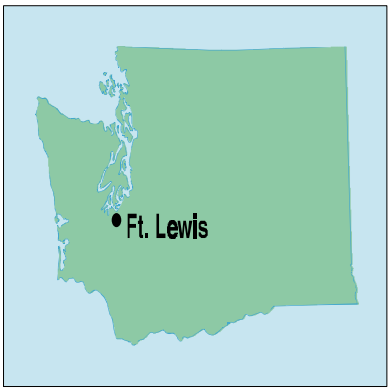
SITE INFORMATION

IDENTIFYING INFORMATION



Site Name: Solvent Refined Coal Pilot Plant (SRCPP)
Location: Ft. Lewis, Washington
Technology: Thermal Desorption
Type of Action: Remedial
ROD Date: October 15, 1993

TECHNOLOGY APPLICATION (1)

Period of Operation: August through December 1996 (11)
Quantity of Material Treated During Application: 104,336 tons of soil were treated during the application, including 2,200 tons during the field demonstration. (4)

BACKGROUND

Site Background (6, 7):

- Ft. Lewis is located approximately 12 miles south of the city of Tacoma, Washington; the 86,000-acre fort is divided by I-5 into North Ft. Lewis and main Ft. Lewis. The SRCPP occupies an area of approximately 25 acres between Sequalitchew Lake and Hamer Marsh on North Ft. Lewis.
- The SRCPP was operated from 1974 to 1981 as a production and research facility that worked to develop a solvent extraction process to derive petroleum hydrocarbon products from coal. Operations conducted at the SRCPP included heat extraction and thermal cracking.
- Treated liquid wastes from the process were sent to an unlined wastewater lagoon adjacent to the site. Surface runoff was collected and discharged at two points, one north and one south of the facility; the runoff later was redirected and sent to an wastewater treatment plant on site.
- Raw materials used in the process included coal, coal-derived organic liquids, water, and hydrogen gas; the process also required the use of catalysts.
- By-products of the process included such liquids as phenols, gasoline, kerosene, and fuel oil and such gases as hydrogen sulfide, carbon monoxide, carbon dioxide, and methane.
- Soil at the SRCPP was contaminated by leaks and spills of process materials that occurred during operations at the plant.

SIC Code: 9711 (National Security)

Waste Management Practice that Contributed to Contamination: Leaks and spills

Site Investigation (6, 7):

- From 1993 to 1994, a remedial investigation (RI) was performed at the SRCPP to identify potential effects on soil, groundwater, surface water, and sediments in Sequalitchew Lake and Hamer Marsh.

- Soil contamination was investigated by drilling 23 borings and excavating 20 test pits within and in the vicinity of the SRCPP. In addition, one hand auger boring was installed in a former wastewater treatment area. Soil samples were collected from each exploration and analyzed for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and metals. Table RI-1 summarizes the results of analyses of soil samples collected during the RI for VOCs, SVOCs, and metals, in terms of concentration ranges measured and frequencies of detection.

- The RI found that VOCs, SVOCs, and metals characteristic of SRCPP operations (metals from coal and catalysts) were present in soils at the site. In addition, it concluded that the distribution of contaminants beneath the SRCPP was highly variable and discontinuous in nature. Polycyclic aromatic hydrocarbons (PAH) were detected throughout the SRCPP, with average individual PAH concentrations of PAH typically not exceeding 2 mg/kg.

- Table RI-1 shows that the relatively lowest frequency of detection was that for VOCs (detected in fewer than 20 of 85 samples), while the frequency of detection of PAHs and metals was relatively greater.

Table RI-1. Results of Analysis of Soil Samples Collected During the RI (6)

Detected Analyte	Concentration Range (mg/kg)	Frequency of Detection[b]
VOCs:		
Benzene	<0.052-0.30	1/85
Chloroform	<0.054-0.3	2/85
Ethylbenzene	<0.052-12	8/85
2--Hexanone	<0.052-11	1/85
Tetrachloroethene	<0.052-0.98	17/85
1,1,1-Trichloroethane	<0.052-0.20	1/85
Trichloroethene	<0.052-0.12	2/85
Toluene	<0.052-5.2	13/85
Total Xylenes	<0.052-34	15/85
SVOCs--PAHs:		
Acenaphthene	<0.18-69	30/159
Acenaphthylene	<0.18-1.05	8/159
Anthracene	<0.18-30	41/159
Benzo(a)anthracene	<0.18-12	42/159
Benzo(b)fluoranthene	<0.18-17	53/159
Benzo(k)fluoranthene	<0.18-5.3	33/159
Benzo(g,h,i)perylene	<0.18-5.7	48/159
Benzo(a)pyrene	<0.18-8.8	48/159
Chrysene	<0.18-19	54/159
Dibenzo(a,h)anthracene	<0.18-1.2	14/159
Dibenzofuran	<0.18-99	43/159
Fluoranthene	<0.18-130	61/159
Fluorene	<0.18-84	37/159
Indeno(1,2,3-cd)pyrene	<0.18-3.3	43/159
2-Methylnaphthalene	<0.18-270	40/159
Naphthalene	<0.18-290	32/159
Phenanthrene	<0.18-410	73/159
Pyrene	<0.18-79	69/159

