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WESTON
MANAGERS DESIGNERS/CONSULTANTS

REAC SUPPORT ORGANIZATION
GSA RARITAN DEPOT
WOODBRIDGE AVENUE
BUILDING 209, BAY F
EDISON, NJ 08837
PHONE: 201-632-9200

DATE: December 21, 1989

TO: Andre P. Zownir, EPA Work Assignment Manager

THRU: Craig Moylan, REAC Section Chief

FROM: Robert Evangelista, REAC Task Leader

SUBJECT: DOCUMENT TRANSMITTAL UNDER WORK ASSIGNMENT 1-288

Attached please find the following document(s) prepared under this work assignment:

FINAL REPORT FOR
EXTENT OF CONTAMINATION DETERMINATION, BUILDING DECONTAMINATION GUIDELINES, AND BENCH-SCALE REMEDIAL TESTS FOR THE CHEMICAL COMMODITIES INC., SITE, OLATHE, KANSAS

cc: Central File WA 1-288 (w/attachment)
W. Scott Butterfield (w/o attachment)
B. Cibulskis (w/o attachment)

rd:eh/EVNGLSTA/FR-2288

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EXTENT OF CONTAMINATION DETERMINATION, BUILDING DECONTAMINATION GUIDELINES, AND BENCH-SCALE REMEDIAL TESTS FOR THE CHEMICAL COMMODITIES INC., SITE, OLATHE, KANSAS

December, 1989

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FINAL REPORT

Prepared by:

Roy F. Weston, Inc.

Robert Evangelista — 12/21/89 (Date)
Task Leader

W. Scott Butterfield — 12/21/89 (Date)
Project Manager

Prepared for:

US EPA/ERT

Andre P. Zownir
Work Assignment Manager

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

U.S. EPA Region VII requested support from the U.S. EPA Environmental Response Team (ERT) to provide support at the Chemical Commodities Inc. (CCI) site in Olathe, Kansas. The ERT and their Response Engineering and Analytical Contractor (REAC) provided technical assistance to the region for an extent of soil, groundwater, and warehouse contamination study and remedial options for the site's soil and warehouse.

The sampling took place during three site visits. Two bench-scale remediation studies were performed off-site with representative CCI soil.

The most prevalent groundwater contaminant is trichloroethene (TCE). Out of 24 samples, TCE was found in concentrations greater than 100,000 and 10,000 ug/l on 8 and 21 events. Other major contaminants were: 1,1-dichloroethane, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, 1,2-dichloroethane, tetrachloroethene (PCE), and 1,1,2,2 tetrachloroethane. All wells on-site (except KDHE 4) showed major contamination by volatile organic compounds (VOC). Wells ERT1 and ERT2, on the east side of the site, had the highest VOC concentrations, over 500,000 ug/L. In addition, ERT2 and ERT 33 contained a pure hydrocarbon product on the bottom consisting of mainly TCE and PCE. Finally, the contaminant-laden groundwater is believed to be flowing from east to west.

The major soil contaminants at the site are VOCs. The areas on-site containing the highest soil VOCs are the west side of the warehouse and contamination has migrated off site from the north, west and south boundaries. The house north of the site on Keeler Street had low contamination at the 5 foot depth. On the eastern boundary however, high concentrations of VOC were found at the soil/bedrock interface (approximately 20 feet deep). This corresponds to the pure product found in neighboring wells. The soil geotechnical characterization found a high clay soil that exhibited a plastic behavior with low permeabilities. Hydraulic and pneumatic permeabilities were 3.9×10^{-8} to 3.0×10^{-9} and 2.6×10^{-9} to 2.0×10^{-10} cm/sec, respectively. Contaminant characterization of the site's soil found little migration of VOC off-site. Trace amounts of contaminants were found in soil of the house north of the site on Keeler Boulevard and to the east of the site next to the railroad tracks. However, two soil samples taken just at bedrock on the east side found high VOC concentrations. The majority of the soil contamination on site is in three locations: 1) the area bounded to the east by the warehouse and the west by truck trailer H, shed F and sample point ERT20; 2) the grassy area north of shed A; and 3) the pit in the northeast corner.

