- Case 1 -
Thermal Desorption at the Metaltec Superfund Site

Thermal Desorption at the Metaltec Superfund Site, Franklin Borough, New Jersey

Site Name: Metaltec Superfund Site

Location: Franklin Borough, New Jersey

Period of Operation: December 1994 - January 1995

Cleanup Type: Remedial

Technology: Thermal Desorption
- A low temperature enhanced volatilization system provided by Williams Environmental was used to treat soil at the site
- The desorber was a direct-fired, rotary dryer equipped with a gas burner and operated using countercurrent flow under negative pressure
- Soil was heated in the desorber to a temperature of 750°F for 15-20 minutes
- Emission controls included a baghouse, thermal oxidizer, quench, and scrubber

Cleanup Authority:
CERCLA- ROD issued June 30, 1986

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Contaminants: Chlorinated Volatile Organic Compounds (VOCs) and Heavy Metals
- Maximum concentrations in soil were trichloroethene (TCE)
- 7,600 mg/kg and 1,2-dichloroethene (DCE) - 6,600 mg/kg

Waste Source: Disposal in lagoon; spills

Type/Quantity of Media Treated: Soil
- 4,215 yds^3 treated
- Soil was characterized as stiff sandy clays; silty, sandy clays; and sands and gravel
- Moisture content was 20%

Purpose/Significance of Application: Demonstration of composting technology for treatment of soil contaminated with chlorinated pesticides

Regulatory Requirements/Cleanup Goals:
- The ROD specified the following cleanup goals: vinyl chloride - 33 mg/kg; tetrachloroethene (PCE) - 0.05 mg/kg; trans-1,2-DCE - 33 mg/kg; TCE - 5.6 mg/kg; chloroform - 5.6 mg/kg; 1,1,1-trichloroethane - 0.41 mg/kg; and 1,1-dichloroethane - 7.2 mg/kg
- The ROD required that treated soil that failed to meet the TCLP metals requirements be shipped off-site for stabilization and disposal at an approved RCRA permitted facility.
- Air emissions standards were specified in a NJDEP air permit, including a destruction and removal efficiency (DRE) for the thermal oxidizer of 99.99%

Results:
- All soil met the cleanup goals on the first pass through the desorber and no soil was retreated. Data on the concentration of individual constituents in the treated soil were not provided
- A performance test was performed to demonstrate compliance with soil cleanup requirements and air emissions standards, and to establish operating parameters for the remainder of the project. During the performance test (three runs), all treated soil samples were below the detection limit of 0.002 mg/kg for PCE and TCE. All emission results met the test objectives with the exception of lead and sulfur oxides, which were deemed acceptable by the USACE and EPA .

Costs:
- The total cost for treatment of 4,215 cubic yards of contaminated soil at this site was $998,238. This included costs for technology mobilization, setup, and demobilization, planning and preparation, and equipment and appurtenances.

- The calculated unit cost for this application was $237 per cubic yard of soil (based on a total of 4,215 cubic yards of soil treated).

Description: From 1965 to the mid 1980s, the Metaltec Corporation, a subsidiary of Aerosystems Technology Corporation, operated a metal-plating facility in Franklin Borough, Sussex County, New Jersey. The facility produced assorted metal parts including metal ballpoint pen casings, paint spray guns, and lipstick cases. During that time, wastewater from the plating operations was discharged on-site to an unlined wastewater lagoon. In addition, wastes were spilled and dumped in various locations at the facility. The unlined wastewater lagoon was abandoned sometime in the 1980s and subsequently backfilled by the owners. In 1980, the New Jersey Department of Environmental Protection (NJDEP) conducted several investigations of the former wastewater lagoon and a pile of green material that was stored at the site, and found that soil and groundwater in these areas were contaminated by VOCs and heavy metals. The site was placed on the National Priorities List (NPL) in September, 1983.

A thermal desorption system was used at the site to treat soil contaminated with VOCs. This system treated 4,215 yds^3 of contaminated soil to below cleanup goals in less than 2 months, with no soil requiring retreatmenttt. According to the vendor, the thermal desorption system was operated at a 75% on-stream efficiency despite severe weather conditions. In addition,

the vendor was able to maintain the contract-required schedule despite delays in the air permitting process. The vendor indicated that developing an active relationship with the community allowed operations to be extended from 12 hours/day to 24 hours/day, which was critical to maintaining the project schedule.

Cost and Performance Summary Report
Thermal Desorption at the Metaltec/Aerosystems Superfund Site
Franklin Borough, New Jersey

Summary Information [1,2,3,7,9,10]

From 1965 to the mid 1980s, the Metaltec Corporation, a subsidiary of Aerosystems Technology Corporation, operated a metal-plating facility in Franklin Borough, Sussex County, New Jersey. The facility produced assorted metal parts including metal ballpoint pen casings, paint spray guns, and lipstick cases. During that time, wastewater from the plating operations was discharged on-site to an unlined wastewater lagoon. In addition, wastes were spilled and dumped in various locations at the facility. The unlined wastewater lagoon was abandoned sometime in the 1980s and subsequently backfilled by the owners. The site is currently being used to manufacture glassware and to assemble ice machines.

In 1980, the New Jersey Department of Environmental Protection (NJDEP) conducted several investigations of the former wastewater lagoon and a pile of green material that was stored at the site (referred to as the green pile area). The results of the investigations found soil and groundwater contamination in these areas, including organics such as trichloroethene (TCE) and heavy metals such as nickel and chromium. In addition, the Borough's public drinking water well and several private drinking water wells in the vicinity of the site were found to be contaminated.

A remedial investigation (RI), conducted in 1984, defined four discrete parcels of property at the site with elevated levels of organics and metals in soil and groundwater. The highest levels of organic contamination were found in the area of Parcel 1, where the former wastewater lagoon was located. TCE and trans-1,2-dichloroethene were found in soil at levels as high as 7,600 mg/kg and 6,600 mg/kg, respectively. TCE and trans-1,2-dichloroethene were found in groundwater at levels as high as 3.9 mg/L and 10 mg/L, respectively.

The contamination in Parcels 2 (loading dock area), 3 (area in rear of manufacturing building), and 4 (former location of green pile) was primarily metals, including copper, zinc, lead, chromium, and manganese.