Table RI-1. Results of Analysis of Soil Samples Collected During the RI (6) (continued)

Detected Analyte	Concentration Range (mg/kg)	Frequency of Detection[b]
SVOCs--Others:		
Aniline	0.11 J-1.4	1/159
Benzoic Acid	<5.3-0.49 J	1/159
Bis (2-ethylhexyl)phthalate	0.041 J-19	8/159
Di-n-octylphthalate	<0.18-0.15 J	1/159
2,6-Dinitrotoluene	<0.18-0.52	NR
4,6-Dinitro-2-methyl phenol	<0.91-0.95 J	1/159
N-Nitrosodimethylamine	<0.18-0.14 J	1/159
Phenol	<0.18-1.2	5/159
2-Methyl phenol	<0.18-0.41 J[a]	1/159
4-Methyl phenol	<0.18-0.575 J	7/159
2,4-Dimethylphenol	<0.18-0.36 J	8/159
Total Metals:		
Antimony	<0.26-3.25	7/69
Arsenic	0.78-12	69/69
Barium	22-84	69/69
Beryllium	<0.26-0.52	10/69
Cadmium	<0.26-2.5	5/69
Chromium	3.8-19	69/69
Copper	8-1700	69/69
Iron	6200-37000	69/69
Lead	<1.54-120	69/69
Manganese	110-500	69/69
Mercury	<0.10-0.11	1/69
Nickel	6.7-26	69/69
Selenium	<0.16-0.90	3/69
Silver	<0.26-1.5	11/69
Zinc	13-220	69/69

Notes:
[a] All measured values are below method reporting limit (MRL)
[b] Frequency of detection is calculated as the number of samples that exhibit detections divided by the total number of samples taken.
J Estimated concentration
NR Not reported

- On the basis of the results of the RI, 11 zones were identified (Areas A through K), where contaminated soil was to be excavated. Figure 1 shows those areas. Figure 1 also shows the originally planned vertical extent of excavation for each of those areas and the planned locations of confirmatory samples in each of the areas. Sample frequency was based on the results of pre-excavation sampling used to designate each area as hot, moderate, or cool.

- Dames & Moore performed a pre-remediation surface soil chemical survey in September 1995 to determine whether additional areas of soil contamination were present outside the area covered by the original soil excavation plan. In total, 173 surficial soil samples were taken from outside the original soil excavation area. The results of analysis of those samples supported the inclusion of six additional areas (Areas L through Q) in the excavation plan. Figure 1 also shows those areas.

