CB&I Federal Services LLC

Final
November 2014

Addendum to the Feasibility Study for Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3 (Including TNTA to WWTP1 Sewer Lines and TNTB to WWTP1 Sewer Lines) FUDS Project No. G05OH001817 Updated Cost Tables

Former Plum Brook Ordnance Works Sandusky, Ohio

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Nashville District

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November 18, 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: **Final Addendum to the Feasibility Study for**
Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3
FUDS Project No. G05OH001817
(Including TNTA to WWTP1 Sewer Lines and TNTB to WWTP1 Sewer Lines)
Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio
Contract No. W912P5-12-D-0001: Shaw Project Number 145159

Dear Ms. Coleman:

In accordance with the requirements of Delivery Order No. DO01 of Contract No. W912P5-12-D-0001 awarded to CB&I Federal Services LLC, we are pleased to submit this Final Addendum to the Feasibility Study for Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3 (Including TNTA to WWTP1 Sewer lines and TNTB to WWTP1 Sewer Lines) at the Former Plum Brook Ordnance Works (PBOW) located in Sandusky, Ohio. This final 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 of this document 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
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Client Name: U.S. Army Engineer District, Nashville; CELRN-EC-E

Project Description: Addendum to Feasibility Study for WWTP1 and WWTP3: Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio

Contract No. W912P5-12-D-0001

Delivery Order No. DO01

Project No. 145159

Task/Phase Number: 14000000

Document Type

		Identify specific section or segment covered by this checkprint
☐	Technical / Cost Proposal	
☐	RFP	
☐	Contract / Subcontract	
☐	Work Plans	
☐	Report	
☐	Risk Assessment / Evaluation	
☐	Specifications & Plans	
☐	Design Calculations	
☐	Tables	
☐	Drawings / Figures	FS Addendum: Updated Cost Tables
X	Other:	

Document Origin

- X Originator Developed
- ☐ Edited Standard
- ☐ Client Furnished

Document Status

- ☐ Preliminary
- ☐ Internal Draft
- ☐ Draft
- ☐ Draft Final
- X Final
- ☐ Other:

	Required Person	Signature	Date
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Addendum to the Feasibility Study for Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3
FUDS Project No. G05OH001817
(Including TNTA to WWTP1 Sewer Lines and TNTB to WWTP1 Sewer Lines)
Updated Cost Tables
Former Plum Brook Ordnance Works, Sandusky, Ohio

This Addendum to the Feasibility Study (FS) for Waste Water Treatment Plant No. 1 (WWTP1) and Waste Water Treatment Plant No. 3 (WWTP3) was prepared to update the costs and remedial durations for the remedial alternatives presented in the FS (CB&I Federal Services LLC, 2014) for this Formerly Used Defense Sites (FUDS) project. Updated cost tables are attached. Other than the costs and durations, the remainder of the FS 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 Action	$0	0
2	Excavation and Off-Site Disposal	$279,000	12
3	Excavation, Windrow Composting, and On-Site Disposal	$409,000	14
4	Excavation, Alkaline Hydrolysis, and On-Site Disposal	$643,000	17

Reference:

CB&I Federal Services LLC, 2014, ***Feasibility Study, Waste Water Treatment Plant No. 1 and Waste Water Treatment Plant No. 3, FUDS Project No. G05OH001817 (Including TNTA to WWTP1 Sewer Lines and TNTB to WWTP1 Sewer Lines)***, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, April.

Table 4-1

Alternative 2 Cost Estimate
(Excavation and Off-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

Alternative 2	**Site:**	TNTA to WWTP1 Sewer Lines
Excavation/Off-Site Disposal		Plum Brook Ordnance Works
Cost Estimate	**Date:**	**9/19/2014**

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	$5,000.00	/ea	$5,000.00
			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		Subtotal
Labor/Equipment:				
Mobe/Demobe	1	$5,000.00	/ls	$5,000.00
Office Trailer (set up/tear down)	0	$500.00	/ls	$0.00
			Subtotal	**$5,000.00**

Table 4-1

Alternative 2 Cost Estimate
(Excavation and Off-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

3.0 Site Preparation

Includes:

1. Survey and mark proposed remediation area
2. Construction and maintenance of Erosion and Sediment Controls
3. Clearing (medium brush without grubbing) will be performed in 100% of excavation area.
4. Assumed vegetative debris to be placed adjacent to site to decompose.

Assumptions and Calculations:

1. Area to be cleared (acres) =	0.50
2. Daily output clearing crew (acres/day) =	1
3. Days clearing contractor in field =	1
4. Silt Fence to be installed (lf) =	500
5. Daily ouput silt fencing crew (LF/day) =	500
6. Days silt fence crew in field =	1
7. Prepare stockpile area (days) =	1
8. Work hours/day =	8

Contractor:					
Site PM	24	$120.00	/hr	$2,880.00	
Site Superintendent	24	$115.00	/hr	$2,760.00	
QA (Sampling) Coordinator	24	$80.00	/hr	$1,920.00	
H&S Coordinator	24	$130.00	/hr	$3,120.00	
Equipment Operator	3	$406.00	/day	$1,218.00	
Truck Driver	3	$341.60	/day	$1,024.80	
Laborer	3	$293.00	/day	$879.00	
Equipment:					
Excavator	1	$775.00	/day	$775.00	
Dump Truck	1	$895.00	/day	$895.00	
P/U Truck	1	$160.00	/day	$160.00	
Subcontractor:					
Surveying Crew	1	$2,000.00	/day	$2,000.00	
Bushhog	0.5	$500.00	/acre	$250.00	
Materials:					
Field Instruments	2	$46.00	/day	$92.00	
Silt Fencing	500	$1.60	/ft	$800.00	
				Subtotal	**$18,774.00**

Table 4-1

Alternative 2 Cost Estimate
(Excavation and Off-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

4.0 Excavation of Contaminated Soil

Includes:
1. Excavation of soil to a depth of 2 feet bgs with contaminants exceeding RGOs.
2. Collect confirmatory samples to verify extent of excavation.