The sampling and analyses effort for the warehouse discovered a high concentration of semi-volatile organics and heavy metals in the sweep and chip sample from the floor of the front and back rooms. The back room sweep contained 3,506,923 ug/kg total semi-volatile organics with the majority of the compounds being phenolics. However, a 100 square centimeter wipe sample of the brick wall between the two rooms contained no significant contaminants.

One recommended remedial option for eliminating or reducing groundwater contamination is an interceptor trench on the perimeter of the site. Since the groundwater flow is extremely low, a time actuated pump at the bottom of a manhole is recommended to pump the standing water to a tanker truck near the wellhead. The cost of a 1200 foot long trench around the site ranged from $38,500 to $210,000 depending on contractor and construction technique. If sheeting and shoring is used during the trench construction, the price ranges from $1,600,000 to $2,000,000. Another remedial option is a slurry wall barrier. This remedial technique can be constructed for $360,000 to $720,000; however, care must be exercised to insure compatibility between the grout and the pure product at bedrock.

The recommended techniques for building decontamination for the CCI warehouse is gritblasting or hydroblasting. Gritblasting is the preferred technique because it removes more of the contaminated surface and provides an easier collection of the contaminated residual. Both these techniques have been previously used successfully at Superfund sites by the U.S. EPA. This report contains the U.S. EPA contacts for those sites. Gritblasting costs of $44,000 was quoted by a contractor and $127,675 was estimated from the literature.

Bench-scale tests investigated two remedial technologies for treating the CCI soil: in-situ volatilization (ISV) and low temperature thermal treatment (LT3). ISV removed 84% of the VOC contamination, which is too low a removal rate for the optimistic bench-scale system used for the test. The system was optimistic because the flow rate of air used to purge the soil was much higher than would be realized in the low permeability soil at CCI. Therefore, the expected removal rate of a full-scale system would be lower than the test. LT3 removed 91% of the VOC (from 226 to 21 mg/kg); however, acetone and 2-butanone exhibited residual concentration higher than in the untreated soil. This increase could either be the result of a contaminant transformation or laboratory contamination. When the high residual levels of acetone and 2-butanone are factored out the resulting VOC level is still slightly higher than recommended level. The VOC removals were not good enough to recommend a technology requiring excavation of VOC-laden soil and that would entail the costs of removing local residents or working under an inflatable dome during full-scale operations.

Off-site incineration of the estimated 13,000 cubic yards of contaminated CCI soil was found to be very expensive. The cost of excavation, transportation, incineration, and landfilling ranged from $28,990,875 to $41,934,000. If only the hot spot around the "pit" in the northeast corner of the site was removed and this minimum soil volume of 1,900 yd^3 was treated, the estimated cost for excavation, transportation, incineration, and land filling ranged from $4,161,713 to $6,030,400. The treatment of this minimum soil volume represents a partial remediation of the site.

A proprietary technology which performs in-situ hot air/steam cleaning of VOC contaminated soil was explored. Although the technology could not be currently evaluated for technical and economic feasibility via bench-or pilot-scale treatability tests, the estimated costs are $200 to $300 per cubic yard or $2,600,000 to $3,900,000 for the 13,000 cubic yards.

The range of costs for recommended items are:

- Interceptor trench - $36,500 to $2,000,000 depending on construction method
- Slurry wall - $360,000 to $720,000 around north, west and south sides of site
- Grit blasting - $44,000 to $127,675
- Incineration - $4,161,713 to $6,030,400, 1,900 yd^3
  - $28,990,875 to $41,934,000, 13,000 yd^3
- Steam cleaning - $2,600,000 to $3,900,000

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

rd:eh/EVNGLSTA/FR-2288

LIST OF SITE MAPS

NUMBER

1.0 INTRODUCTION

The Chemical Commodities Inc. (CCI) site is located outside of Kansas City, Kansas. The company has an on-going operation that consists of the purchase and recall of used, off-specification, and surplus chemicals of all types. Previous sampling efforts by the Region VII Technical Assistance Team found organics in the soil and groundwater at the CCI site. The U.S. EPA Region VII requested support from the U.S. EPA Environmental Response Team (ERT) to provide an extent of contamination study for the CCI site, to study the feasibility of in-situ soil remediation, and to evaluate on-site building decontamination. These efforts were provided in order to determine the potential threat posed to surrounding community by the site's contaminants.

