labor:				
Site PM	888	\$120.00 /hr	\$106,560.00	See note 7 above
Site Superintendent	888	\$115.00 /hr	\$102,120.00	See note 7 above
QA Coordinator	888	\$80.00 /hr	\$71,040.00	See note 7 above
H&S Coordinator	888	\$130.00 /hr	\$115,440.00	See note 7 above
Wheel Loader Operator	111	\$406.00 /day	\$45,066.00	See note 8 above
Truck Drivers	474	\$341.60 /day	\$161,918.40	See note 9 above
Materials:				
Level D PPE	111	\$10.00 /day	\$1,110.00	
Equipment:				
CAT 924K Wheel Loader	6	\$4,000.00 /4-wks	\$24,000.00	
Dump Trucks	24	\$4,000.00 /4-wks	\$94,800.00	
Office Trailer	6	\$800.00 /mo	\$4,800.00	
Generator	6	\$595.00 /mo	\$3,570.00	
P/U Truck	6	\$1,200.00 /mo	\$7,200.00	
Analytical:				
<i>Waste Characterization Soil Sampling:</i>				
TCLP 2,4-DNT	67	\$125.00 /ea	\$8,375.00	
NACs (8330)	67	\$125.00 /ea	\$8,375.00	
<i>Stormwater Sampling:</i>				
TCLP 2,4-DNT	5	\$125.00 /ea	\$625.00	
NACs (8330)	5	\$125.00 /ea	\$625.00	
Off-Site Disposal Costs:				
Disposal (Non-Haz)	31,582	\$52.00 /ton	\$1,642,264.00	Erie County Landfill
Stormwater Disposal	20,000	\$0.25 /gal	\$5,000.00	Enviro-Tank Clean
			Subtotal	\$2,296,328.00

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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8.0 Site Restoration				
Includes:				
1. Sample and analyze soil believed to be uncontaminated.				
2. Backfill excavated areas with uncontaminated excavated soil and clean backfill.				
3. Re-seed site.				
Assumptions and Calculations:				
1. Volume of consolidated soil excavated (bcy) =				34,998 bcy
2. Soil compaction factor =				1.15 lcy/bcy
3. Volume of soil required for backfill =				40,248 lcy
4. Vol. of stockpiled uncontaminated soil used to slope excavation				6,803 bcy
5. Volume of soil within remedial area that is uncontaminated				7,049 bcy
6. Vol. of excavated soil used for backfill =				18,008 lcy
7. Volume of offsite backfill required =				22,240 lcy
8. Track loader production =				589 lcy/day
9. No. of track loaders				2 loaders
10. Total track loader output =				1,178 lcy/day
11. Field days required to backfill soil =				35 days
12. CAT 815F2 soil compactor wheel drum width =				3.25 ft
13. Soil compactor ground speed, 10% rolling (total) resistance =				5 mph
14. Compacted lift thickness =				6 in
15. No. of soil compactor passes =				6 passes/lift
16. Soil compactor production, 100% efficiency =				529 bcy/hr
17. Soil compactor efficiency =				83%
18. Soil compactor production =				4,039 lcy/day
19. Number of field crew =				3 workers
20. Reseeding time =				5 days
21. Task duration =				40 days
22. Days per work week =				5 days/week
23. Hours per work day =				8 hrs/day
24. Characterization sampling for onsite backfill: 1 sample per				300 lcy
25. No. of onsite backfill samples				60 samples
	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 Coordinator	320	\$80.00 /hr	\$25,600.00
	H&S Coordinator	320	\$130.00 /hr	\$41,600.00
	Track Loader Operator	35	\$406.00 /day	\$14,210.00
	Soil Compactor Operator	35	\$406.00 /day	\$14,210.00
	Laborer	35	\$341.60 /day	\$11,956.00
	Reseeding	122	\$80.00 /1000 ft ²	\$9,760.00
	Road Repair	1	\$175,000.00 /ls	\$175,000.00 Erie Blacktop
Equipment:				
	CAT 953 Track Loader	4	\$8,800.00 /4-wks	\$35,200.00
	CAT 815F2 Soil Compactor	2	\$12,600.00 /4-wks	\$25,200.00
	Office Trailer	2	\$800.00 /mo	\$1,600.00
	Generator	2	\$595.00 /mo	\$1,190.00
	P/U Truck	2	\$1,200.00 /mo	\$2,400.00
Material:				
	Backfill	22,240	\$12.00 /cy	\$266,880.00 delivered to site
	PID rental	2	\$974.00 /mo.	\$1,948.00
	CGI rental	2	\$380.00 /mo.	\$760.00
	Level D PPE	120	\$10.00 /day	\$1,200.00
Analytical:				
	NACs (8330)	60	\$125.00 /ea	\$7,500.00
	Shipping	10	\$40.00 /ea	\$400.00
				Subtotal \$711,814.00