Assumptions and Calculations:

1. Bank cubic yards (BCY) of soil excavated =	11	
2. Swell factor for soil upon excavation =	1.3	
3. Loose cubic yards (LCY) of soil excavated =	14	
4. Density of unconsolidated soil (tons/cy) =	1.1	
5. Mass of unconsolidated soil (tons) =	16	
6. Capacity of screening plant (tons/hr) =	100	
7. Excavator: hydraulic		
8. Excavator bucket heaped capacity (LCY) =	1	
9. Excavator cycle time (sec) =	18	
10. Excavator cycles/min =	3.3	
11. Excavator load factor =	0.75	
12. Excavator bucket fill factor =	0.6	excavation in lifts
13. Excavator work minutes/hour =	50	
14. Excavator output (BCY/day) =	594	
15. Days to excavate soil =	1	
15b. Time on site (days) =	1	
16. Dump truck capacity (cy) =	12	
17. Dump truck haul distance (mi.) =	0.5	
18. Dump truck output (cy/day) =	250	
19. Number of dump trucks per day =	1	
20. Number of excavation subcontractor crew =	3	
21. Lineal foot of excavation per confirmation sample =	20	
22. Resampling factor for confirmation sampling =	2	
23. Number of confirmatory samples from excavated area =	8	
24. Excavation area (SF) =	150	
25. Fraction of excavation work performed in Level C PPE =	0.00	
26. Labor productivity factor for Level C work =	0.67	
27. Days excavation crew in Level C =	0	
28. Perimeter of excavation area (ft) =	62	
29. Hours/workday =	8	

Service/Materials	Unit	Unit Cost		Subtotal
Labor:				
Site PM	8	$120.00	/hr	$960.00
Site Superintendent	8	$115.00	/hr	$920.00
QA (Sampling) Coordinator	8	$80.00	/hr	$640.00
H&S Coordinator	8	$130.00	/hr	$1,040.00
Equipment Operator	1	$406.00	/day	$406.00
Laborers	1	$293.00	/day	$293.00
Truck Drivers	1	$341.60	/day	$341.60

Table 4-1

Alternative 2 Cost Estimate
(Excavation and Off-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

4.0 Excavation of Contaminated Soil (continued)

Equipment:				
Excavator	1	$775.00	/day	$775.00
Dump Truck	1	$895.00	/day	$895.00
P/U Truck	1	$160.00	/day	$160.00
Analytical:				
SVOCs (8270C)	0	$175.00	/ea	$0.00
NACs (8330)	8	$105.00	/ea	$840.00
NAC field analyses	8	$40.00	/ea	$320.00
Shipping	1	$40.00	/ea	$40.00
Materials & Services:				
Level D PPE	3	$10.00	/day	$30.00
PID rental	1	$33.00	/day	$33.00
CGI rental	1	$13.00	/day	$13.00
			Subtotal	**$7,707.00**

5.0 Off-Site Disposal

Includes:

1. Dispose of composted soil at a non-hazardous waste landfill.
3. Analysis for off-site waste disposal.
4. Percent of excavated soil assumed to be hazardous. 0 percent
5. Waste characterization and disposal sampling: 1 sample per 300 CY
6. Time onsite waiting for waste characterization analysis

Assumptions and Calculations:

1. Volume of excavated soil (BCY) =	11	
2. Volume of excavated soil (LCY) =	14.3	
3. Tons of total soil for disposal =	16	
4. Volume of nonhazardous soil for disposal (LCY) =	14.3	
5. Quantity of D030 soil for haz disposal =	0	
6. Total volume of unconsolidated hazardous soil (LCY) =	0	
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 ($/ton) =	0	included in disposal
10. Haz waste transportation cost ($/ton) =	35	
11. D030 Haz waste disposal cost ($/ton) =	150	EO Environmental
12. Haz waste regulatory fees ($/ton) =	10	
13. Number of crew =	3	
14. Dump truck capacity (CY) =.	12	
15. Travel duration (round trip) to non-haz landfill (hrs) =	2	
16. Loads of non-haz waste or trips (hrs) =	2	
17. Output of front-end loader (cy/day) =	889	1.25 CY loader
18. No. of wheel loaders =	0	Loaded in Section 4.0
19a. Time to load and haul soil (days) =	1	
19a. Analytical TAT (days) =	10	
19b. Number of field days =	11	
20. Volume of stormwater requiring off-site disposal (gal) =	0	