This engineering study had eight objectives: 1) to determine the extent of soil contamination; 2) to determine the soil characteristics that will impact remediation efforts; 3) to explore viable remediation technologies for the contaminated soil; 4) to perform bench-scale engineering studies to obtain performance data on viable soil remediation alternatives; 5) to determine the contamination of the site buildings; 6) to determine the extent of groundwater contamination; 7) to explore the remedial options for the warehouse building; and 8) to obtain information on groundwater flow characteristics on and around the site.

The scope of the project was to sample and analyze the soil, the groundwater, and the buildings at CCI as requested by the ERT. In addition, the project explored potential remedial technologies for the CCI site soil and warehouse building.

2.0 METHODOLOGY

ERT and REAC personnel visited the CCI site on three separate occasions during July through September 1989, to characterize the site for an extent of contamination determination and to obtain samples for bench-scale soil treatment tests. Two bench-scale engineering tests were performed to evaluate potential remedial technologies. The methodologies used during the site visits and during the bench-scale studies are detailed in the methodology section.

In accordance with the General Field Sampling Guidelines (SOP #2001) the extent of contamination sampling had the prime objective of characterizing "a waste site accurately so that is impact on human health and/or the environment can be properly evaluated"; while for the bench-scale tests, sampling was performed to "accurately represent the larger body of material under investigation."

For all sampling on this project, the following tasks were performed in accordance with the appropriate ERT/REAC SOP:

SOP#	SOP NAME	SAMPLING TASKS
2002	Sample Documentation	Filled out field data sheets Filled out chain of custodies Filled out sample labels Affixed chain of custody seals
2003	Sample Storage, Preservation and Shipping	Obtained minimum required volume Placed sample into proper container Preserved samples at approximately 4°C Adhered to required holding times

2005	QA/QC Samples	Duplicate samples Trip blanks
2006	Sampling Equipment Decontamination	Equipment decontamination
2007	Groundwater Well Sampling	Groundwater sampling
2011	Wipe Samples, Chip Samples, Sweep Test	Warehouse sampling
2012	Soil Sampling	On- and offsite soil sampling

During the three site visits, the ERT/REAC team installed monitoring wells, bored holes within and adjacent to the site for soil sample analysis, sampled groundwater in new and existing wells, sampled soils for physical characteristics, sampled buildings, and obtained soil samples for bench-scale engineering tests. These samples were analyzed for VOAs, BNAs, and priority pollutant metals. VOA analyses were performed on all samples, and BNA and priority pollutant metal analyses on select samples. Two potential remedial technologies were bench-scale tested for feasibility. Finally, building decontamination methods were evaluated.

2.1 First Site Visit

During this visit on July 25 and 26, 1989, six soil samples were collected from locations inside or near storage sheds within the CCI site at a depth of approximately one foot. These samples were subsequently analyzed by Weston/REAC for volatile organic compounds (VOCs), semi-volatile organic compounds (BNAs), and priority pollutant metals (pp metals). Two additional soil samples were characterized by Weston's Environmental Technology Laboratory (ETL) for the following physical parameters: particle size distribution and permeability (disturbed soil).

2.2 Second Site Visit

During the second site visit on August 7 to 12, 1989, an EPA drill rig bored sample holes at 28 locations, designated ERT 1 to ERT 29 (ERT 11 not taken). The location of all sampling points and wells can be found in Maps 1 through 16. These boreholes were placed, when possible, on grid points of 50-foot centers. Samples were taken using split spoons from each hole at four different depths: 1, 5, 10, and 15 feet. Four samples were taken at 20 feet. Samples were placed into 40-ml VOA vials for on-site headspace analysis using a Photovac gas chromatograph. A total of 108 soil samples were analyzed by the Photovac on-site and a total of 38 samples were analyzed by GC/MS at REAC for confirmation.

During this visit, two additional wells were installed along the perimeter of the site at locations ERT1 and ERT2 as designated by the EPA On-Scene Coordinator (OSC). Groundwater VOC samples were taken from the six existing wells as well as from these two newly installed wells. These new well samples then were analyzed for VOCs and BNAs. The VOA sample from ERT2 was taken from the mid-level of the water column and from the bottom of the well (to recover pure hydrocarbon product). Depth to groundwater was logged for all wells.