Table 4-2

**Alternative 3 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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9.0 Overall Cost		
	Total Capital Cost	\$7,240,700.00
	Contingency (25%)	\$1,810,175.00
	Contractor Oversight (5%)	\$362,035.00
	Total Cost	\$9,412,900.00

Notes:

^a Final Compost After Action Report, TNT Area B and Pentolite Road Red Water Pond Area, WTI, Inc, July 2006.

^b Bulk density of compost at Crane using same recipe was 0.368 tons/cy = 736 lb/cy

^c http://cdn.intechopen.com/pdfs/17491/InTech-Biomass_feedstock_pre-processing_part_1_pre_treatmen.pdf

^d Windrow disposal time is restricted by the receiving capacity of Erie County Landfill. Windrow disposal and construction would be staggered. As one windrow is moved off site, a second one will be constructed immediately afterward.

^e On-Farm Composting Handbook, Natural Resource, Agriculture, and Engineering Service Cooperative Extension, NRAES-54

*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
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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Alternative 4 Excavation/Alkaline Hydrolysis/Onsite-Offsite Disposal Cost Estimate	Site: Pentolite Road Red Water Pond Area Plum Brook Ordnance Works Date: 10/8/2014																								
<p>Scope:</p> <ol style="list-style-type: none"> 1. Prepare work plans and closeout report, and complete procurement. 2. Mobilize/demobilize equipment and personnel. 3. Prepare site for remedial activity. 4. Excavate contaminated soil, perform confirmation sampling & characterize waste. 5. Alkaline hydrolysis and neutralization of soil that contains 2,4-DNT above remedial goals. 6. On site disposal of soil treated via alkaline hydrolysis. 7. Site restoration. 																									
1.0 Treatability Study, Work Plans, Reports 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; width: 60%;">Service</th> <th style="text-align: center; width: 10%;">Unit</th> <th style="text-align: left; width: 30%;">Unit Cost</th> <th style="text-align: right; width: 10%;">Subtotal</th> </tr> </thead> <tbody> <tr> <td>Work Plans and Final Report</td> <td style="text-align: center;">1</td> <td>\$140,000.00 /ls</td> <td style="text-align: right;">\$140,000.00</td> </tr> <tr> <td style="padding-left: 20px;">Procurement</td> <td style="text-align: center;">1</td> <td>\$10,000.00 /ls</td> <td style="text-align: right;">\$10,000.00</td> </tr> <tr> <td colspan="3"></td> <td style="text-align: right;">Subtotal</td> </tr> </tbody> </table>	Service	Unit	Unit Cost	Subtotal	Work Plans and Final Report	1	\$140,000.00 /ls	\$140,000.00	Procurement	1	\$10,000.00 /ls	\$10,000.00				Subtotal	<p style="text-align: right;">\$150,000.00</p>								
Service	Unit	Unit Cost	Subtotal																						
Work Plans and Final Report	1	\$140,000.00 /ls	\$140,000.00																						
Procurement	1	\$10,000.00 /ls	\$10,000.00																						
			Subtotal																						
2.0 Mobilization/Demobilization of Equipment and Personnel																									
<p>Includes:</p> <ol style="list-style-type: none"> 1. Mobilization and demobilization of local equipment and personnel. 2. Set-up/tear down office trailer. <p>Assumptions:</p> <ol style="list-style-type: none"> 1. Labor and equipment are available locally. 2. Pressure washer to be purchased for use during project. 																									
<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; width: 60%;">Service/Materials</th> <th style="text-align: center; width: 10%;">Unit</th> <th style="text-align: left; width: 30%;">Unit Cost</th> <th style="text-align: right; width: 10%;">Subtotal</th> </tr> </thead> <tbody> <tr> <td colspan="4">Labor/Equipment:</td> </tr> <tr> <td style="padding-left: 20px;">Mobe/Demobe</td> <td style="text-align: center;">1</td> <td>\$5,000.00 /ls</td> <td style="text-align: right;">\$5,000.00</td> </tr> <tr> <td>Office Trailer (set up/tear down)</td> <td style="text-align: center;">1</td> <td>\$500.00 /ls</td> <td style="text-align: right;">\$500.00</td> </tr> <tr> <td style="padding-left: 20px;">Pressure Washer</td> <td style="text-align: center;">1</td> <td>\$500.00 /ls</td> <td style="text-align: right;">\$500.00</td> </tr> <tr> <td colspan="3"></td> <td style="text-align: right;">Subtotal</td> </tr> </tbody> </table>	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	<p style="text-align: right;">\$6,000.00</p>
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																						