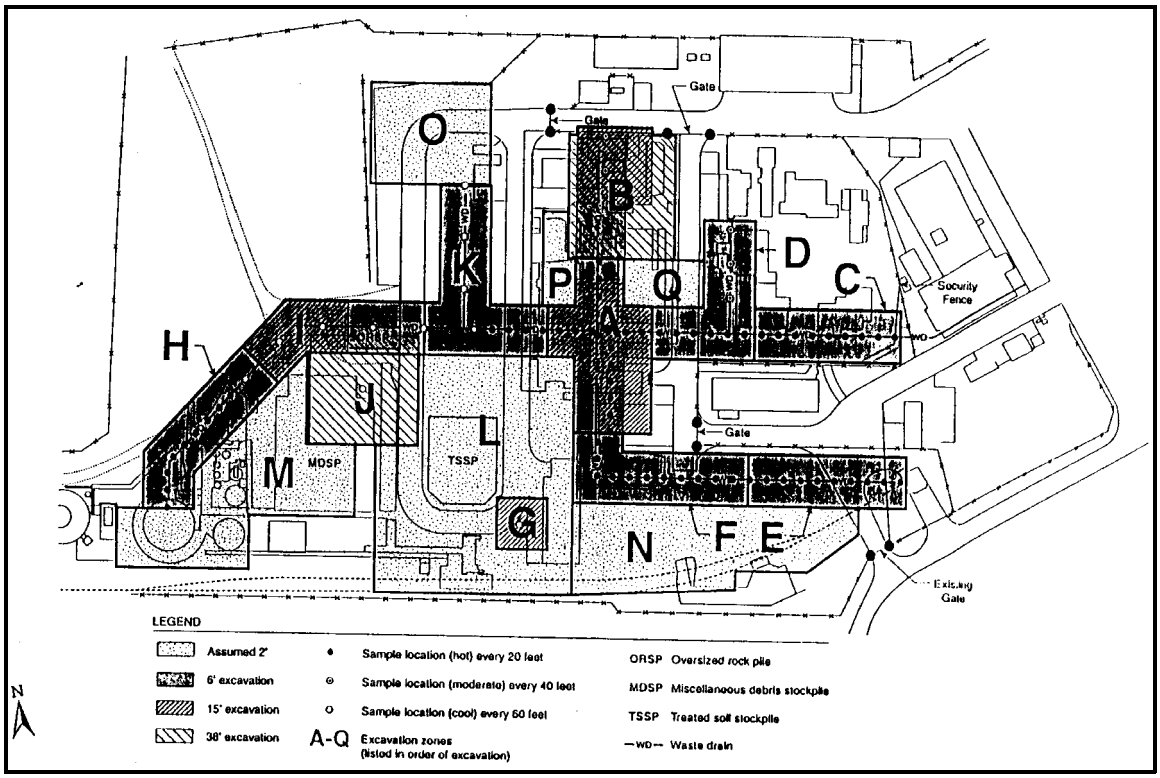


Figure 1. Soil Excavation Zones [11]

SITE LOGISTICS/CONTACTS

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MATRIX AND CONTAMINANT DESCRIPTION

MATRIX IDENTIFICATION

Soil (ex situ)

CONTAMINANT CHARACTERIZATION (6)

- Semivolatiles (Nonhalogenated) - carcinogenic polycyclic aromatic hydrocarbons (cPAH), metals
- Seven cPAHs and arsenic, were identified as contaminants concern in soil at the SRCPP. The seven cPAHS were: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- The substances were identified as contaminants of concern on the basis of their occurrence and distribution in the soil and a risk-based screening approach. Under the screening approach, an estimate was made of the potential that given constituents would affect groundwater adversely if pavements at the site were removed. The estimate showed that the cPAHs would affect groundwater adversely, while the arsenic would not. Therefore, although arsenic was identified as a contaminant of concern, no remedial action for arsenic was found to be necessary.

CONTAMINANT PROPERTIES (9)

Contaminant	Chemical Formula	Molecular Weight (g/mole)	Boiling Point (C at 1 atm)	Melting Point (C at 1 atm)
Benzo(a)anthracene	$C_{18}H_{12}$	228.29	425	160.7
Benzo(b)fluoranthene	$C_{20}H_{12}$	252.32	480	168
Benzo(k)fluoranthene	$C_{20}H_{12}$	252.32	480	217
Benzo(a)pyrene	$C_{20}H_{12}$	252.32	310-312	179-179.3
Chrysene	$C_{18}H_{12}$	228.29	448	255-256
Dibenzo(a,h)anthraene	$C_{22}H_{14}$	278.35	535	266
Indeno(1,2,3-cd)pyrene	$C_{22}H_{12}$	276.35	530	162.5-164

MATRIX CHARACTERISTICS AFFECTING TREATMENT COST OR PERFORMANCE (6, 10, 13)

Parameter	Value
Soil Classification	Various sand and gravel
Clay Content/Particle Site Distribution	Information not available
Soil Plasticity	Information not available
Moisture Content	4%
Total Petroleum Hydrocarbons	Not Detected - 8200 mg/kg
Presence of Alkaline Metal Salts	Information not available
Lower Explosive Limit	Information not available

TREATMENT SYSTEM DESCRIPTION

PRIMARY TREATMENT TECHNOLOGY

Thermal desorption

SUPPLEMENTARY TREATMENT TECHNOLOGIES

Pre-treatment (soil): screening

Post-treatment (off-gas): baghouse and thermal oxidizer

TIMELINE (8, 11)

Date	Activity
1974 - 1981	SRCPP operated as a production and research facility.
1993 - 1994	Remedial investigation was conducted.
September 1995	Pre-remediation surface soil chemistry survey was conducted.
May - December 1996	Contaminated soil was excavated and post-excavation sampling conducted.
June 1996	Field demonstration test of size sorting was conducted.
August 5 - 9, 1996	Equipment startup was performed.
August 12 - 14, 1996	Field demonstration test of soil treatment was performed.
August 15 - December 9, 1996	Full-production thermal desorption treatment was performed.
December 1996 - March 1997	Post-remediation confirmation sampling was conducted.
December 15, 1997	Final Chemical Reports 2 and 3 were submitted.