2.3 Third Site Visit

The third site visit on September 11 to 19, 1989, included soil, groundwater, and building sampling. Six additional boreholes were drilled for soil samples. These boreholes were designated ERT11 and ERT30 to 34. These soil samples were analyzed for VOCs. Additionally, all existing wells, except EPA1, were sampled and the waters analyzed for VOCs. Depth to groundwater and volume of water was logged for each well. Finally, the Chemical Commodities warehouse building was sampled for BNAs and select pp metals: antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc.

The CCI warehouse was sweep, chip, and wipe sampled to determine the nature and extent of contamination. The sweep sample consisted of a random sweep of loose material on the floor of each room, front and back, with a broom. The material from each room was then composited. The chip samples were a composite of materials removed from each room's floor by an impact drill. The drill bored approximately 0.5 inch deep in ten locations around the rooms. Wipe samples were taken from a 100-square centimeter section of the east wall between the front and back room, using a hexane coated gauze pad. This wall section contained a dark stained brick surface approximately five feet above the floor. A hexane coated gauze pad was used as a blank wipe. The aforementioned samples were analyzed for both semi-volatile organics and select priority pollutant metals. The "select" metals were designated as those that were found during previous ERT/REAC sampling at the CCI site.

2.4 Remediation Technologies

Potential remedial treatment technologies for both contaminated soil and buildings were evaluated by reviewing current literature, reading recent U.S. EPA documents, exploring databases, and communicating with technical contacts. For soil contaminated with volatile organic compounds, bench-scale engineering tests were performed at Weston's Environmental Testing Laboratory (ETL), Lionville, Pennsylvania, for in-situ volatilization (ISV) and low temperature thermal treatment (LT3). Sampling and analysis of all bench-scale test soils for VOAs were provided by Weston/REAC. For the ISV test, soil was weighed and placed into the bench-scale unit. The unit's air blower was turned on and the influent and effluent humidity, temperature, and volatile organic content was monitored. For the LT3 test, the soil was first hand screened with 0.25 in mesh and placed into the bench-scale unit. The treated soil was collected in a pan after each pass. This soil was sampled from the pan and placed into the unit for the next treatment pass.

2.5 Analyses

VOC analyses for soil and water were performed according to a modified US EPA Method 524.2 using a HP 5995C Gas Chromatograph/Mass Spectrometer (GC/MS) equipped with a Tekmar LSC 2000 purge and trap concentrator. The method modification for water samples was a reduced sample size of 5 ml [1]. BNA analyses were performed according to the separator extraction technique of US EPA method 625 with a HP 5995C GC/MS [2].

Priority pollutant metals were analyzed according to US EPA Method # 7000 series [3]. Analysis for beryllium, cadmium, chromium, copper, nickel, silver, zinc, and iron were performed by flame atomic absorption using a Varian SpectrAA-300. Mercury analysis was

performed o Varian SpectrAA-300 equipped for cold vapor technique. Method 7470 for mercury analysis was modified with a 50-ml sample size, a 100-ml final volume, and a Varian VGA-76 vapor gas analyzer. Analysis for arsenic, antimony, lead, thallium, and selenium were performed by a graphite furnace atomic absorption using either a Varian 400-Z or a Varian SpectrAA-20 both equipped with a GTA-95 graphite furnace unit.

3.0 RESULTS

This section highlights the significant evidence from the sampling effort, which determined the extent of contamination at the CCI site. Table 1 provides a key to the samples taken at the CCI site: their location, their depth (where applicable), the matrix sampled, the sample number of designation, the analytical instrument used, and the parameters analyzed. Groundwater analyses are summarized in Tables 2 through 5. Groundwater potentiometric head contours are indicated on Maps 1 to 4. Soil characteristics results are in Tables 6 to 9 and Figures 1 and 2. Soil analytical results are in Maps 5 to 16. Finally, the results of the bench-scale treatment studies are summed in Section 3.4 and presented in Appendix C.