The site was placed on the National Priorities List (NPL) in September, 1983. In June 1986, EPA signed a record of decision (ROD) for operable unit (OU) 1 at the site specifying remediation of soil and restoration of the water supply (groundwater remediation was subsequently addressed in a 1990 ROD for OU 2). For Parcel 1, the ROD specified excavation of contaminated soil and treatment using an asphalt dryer (thermal desorption). For Parcels 2, 3, and 4, the ROD specified excavation, followed by off-site disposal. According to the ROD, because the soil contamination in Parcels 2, 3, and 4 was primarily inorganic, the soil could not be treated in the same manner as the soil from Parcel 1. This report focuses on the treatment of contaminated soil from Parcel 1 using thermal desorption.

A total of 4,215 cubic yards of contaminated soil from Parcel 1 was treated using thermal desorption. The period of operation for this application was December 1, 1994 through January 29, 1995.

CERCLIS ID Number:	NJD002517472
Type of Action:	Remedial
Lead:	EPA

Timeline [2,9]

June 30, 1986	ROD signed for OU 1 addressing soil contamination and restoration of drinking water supply
September 27, 1990	ROD signed for OU 2 addressing groundwater contamination
December 1994 - January 1995	Treatment performed
May 1, 1995	Project closeout

Factors That Affected Cost or Performance of Treatment [8,10]

Listed below are the key matrix characteristics for this technology and the values measured for each during site characterization.

Matrix Characteristics

Parameter	Value
Soil Classification:	Stiff sandy clays; silty, sandy clays; sands and gravel
Clay Content and/or Particle Size Distribution:	Particle size ranges from 0.001 mm to 50 mm
Moisture Content:	<20%
Petroleum Hydrocarbons:	Not available
Bulk Density:	2.26 tons/cubic yard

Treatment Technology Description [2,6,9,10]

The technology used to treat the contaminated soil from Parcel 1 at this site was the low temperature enhanced volatilization (LTEV) system provided by Williams Environmental Services, Inc. (Williams), the technology vendor. The system was a countercurrent thermal desorber that used a rotary dryer, equipped with a gas fired burner, to provide direct heat to volatilize the organic constituents from the soil. The unit was operated under negative pressure and a blower and fan were used to provide air to the burner. Emissions controls included a baghouse, thermal oxidizer, quench, and scrubber.

As the soil passed through the desorber, the soil temperature initially was raised to 212°F to remove water, then was raised to approximately 750°F as the soil moved toward the discharge end of the desorber. According to Williams, the use of a countercurrent flow allowed high exit soil temperatures to be readily attained and the desorber was constructed of a special alloy designed to withstand temperatures up to 1000°F.

As the treated soil exited the desorber (at 750°F) on the conveyor, it was combined with baghouse dust. The soil was then quenched and a negative pressure was maintained on the discharge conveyor through the desorber breaching to capture steam generated during the quenching operation. The treated soil was then removed and stockpiled.

Off-gases were sent to a baghouse to remove particulates, then to a thermal oxidizer to destroy residual organics. The thermal oxidizer was operated at about 1800°F. The gases were then rapidly cooled to 185°F in the quencher and sent to the scrubber where the gases were neutralized with caustic prior to discharge to the atmosphere.

The unit was initially operated 12 hours per day, six days a week. According to the vendor, after working with the community, operations were able to be expanded to 24 hours per day, seven days a week.

Treated soil that met the cleanup goals for volatiles and for toxicity characteristic leaching procedure (TCLP) metals were disposed off-site in an approved RCRA landfill.

Operating Parameters [2,10]

Listed below are the key operating parameters for this technology and the values measured for each.

Operating Parameter	Value
Residence Time	15-20 minutes
System Throughput	16.38 tons per hour
Soil Exit Temperature	750° F
Rotary Dryer Exit Gas Temperature	350 - 500°F
Pressure (I.D. Fan pressure differential)	17 inches of water
Pressure (Rotary Dryer Burner)	-0.05 inches of water
Thermal Oxidizer Temperature	1800°F
Quench Temperature	185°F

Performance Information [1,2,5,10]

The ROD specified the following cleanup goals for treated soil:

- vinyl chloride - 33 mg/kg
- tetrachloroethene - 0.05 mg/kg
- trans-1,2-dichloroethene - 33 mg/kg
- TCE - 5.6 mg/kg
- chloroform - 5.6 mg/kg
- 1,1,1-trichloroethane - 0.41 mg/kg
- 1,1-dichloroethane - 7.2 mg/kg

In addition, the ROD required that treated soil that failed to meet the TCLP metals requirements be shipped off-site for stabilization and disposal at an approved RCRA permitted facility.

The air emissions standards specified in the NJDEP air permit for the unit were a destruction and removal efficiency (DRE) for the thermal oxidizer of 99.99%, and:

- nitrogen oxides - 10.12 lb/hr
- carbon monoxide - 3.49 lb/hr (50 ppmdv @ 7% O_2)
- total non-methane hydrocarbons (as CH_4) - 1 lb/hr (25 ppmdv @ 7% O_2)
- total suspended particulates - 4.12 lb/hr (0.03 gr/dscf)

- respirable particulates (PM-10) - 4.12 lb/hr (0.03 gr/dscf)
- arsenic - 9.59 $x10^{-6}$ lb/hr
- beryllium - 4.11 $x10^{-11}$ lb/hr
- lead - 1.10 $x10^{-4}$ lb/hr
- sulfur oxides - 0.014 lb/hr
- hydrogen chloride - 3.67 lb/hr

A performance test was performed to demonstrate compliance with soil cleanup requirements and air emissions standards, and to establish operating parameters for the remainder of the project. During the performance test (three runs), all treated soil samples were below the detection limit of 0.002 mg/kg for PCE and TCE. All emission results met the test objectives with the exception of lead and sulfur oxides. The exceedance of the lead limit occurred in one run and was considered to be an outlier, attributed to a hot spot of lead contamination. The exceedance of the sulfur oxide limit was found to be the results of the sulfur content of the propane. As a result, the permit exceedances were deemed acceptable by the USACE and EPA representatives for the site and the system was found to be in compliance with all air permit requirements.

A total of 4,215 cubic yards of contaminated soil was treated during this application. All soil met the cleanup goals on the first pass and no soil was retreated. Data on the concentration of individual constituents in the treated soil were not provided.