TREATMENT SYSTEM SCHEMATIC AND TECHNOLOGY DESCRIPTION AND OPERATION (8, 11)

Construction

- The low-temperature thermal desorption (LTTD) system used in this application was supplied by Midwest Soil Remediation, of Elgin, Illinois. The system consisted of a rotary thermal desorber system rated at 64 million British Thermal Units per hour (MM BTU), a baghouse rated at 48,000 actual cubic feet per minute (acfm), and a thermal oxidizer rated at 74 MM BTU/hr.

- The LTTD system was a direct-fired unit, in that the rotary kiln heated the soil through direct contact between the oil-fired burner exhaust and the soil.

Operation

- Figure 2 is a schematic diagram of the process flow for soil and gases in the LTTD system. As Figure 2 shows, soil entered the system through a primary feeder (hopper) and passed through a screen (1 1/2-inches) and a belt weigh scale before it was conveyed to the rotary desorber. Treated soil went through a thermal dust conductor and soil cooler before exiting through a stacking conveyor onto piles of soil.

- A combustion burner fed hot gases countercurrent to the flow of soil through the desorber. Gases from the desorber passed through a baghouse and were recycled to the desorber or thermally oxidized and discharged to the atmosphere through a stack.

- Several post-excavation soil samples showed evidence that soil containing cPAHs at concentrations above cleanup levels were being left in place at the site. However, a sitewide statistical analysis of the final post-excavation soil samples indicated that the 95 percent upper confidence limit for the concentration of cPAHs at the bottom of all of the excavations was 0.55 mg/kg, a concentration that was below the 1.0 mg/kg cleanup level. (See the discussion of cleanup levels under Performance Objectives.)

System Monitoring Requirements (11)

Parameter Monitored	Frequency	Operating Parameters
Soil temperature in thermal desorber	Twice per hour during field demonstration test and once per hour thereafter	700 to 750°F
Pressure drop in baghouse		3.5 - 7.5 inches WC
Temperature of the thermal oxidizer		Higher than 1600°F

Closure

- From December 1996 through March 1997, 57 confirmatory surface soil samples were collected from areas of the site at which site remediation activities had been carried out to confirm that previously uncontaminated surface soil had not been contaminated during the remedial action (RA). Several additional contaminated areas were excavated to a depth at which concentrations of cPAH were found to be below the cleanup standard. Soil excavated at that time was disposed of at an offsite landfill.

- In May, June, and November 1996 groundwater samples were collected from five monitoring wells. In all three rounds of sampling, cPAH and total petroleum hydrocarbons (TPH) were measured at levels below detection limits and results for metals were similar to the data collected during the 1993-94 Remedial Investigation/Feasibility Study (RI/FS). On the basis of these data, the contractor concluded that groundwater had not been affected by site remediation activities.

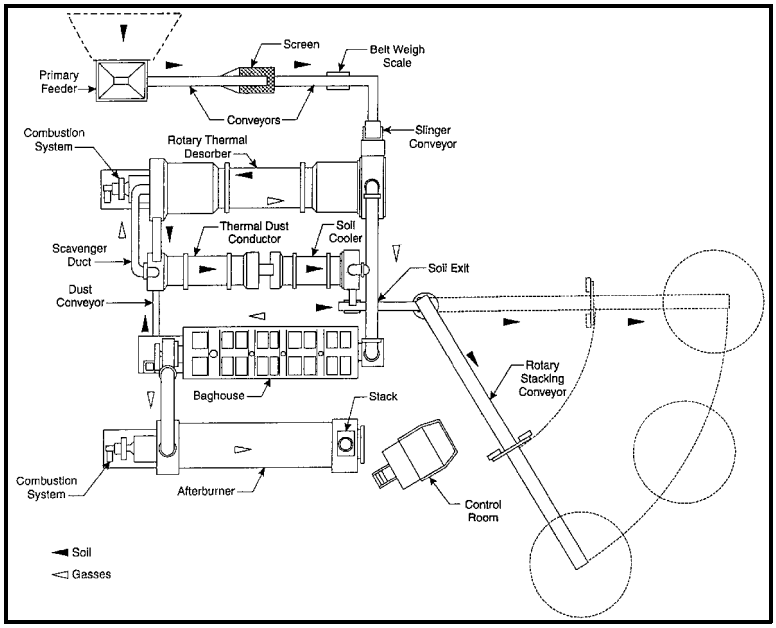

Figure 2. Low-Temperature Thermal Desorption Process Flow Diagram (8)