The building decontamination strategy involved two phases: 1) the nature and extent of contamination and 2) development of a site-specific decontamination plan. The extent of contamination is presented in the Results section, while the building decontamination plan is in the Discussion section.

4.0 DISCUSSION OF RESULTS

4.1 Groundwater

Groundwater analyses for all well locations from both the ERT/REAC and the Region VII Technical Assistance Team (TAT) sampling efforts are summarized in Tables 2, 3, and 4. The location of all wells are shown on Maps 1 to 19.

Trichloroethene (TCE) was the most prevalent contaminant found in the groundwater at the CCI site, with significant quantities of TCE discovered in the groundwater from all wells except KDHE 4. The most contaminated groundwaters were from Wells ERT 1, ERT 2 and Borehole ERT33 on the east side of the site. These wells were consistently found to have greater than 500,000 ug/L (ppb) VOC. ERT 1 had 671,072 and 661, 300 ug/L VOC on two separate samplings, while ERT 2 had 591,215 and 748,680 ug/L VOC. Carbon tetrachloride and trichloroethene were found in well ERT 1 at concentrations greater than 100,000 ug/L. The groundwater from ERT 1 also contained 1,1-dichloroethene, cis-1,2-dichloroethene, chloroform, 1,1,1-trichloroethane, and 1,2-dichloroethane in concentrations greater than 10,000 ug/L. In well ERT 2, 1,1,2,2-tetrachloroethane and trichloroethene concentrations were greater than 100,000 ug/L. In addition, the ERT 2 groundwater contained 1,1-dichloroethene, methylene chloride, 1,1,1-trichloroethane, and tetrachloroethene in concentrations greater than 10,000 ug/L. Borehole ERT33 water contained 77,390,000 ug/L VOC. This extremely high VOC concentration was the result of pure hydrocarbon phase mixed with aqueous phase. A pure hydrocarbon liquid was extracted from the bottom of Well ERT2. This liquid contained 952,925,000 ug/L VOC or approximately 95% hydrocarbon (predominantly trichloroethene and tetrachloroethene).

Groundwater samples from Wells CCI 101, EPA 1, and KDHE 1 were also found to be highly contaminated. Analyses from three separate samplings showed CCI 101 contained 295,300, 42,360, and 356,280 ug/L VOC. EPA 1 had 605,800, 701,300, and 120,961 ug/L VOC, and KDHE 1 had 289,530, 319,766, and 118,779 ug/L. These wells, located in 3 of 4 corners of the site, also contained the following compounds, with concentrations greater than 10,000 ug/L:

TABLE 1. KEY TO CHEMICAL COMMODITIES INC. SITE SAMPLES

Sample Location	Sample Depth (ft.)	Matrix	Sample #	Instrument	Analysis
ERT1	2	S	5271B	Photovac	VOA
	15	S	C	Photovac	VOA
	15	S	D	**GCMS**	VOA
	18	S	F	Photovac	VOA
ERT2	1	S	5270A	Photovac	VOA
	5	S	B	Photovac	VOA
	10	S	D	Photovac	VOA
	20	S	E	Photovac	VOA
ERT3	1	S	5269E	Photovac	VOA
	5	S	A	Photovac	VOA
	10	S	B	Photovac	VOA
	15	S	C	Photovac	VOA
ERT4	1	S	5268A	Photovac	VOA
	5	S	B	Photovac	VOA
	10	S	C	Photovac	VOA
	10	S	D	**GCMS**	VOA
	15	S	G	Photovac	VOA
ERT5	1	S	5267A	Photovac	VOA
	5	S	B	Photovac	VOA
	10	S	C	Photovac	VOA
	15	S	G	Photovac	VOA
ERT6	1	S	5251A	Photovac	VOA
	1	S	B	**GCMS**	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT7	1	S	4163A	Photovac	VOA
	5	S	C	Photovac	VOA
	5	S	D	**GCMS**	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT8	1	S	5266A	Photovac	VOA
	5	S	B	Photovac	VOA
	10	S	D	Photovac	VOA
	15	S	F	Photovac	VOA

TABLE 1. KEY TO CHEMICAL COMMODITIES INC. SITE SAMPLES (CONT'D)