21. Stormwater shall be analyzed for TCLP semivolatiles prior to transport.

22. At one sample per truckload, number of samples (ea) =	1

Table 4-1

Alternative 2 Cost Estimate
(Excavation and Off-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

5.0 Off-Site Disposal (Continued)

Service/Materials	Unit	Unit Cost		Subtotal	
Labor:					
Site PM	88	$120.00	/hr	$10,560.00	
Site Superintendent	88	$115.00	/hr	$10,120.00	
QA (Sampling) Coordinator	88	$80.00	/hr	$7,040.00	
H&S Coordinator	88	$130.00	/hr	$11,440.00	
Equipment Operator	11	$406.00	/day	$4,466.00	
Laborers	11	$293.00	/day	$3,223.00	
Truck Drivers	11	$341.60	/day	$3,757.60	incl in disposal cost
Equipment:					
Excavator	11	$775.00	/day	$8,525.00	
Dump Truck	11	$895.00	/day	$9,845.00	
P/U Truck	11	$160.00	/day	$1,760.00	
Analytical:					
Waste Characterization Sampling (Soil):					
Complete TCLP	1	$750.00	/ea	$750.00	
Stormwater Sampling:					
TCLP 2,4-DNT	0	$135.00	/ea	$0.00	
Off-Site Disposal Costs:					
Transportation (Non-Haz Waste)	4	$72.00	/hr	$288.00	truck & driver
Disposal Cost (Non-Haz waste)	16	$52.00	/ton	$832.00	Erie County Landfill
Transportation (Haz Waste)	0	$35.00	/ton	$0.00	
Disposal Cost (D030 haz waste)	0	$160.00	/ton	$0.00	
Stormwater Disposal	0	$0.25	/gal	$0.00	Enviro-Tank Clean
				Subtotal	**$72,607.00**

6.0 Site Restoration

Includes:
1. Backfill excavated areas with clean backfill.
2. Re-seed site.
3. Confirmation sampling of soil staging areas.
4. General area cleanup

Assumptions and Calculations:

1. Field days for seeding and cleanup =	1
2. Number of field crew =	2
3. Work hours/day =	8
4. Restoration area (acre) =	0.50
5. Backfill compaction factor =	1.15

Service/Materials	Unit	Unit Cost		Subtotal
Labor:				
Site PM	8	$120.00	/hr	$960.00
Site Superintendent	8	$115.00	/hr	$920.00
QA (Sampling) Coordinator	8	$80.00	/hr	$640.00
H&S Coordinator	8	$130.00	/hr	$1,040.00
Equipment Operator	1	$406.00	/day	$406.00
Laborers	1	$293.00	/day	$293.00
Truck Drivers	1	$341.60	/day	$341.60

Table 4-1

Alternative 2 Cost Estimate
(Excavation and Off-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

6.0	**Site Restoration (Continued)**					
	Equipment:					
	Excavator	1	$775.00	/day	$775.00	
	Dump Truck	1	$895.00	/day	$895.00	
	P/U Truck	1	$160.00	/day	$160.00	
	Material:					
	Backfill	13	$12.00	/cy	$151.80	delivered to site
	Field Instruments	1	$46.00	/day	$46.00	
	Level D PPE	2	$10.00	/day	$20.00	
	Analytical:					
	SVOCs	4	$175.00	/ea	$700.00	
	NACs (8330)	4	$105.00	/ea	$420.00	
	Shipping	1	$40.00	/ea	$40.00	
					Subtotal	**$7,808.00**
7.0	**Overall Cost**					
					Total Capital Cost	**$206,900.00**
					Contingency (30%)	**$62,070.00**
					Contractor Oversight (5%)	**$10,345.00**
					Total Cost	**$279,000.00**

*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
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

Alternative 3
Excavation/Composting/On-Site Disposal
Cost Estimate

Site: TNTA to WWTP1 Sewer Lines
Plum Brook Ordnance Works
Date: 9/19/2014

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. On-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
			Subtotal	**$5,500.00**

Table 4-2

Alternative 3 Cost Estimate
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

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 vegetative debris to be placed adjacent to site to decompose.

Assumptions and Calculations:

1. Area to be cleared (acres) =	0.5
2. Daily output clearing crew (acres/day) =	1
3. Days clearing contractor in field =	1
4. Silt Fence to be installed (lf) =	500
5. Daily ouput silt fencing crew (LF/day) =	500
6. Days silt fence crew in field =	1
7. Prepare stockpile area (days) =	1
8. Work hours/day =	8

Contractor:					
Site PM	24	$120.00	/hr	$2,880.00	
Site Superintendent	24	$115.00	/hr	$2,760.00	
QA (Sampling) Coordinator	24	$80.00	/hr	$1,920.00	
H&S Coordinator	24	$130.00	/hr	$3,120.00	
Equipment Operator	3	$406.00	/day	$1,218.00	
Truck Driver	3	$341.60	/day	$1,024.80	
Laborer	3	$293.00	/day	$879.00	
Equipment:					
Excavator	1	$775.00	/day	$775.00	
Dump Truck	1	$895.00	/day	$895.00	
P/U Truck	1	$160.00	/day	$160.00	
Subcontractor:					
Surveying Crew	1	$2,000.00	/day	$2,000.00	
Bushhog	0.5	$500.00	/acre	$250.00	
Materials:					
Field Instruments	2	$46.00	/day	$92.00	
Silt Fencing	500	$1.60	/ft	$800.00	
				Subtotal	**$18,774.00**

Table 4-2

Alternative 3 Cost Estimate
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

4.0 Excavation of Contaminated Soil

Includes:
1. Excavation of soil to a depth of 2 feet bgs with contaminants exceeding RGOs.
2. Collect confirmatory samples to verify extent of excavation.