- On the basis of the results of post-excavation and closure sampling, the contractor determined that a total of six areas of soil containing cPAHs at concentrations above cleanup standards remained in place. Three of those areas were considered to be "*de minimus*" because of the extent of excavation performed in each area. The other three areas remained in place at the site under the direction of the USACE. The contractor stated that those three areas likely will require remediation in the future to attain cleanup levels that are appropriate to the residential use identified in the future land use scenario for the site.

OPERATING PARAMETERS AFFECTING TREATMENT COST OR PERFORMANCE (8)

Parameter	Value
Residence Time	Information not available
System Throughput	Approximately 50 to 150 tons per hour
Temperature (of thermal desorber)	Approximately 700 to 750°F
Drum Pressure (of thermal desorber)	-0.05 to -0.9 inches WC
Baghouse Inlet Temperature	205 to 323°F
Baghouse Outlet Temperature	190 to 301°F
Baghouse Pressure Change	1.6 to 7.6 inches WC
Thermal Oxidizer Temperature	956 to 1,813°F

TREATMENT SYSTEM PERFORMANCE

PERFORMANCE OBJECTIVES

- Table CL-1 summarizes the cleanup levels established for treated soil in this application, and the sources of the cleanup levels.

Table CL-1. Summary of Cleanup Levels for Treated Soil at the SRCPP (6)

Contaminant	Cleanup Level (mg/kg)	Source of Cleanup Level
Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, chrysene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene	1.0 for the sum of the concentrations for all seven cPAHs	Record of Decision (12)
Fuel hydrocarbons - diesel range (referred to as TPH-diesel)	200	Ft. Lewis base management (6)
Fuel hydrocarbons - oil range (referred to as TPH-oil)	200	Ft. Lewis base management (6)

- The cleanup level identified for this application was the sum of the concentrations for all seven cPAHs, and were derived from Washington State Model Toxics Control Act (MTCA) Method B cleanup levels for ingestion of soil containing cPAHs. The slope factor and MCL for benzo(a)pyrene was used in calculating cleanup levels for all cPAHs; consequently, cleanup levels are identical for all of cPAHs are the same. The Method B cleanup level represents a one-in-one million risk for each cPAH, producing an aggregate risk of seven in one million. (10)

- Air emission limits for this application were established by the Puget Sound Air Pollution Control Agency (PSAPCA). The PSAPCA identified the following limits (8):
  - Pressure drop across baghouse: 3.5 to 7.5 inches WC
  - Minimum temperature in thermal oxidizer: 1,600^{o}F
  - Maximum exhaust stack opacity: 5 percent
  - Maximum exhaust stack emissions of particulate matter: 0.02 grains per dry standard cubic foot (gr/dscf)
  - Maximum exhaust stack emissions of cPAHs: 0.04 pounds per hour

TREATMENT PERFORMANCE DATA (8,11)

- For the field demonstration test, treatment was conducted for three days, with each day consisting of one eight-hour shift. Composite samples were collected as soil was fed into the LTTD unit and as soil exited from the LTTD unit. Each composite sample consisted of individual grab samples taken at approximately one-half hour intervals; collection of the exit samples began one-half hour later than collection of feed samples. Samples were composited at the one-hour, four-hour, and eight-hour intervals. In addition, two field duplicate samples were collected for quality control purposes.

- Table TPD-1 summarizes the results of analysis of the samples collected during the field demonstration test, in concentrations of individual cPAHs and total concentrations of cPAHs.