Sample Location	Sample Depth (ft.)	Matrix	Sample #	Instrument	Analysis
ERT9	1	S	5265A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	GCMS	VOA
ERT10	1	S	4164A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	10	S	F	GCMS	VOA
	15	S	G	Photovac	VOA
ERT11	5	S	5475A	GCMS	VOA
	10	S	B	GCMS	VOA
	15	S	D	GCMS	VOA
ERT12	1	S	5259A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	10	S	I,J,K	GCMS	VOA
	15	S	G	Photovac	VOA
ERT13	1	S	5258A	Photovac	VOA
	5	S	C	Photovac	VOA
	5	S	D	GCMS	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
	20	S	I	Photovac	VOA
ERT14	1	S	5264A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	10	S	F	GCMS	VOA
	15	S	G	Photovac	VOA
ERT15	1	S	5263A	Photovac	VOA
	5	S	C	Photovac	VOA
	5	S	D	GCMS	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT16	1	S	5262A	Photovac	VOA
	5	S	C	Photovac	VOA
	5	S	D	GCMS	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA

rd/EVNGLSTA/TAB1-288

TABLE 1. KEY TO CHEMICAL COMMODITIES INC. SITE SAMPLES (CONT'D)

Sample Location	Sample Depth (ft.)	Matrix	Sample #	Instrument	Analysis
ERT17	1	S	5261A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT18	1	S	5260A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT19	1	S	5257A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT20	1	S	5256A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT21	1	S	5255A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT22	1	S	5254A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT23	1	S	5253A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT24	1	S	5252A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	15	S	G	Photovac	VOA
ERT25	1	S	4169A	Photovac	VOA
	5	S	D	Photovac	VOA
	10	S	G	Photovac	VOA
	10	S	K,L	GCMS	VOA
	15	S	J	Photovac	VOA

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TABLE 1. KEY TO CHEMICAL COMMODITIES INC. SITE SAMPLES (CONT'D)

Sample Location	Sample Depth (ft.)	Matrix	Sample #	Instrument	Analysis
ERT26	1	S	4168A	Photovac	VOA
	5	S	D	Photovac	VOA
	10	S	G	Photovac	VOA
	15	S	J	Photovac	VOA
ERT27	1	S	4165A	Photovac	VOA
	5	S	C	Photovac	VOA
	10	S	E	Photovac	VOA
	10	S	F	GCMS	VOA
	15	S	H	Photovac	VOA
ERT28	1	S	4167A	Photovac	VOA
	5	S	D	Photovac	VOA
	10	S	G	Photovac	VOA
	15	S	J	Photovac	VOA
ERT29	1	S	4171B,C	GCMS	VOA
	5	S	E,F	GCMS	VOA
	10	S	H,I	GCMS	VOA
	10	S	4172A,B,C	GCMS	VOA*
	15	S	4171L	GCMS	VOA
ERT30	5	S	5477B	GCMS	VOA
	10	S	D	GCMS	VOA
ERT31	5	S	5476B	GCMS	VOA
	10	S	D	GCMS	VOA
ERT32	5	S	5478B	GCMS	VOA
	10	S	D	GCMS	VOA
ERT33	15	S	5488B	GCMS	VOA
	20	S	D	GCMS	VOA
ERT34	15	S	5487B	GCMS	VOA
	20	S	D	GCMS	VOA
RR Balast	1	Balast	4170B	GCMS	VOA
Inside-shed A	1	S	ShedA	GCMS,AA	VOA, BNA, pp metals
Inside-shed B	1	S	ShedB	GCMS,AA	VOA, BNA, pp metals

* Matrix spike and matrix spike duplicate

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TABLE 1. KEY TO CHEMICAL COMMODITIES INC. SITE SAMPLES (CONT'D)