Performance Data Quality

No specific information on performance data quality was provided in the available references. However, no deviations were noted.

Cost Information [4,9]

The thermal treatment of the Parcel 1 contaminated soil was procured by the U.S. Army Corps of Engineers (USACE) through an open solicitation. USACE provided oversight during the application. Sevenson Environmental Services, Inc. was awarded the contract and subcontracted to Williams Environmental Services, Inc. to provide the thermal desorber.

The actual costs for this project were provided by the remediation contractor, Sevenson Environmental Services, Inc., based on invoiced costs, and by Williams Environmental Services, Inc. Table 1 presents the costs for the project.

The total cost for the LTEV application for the treatment of 4,215 cubic yards contaminated soil from Parcel 1 at the Metaltec/Aerosystems site was $998,238. The calculated unit cost for this application was $237 per cubic yard of soil (based on a total of 4,215 cubic yards of treated soil).

Table 1 - Actual Project Costs [4,10]

Cost Category/Element	Cost (1998 $ Basis)
1. Capital Cost for Technology	
Technology mobilization, setup, and demobilization - mobilization/demobilization of LTEV equipment	289,771
Planning and preparation	50,000
Site work	See other project costs
Equipment and appurtenances - thermal treatment (4,215 CY)	658,467
Startup and testing	Included in capital costs
Other (Includes nonprocess equipment)	0
TOTAL CAPITAL COSTS	998,238
2. O&M for Technology	
Labor; materials; utilities and fuel; equipment ownership, rental, or lease; performance testing and analysis; other	Included in capital costs
TOTAL OPERATION AND MAINTENANCE COSTS	Included in capital costs
3. Other Technology-Specific Costs	
Compliance testing and analysis - post-treatment sampling - post-excavation confirmation sampling	 55,100 33,120
Soil, sludge, and debris excavation, collection, and control - contaminated soil excavation (5583 CY) - contaminated soil excavation (2858 CY)	 290,316 375,173
Disposal of residues - transport and disposal of treated soil as hazardous waste - backfill and grading - common fill - off-site transportation and disposal as hazardous waste of excavated soil material too large to be thermally treated and below grade vegetation debris (150 tons) - off-site transportation and disposal as hazardous waste of excavated soil material too large to be thermally treated and below grade vegetation debris (2858 tons) - backfilling and grading P00002	 838,785 94,911 39,450 751,654 11,487

Table 1 (continued)- Actual Project Costs [4,10]

Cost Category/Element	Cost (1998 $ Basis)
4. Other Project Costs	
- health and safety services	130,000
- gravel base in CRZ (500 CY)	22,000
- gravel base in CRZ (43 CY)	1,892
- off-site transportation and disposal of gravel from CRZ as hazardous waste (500 CY)	82,500
- off-site transportation and disposal of gravel from CRZ as hazardous waste (43 CY)	7,095
- groundwater collection and treatment facilities	284,000
- All other project work	665,000
Total cost (year basis for cost)	4,680,721
Total cost for calculating unit cost	998,238
Quantity treated	4,215 cubic yards
Calculated unit cost	237 per cubic yard
Basis for quantity treated	quantity of soil treated in thermal desorber

Observations and Lessons Learned

The LTVS system treated soil contaminated with VOCs to below cleanup goals in less than 2 months, with no soil requiring retreatment.

According to the vendor, the LTVS was operated at a 75% on-stream efficiency despite severe weather conditions. In addition, the vendor was able to maintain the contract required schedule despite delays in the air permitting process.

The vendor also indicated that developing an active relationship with the community allowed operations to be extended from 12 hours/day to 24 hours/day, which was critical to maintaining the project schedule. Good community relations were also important as the nearest residence was only 50 feet from the soil discharge pad.

Contact Information

For more information about this application, please contact:

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* Indicates primary contact for this application

References

The following references were used in the preparation of this report.

1. EPA. 1986. Record of Decision (ROD) for Metaltec/Aerosystems, NJ. June 30.

2. Williams Environmental Services, Inc. 1994 "LTVS Plan - Metaltec/Aerosystems Site - Franklin, New Jersey." May 3.

3. EPA. 1996 Annual Status Report for Innovative Treatment Technologies. "Metaltec/Aerosystems."

4. Sevenson Environmental Services, Inc. 1998. Invoice for Contract No. DACW41-93-C-9008 (Metaltec). October 23.

5. New Jersey Department of Environmental Protection. 1994. "Air Pollution Control Permit Equivalent to Construct and Operate LTVS at Metaltec/Aerosystems Superfund Site, Franklin Borough, Sussex County, New Jersey, DEP Log# 01-93-4964. August 9.

6. Klotzbach, Elizabeth. Sevenson Environmental Services. Telephone Communication with Catherine Cooney, Tetra Tech EM Inc., Response to Questions about Metaltec, April 5, 1999.

7. Weissman, Daniel. EPA Region 2. Telephone Communication with Catherine Cooney, Tetra Tech EM Inc., Response to Questions about Metaltec, March 24, 1999.

8. USACE. 1992. "Supplemental Information for Excavation, Treatment, and Removal of Contaminated Soil - Metaltec Aerosystems Site, New Jersey." Volume 3 - Step 1 of Two-Step Formal Advertising. April.

9. Ronny Hwee, USACE. Comments on Draft Report for Metaltec. March 14, 2000.

8. Mark A. Fleri, P.E., Williams Environmental Services, Inc. Comments on Draft Metaltec Report. April 17, 2000.

Acknowledgments

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- Case 2 -
DRE Emissions Test Results – SFP Airport Plot 50

Southwest Soil Remediation
Tucson, AZ

DRE Emissions Test Results
San Francisco, California

Test Date: March 21, 1996

BEST ENVIRONMENTAL, INC.
15890 Foothill Boulevard
San Leandro, California 94578
(510) 278-4011 FAX (510) 278-4018

April 1, 1996

Attn: Jae Chang
Southwest Soil Remediation, Inc.
3951 East Columbia Street
Tucson, AZ 85714

Subject: Trichloroethylene (TCE) destruction & removal (DRE) efficiency emissions testing of the soil remediation unit located at the SFO Airport Plot 50, San Francisco, CA 94128; BAAQMD Application #25656.