Table TPD-1. Treatment Performance Data from Field Demonstration Test - mg/kg (8)

Sample/Contaminant			Benzo(a)anthracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Chrysene	Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	Total cPAH
Soil Cleanup Level										**1.0**
Sample ID	**Laboratory ID**	**Date Collected**								
FFDT11	58664-01	8/12/96	0.62	0.59	0.13	0.42	0.83	0.035 U	0.17	2.8
FFDT41	58664-02	8/12/96	0.52	0.64	0.034 U	0.48	0.61	0.034 U	0.21	2.5
FFDT81	58664-03	8/12/96	0.56	0.63	0.068	0.54	0.67	0.035 U	0.23	2.7
EXFDT11	58664-04	8/12/96	0.027 J	0.042	0.033 U	0.022 J	0.043	0.033 U	0.033 U	0.13
EXFDT112	58664-05	8/12/96	0.034 J	0.066	0.035 U	0.035	0.063	0.035 U	0.035 U	0.20
EXFDT41	58664-06	8/12/96	0.038	0.059	0.035 U	0.032 J	0.048	0.035 U	0.035 U	0.18
EXFDT81	58664-07	8/12/96	0.059	0.083	0.035 U	0.047	0.074	0.035 U	0.035 U	0.26
FFDT12	58696-01	8/13/96	0.43	0.45	0.10	0.42	0.54	0.032 J	0.14	2.1
FFDT42	58696-02	8/13/96	1.20	0.67	0.21	0.55	1.20	0.040	0.28	4.2
FFDT82	58696-03	8/13/96	0.47	0.40	0.065	0.320	0.54	0.029 J	0.15	2.0
EXFDT12	58696-04	8/13/96	0.035 U	0.035 U	0.035 U	0.035 U	0.024 J	0.035 U	0.035 U	0.024
EXFDT42	58696-05	8/13/96	0.033 J	0.050	0.036 U	0.027 J	0.061	0.036 U	0.036 U	0.17
EXFDT82	58696-06	8/13/96	0.028 J	0.037	0.034 U	0.020 J	0.029 J	0.034 U	0.034 U	0.11
FFDT13	58726-01	8/14/96	0.13	0.13	0.041	0.099	0.17	0.035 U	0.029 J	0.60
FFDT43	58726-02	8/14/96	0.31	0.29	0.11	0.26	0.41	0.034 U	0.097	1.5
FFDT83	58726-03	8/14/96	0.36	0.33	0.064	0.25	0.47	0.034 U	0.099	1.6
EXFDT13	58726-04	8/14/96	0.017 J	0.033 U	0.033 U	0.033 U	0.026 J	0.033 U	0.033 U	0.043
EXFDT43	58726-05	8/14/96	0.032 J	0.037	0.034 U	0.034 U	0.046	0.034 U	0.034 U	0.12
EXFDT83	58726-06	8/14/96	0.025 J	0.035 U	0.035 U	0.035 U	0.037	0.035 U	0.035 U	0.062
EXFDT832	58726-07	8/14/96	0.030 J	0.032 J	0.034 U	0.034 U	0.043	0.034 U	0.034 U	0.11

J = Analyte was analyzed for and positively identified, but the associated numerical value is an estimated quantity.
U = Analyte was analyzed for but not detected.

Sample EXFDT112 is the field duplicate of EXFDT11. Sample EXFDT832 is the field duplicate of EXFDT83.
Sample Prefixes: FFDT - Feed sample from the field demonstration test collected before soil entered the LTTD unit.
EXFDT - Exit sample from the field demonstration test of soil leaving the LTTD.

- As Table TPD-1 shows, feed samples from the field demonstration test had total concentrations of cPAHs ranging from 0.6 mg/kg to 4.2 mg/kg, with eight of nine samples measured at a concentration higher than 1.0 mg/kg. Exit samples had total concentrations of cPAHs ranging from 0.024 mg/kg to 0.26 mg/kg, less than the 1.0 mg/kg cleanup level established for this application. The average concentration of total cPAH in the feed samples was 2.2 mg/kg, and the average in the exit samples was 0.13 mg/kg.

- The field demonstration test determined that a screen size of one and one-half inches was the most appropriate screen size for sorting coarse material (oversize) from soil to be treated. That screen size was found to produce oversize material that had concentration of cPAHs of less than 1.0 mg/kg, and a concentration of TPH of less than 200 mg/kg.

- Each day during full production, a composite of three discrete soil samples from the treated soil exiting the cooler was taken and analyzed for cPAHs. No pre-treatment samples of the soil were taken during full production. According to the contractor's report, the results of analysis of the treated soil indicated that the treated soil had concentrations of cPAHs below the 1.0 mg/kg cleanup level. This was based on an analysis of 93 sample of tested soil. The results ranged from below detection limits to 0.44 mg/kg.

- No data from analyses of the treated soil for concentrations of fuel hydrocarbons were available.