Assumptions and Calculations:

1. Bank cubic yards (BCY) of soil excavated =	11	
2. Swell factor for soil upon excavation =	1.3	
3. Loose cubic yards (LCY) of soil excavated =	14.3	
4. Density of unconsolidated soil (tons/cy) =	1.1	
5. Mass of unconsolidated soil (tons) =	15.7	
6. Capacity of screening plant (tons/hr) =	100	
7. Excavator: hydraulic		
8. Excavator bucket heaped capacity (LCY) =	1	
9. Excavator cycle time (sec) =	18	
10. Excavator cycles/min =	3.3	
11. Excavator load factor =	0.75	
12. Excavator bucket fill factor =	0.6	excavation in lifts
13. Excavator work minutes/hour =	50	
14. Excavator output (BCY/day) =	594	
15. Days to excavate soil =	1	
16. Dump truck capacity (cy) =	12	
17. Dump truck haul distance (mi.) =	0.5	
18. Dump truck output (cy/day) =	250	
19. Number of dump trucks per day =	1	
20. Number of excavation subcontractor crew =	3	
21. Lineal foot of excavation per confirmation sample =	20	
22. Resampling factor for confirmation sampling =	2	
23. Number of confirmatory samples from excavated area =	8	
24. Excavation area (SF) =	150	
25. Fraction of excavation work performed in Level C PPE =	0.00	
26. Labor productivity factor for Level C work =	0.67	
27. Days excavation crew in Level C =	0	
28. Perimeter of excavation area (ft) =	62	
29. Hours/workday =	8	

Service/Materials	Unit	Unit Cost	Subtotal
Labor:			
Site PM	8	$120.00 /hr	$960.00
Site Superintendent	8	$115.00 /hr	$920.00
QA (Sampling) Coordinator	8	$80.00 /hr	$640.00
H&S Coordinator	8	$130.00 /hr	$1,040.00
Equipment Operator	1	$406.00 /day	$406.00
Laborers	1	$293.00 /day	$293.00
Truck Drivers	1	$341.60 /day	$341.60

Table 4-2

Alternative 3 Cost Estimate
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

4.0 Excavation of Contaminated Soil (continued)				
Equipment:				
Excavator	1	$775.00 /day	$775.00	
Dump Truck	1	$895.00 /day	$895.00	
P/U Truck	1	$160.00 /day	$160.00	
Analytical:				
SVOCs (8270C)	0	$175.00 /ea	$0.00	
NACs (8330)	8	$105.00 /ea	$840.00	
NAC field analyses	8	$40.00 /ea	$320.00	
Shipping	1	$40.00 /ea	$40.00	
Materials & Services:				
Level D PPE	3	$10.00 /day	$30.00	
PID rental	1	$33.00 /day	$33.00	
CGI rental	1	$13.00 /day	$13.00	
			Subtotal	**$7,707.00**

Table 4-2

Alternative 3 Cost Estimate
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

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. Pre-compliance testing: after compost formation & at end of treatment.
5. Pre-compliance testing using definitive field analysis for NAC.
6. Percent of excavated material treated via composting: 100%
7. Turnaround time of 3 days for rush analytical for waste characterization

Assumptions:

1. Laydown area is 180' feet wide x 270 feet long.				
2. In place volume of soil to be treated (BCY) =	11			
3. Swell factor for soil upon excavation =	1.3			
4. Volume of excavated soil to be treated (LCY) =	14.3			
5. Density of unconsolidated soil (tons/CY) =	1.1			
6. Mass of unconsolidated soil (tons) =	15.7			
7. Weight/volume percent of soil in compost =	74.7%	25%		
8. Weight/volume percent of manure in compost =	5.7%	3%		
9. Weight/volume percent of straw in compost =	19.6%	72%		
10. Mass of soil in compost (lbs) =	31460			
11. Mass of manure in compost (lbs) =	2401			
12. Mass of straw in compost (lbs) =	8255			
13. Mass of compost (lbs) =	42115			
14. Volume of manure (CY) =	2.8		864	lb/cy
15. Volume of straw (CY) =	36.4		227	lb/cy
16. Total volume of compost materials (CY) =	53.4			
17. Number of treatment batches =	1			
18a. Treatment duration per batch =	6	weeks		
18b. Compliance analytical TAT =	2	weeks		
18c. Total treatment duration including analytical =	8	weeks		
19. Work days per week =	7			
20. Number of batches during one treatment cycle =	1			
21. Number of treatment cycles =	1			
22. Duration of field work (days) =	56			
23. Work weeks =	8			
24. Work days - windrow prep =	2			
25. Work days - normal operation =	54			
26. Work hours per day - windrow prep =	8			
27. Work hours per day normal operation =	4			
21. Crew size - chemical addition	6			
22. Crew size - normal operation	6			
19. Volume inflation factor for compost (CY compost/CY soil) =	1.82	Crane - Jerger & Woodhull (2000)		
20. Volume of compost at end of treatment (CY) =	26.00	75% vol increase at Umatilla		
21. Bulk density of compost at the end of treatment (tons/CY) =	0.810			
22. Number of field crew =	3			
23. Pre-compliance testing shall weekly per windrow and consist of:				
- EnSys TNT 20, one per batch. Number of samples =	6			
- EnSys TNT 20, no. of samples per kit =	19			
- Total NAC, one per batch. Number of samples =	6			
24. Compliance testing shall be performed per windrow at the end of treatment period. Sampling shall consist of:				
- Total NACs. Number of samples =	1			
25. Days per work week =	5			
26. Work hours/day =	4			