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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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 in 100% of excavation area.				
5. Assumed mulch is not contaminated.				
6. Assumed mulch and vegetative debris to be placed adjacent to site to decompose.				
Assumptions and Calculations:				
1. Area to be cleared (acres) =				3.8 acres
2. Daily output clearing crew (acres/day) =				1
3. Days clearing contractor in field =				4 days
4. Silt Fence to be installed (lf) =				5,000
5. Daily output silt fencing crew (LF/day) =				1000
6. Days silt fence crew in field =				5 days
6a Site prep time =				15 days
7. Number of Hay Bales =				1,000
8. Work hours per day =				8 hrs
	Service/Materials	Unit	Unit Cost	Subtotal
	Decontamination Pad	1	\$10,000.00 LS	\$10,000.00
	Road Improvement	1	\$25,000.00 LS	\$25,000.00
	Weigh Station	1	\$5,000.00 LS	\$5,000.00
Contractor:				
	Site PM	120	\$120.00 /hr	\$14,400.00
	Site Superintendent	120	\$115.00 /hr	\$13,800.00
	QA (Sampling) Coordinator	120	\$80.00 /hr	\$9,600.00
	H&S Coordinator	120	\$130.00 /hr	\$15,600.00
	Equipment Operator	15	\$406.00 /day	\$6,090.00
	Laborer	15	\$341.60 /day	\$5,124.00
	Laborer	15	\$341.60 /day	\$5,124.00
Subcontractor:				
	Surveying Crew	1	\$2,000.00 /day	\$2,000.00
	Bushhog	3	\$500.00 /ac	\$1,500.00
Materials:				
	Field Instruments	2	\$1,150.00 /wk	\$2,300.00
	Silt Fencing	5,000	\$1.60 /ft	\$8,000.00
	Hay Bales	1,000	\$5.00 /ea	\$5,000.00
	Surface Water Controls	1	\$5,000.00 /ls	\$5,000.00
				Subtotal
				\$133,538.00