Test Date: March 21, 1996

Sampling Location: The outlet of the thermal oxidizer (A-2) and baghouse. The outlet sampling ports are located approximately 2 diameters upstream and 5 diameters downstream from any disturbance.

Sampling Personnel: Sampling was performed by Regan Best and Steve Allen of BEST ENVIRONMENTAL, INC.

Observing Personnel: The Bay Area Air Quality Management District (BAAQMD) was not notified of the test as it was not for compliance purposes.

Process Description: Southwest Soil Remediation operates a soil remediation unit for the removal of volatile organic compounds (VOC) from the soil. VOC's are stripped from the soil in a rotary kiln, ducted through two cyclones and then into a thermal oxidizer which is maintained at no less than 1800 degrees F. The exhaust gases are then passed through a scrubbing tower, baghouse and finally out the stack. A flow schematic is contained in the appendix of this report. The facility process rate during the testing was 20 TPH.

Test Program: Six tests of 20 minute duration were conducted at the oxidizer outlet for TCE using the EPA Method 0030 Volatile Organic Sampling Train (VOST). Bay Area Air Quality Management District (BAAQMD) methods were performed to determine stack gas moisture and volumetric flowrate. For reporting purposes the results from the VOST tests were divided into two groups of three runs and designated Runs 1 and 2.

During the test period SSR personnel collected soil samples every 10 minutes from the soil prior to entering the kiln. The samples were composited into two samples coincident with the outlet test periods.

TCE analysis of the soil samples was performed by R.J. Lee Group

in San Leandro, CA. TCE analysis of the VOST train samples was performed by Air Toxics Ltd. in Folsom, CA.

Sampling and Analysis Methods: The following Bay Area Air Quality Management District (BAAQMD) and U.S. Environmental Protection Agency (EPA) sampling and analytical methods were used:

EPA	0030 (VOST)	TCE (Trichloroethylene)
EPA	3	Carbon Dioxide & Oxygen by Fyrite
BAAQMD	ST-17&18	Stack Gas Volumetric Flowrate
BAAQMD	ST-23	Water Vapor

Test Results and Discussion: Emission and efficiency results are presented in Table 1. Destruction Efficiency (DE) for the thermal oxidizer unit for TCE averaged 99.995%. Outlet TCE concentration and emission rate averaged 0.14 ppb and 0.024 g/hr.

The inlet emission rate was calculated from the facility process rate of 20 TPH and the soil analysis which was reported on a weight basis for TCE in mg/kg. The emission rate was calculated as follows:

$$g/hr = mg/kg \times (TPH \times 2000 lb/ton \times 453.6\ g/lb / 1{,}000{,}000)$$

Stack gas volumetric flowrate calculations, lab report, field data sheets, emission calculations, QA/QC equipment records and a copy of the Authority to Construct are all appended to this report.

If you have any questions regarding this report, or if BEST ENVIRONMENTAL can be of any further assistance, please call.

Submitted by

Regan Best
Project Manager

Reviewed by

Dan Cartner
Operations Manager

TABLE 1

Southwest Soil Remediation
SFO Thermal Oxidizer SRU

RUN #	1		2			AVG	
EST LOCATION	Inlet	Outlet	Inlet	Outlet		Inlet	Outlet
EST DATE	3-21-96		3-21-96				
EST TIME	1225-1341		1349-1505				
LOWRATE, DSCFM		14,055		14,748			14,402
H_2O, %	N.A.	43.1	N.A.	42.1		N.A.	42.6
O_2, %	N.A.	11.3	N.A.	11.3		N.A.	11.3
CO_2, %	N.A.	5.5	N.A.	5.5		N.A.	5.5
Sample Vol., liters	N.A.	53.50	N.A.	52.75		N.A.	53.12
TCE, ng		< 30.0		50.0			40.0
TCE, ppb		< 0.103		0.174			0.139
TCE, grams/Hr	300.83	< 0.013	438.00	0.024		369.4	0.019
TCE D.E., %	> 99.996		99.995			99.995	

WHERE,

CO_2 = Carbon Dioxide

O_2 = Oxygen

TCE = Trichloroethylene (M.W. = 134.4)

ppb = Part per Billion

Lbs/hr = Pounds Per Hour Emission Rate

DSCFM = Dry Standard Cubic Feet Per Minute

D.E. = Destruction Efficiency

N.M. = Not Measured

N.A. = Not Applicable

CALCULATIONS,

D.E. = 100 * (Inlet TCE g/hr - Outlet TCE g/hr) / Inlet TCE g/hr

g/hr = ppb * DSCFM * 1.56E-7 * M.W. * 0.4536

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- Case 3 -
Longhorn, Army Ammunition Plan
Burning Ground No. 3

Low Temperature Thermal Desorption at Longhorn Army Ammunition Plant, Karnack, Texas

Site Name: Longhorn Army Ammunition Plant, Burning Ground No. 3

Location: Karnack, Texas

Period of Operation: - Proof of Performance Test - February 1997
- Full-Scale Operation - February to December 1997

Cleanup Type: Full scale

Project Management:
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Vendor:
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Karnack, TX 75661
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Technology:
On-Site Low Temperature Thermal Desorption (LTTD)
- Soil was fed through a vibrating screen to remove large debris
- Soil passed counter-current to hot combustion gases in one of two parallel LTTD units
- Soil was heated between 350 and 650 °F
- The gas stream from each LTTD unit passed through a baghouse and then the two streams were combined
- The combined gas stream was preheated to 680 °F prior to entering the catalytic oxidizer where desorbed VOCs in the gas stream were destroyed
- Hot gases exiting the oxidizer passed through a heat exchanger, multi-stage quench and packed bed scrubber
- Solids exiting the thermal desorption units and baghouses were stockpiled for compliance sampling

Cleanup Authority: CERCLA and State ROD date - May 1995

Regulatory Contacts:
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Diane Poteet
TNRCC
Superfund Investigation,
MC-143
12100 Park 35 Circle, Bldg. D
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Contaminants: Organic Compounds - Volatiles (Halogenated)
- Trichlororethylene (TCE) and Methylene Chloride
- Maximum concentrations in mg/kg - TCE (1,000 mg/kg) and Methylene Chloride (742 mg/kg)