Table 4-2

Alternative 3 Cost Estimate
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

5.0 Windrow Composting of Contaminated of Soil (continued)

Service/Materials	Unit	Unit Cost		Subtotal	
Labor:					
Site PM	232	$120.00	/hr	$27,840.00	
Site Superintendent	232	$115.00	/hr	$26,680.00	
QA/Sampling Coordinator	232	$80.00	/hr	$18,560.00	
H&S Coordinator	232	$130.00	/hr	$30,160.00	
Equipment Operator	29	$406.00	/day	$11,774.00	
Equipment Operator	29	$406.00	/day	$11,774.00	
Laborer	29	$341.60	/day	$9,906.40	
Equipment:					
Excavator	2	$6,150.00	/mo	$12,300.00	
Backhoe	2	$2,000.00	/mo		
Tractor	2	$230.00	/day	$460.00	
Straw Blower	2	$320.00	/day	$640.00	
500 gal Water Trailer	2	$735.00	/mo	$1,470.00	
21,000 gal Frac Tank	2	$1,400.00	/mo	$2,800.00	
Trash Pump	2	$435.00	/mo	$870.00	
Air Monitoring	1	$750.00	/ls	$750.00	
Office Trailer	2	$500.00	/mo	$1,000.00	
Generator	2	$595.00	/mo	$1,190.00	
P/U Truck	2	$1,050.00	/mo	$2,100.00	
Spectrophotometer	0	$3,012.00	/ls	$0.00	Previously purchased
Materials:					
Straw	36.4	$11.25	/cy	$409.11	
Manure	2.8	$25.00	/cy	$69.47	
Water	1.1	$9.40	/kgal	$10.26	
Level D PPE	90	$10.00	/day	$900.00	
Analytical:					
Pre-Compliance Sampling:					
EnSys Kit (TNT 20) - 19 samples per kit	1	$572.00	/ea	$572.00	
Total NACs	6	$105.00	/ea	$630.00	
Compliance Sampling:					
Complete TCLP	1	$750.00	/ea	$750.00	
				Subtotal	**$135,775.00**

Table 4-2

Alternative 3 Cost Estimate
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

6.0 On-Site Disposal

Includes:

1. Percent of treated compost that can be disposed on-site = 100%
2. Volume of treated compost, on-site disposal/surface cover (cy) = 26
3. Analytical results from compliance testing following composting will be used for disposal.
4. Time onsite waiting for waste characterization analysis

Assumptions and Calculations:

1. Volume of compost used as backfill material (LCY) =	26	
2. Loader output (CY/day) =	889	1.25CY loader
3a. TAT on analytical (days) =	3	
3b. Days to load compost =	1	
3c. Number of field days =	4	
4. Dump truck capacity (CY) =	12	
5. Dump truck haul distance (mi.) =	0.5	
6. Dump truck output (CY/day) =	300	
7. No. of dump trucks per day =	1	

8. The compost shall be stockpiled prior to use as backfill material as part of site restoration.

Service/Materials	Unit	Unit Cost		Subtotal	
Labor:					
Site PM	32	$120.00	/hr	$3,840.00	
Site Superintendent	32	$115.00	/hr	$3,680.00	
QA/Sampling Coordinator	32	$80.00	/hr	$2,560.00	
H&S Coordinator	32	$130.00	/hr	$4,160.00	
Equipment Operator	4	$406.00	/day	$1,624.00	
Laborer	4	$293.00	/day	$1,172.00	
Truck Drivers	4	$341.60	/day	$1,366.40	
Equipment:					
Wheel Loader	4	$720.00	/day	$2,880.00	load compost
Dump Truck	4	$895.00	/day	$3,580.00	haul compost
65-hp Dozer	4	$350.00	/day	$1,400.00	spread compost
P/U Truck	4	$160.00	/day	$640.00	
Material:					
Field Instruments	4	$46.00	/day	$184.00	
Level D PPE	8	$10.00	/day	$80.00	
				Subtotal	**$27,166.00**

Table 4-2

Alternative 3 Cost Estimate
(Excavation, Composting, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

7.0 Site Restoration

Includes:
2. Re-seed site.
3. Confirmation sampling of soil staging areas.
4. General area cleanup

Assumptions and Calculations:

1. Field days for seeding and cleanup =	1
2. Number of field crew =	2
3. Work hours/day =	8
4. Restoration area (acre) =	0.50