- The air emissions testing during the operation test of the LTTD systems showed that average emissions of particulate matter were 0.017 gr/dscf, and that no emissions of cPAHs were detected at or above the specified reporting limits, corresponding to a calculated emission rate of less than 0.0003 pounds per hour. In addition, the opacity measured during the test was zero percent. The system generally met the requirements of PSAPCA for pressure drop across the baghouse and for minimum temperature in the thermal oxidizer. According to the contractor, the air emission results met the requirements established by PSAPCA for this application.

Material Balance: No quantitative material balance was completed for this application because of the limited amount of matched performance data on untreated and treated soil.

Links to Operating Conditions: The LTTD system was found to meet the cleanup levels established for this application, operating at a temperature of 700 to 750°F with a system throughput of 50 to 150 tons/hr.

Removal Efficiencies: An average removal efficiency of 94 percent for cPAHs was calculated for the field demonstration test phase of this application on the bases of an average concentration of cPAHs in the feed samples of 2.2 mg/kg and an average in the exit samples of 0.13 mg/kg.

PERFORMANCE DATA QUALITY (6,7,8,11)

- The contract specifications for this application required the use of Environmental Protection Agency SW-846 Method 8270 for analysis of SVOCs in soil. That method uses gas chromatography and mass spectroscopy (GC/MS). The contract required GC/MS for quantification of cPAHs and required that measured values be based on a 95 percent upper confidence limit on the mean. Post-excavation sampling indicated that the 95 percent upper confidence limit was 0.55 mg/kg.

- The contract required that a minimum detection limit of 0.1 mg/kg be achieved for each of the cPAHs that were identified as contaminants of concern and that the contractor refine the analytical methodology as needed to meet the data quality objectives for this application. This criterion was satisfied, except in the case of some samples submitted to the QA laboratory.

- Fuel hydrocarbons were analyzed by the Washington State Department of Ecology Diesel Method Modified, rather than the EPA SW-846 Method 8015 (extended), with a minimum detection limit of 50 mg/kg.

- Analytical laboratories used during this application were: Pace Laboratory; Analytical Resources, Inc. (ARI); Sound Analytical Services, Inc.; and AMTest Air Quality LLC.

- Air emission source testing included collection of samples at sample port and traverse point locations (EPA Test Method 1) and testing for velocity and volumetric flow rate (EPA Test Method 2); molecular weight (fixed gas composition)(EPA Test Method 3); stack gas moisture (EPA Test Method 4); particulate emissions (EPA Test Method 5); sulfur dioxide (EPA Test Method 6C); nitrogen oxides (EPA Test Method 7E); opacity (EPA Test Method 9); and total hydrocarbons and VOCs (EPA Test Method 25A). Air emissions of PAHs were analyzed by EPA SW-846 Method 0010.

- QA/QC procedures used in this application included review of holding times and use of blanks, surrogates, matrix spikes, matrix spike duplicates, field duplicates, laboratory control samples, field duplicate samples, and split samples.

- According to the contractor's report, procedures for monitoring dust, organic vapor, and noise set forth in the health and safety plan were followed.

TREATMENT PLAN (7, 8, 11)

- The ROD for this application specified that contaminated soil at the site would be treated with thermal desorption or soil washing. Thermal desorption was selected for this application, on the bases of the results of a treatability study.

- The prime contractor for this application developed a remedial action management plan (RAMP) in August 1995. The RAMP described health and safety requirements and included the contractor's quality control plan, chemical data management plan, the environmental protection and stormwater plan, the soil treatment plan, the materials handling plan, the waste management plan, the demolition and decontamination plan, and the site demobilization and restoration plan.

- This application was completed in three phases: (1) pre-remediation activities, (2) remediation at full production, and (3) confirmation of closure. The pre-remediation phase included a surface-soil chemical survey and a field demonstration test of thermal desorption. The full-production phase included thermal desorption treatment of the majority of soil, as well as continued sampling and testing of groundwater and storm water; aboveground demolition; and disposal of investigation-derived wastes and the wastes that were sent off site. The confirmation of closure phase included a return visit to the site to identify areas that might have remained contaminated with cPAHs.

- The field demonstration test involved identifying the appropriate screen size for sorting coarse material (oversize) from the soil to be treated, and treating "highly contaminated" (soil known through sampling to contain high concentrations of cPAHs and TPH), as well as collecting and analyzing samples of soil from the feed point and exit point of the LTTD unit and associated testing for stack emissions.

- Before the field demonstration test was conducted, the equipment was started so that the system's mechanical components could be adjusted and the operating parameters set.