Waste Source: Open burning, incineration, evaporation, and burial of pyrotechnic and combustible solvent wastes

Type/Quantity of Media Treated: Soil (ex situ)
- 32,293 cubic yards (51,669 tons) of soil
- Average Clay Content: 31.5 %
- Mean Particle Size: 0.032 mm
- Average Moisture Content: 17.5 %
- Bulk Soil Density: 1.6 tons per cubic yard

Purpose/Significance of Application: Thermal desorption to treat chlorinated solvents in the site soil and source materials

Regulatory Requirements/Cleanup Goals:
- If TCE or methylene chloride concentrations in the soil were below 40 mg/kg, the treatment objective was to reduce the concentrations to 2 mg/kg or lower.
- If TCE or methylene chloride concentrations in the soil exceeded 40 mg/kg, the treatment objective was to reduce the concentrations by at least 95%.
- Air emission requirements included control of total chemical emissions, particulate matter and 2,3,7,8-tetrachlorinated dibenzo-p-dioxin toxic equivalents in the stack gas.

Results:
- Sampling of treated soil indicated that all soil cleanup goals were met.
- Emissions data from the Proof of Performance test and full-scale operations indicated that all emissions standards were met.

Costs:
- The total cost for this project was $4,886,978.
- The total cost for treatment was $151 per cubic yard ($95 per ton) of contaminated material.

Description: Burning Ground No. 3 was operational from 1955 to 1997. The site was used for the treatment, storage, and disposal of pyrotechnic and combustible solvent wastes including open burning, incineration, evaporation and burial. Site investigations indicated the presence of high concentrations of chlorinated solvents and heavy metals in subsurface soils and shallow groundwater at the site. In addition, buried sawdust and other solvent-contaminated wastes were encountered. A ROD was signed in May 1995, specifying LTTD

as the remedial technology for addressing soil contamination at the site. Site soil cleanup goals were specified in the ROD.

Mobilization and set-up of the soil treatment plant (STP) occurred in January 1997. System start-up and shake down and the Proof of Performance test were conducted in February 1997. After successfully demonstrating that the STP could meet performance requirements, the STP was put into full production. Soil/source material excavation and full-scale operation of treatment system was performed between February and December 1997. The STP consisted of a counter-current, LTTD system followed by a low-temperature, catalytic oxidation system to treat the LTTD off-gas. After confirming that treated soil met the cleanup criteria, the soil was used as general fill material for landfill caps at two sites at the LHAAP. Demobilization of the STP from the site was completed in January 1998 and site restoration was completed by June 1998.

Final
April 30, 1999

COST AND PERFORMANCE REPORT

Low Temperature Thermal Desorption
at Longhorn Army Ammunition Plant, Burning Ground No. 3
Karnack, Texas

April 1999

Prepared by:
U.S. Army Corps of Engineers
Hazardous, Toxic, Radioactive Waste
Center of Expertise

SITE INFORMATION

IDENTIFYING INFORMATION (1)

Site Name:	Longhorn Army Ammunition Plant (LHAAP), Burning Ground No. 3
Location:	Karnack, Texas
CERCLIS #:	TX6213820529
ROD Date:	May 1995
Technology:	On-Site Low Temperature Thermal Desorption (LTTD)
Type of Action:	Remedial (Interim)

Figure 1 shows the location of the LHAAP in Texas, and Figure 2 shows the location of Burning Ground No. 3 at the LHAAP.

TECHNOLOGY APPLICATION (1,2,3)

Period of Operation:
Treatability Study – December 1993
Proof of Performance Test – February 1997
Full-scale operation – February through December 1997

Quantity of Material Treated During Application:
32,293 cubic yards (CY) or 51,669 tons of soil

In addition to treatment of contaminated soil by LTTD, site operations included extraction and treatment of contaminated shallow groundwater. Groundwater is being treated by metals precipitation and air stripping for removal of organics. Off-gases from the air stripper are being treated by catalytic oxidation. Groundwater treatment is not addressed in this report.

BACKGROUND

Site Background and History (1,14):

- The LHAAP is located on 8,493 acres of land in the town of Karnack in central east Texas.
- Plant 1 at LHAAP was established in October 1942 with the primary mission of producing trinitrotoluene (TNT) flake. TNT production continued at the facility until August 1945. The plant was put on standby status from 1945 until February 1952. Pyrotechnic ammunition (photo flash bombs, simulators, hand signals, and tracers were manufactured at LHAAP from 1952 until 1956. The Plant 3 area rocket motor facility began operation in November 1955 and continued until 1965, when production of pyrotechnic and illuminating ammunition was re-established.
- More recent operations at LHAAP include compounding of pyrotechnic and propellant mixtures; loading, assembly and packing activities; accommodating receipt and shipment of containerized cargo; and the maintenance or layaway of standby facilities and equipment as they apply to mobilization planning. In addition, the installation has been responsible for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate-Range Nuclear Force (INF) Treaty in effect between the United States and the former Soviet Union.

- Currently, LHAAP is inactive. Demilitarization activities have begun.