Service/Materials	Unit	Unit Cost	Subtotal
Labor:			
Site PM	8	$120.00 /hr	$960.00
Site Superintendent	8	$115.00 /hr	$920.00
QA (Sampling) Coordinator	8	$80.00 /hr	$640.00
H&S Coordinator	8	$130.00 /hr	$1,040.00
Equipment Operator	1	$406.00 /day	$406.00
Laborers	1	$293.00 /day	$293.00
Truck Drivers	1	$341.60 /day	$341.60
Equipment:			
Excavator	1	$775.00 /day	$775.00
Dump Truck	1	$895.00 /day	$895.00
P/U Truck	1	$160.00 /day	$160.00
Material:			
Field Instruments	1	$46.00 /day	$46.00
Level D PPE	2	$10.00 /day	$20.00
Analytical:			
SVOCs	4	$175.00 /ea	$700.00
NACs (8330)	4	$105.00 /ea	$420.00
Shipping	1	$40.00 /ea	$40.00
		Subtotal	**$7,657.00**

8.0 Overall Cost

Total Capital Cost	**$302,600.00**
Contingency (30%)	**$90,780.00**
Contractor Oversight (5%)	**$15,130.00**
Total Cost	**$409,000.00**

*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
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

Alternative 4
Excavation/Alkaline Hydrolysis/On-Site Disposal
Cost Estimate

Site: TNTA to WWTP1 Sewer Lines
Plum Brook Ordnance Works
Date: 9/19/2014

Scope:
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

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	$140,000.00	/ls	$140,000.00
Procurement	1	$10,000.00	/ls	$10,000.00
			Subtotal	**$150,000.00**

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
			Subtotal	**$5,500.00**

Table 4-3

Alternative 4 Cost Estimate
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

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 vegetative debris to be placed adjacent to site to decompose.

Assumptions and Calculations:

1. Area to be cleared (acres) =	0.5
2. Daily output clearing crew (acres/day) =	1
3. Days clearing contractor in field =	1
4. Silt Fence to be installed (lf) =	500
5. Daily ouput silt fencing crew (LF/day) =	500
6. Days silt fence crew in field =	1
7. Prepare stockpile area (days) =	1
8. Work hours/day =	8

Contractor:					
Site PM	24	$120.00	/hr	$2,880.00	
Site Superintendent	24	$115.00	/hr	$2,760.00	
QA (Sampling) Coordinator	24	$80.00	/hr	$1,920.00	
H&S Coordinator	24	$130.00	/hr	$3,120.00	
Equipment Operator	3	$406.00	/day	$1,218.00	
Truck Driver	3	$341.60	/day	$1,024.80	
Laborer	3	$293.00	/day	$879.00	
Equipment:					
Excavator	1	$775.00	/day	$775.00	
Dump Truck	1	$895.00	/day	$895.00	
P/U Truck	1	$160.00	/day	$160.00	
Subcontractor:					
Surveying Crew	1	$2,000.00	/day	$2,000.00	
Bushhog	0.5	$500.00	/acre	$250.00	
Materials:					
Field Instruments	2	$46.00	/day	$92.00	
Silt Fencing	500	$1.60	/ft	$800.00	
				Subtotal	**$18,774.00**

Table 4-3

Alternative 4 Cost Estimate
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

4.0 Excavation of Contaminated Soil

Includes:
1. Excavation of soil to a depth of 2 feet bgs with contaminants exceeding RGOs.
2. Collect confirmatory samples to verify extent of excavation.

Assumptions and Calculations:

1. Bank cubic yards (BCY) of soil excavated =	11	
2. Swell factor for soil upon excavation =	1.3	
3. Loose cubic yards (LCY) of soil excavated =	14	
4. Density of unconsolidated soil (tons/cy) =	1.1	
5. Mass of unconsolidated soil (tons) =	15.7	
6. Capacity of screening plant (tons/hr) =	100	
7. Excavator: hydraulic		
8. Excavator bucket heaped capacity (LCY) =	1	
9. Excavator cycle time (sec) =	18	
10. Excavator cycles/min =	3.3	
11. Excavator load factor =	0.75	
12. Excavator bucket fill factor =	0.6	excavation in lifts
13. Excavator work minutes/hour =	50	
14. Excavator output (BCY/day) =	220	
15. Days to excavate soil =	1	
16. Dump truck capacity (cy) =	12	
17. Dump truck haul distance (mi.) =	0.5	
18. Dump truck output (cy/day) =	250	
19. Number of dump trucks per day =	1	
20. Number of excavation subcontractor crew =	3	
21. Lineal foot of excavation per confirmation sample =	20	
22. Resampling factor for confirmation sampling =	2	
23. Number of confirmatory samples from excavated area =	8	
24. Excavation area (SF) =	150	
25. Fraction of excavation work performed in Level C PPE =	0.00	
26. Labor productivity factor for Level C work =	0.67	
27. Days excavation crew in Level C =	0	
28. Perimeter of excavation area (ft) =	62	
29. Hours/workday =	8	

Service/Materials	Unit	Unit Cost		Subtotal
Labor:				
Site PM	8	$120.00	/hr	$960.00
Site Superintendent	8	$115.00	/hr	$920.00
QA (Sampling) Coordinator	8	$80.00	/hr	$640.00
H&S Coordinator	8	$130.00	/hr	$1,040.00
Equipment Operator	1	$406.00	/day	$406.00
Laborers	1	$293.00	/day	$293.00
Truck Drivers	1	$341.60	/day	$341.60