TREATMENT SYSTEM COST

PROCUREMENT PROCESS (3, 7)

- USACE, through its Seattle, Washington District office, administered the remediation activities at the SRCPP. Dames & Moore was selected as the prime contractor for this activity under USACE Contract No. DACA67-95-C-0062.

- USACE received seven bids for this application, ranging in cost from $3,513,349 to $5,426,030. The Dames & Moore bid was the lowest of the seven.

TREATMENT SYSTEM COST (6)

- The original bid submitted by Dames & Moore for this application was $3,513,349 and included the first six items (with subitems) shown in Table C-1. As Table C-1 shows, the cost of thermal desorption treatment of the first 37,000 tons of soil was projected to be $1,261,700, or $34.10 per ton of soil treated.

- For this application, 23 modifications were identified, covering such items as an increase in the quantity of additional soil treated from 15,000 to 67,336 tons; excavation of contaminated soil from the area in which the LTTD unit was to be set up; and demolition of a railroad spur at that location. To reflect the 23 modifications, the cost for this contract was revised to a total cost of $7,100,467.

Table C-1. Summary of Original Bid and Actual Costs (4, 6)

ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE ($)	AMOUNT ($)
0001	Design and Management Plan and Reporting	1	Job	Lump Sum	196,670
0002	Excavation and Size Separation of Soil				
0002A	Excavation of first 40,000 Cubic Yards (yd^3)	40,000	(yd^3)	7.08	283,200
0002B	Excavation of next 10,000 Cubic Yards (yd^3)	10,000	(yd^3)	7.08	70,800
0003	Treatment of Contaminated Soil				
0003A	Treatment of first 37,000 Tons	37,000	tons	34.10	1,261,700
0003B	Treatment of next 15,000 Tons	15,000	tons	33.72	505,800
0004	Soil Excavation and Stockpiling	4,000	(yd^3)	3.24	12,960
0005	Field and Laboratory Chemical And Analytical Testing of Soils				
0005A	First 1,200 tests	1,200	each	145.64	174,768
0005B	Next 300 tests	300	each	145.64	43,692
0006	Demolition and Site Work	1	Job	Lump Sum	963,759
			TOTAL	$3,513,349	

- As of August 12, 1998, approved payment of $7,094,767.23 in costs for this application, including $3,532,270 for thermal desorption treatment of 104,336 tons of soil. All items are paid in full.

REGULATORY/INSTITUTIONAL ISSUES

- The remedial activity at the SRCPP was conducted under a federal facilities agreement (FFA) among EPA, the U.S. Army, Ft. Lewis, and the State of Washington Department of Ecology. The ROD prepared for this application describes requirements for excavation and remediation of contaminated soil, monitoring of the groundwater of the upper aquifer, and maintenance of institutional controls at the SRCPP. (6,7,12)

- Under the FFA, the U.S. Army was designated the lead agency, with approval by EPA and concurrence by the state. (12)

OBSERVATIONS AND LESSONS LEARNED

COST OBSERVATIONS AND LESSONS LEARNED

- The total cost for this application was approximately $7,100,000. The unit cost for thermal desorption treatment of contaminated soil was approximately $34 per ton treated, and for the entire RA was approximately $68 per ton treated.

- The original bid for this application was approximately $3,500,000. There were 23 modifications to the bid, resulting in a final cost that was approximately twice the original. Modifications included such items as an increase in the quantity of soil requiring treatment and additional site work.

PERFORMANCE OBSERVATIONS AND LESSONS LEARNED

- The LTTD system used at the SRCPP achieved soil cleanup levels and air emission standards during the treatment of approximately 104,000 tons of contaminated soil from August through December 1996 at a desorber temperature generally between 700 and 750 ^{o}F.

- During the field demonstration test, the system treated soil contaminated with total cPAHs at levels ranging from 0.6 mg/kg to 4.2 mg/kg to less than the 1.0 mg/kg cleanup level established for this application. The average concentration in the feed samples was 2.2 mg/kg, and the average in the exit samples was 0.13 mg/kg.

- During full operation of the LTTD system, samples of treated soil had total concentrations of cPAHs ranging from below detection limit to 0.44 mg/kg.

OTHER OBSERVATIONS AND LESSONS LEARNED

- The field demonstration test determined that a screen size of one and one-half inches was the most appropriate screen size for sorting coarse material (oversize) from the soil to be treated. That screen size was found to produce oversize material that had a concentration of cPAHs of less than 1.0 mg/kg and a concentration of TPH of less than 200 mg/kg.

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13. Record of Telephone Conversation with Kira Lynch, USACE, Berman, Michael H., September 14, 1998.

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