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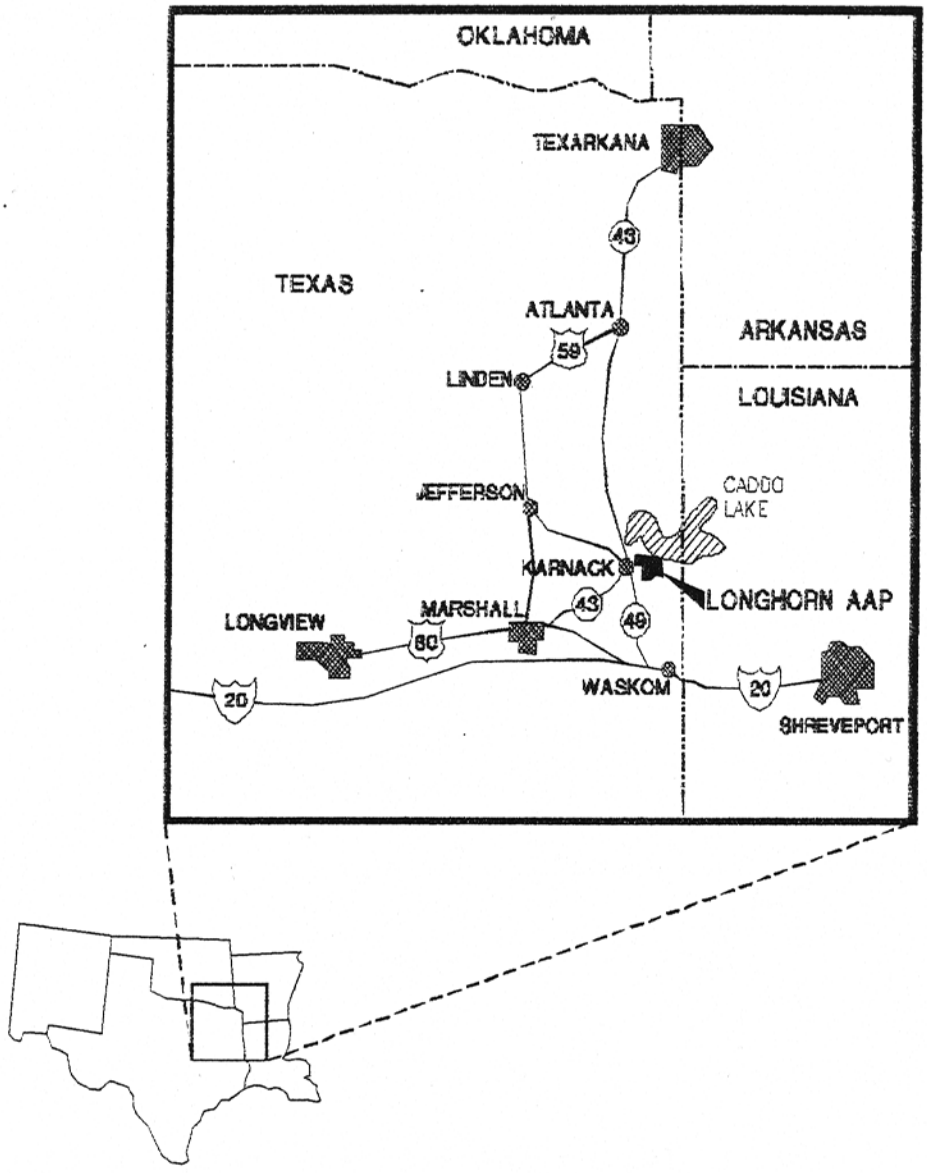

Figure 1. Location of the Longhorn Army Ammunition Plant in Texas

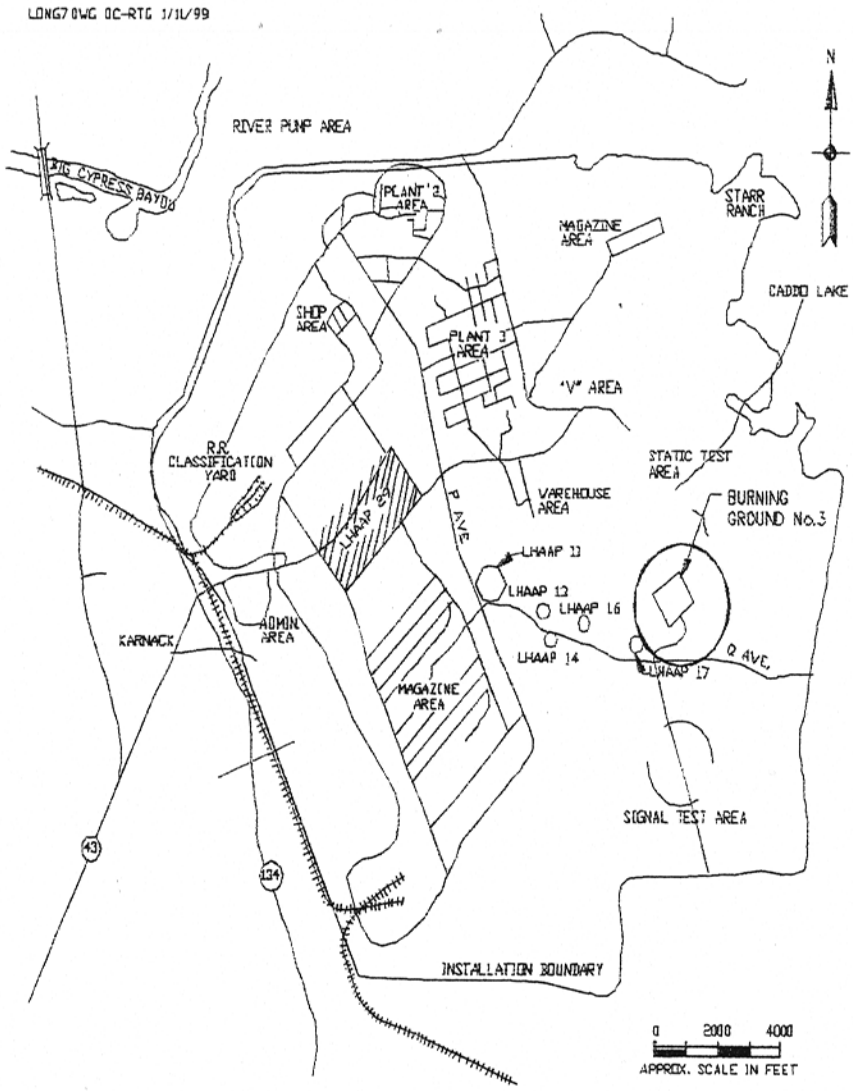

Figure 2. Location of Burning Ground No. 3 at the LHAAP

- Burning Ground No. 3 was operational from 1955 to 1997. The site was used for the treatment, storage, and disposal of pyrotechnic and combustible solvent wastes including open burning, incineration, evaporation and burial.

- An unlined evaporation pond (UEP) was constructed at the burning ground in 1963 to store wastes resulting from the washout of rocket motor casings. In 1973, the UEP also began receiving wash water from LHAAP operations involving pyrotechnic material preparation and mixing. The wash water included solvent residues and solids which commonly contained aluminum, arsenic, barium, cadmium, chromium, iron, lead, magnesium, sodium, strontium, zinc, nitrite, nitrate, phosphate, acetone, ethyl alcohol, methyl ethyl ketone, methylene chloride, trichloroethylene, and toluene.