Sample Location	Sample Depth (ft.)	Matrix	Sample #	Instrument	Analysis
Behind-shedA&B	1	S	ShedABback	GCMS,AA	VOA, BNA, pp metals
Inside-shed F	1	S	ShedF	GCMS,AA	VOA, BNA, pp metals
Front of-shed L	1	S	ShedL	GCMS,AA	VOA, BNA, pp metals
Front of-shed D	1	S	YardEDC	GCMS,AA	VOA, BNA, pp metals
ERT1	---	W	ERT1	GCMS	VOA,BNA
	---	W	5453	GCMS	VOA
ERT2	Middle	W	ERT2	GCMS	VOA, BNA
	Bottom	W	ERT2B	GCMS	VOA
	Middle	W	5454	GCMS	VOA
EPA1	---	W	EPA101	GCMS	VOA
	---	W	5453	GCMS	VOA
EPA2	---	W	5451	GCMS	VOA
CCI101	---	W	EPA2	GCMS	VOA
	---	W	5452	GCMS	VOA
KDH&E1	---	W	Statewell1	GCMS	VOA
	---	W	5447	GCMS	VOA
KDH&E2	---	W	Statewell2	GCMS	VOA
	---	W	5448	GCMS	VOA
KDH&E3	---	W	4173,A,B,C	GCMS	VOA
	---	W	D,E,F	GCMS	VOA*
	---	W	5449	GCMS	VOA
KDH&E4	---	W	4173,G,H,I	GCMS	VOA
	---	W	H,K,L	GCMS	VOA*
	---	W	5450	GCMS	VOA
In-Situ Volatilization before Treatment	**	S	ISV Initial A,B	GCMS	VOA

* Matrix spike & matrix spike duplicate
** Composite sample from locations ERT3, ERT13, and ERT20 @ depths 1 to 15 ft

rd/EVNGLSTA/TAB1-288

TABLE 1. KEY TO CHEMICAL COMMODITIES INC. SITE SAMPLES (CONT'D)

Sample Location	Sample Depth (ft.)	Matrix	Sample #	Instrument	Analysis
In-Situ Volatilization @ 3 hours	**	S	ISV 3 hr. A,B	GCMS	VOA
In-Situ Volatilization @ 43 hours	**	S	ISV 43 hr. A,B	GCMS	VOA
Low Temp Therm Treatment - Before	**	S	InitialA,B	GCMS	VOA
Low Temp Therm Treatment - After pass 1	**	S	LT3Pass1A,B	GCMS	VOA
Low Temp Therm Treatment - After pass 2	**	S	LT3Pass2A,B	GCMS	VOA
Low Temp Therm Treatment - After pass 3	**	S	LT3Pass3A,B	GCMS	VOA
Wall between front & back room in warehouse	---	Wipe	5482A B C D	GCMS AA GCMS AA	BNA pp metals BNA control pp metals control
Front room floor in warehouse	---	Sweep	5483A B	GCMS AA	BNA pp metals
Back room floor in warehouse	---	Sweep	5484A B	GCMS AA	BNA pp metals
Back room floor in warehouse	---	Chip	5485A B	GCMS AA	BNA pp metals
Front room floor in warehouse	---	Chip	5486A B	GCMS AA	BNA pp metals

** Composite sample from locations ERT3, ERT13, and ERT20 @ depths 1 to 15 ft

rd/EVNGLSTA/TAB1-288

<027E\027&l10\027(s16.66H>

TABLE 2. GROUNDWATER ANALY: OR VOLATILE ORGANIC COMPOUNDS IN
WELLS ERT1, ERT2, ERT33, AND ERT34
CHEMICAL COMMODITIES INC. SITE