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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4.0 Excavation of Contaminated Soil				
Includes:				
1. Excavation of soil with contaminants exceeding RGs.				
2. Screen oversize material.				
3. Stockpile screened soil				
4. Collect confirmatory samples to verify extent of excavation.				
Assumptions and Calculations:				
1a. Remedial area		121,783 ft ²		
1b. Cubic yards (bank) of soil within remedial area =		28,195 bcy		
2. Total depth of excavation (feet) =		8 ft		
3. Slope line (run/rise) in lieu of shoring		2 ft/ft		
4. Perimeter of excavation		2,870 ft		
4a. Cutback area for excavation slope		45,920 ft ²		
5. Unit volume of excavated soil within slope line		2.37 bcy/ft		
6. Volume of excavated soil within slope line		6,803 bcy		
7. Total volume of soil excavated		34,998 bcy		
8. Swell factor for soil upon excavation =		1.3		
9. Cubic yards (loose) of unconsolidated soil =		45,497 lcy		
10. Density of unconsolidated soil =		1.1 tons/lcy		
11. Mass of unconsolidated soil =		50,047 tons		
12. Capacity of screening plant =		300 tons/hr		
13. Hydraulic excavator, CAT 321D bucket size		1.31 bcy		
13a. Excavator cycle time		0.42 min		
13b. Excavator production, 100% efficiency, CAT p4-210		187 lcy/hr		
13c. Excavator efficiency		75%		
13d. Excavator production (tons/hr), (lcy/hr) =	39	36 lcy/hr		
14. Excavator production (tons/day)/(bcy/day) =	315	286 lcy/day		
15. Days to excavate soil =		160 days		
16. Maximum distance to stockpile =		400 ft		
17. Track loader CAT 963D bucket size		3.2 lcy		
18. Track loader load and dump times =	0.07	0.04 min		
19. Max. round trip travel time excavation to stockpile		1.8 min		
20. Track load maneuver time =		0.2 min		
21. Track loader max. cycle time =		2.11 min		
22. Track loader cycles per hour, 100% efficiency		28.4 cycles/hr		
23. Loader efficiency		83%		
24. Track loader cycles per hour		23		
25. Track loader production =		74 lcy/hr		
26. No. of loaders required =		1 loaders		
27. Number of excavation crew =		3 workers		
28. Number of screening crew =		2 workers		
29. Lineal foot of excavation per confirmation sample =		20 ft		
30. Resampling factor for confirmation sampling =		110%		
31. Number of confirmatory samples from excavated area =		420 samples		
32. Excavation area =		95,157 ft ²		
33. Fraction of excavation work performed in Level C PPE =		10%		
35. Days excavation crew in Level C =		16 days		
36. Days screening crew in Level C =		16 days		
38. Work days per week		5 days		
39. Work hours per day		8 hrs		
	Service/Materials	Unit	Unit Cost	Subtotal
Labor:				
	Site PM	1,280	\$120.00 /hr	\$153,600.00
	Site Superintendent	1,280	\$115.00 /hr	\$147,200.00
	QA (Sampling) Coordinator	1,280	\$80.00 /hr	\$102,400.00
	H&S Coordinator	1,280	\$130.00 /hr	\$166,400.00
	Chemist (home office)	128	\$600.00 /day	\$76,800.00
	Excavator Operator	160	\$406.00 /day	\$64,960.00
	Track Loader Operator	160	\$406.00 /day	\$64,960.00
	Track Loader Operator	160	\$406.00 /day	\$64,960.00
	Screening Plant Operator	160	\$406.00 /day	\$64,960.00
	Laborer	160	\$341.60 /day	\$54,656.00

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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4.0 Excavation of Contaminated Soil (continued)				
Equipment:				
CAT 321D Excavator	7	\$6,500.00	/4-wks	\$45,500.00
300-ton/hr Screening Plant	7	\$9,000.00	/4-wks	\$63,000.00
CAT 953 Track Loader	7	\$8,800.00	/4-wks	\$61,600.00
2000 gal. Water Truck	7	\$3,800.00	/4-wks	\$26,600.00
Office Trailer	8	\$800.00	/mo	\$6,400.00
Generator	8	\$595.00	/mo	\$4,760.00
P/U Truck	8	\$1,200.00	/mo	\$9,600.00
Analytical:				
<i>Excavation Confirmation Sampling:</i>				
NACs (8330)	420	\$125.00	/ea	\$52,500.00
NAC field analyses	420	\$40.00	/ea	\$16,800.00
Shipping	28	\$40.00	/ea	\$1,120.00
Materials & Services:				
Level D PPE	720	\$10.00	/day	\$7,200.00
Level C PPE	80	\$35.00	/day	\$2,800.00
PID rental	8	\$974.00	/mo.	\$7,792.00
CGI rental	8	\$380.00	/mo.	\$3,040.00
Subtotal				\$1,269,608.00

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
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5.0 Alkaline Hydrolysis with Neutralization

Includes:

1. Alkaline hydrolysis of soil with NaOH and ferric sulfate.
2. Post-treatment acidification of soil with acetic acid to $\text{pH} \leq 12$.

Assumptions and Calculations:

1. Percent of excavated soil in remedial area that is contaminated:	75%
2. Percent of contaminated soil hazardous for 2.4-DNT:	20%
3. Width of treatment area ^a	156 ft
4. Length of treatment area ^a	323 ft
5. Volume of excavated soil in remedial area	28,195 bcy
6. Swell factor for soil upon excavation =	1.3
7. Volume of excavated soil in remedial area =	36,654 lcy
8. Volume of hazardous soil to be treated	7,331 lcy
9. Bulk density of loose soil	1.1 tons/lcy
10. Mass of hazardous soil to be treated	8,064 tons
11. Treatment row batch volume	375 lcy
12. Number of windrows during one treatment cycle =	13 windrows/cycle
13. Dosage of caustic soda, NaOH pellets ^a	3% wt%
14. Dosage of caustic soda, NaOH pellets =	66 lb/lcy soil
15. Water, used to saturate soil with water =	37 gal/lcy soil
16. Dosage of ferric sulfate 50% solution ^b	2.2 gal/cy soil
17. Dosage of 80% CH_3OOH (post-treatment to $\text{pH} \leq 12$) ^c	1.1 gal/lcy soil
18. Dosage of 80% CH_3OOH (post-treatment to $\text{pH} \leq 10$) ^c	11.8 gal/lcy soil
19. NaOH mol wt =	40 lb/lb mol
20. Windrow treatment time with acidification to $\text{pH} \leq 10$	17 weeks/batch
21. Erie County Landfill waste capacity per day	200 tons
22. Bulk density of treated soil =	1.5 tons/lcy
23. Mass of treated soil in a windrow =	562.5 tons
24. Total number of treatment windrows =	20 windrows
25. Number of treatment cycles =	2 cycles
26. Total workdays to treat soil (post-treatment to $\text{pH} \leq 10$) =	136 workdays
27. Treatment duration (post-treatment $\text{pH} \leq 12$) =	34 wks
28. Hours per workday	10 hrs
29. Workdays per week	4 days
30. Number of field crew =	6 workers
31. Mass of caustic soda =	483,833 lb
32. Volume of ferric sulfate 50% solution =	16,128 gal
33. Density of 50% ferric sulfate solution =	11.97 lb/gal
34. Volume of acetic acid 80% solution (post-treatment $\text{pH} \leq 12$)	8,064 gal
35. Volume of acetic acid 80% solution (post-treatment $\text{pH} \leq 10$)	86,504 gal
36. Density of 80% acetic acid solution =	8.92 lb/gal
37. Volume of water =	271,240 gal
38. Compliance sampling after AH prior to acidification for nitroaromatics, nitrate, nitrite, and pH.	
39. Compliance sampling after acidification for nitrate, nitrite and pH.	
40. Number of composite samples per windrow	1 sample
41. Temporary storage is required for the caustic soda pellets and 50% ferric sulfate preventing	
42. The caustic soda pellets come in 2000 pound super sacks at approximately 4-feet by 4-feet by 3-feet high.	
43. Number of caustic soda super sacks =	242 supersacks
44. Required storage capacity for caustic soda pellets (cf) =	11,616 ft^3
45. The 50% ferric sulfate solution comes in 330 gallon totes at approximately 46.5-inches by 46.5-inches by	
46. Volume of tote container	300 gal
47. Number of totes for 50% ferric sulfate solution =	54 totes
48. Required storage capacity for 50% ferric acid solution =	3,244 ft^3
49. Number of totes for 80% acetic acid solution =	289 totes
50. Required storage capacity for 50% ferric acid solution =	17,359 ft^3
51. Temporary storage shall be provided utilizing a 48-foot swing open-door land-sea cargo trailer. The trailer is	
52. Available capacity in the Land-Sea Cargo Trailer (cf) =	1,920
53. Number of Land-Sea Cargo Trailers for NaOH storage =	7
54. Number of Land-Sea Cargo Trailers for ferric sulfate storage =	2
55. Number of Land-Sea Cargo Trailers for acetic acid storage =	9