- Sawdust soaked with methylene chloride and other solvents was stockpiled along the southern berm of the UEP and was burned in trenches in the western portion of the burning ground. In 1979, an Air Curtain Destructor (ACD) was constructed in the western corner of the burning ground for the purpose of burning explosives-contaminated wastes. Use of burn pits and trenches reportedly was discontinued in 1984.

- The UEP was closed as a RCRA interim status surface impoundment in 1986 by removing all waste and capping the impoundment.

- As part of the INF Treaty activities being conducted at LHAAP, a burn cage was constructed and used from 1989 to 1993 at the Burning Ground No. 3 for the open burning of Pershing II missile motors. The burn cage was removed between 1993 and 1996.

- The ACD is currently operational and will be used during demilitarization activities at LHAAP. In addition, some areas of the burning ground are currently being used for storage. No other activities are currently being conducted at Burning Ground No. 3.

SIC Code:
9711B (Ordnance Production and Storage) and 9711C (Ordnance Testing and Maintenance)

Waste Management Practices that Contributed to Contamination (1):
The site was used for the treatment, storage, and disposal of pyrotechnic and combustible solvent wastes. Disposal activities performed at the site include open burning, incineration, evaporation, and burial. Historical waste management units include open burning pits, the UEP, stockpiles of solvent soaked sawdust, and suspected waste burial pits.

Site Investigations (1,4):

- As part of the U.S. Army Installation Restoration Program, LHAAP began an environmental investigation of current and previously used waste disposal sites in 1976.

- The investigations at the Burning Ground No. 3 site indicated the presence of high concentrations of chlorinated solvents and heavy metals in the shallow groundwater and the presence of buried waste. Sources of groundwater contamination included the UEP, trenches containing solvent-contaminated wastes, and possibly contaminated soils at various burn pit locations.

- High concentrations of solvents (volatile organic compounds (VOCs), primarily methylene chloride and trichloroethylene), and traces of heavy metals have been detected in subsurface soils. From

1987 through 1989, 174 soil samples were analyzed for VOCs.

- Phase I of the Interim Remedial Action (IRA) at Burning Ground No. 3 included confirmation sampling required to complete site characterization and several laboratory treatability studies for contaminated soil and groundwater. The treatability studies were conducted from December 1993 to June 1994 using representative samples of soil and groundwater. The IRA is being managed by the USACE.

- Under Phase I, two soil treatment technologies for VOC removal were evaluated: high temperature incineration and LTTD. The treatability study results indicated that effective reduction in contaminant concentrations could be achieved but not to a level that would meet the post-treatment soil concentrations listed in the Land Disposal Restrictions (LDRs), 40 CFR 268. The studies showed that the treatment technologies could comply with the LDRs through a Treatability Variance in 40 CFR 268.44 for the wastes (spent halogenated solvents, F002, for non-specific sources).

- VOCs, barium, chromium, and lead were detected in site soil samples collected during the LTTD treatability study. In addition, buried sawdust was encountered in the area adjacent to the southeast corner of the ACD.

- During the course of the treatability studies, it was determined that the metals contamination in the soil was not leachable according to the Toxicity Characteristic Leaching Procedure (TCLP). Therefore, stabilization and chemical extraction treatability tests were not performed for metals in the soil. It was decided that the selected treatment technology would address VOC contamination only.

SITE LOGISTICS/CONTACTS (5)

Role	Contact Information	
Site Contacts	Oscar Linebaugh (Technical Contact) USACE, Ft. Worth District Eastern Area Office (318) 676-3365 x 225	David Tolbert (Environmental Contact) Longhorn/Louisiana Army Ammunition Plant Highway 80 East, Gate 4 Doyline, LA 71055 (903) 679-2054
Project Manager	Jonna Polk USACE, Tulsa District 1645 South 101st Avenue Tulsa, OK 74128-4629	
Regulatory Contacts	Chris Villarreal U.S. EPA Region 6 1445 Ross Avenue Suite 1200 Dallas, TX 75202-2733 (214) 665-6758	Diane Poteet TNRCC Superfund Investigation, MC-143 12100 Park 35 Circle, Bldg. D Austin, TX 78753

Remediation Contractor

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MATRIX AND CONTAMINANT DESCRIPTION

MATRIX IDENTIFICATION

Soil (ex situ)

SITE GEOLOGY/STRATIGRAPHY (1)

- Burning Ground No. 3 is situated on an outcrop of the Wilcox Group, with a contact between the primary materials of the Wilcox and recent alluvium running across the western corner of the site. This contact approximates the 100-year floodplain elevation of 180 feet above mean sea level (msl).

- Stratigraphic correlation is difficult due to the lateral and vertical heterogeneity of the materials comprising the Wilcox Group. Subsurface data show very few strata to be continuous across the site area. These strata are typical of the Wilcox Group, consisting of varying thicknesses of fine- to medium-grained sands, silts, and clays that are lenticular and discontinuous in nature.

- The Wilcox Group is underlain conformably by the predominantly calcareous clay of the Midway Group. The Midway Group tends to serve as a relatively impermeable basement to the overlying water-bearing Wilcox. Data collected during previous investigations at the site suggest that the contact between the Wilcox and Midway Groups occurs anywhere from an approximate elevation of 80 feet above msl immediately east of the burning grounds area to approximately 25 feet above msl on the western side of the site.

- Groundwater at Burning Ground No. 3 generally occurs under unconfined conditions. Depth to groundwater, which has been measured at one foot to 23 feet beneath the ground surface, has been observed to fluctuate approximately 2 feet over a 6-month period, reflecting seasonal variations in rainfall. Because groundwater is mounded at Burning Ground No. 3, groundwater flows away from the site in all directions.

CONTAMINANT CHARACTERIZATION (1)

Primary Contaminant Group: Organic Compounds - Volatiles (Halogenated)

Key Specific Contaminants: Methylene Chloride
Trichloroethylene (TCE)

CONTAMINANT PROPERTIES (6,7,8,9)

Table 1 lists selected properties for the key specific contaminants present at Burning Ground No. 3.