Table 4-3

Alternative 4 Cost Estimate
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

4.0 Excavation of Contaminated Soil (continued)					
Equipment:					
Excavator	1	$775.00	/day	$775.00	
Dump Truck	1	$895.00	/day	$895.00	
P/U Truck	1	$160.00	/day	$160.00	
Analytical:					
SVOCs (8270C)	0	$175.00	/ea	$0.00	
NACs (8330)	8	$105.00	/ea	$840.00	
NAC field analyses	8	$40.00	/ea	$320.00	
Shipping	1	$40.00	/ea	$40.00	
Materials & Services:					
Level D PPE	3	$10.00	/day	$30.00	
PID rental	1	$33.00	/day	$33.00	
CGI rental	1	$13.00	/day	$13.00	
				Subtotal	**$7,707.00**

Table 4-3

Alternative 4 Cost Estimate
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

5.0 Alkaline Hydrolysis

Includes:

1. Treat the TNT contaminated soil with caustic soda pellets and 50% ferric sulfate solution.
2. Alkaline hydrolysis treated soil neutralized with acetic acid.
3. Temporary storage for the caustic soda pellets, 50% ferric sulfate, and 80% acetic acid.
4. Turnaround time of 3 days for rush analytical for waste characterization

Assumptions and Calculations:

1. Volume of consolidated soil to be treated (cy) =	11	
2. Swell factor for soil upon excavation =	1.3	
3. Cubic yards of unconsolidated soil (LCY) =	14.3	
4. Treatment batch size (cy) =	250	
5. Caustic soda, NaOH pellets =	61	lb/cy soil
6. Water, used to saturate soil with water =	37	gal/cy soil
7. Dosage of ferric sulfate 50% solution [b]	2.2	gal/cy soil
8. NaOH mol wt =	40	lb/lb mol
9. Dosage of 80% CH_3OOH (post-treatment to pH ≤ 12) [c]	1.1	gal/lcy soil
10. Dosage of 80% CH_3OOH (post-treatment to pH ≤ 10) [c]	11.8	gal/lcy soil
9. Treatment duration per batch (weeks) =	3	
10. Work days per week =	5	Small volume treatment operation
11. AH treatment duration per batch =	10	weeks/batch
11a. Time to acidify AH-treated soil to ≤pH 10 for onsite disposal =	3	weeks/batch
11b. Treatment duration per batch =	13	weeks/batch
11c Compliance analytical TAT =	2	weeks
11d Treatment duration incl analytical [d] =	15	weeks
11. Treatment duration per batch =	75	work days
12. Number of batches =	1	
13. Number of batches during one treatment cycle =	1	
14. Number of treatment cycles =	1	
15. Duration of field work =	75	days
16. Work weeks =	15	weeks
17. Work days - chemical addition =	2	
18. Work days - normal operation =	73	
19. Work hours per day - chemical addition =	8	
20. Work hours per day normal operation =	4	
21. Crew size - chemical addition	6	
22. Crew size - normal operation	6	
23. Mass of caustic soda (lb) =	872	
24. Volume of ferric sulfate 50% solution (gal) =	31	
25. Density of 50% ferric sulfate solution (lb/gal) =	11.97	
37. Volume of acetic acid 80% solution (post-treatment pH ≤ 12)	16	gal
38. Volume of acetic acid 80% solution (post-treatment pH ≤ 10)	169	gal
38. Volume of acetic acid 80% solution (post-treatment pH ≤ 10)	3	drums
39. Density of 80% acetic acid solution =	8.92	lb/gal
26. Volume of water (gal) =	529	

27. Compliance sampling for alkaline hydrolysis prior to neutralization shall consist of nitroaromatics, nitrate and nitrite, and pH, one sequence per batch.
28. Caustic soda pellets available in 2000 pound super sacks, 4-feet by 4-feet by 3-feet high.

29. Number of caustic soda super sacks (ea) =	1
30. Required storage capacity for caustic soda pellets (cf) =	48

Table 4-3

Alternative 4 Cost Estimate
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

5.0 Alkaline Hydrolysis (continued)

31. 50% ferric sulfate solution available in 330 gallon totes, 46.5-inches by 46.5-inches by 48-inches high.
32. Number of 50% ferric sulfate solution totes (ea) = 1
33. Required storage capacity for 50% ferric acid solution (cf) = 61
34. Temporary chemical storage provided in a 48-foot swing open-door land-sea cargo trailer. The trailer is 45.42-feet long by 8.25 -feet wide by 9-feet high. 40 super sacks per trailer. The monthly rental is $100/mo.
35. Available capacity in the Land-Sea Cargo Trailer (cf) = 1,920
36. Number of Land-Sea Cargo Trailers for caustic soda pellets (ea) 1
37. Number of Land-Sea Cargo Trailers for 50% ferric sulfate solution (ea) = 1