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
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5.0 Alkaline Hydrolysis with Neutralization (continued)				
Service/Materials	Unit	Unit Cost	Subtotal	
Labor:				
Site PM	1,360	\$120.00 /hr	\$163,200.00	
Site Superintendent	1,360	\$115.00 /hr	\$156,400.00	
QA (Sampling) Coordinator	1,360	\$80.00 /hr	\$108,800.00	
H&S Coordinator	1,360	\$130.00 /hr	\$176,800.00	
Equipment Operator	136	\$507.50 /day	\$69,020.00	
Equipment Operator	136	\$507.50 /day	\$69,020.00	
Equipment Operator	136	\$507.50 /day	\$69,020.00	
Laborer	136	\$427.00 /day	\$58,072.00	
Equipment:				
Windrow Turner	9	\$45,000.00 /mo	\$405,000.00	
Excavator	9	\$6,500.00 /mo	\$58,500.00	
CAT 924K Wheel Loader	9	\$4,000.00 /mo	\$36,000.00	
CAT 725 Articulated Truck	9	\$9,100.00 /mo	\$81,900.00	
CAT 725 Articulated Truck	9	\$9,100.00 /mo	\$81,900.00	
Fork Lift	9	\$1,250.00 /mo	\$11,250.00	
2000 gal. Water Truck	9	\$3,800.00 /mo	\$34,200.00	
21,000 gal Frac Tank	18	\$1,400.00 /mo	\$25,200.00	
2-in Trash Pump	9	\$345.00 /mo	\$3,105.00	
3-in Trash Pump	9	\$435.00 /mo	\$3,915.00	
Air Monitoring	9	\$750.00 /ls	\$6,750.00	
Office Trailer	9	\$800.00 /mo	\$7,200.00	
Generator	9	\$595.00 /mo	\$5,355.00	
P/U Truck	9	\$1,200.00 /mo	\$10,800.00	
Materials:				
Caustic Soda	483,833	\$1.00 /lb	\$483,833.00	Brenntag Mid South
Ferric Sulfate 50% Solution	16,128	\$3.50 /gal	\$56,448.00	Brenntag Mid South
Acetic Acid 80% Solution	8,064	\$6.50 /gal	\$52,416.00	Brenntag Mid South
Water	271	\$9.40 /kgal	\$2,547.40	
Level C PPE	408	\$35.00 /day	\$14,280.00	
PID rental	8	\$974.00 /mo.	\$7,792.00	
CGI rental	8	\$380.00 /mo.	\$3,040.00	
Chem Storage - NaOH pellets	49	\$100.00 /mo.	\$4,900.00	
Chem Storage - 50% Ferric Sulfate	14	\$100.00 /mo.	\$1,400.00	
Chem Storage - 80% Acetic Acid	18	\$100.00 /mo.	\$1,800.00	
Analytical:				
<i>Pre-Compliance Sampling:</i>				
pH meter	1	\$1,800.00 /ea	\$1,800.00	
<i>Alkaline Hydrolysis Compliance Sampling (1 week TAT):</i>				
NACs (8330)	20	\$125.00 /ea	\$2,500.00	
TCLP 2,4-DNT	20	\$125.00 /ea	\$2,500.00	
E300 - Nitrite and Nitrate	20	\$25.00 /ea	\$500.00	
<i>Post-Treatment Acidification Compliance Sampling (1 week TAT):</i>				
pH	20	\$15.00 /ea	\$300.00	
E300 - Nitrite and Nitrate	20	\$25.00 /ea	\$500.00	
Subtotal			\$2,114,763.00	

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
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6.0 Off-Site Disposal

Includes:

1. Waste characterization of untreated soil for offsite disposal.
2. Characterization of treated soil included in Section 5, Alkaline Hydrolysis
3. Characterization of uncontaminated excavated soil included in Section 8, Site Restoration
4. Offsite disposal of treated and untreated soil at local municipal landfill.
5. Characterization of collected storm water runoff from treatment area.
6. Offsite disposal of stormwater as a nonhazardous waste.
7. This task excludes costs for site PM, site superintendent, QA coordinator, and H&S coordinator that are covered under Section 5.0, Alkaline Hydrolysis, that is ongoing for 110 work days (longest duration task) and runs concurrently with off-site disposal of untreated soil.
8. This task excludes costs for wheel loader and wheel loader operator for loading of treated soil that is accounted for in Section 5, Alkaline Hydrolysis.
9. This task includes trucks and truck drivers for offsite transport of treated and untreated soil.

Assumptions and Calculations:

1. Percent of contaminated soil within remedial area:	75%	
2. Percent of excavated soil assumed to be hazardous.	20%	
3. Waste characterization and disposal sampling: 1 sample per	300 lcy	
4. Erie County Landfill daily capacity	200 tons	
5. Bulk density of loose soil =	1.1 tons/lcy	
5a. Bulk density of alkaline hydrolysis treated soil (saturated) =	1.47 tons/lcy	
6. Volume of soil within remedial area	36,654 lcy	
6a. Volume of contaminated soil	27,491 lcy	
7. Volume of haz soil treated onsite =	7,331 lcy	
8. Volume of nonhaz soil for disposal offsite =	20,160 lcy	
9. Mass of untreated soil for off-site non-haz disposal =	22,176 tons	
10. Mass of treated soil =	10,776 tons	
11. Mass of treatment chemicals =	375 tons	
10. Mass of soil treated onsite (incl. treatment chemicals) =	11,151 tons	Onsite disposal
11. Mass of soil for disposal offsite at municipal landfill	22,176 tons	
12. Average load capacity of a dump truck =.	12 tons	
13. Distance to municipal landfill	10 mi	
14. Round trip travel time to non-haz waste landfill (hr) =	1 hrs	
15. Truck loads to transport non-haz soil =	1,849 loads	
16. Total transportation time to municipal landfill =	1,849 hrs	
17. Daily haul cycles per truck	8 loads	
18. Daily haul capacity per truck	96 tons	
19. Number of trucks required	3 trucks	
20. CAT 924K wheel loader bucket volume	2.5 lcy	
21. Wheel loader cycle time, truck loading =	0.5 min	
22. Cycles per hour, 100% efficiency =	120 cycles/hr	
23. Wheel loader efficiency =	83%	
24. Cycles per hour =	100 cycles/hr	
25. Wheel loader production (lcy/day), (tons/day) =	1,992 2,191 tons/day	
26. No. of wheel loaders =	1 loader	
27. No. of days to complete AH treated soil disposal =	56 days	
28. No. of days to complete untreated soil disposal =	111 days	
29. No. of days to complete nonhazardous soil disposal =	111 days	
30. No. of days to complete hazardous soil disposal =	0 days	
31. Volume of stormwater requiring off-site disposal =	20,000 gal	
32. No. of stormwater samples (1 per truckload) =	5 samples	
33. Work hours per day	8 hrs	
34. Work days per week	5 days	