Table 1. Contaminant Properties

Property	Units	Methylene Chloride	Trichloroethylene
Chemical Formula	-	CH_2Cl_2	C_2HCl_3
Molecular Weight	g/mole	84.94	131.40
Specific Gravity	-	1.336 (20°C)	1.466 (20°C)
Vapor Pressure	mm Hg	349 (20°C)	60 (20°C)
Boiling Point	°C	40-41	86.7
Octanol-Water Partition Coefficient	log K_{ow}	1.25-1.30	2.29-3.30
Soil/Sediment Partition Coefficient	log K_{oc}	0.94	1.81-2.10

NATURE AND EXTENT OF THE CONTAMINANTS (1)

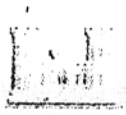
Site investigation data show that at least two known sources contributed to soil and groundwater contamination at the site. The primary source was the past usage of the UEP. Trenches containing solvent-contaminated wastes in the vicinity of the ACD made up the second source. Other potential sources of contamination included:

- Stockpiles of solvent-soaked sawdust,
- Various burn and demolition burial pits,
- A heavy propellant pit, and
- A liquid waste sump.

Figure 3 shows the locations of source units, and previous soil borings with corresponding VOC concentrations. High concentrations of solvents, primarily methylene chloride and trichloroethylene, and traces of heavy metals have been detected in subsurface soil, buried waste, and the uppermost water-bearing zone at the burning ground. From 1987 through 1989, 174 soil samples were analyzed for VOCs. Trichloroethylene was detected in 103 samples with a maximum concentration of 1,000 mg/kg. Methylene chloride was detected in 64 samples with a maximum concentration of 742 mg/kg. Acetone was also detected in 38 of 174 samples with a maximum concentration of 33 mg/kg. These VOCs were also detected in samples collected from potential source areas during the treatability study phase of the project. Barium, chromium, and lead have also been detected in site soil samples at concentrations exceeding expected background concentrations for this area.

Plumes of methylene chloride and trichloroethylene have been observed in the groundwater beneath the site. The methylene chloride plume covered a larger area and had higher concentrations than the trichloroethylene plume. This difference may have been due to methylene chloride being more soluble in water, more mobile, and less likely to be absorbed to the soil than trichloroethylene. The concentrations of methylene chloride, as of April 1994, ranged from approximately 10,550 mg/l, near the center of the plume, to less than 0.005 mg/l, near the northwest edge of the plume. The concentrations of trichloroethylene, as of April 1994, ranged from approximately 1,520 mg/l near the center of the plume, to less than 0.005 mg/l near the northwest edge of the plume.

Groundwater monitoring has indicated the potential presence of free-phase trichloroethylene and methylene chloride in the shallow groundwater beneath Burning Ground No. 3, to the south and east of the UEP, and in the vicinity of the ACD. The free-phases of these compounds are both dense nonaqueous phase liquids (DNAPLs).



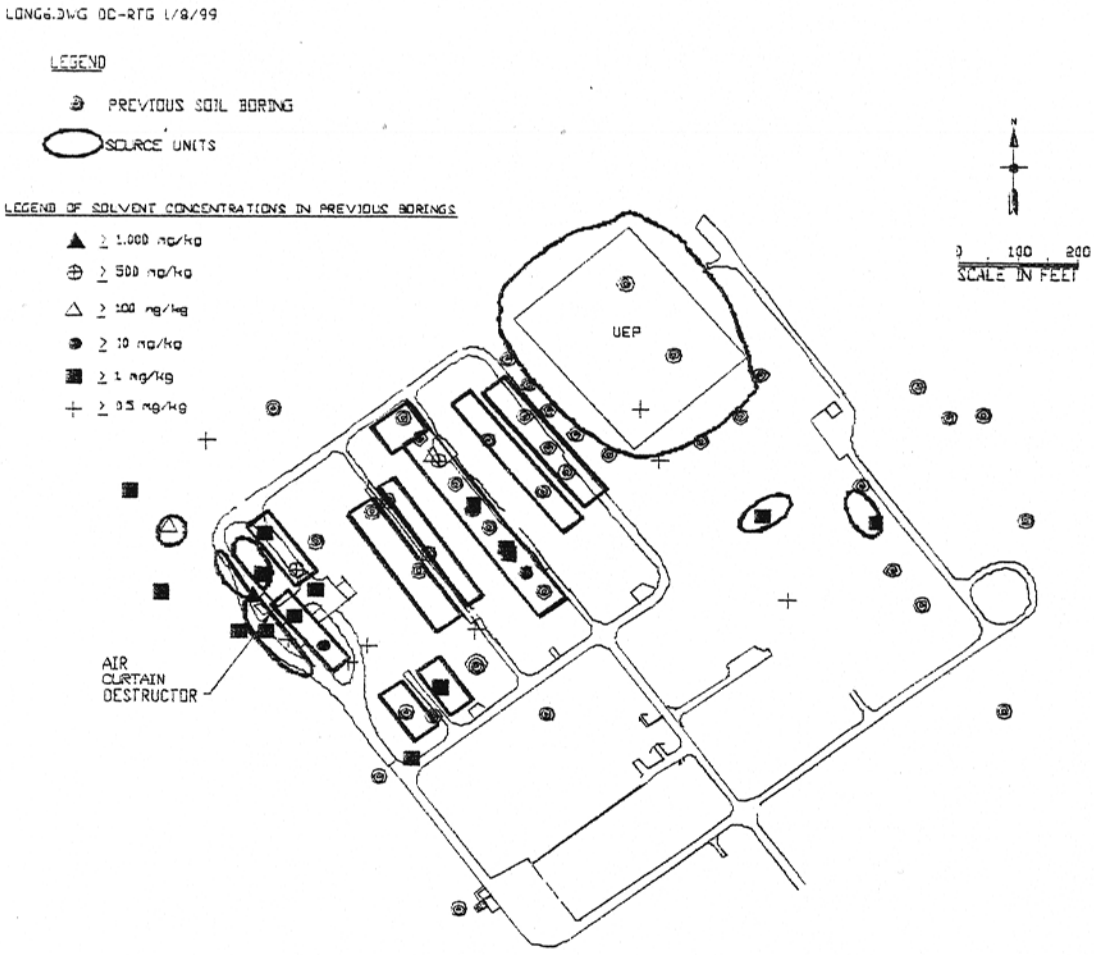


Figure 3. Past Soil Investigations Concentrations of VOCs