Service/Materials	Unit	Unit Cost		Subtotal	
Labor:					
Site PM	308	$120.00	/hr	$36,960.00	
Site Superintendent	308	$115.00	/hr	$35,420.00	
QA/Sampling Coordinator	308	$80.00	/hr	$24,640.00	
H&S Coordinator	308	$130.00	/hr	$40,040.00	
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	
Equipment:					
Excavator	4	$6,150.00	/mo	$24,600.00	
Backhoe	4	$2,000.00	/mo	$8,000.00	
Fork Lift	2	$175.00	/day	$350.00	
500 gal Water Trailer	4	$735.00	/mo	$2,940.00	
21,000 gal Frac Tank	4	$1,400.00	/mo	$5,600.00	
Trash Pump	4	$435.00	/mo	$1,740.00	
Air Monitoring	1	$750.00	/ls	$750.00	
Office Trailer	4	$500.00	/mo	$2,000.00	
Generator	4	$595.00	/mo	$2,380.00	
P/U Truck	4	$1,050.00	/mo	$4,200.00	
Materials:					
Caustic Soda	872	$1.00	/lb	$872.00	Brenntag Mid South
Ferric Sulfate 50% Solution	372	$3.50	/lb	$1,302.00	Brenntag Mid South
Acetic Acid 80% Solution	169	$6.50	/gal	$1,098.50	Brenntag Mid South
Water	1	$9.40	/1000 gal	$9.40	
Level C PPE	12	$35.00	/day	$420.00	
Storage - NaOH pellets	1	$100.00	/mo.	$100.00	
Storage - 50% Ferric Sulfate	1	$100.00	/mo.	$100.00	
Analytical:					
Pre-Compliance Sampling:					
pH meter	0	$1,800.00	/ea	$0.00	Previously purchased
Compliance Sampling for Alkaline Hydrolysis:					
NACs (8330)	1	$105.00	/ea	$105.00	
E300 - Nitrite and Nitrate	1	$25.00	/ea	$25.00	
Compliance Sampling after Staging for pH Reduction:					
pH	1	$10.00	/ea	$10.00	
E300 - Nitrite and Nitrate	1	$25.00	/ea	$25.00	
				Subtotal	**$280,207.00**

Table 4-3

Alternative 4 Cost Estimate
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

6.0 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 =	14	LCY
2. Bulk density of alkaline hydrolysis treated soil (saturated) =	1.47	tons/lcy
3. Mass of alkaline hydrolysis treated soil	21.0	tons
4. Loader output (cy/day) =	889	1.25CY loader
5. Days to load alkaline hydrolysis treated soil =	1	
6. Dump truck capacity (cy) =	12	
7. Dump truck haul distance (mi.) =	0.5	
8. Dump truck output (cy/day) =	200	
9. No. of dump trucks per day =	1	
10. The duration to load & haul treated soil (days) =	1	

Service/Materials	Unit	Unit Cost		Subtotal
Labor:				
Site PM	8	$120.00	/hr	$960.00
Site Superintendent	8	$115.00	/hr	$920.00
QA/Sampling Coordinator	8	$80.00	/hr	$640.00
H&S Coordinator	8	$130.00	/hr	$1,040.00
Equipment Operator	1	$406.00	/day	$406.00
Laborer	1	$293.00	/day	$293.00
Truck Drivers	1	$341.60	/day	$341.60
Equipment:				
Wheel Loader	1	$720.00	/day	$720.00
Dump Truck	1	$895.00	/day	$895.00
65-hp Dozer	1	$350.00	/day	$350.00
P/U Truck	1	$160.00	/day	$160.00
Material:				
Field Instruments	1	$46.00	/day	$46.00
Level D PPE	2	$10.00	/day	$20.00
			Subtotal	**$6,792.00**

Table 4-3

Alternative 4 Cost Estimate
(Excavation, Alkaline Hydrolysis, and On-Site Disposal)
TNTA/WWTP1 Sewer Lines
Former Plum Brook Ordnance Works
Sandusky, Ohio

7.0 Site Restoration

Includes:
2. Re-seed site.
3. Confirmation sampling of soil staging areas.
4. General area cleanup

Assumptions and Calculations:

1. Field days for seeding and cleanup =	1
2. Number of field crew =	2
3. Work hours/day =	8
4. Restoration area (acre) =	0.50

Service/Materials	Unit	Unit Cost		Subtotal
Labor:				
Site PM	8	$120.00	/hr	$960.00
Site Superintendent	8	$115.00	/hr	$920.00
QA/Sampling Coordinator	8	$80.00	/hr	$640.00
H&S Coordinator	8	$130.00	/hr	$1,040.00
Equipment Operator	1	$406.00	/day	$406.00
Laborer	1	$293.00	/day	$293.00
Truck Drivers	1	$341.60	/day	$341.60
Equipment:				
Excavator	1	$775.00	/day	$775.00
Dump Truck	1	$895.00	/day	$895.00
P/U Truck	1	$160.00	/day	$160.00
Material:				
Field Instruments	1	$46.00	/day	$46.00
Level D PPE	2	$10.00	/day	$20.00
Analytical:				
SVOCs	4	$175.00	/ea	$700.00
NACs (8330)	4	$105.00	/ea	$420.00
Shipping	1	$40.00	/ea	$40.00
			Subtotal	**$7,657.00**

8.0 Overall Cost

Total Capital Cost	**$476,600.00**
Contingency (30%)	**$143,000.00**
Contractor Oversight (5%)	**$23,800.00**
Total Cost	**$643,000.00**

[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.