Table 4-3

**Alternative 4 Cost Estimate
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7.0 Off-Site Disposal (continued)			
Service/Materials	Unit	Unit Cost	Subtotal
Labor:			
Site PM	888	\$120.00 /hr	\$106,560.00 See note 7 above
Site Superintendent	888	\$115.00 /hr	\$102,120.00 See note 7 above
QA Coordinator	888	\$80.00 /hr	\$71,040.00 See note 7 above
H&S Coordinator	888	\$130.00 /hr	\$115,440.00 See note 7 above
Wheel Loader Operator	111	\$406.00 /day	\$45,066.00 See note 8 above
Truck Drivers	333	\$406.00 /day	\$135,198.00 See note 9 above
Materials:			
Level D PPE		\$10.00 /day	\$0.00
Equipment:			
CAT 924K Wheel Loader	6	\$4,000.00 /4-wks	\$24,000.00
Dump Trucks	17	\$4,000.00 /mo	\$66,600.00
Office Trailer	6	\$800.00 /mo	\$4,800.00
Generator	6	\$595.00 /mo	\$3,570.00
P/U Truck	6	\$1,200.00 /mo	\$7,200.00
Analytical:			
Waste Characterization Sampling (Soil):			
TCLP 2,4-DNT	92	\$125.00 /ea	\$11,454.58
NACs (8330)	92	\$125.00 /ea	\$11,454.58
Stormwater Sampling:			
TCLP 2,4-DNT	5	\$125.00 /ea	\$625.00
NACs (8330)	5	\$125.00 /ea	\$625.00
Off-Site Disposal Costs:			
Disposal (Non-Haz)	22,176	\$52.00 /ton	\$1,153,163.44 Erie County Landfill
Stormwater Disposal	20,000	\$0.25 /gal	\$5,000.00 Enviro-Tank Clean
Subtotal			\$1,757,357.00

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
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8.0 On-Site Disposal			
Includes:			
1. Load alkaline hydrolysis treated soil and stockpile for use as backfill material. The cost to backfill treated soil is accounted for in Section 8.0, Site Restoration.			
2. Assume all excavated soil treated and used on-site for backfill.			
3. Analytical results from compliance testing following alkaline hydrolysis and neutralization will be used for disposal.			
4. Time onsite waiting for waste characterization analysis			
Assumptions and Calculations:			
1. Volume of AH treated soil used as backfill material =		7,331	LCY
2. Bulk density of alkaline hydrolysis treated soil (saturated) =		1.47	tons/lcy
3. Mass of alkaline hydrolysis treated soil		10,777	tons
4. Loader output (cy/day) =		889	1.25CY loader
5. Days to load alkaline hydrolysis treated soil =		9	
6. Dump truck capacity (cy) =		12	
7. Dump truck haul distance (mi.) =		0.5	
8. Dump truck output (cy/day) =		480	
9. No. of dump trucks per day =		2	
	Service/Materials	Unit	Unit Cost
			Subtotal
Labor:			
	Site PM	90	\$120.00 /hr
	Site Superintendent	90	\$115.00 /hr
	QA/Sampling Coordinator	90	\$80.00 /hr
	H&S Coordinator	90	\$130.00 /hr
	Equipment Operator	9	\$406.00 /day
	Laborer	9	\$293.00 /day
	Truck Drivers	18	\$341.60 /day
Equipment:			
	Wheel Loader	9	\$720.00 /day
	Dump Truck	18	\$895.00 /day
	65-hp Dozer	9	\$350.00 /day
	P/U Truck	9	\$160.00 /day
Material:			
	Field Instruments	9	\$46.00 /day
	Level D PPE	18	\$10.00 /day
			Subtotal
			\$80,264.00

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
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9.0 Site Restoration				
Includes:				
1. Sample and analyze soil believed to be uncontaminated.				
2. Backfill excavated areas with uncontaminated excavated soil and clean backfill.				
3. Re-seed site.				
Assumptions and Calculations:				
1. Volume of consolidated soil excavated (bcy) =				34,998 bcy
2. Soil compaction factor =				1.15 lcy/bcy
3. Volume of soil required for backfill =				40,248 lcy
4. Vol. of stockpiled uncontaminated soil used to slope excavation				6,803 bcy
5. Volume of soil within remedial area that is uncontaminated				7,049 bcy
6. Vol. of excavated soil used for backfill =				18,008 lcy
7. Volume of offsite backfill required =				22,240 lcy
8. Track loader production =				589 lcy/day
9. No. of track loaders				2 loaders
10. Total track loader output =				1,178 lcy/day
11. Field days required to backfill soil =				35 days
12. CAT 815F2 soil compactor wheel drum width =				3.25 ft
13. Soil compactor ground speed, 10% rolling (total) resistance =				5 mph
14. Compacted lift thickness =				6 in
15. No. of soil compactor passes =				6 passes/lift
16. Soil compactor production, 100% efficiency =				529 bcy/hr
17. Soil compactor efficiency =				83%
18. Soil compactor production =				4,039 lcy/day
19. Number of field crew =				3 workers
20. Reseeding time =				5 days
21. Task duration =				40 days
22. Days per work week =				5 days/week
23. Hours per work day =				8 hrs/day
24. Characterization sampling for onsite backfill: 1 sample per				300 lcy
25. No. of onsite backfill samples				60 samples
	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 Coordinator	320	\$80.00 /hr	\$25,600.00
	H&S Coordinator	320	\$130.00 /hr	\$41,600.00
	Track Loader Operator	35	\$406.00 /day	\$14,210.00
	Soil Compactor Operator	35	\$406.00 /day	\$14,210.00
	Laborer	35	\$341.60 /day	\$11,956.00
	Reseeding	122	\$80.00 /1000 ft ²	\$9,760.00
	Road Repair	1	\$175,000.00 /ls	\$175,000.00 Erie Blacktop
Equipment:				
	CAT 953 Track Loader	4	\$8,800.00 /4-wks	\$35,200.00
	CAT 815F2 Soil Compactor	2	\$12,600.00 /4-wks	\$25,200.00
	Office Trailer	2	\$800.00 /mo	\$1,600.00
	Generator	2	\$595.00 /mo	\$1,190.00
	P/U Truck	2	\$1,200.00 /mo	\$2,400.00
Material:				
	Backfill	22,240	\$12.00 /cy	\$266,880.00 delivered to site
	PID rental	2	\$974.00 /mo.	\$1,948.00
	CGI rental	2	\$380.00 /mo.	\$760.00
	Level D PPE	120	\$10.00 /day	\$1,200.00
Analytical:				
	NACs (8330)	60	\$125.00 /ea	\$7,500.00
	Shipping	10	\$40.00 /ea	\$400.00
				Subtotal
				\$711,814.00

Table 4-3

**Alternative 4 Cost Estimate
Pentolite Road Red Water Pond Area Feasibility Study Addendum
Former Plum Brook Ordnance Works
Sandusky, Ohio**

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10.0 Overall Cost	
Total Capital Cost	\$6,223,300.00
Contingency (25%)	\$1,555,800.00
Contractor Oversight (5%)	\$311,200.00
Total Cost	\$8,090,300.00

^a Initial dosage of soil at TNTA of 2 wt% NaOH was not adequate for all batches but 3 wt% was (Owens, 2013).

^b Dosage based on Tetra Tech bench-scale tests performed for TMG (Owens, 2012).

^c Acid dosage based on full-scale remediation of soil at PBOW (Owens, 2013).

^d Estimate of minimum treatment time based on full-scale remediation of soil at PBOW (Owens, 2013)

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