Compound	Well Location	ERT 1		ERT2-Middle		ERT2-Bottom	ERT 33	ERT 34
	Date	8/12/89	9/14/89	8/12/89	9/14/89	8/12/89	9/29/89	9/29/89
	DL* ug/L	10	2000	100	2000	6900 ug/L	5000 ug/L	10 ug/L
Dichlorofluoromethane								
Chloromethane		47				70,000		
Vinylchloride		22						
Bromomethane								
Trichlorofluoromethane								
1,1-Dichloroethene		17,060	15,140	10,953	6,220	1,012,000		129
Methylene Chloride		164		16,174	13,120	351,000		
trans-1,2-Dichloroethene		55		265		25,000		
1,1-Dichloroethane		989		279		11,000		334
cis-1,2-Dichloroethene		10,900	6,500	1,053		45,000		68
Chloroform		11,040	8,420	3,560		450,000		790
1,1,1-Trichloroethane		25,660	24,460	32,660	49,800	33,900,000	4,890,000	3,440
Carbon Tetrachloride		238,520	212,440	3,162		4,500,000		
1,1-Dichloropropene		5						
Benzene				30				
1,2-Dichloroethane		32,380	31,120	5,279	4,080	319,000		
Trichloroethene		317,060	345,880	408,960	564,000	661,000,000	48,400,000	13,000
1,2-Dichloropropane								
Dibromomethane				57				
Bromodichloromethane								
Toluene		4,180	5,140	505		617,000		31
1,1,2-Trichloroethane		103		606		81,000		
Tetrachloroethene		1,568	1,980	30,320	34,400	216,900,000	24,100,000	8,200
Dibromochloromethane								
1,2-Dibromethane								
Chlorobenzene		20				5,000		
1,1,1,2-Tetrachloroethane		10				113,000		
Ethylbenzene		209				20,000		5
p- & m-Xylene		616	760			60,000		
o-Xylene		388				22,000		

*DL = Detection Limit

TABLE 2. GROUNDWATER ANALYSIS FOR VOLATILE ORGANIC COMPOUNDS IN
WELLS ERT1, ERT2, ERT33, AND ERT34 (CONT'D)
CHEMICAL COMMODITIES INC. SITE

Compound	Well Location / Date / DL* ug/L	ERT 1 8/12/89 10	ERT 1 9/14/89 2000	ERT2-Middle 8/12/89 100	ERT2-Middle 9/14/89 2000	ERT2-Bottom 8/12/89 6900 ug/L	ERT 33 9/29/89 5000 ug/L	ERT 34 9/29/89 10 ug/L
Styrene						4,000		
Bromoform								
1,1,2,2,-Tetrachloroethane		6,380	7,360	108,760	68,220	33,127,000		
n-Propylbenzene		67						
2-Chlorotoluene								
1,3,5-Trimethylbenzene		115				8,000		
1,2,4-Trimethylbenzene		404				22,000		
1,3-Dichlorobenzene		50						
1,4-Dichlorobenzene		251				5,000		
1,2-Dichlorobenzene		1,943	2,100			118,000		
1,2-Dibromo-3-Chloropropane		22						
1,2,4-Trichlorobenzene						8,000		
Hexachlorobutadiene						12,000		
Naphthalene		9				58,000		
Acetone		269			8,780			
Carbon Disulfide		414						
2-Butanone		119				62,000		
4-Methyl-2-Pentanone		35		22				
TOTAL VOC		671,072	661,300	591,215	748,680	952,925,000	77,390,000	25,966

*DL = Detection Limit

TABLE 3. GROUNDWATER ANALYSIS FOR VOLATILE ORGANIC COMPOUNDS IN WELLS KDHE1, KDHE2, AND KDHE 3
CHEMICAL COMMODITIES INC. SITE

Compound	Well Location	KDHE #1			KDHE #2			KDHE #3			
	Date	2/24/89	8/12/89	9/14/89	2/24/89	8/12/89	9/14/89	2/24/89	8/12/89	8/12/89	9/14/89
	DL* ug/L	>4200	10	100	10000	1	250	>330	50	50	250
Dichlorodifluoromethane										13	
Chloromethane			26			24					
Vinylchloride											
Bromomethane						2					
Trichlorofluoromethane			13								
1,1-Dichloroethene		4,200	7,820	1,390		33		140	44	48	278
Methylene Chloride		33,000	33,040	7,418	11,000	10		260			
trans-1,2-Dichloroethene		750	113			31					
1,1-Dichloroethane			62			12					
cis-1,2-Dichloroethene			899	1,024		395	1,140				
Chloroform		680	1,332	80		233		140	85	74	
1,1,1-Trichloroethane		22,000	15,500	3,738		118	203	330	87	92	850
Carbon Tetrachloride			149		200,000	33,950	16,740	2,900	730	728	8,530
1,1-Dichloropropene											
Benzene			29								
1,2-Dichloroethane		2,400	3,640	464		455	135	340	90	100	555
Trichloroethene		70,000	83,300	8,850	37,000	6,966	4,018	7,600	2,243	2,433	15,561
1,2-Dichloropropane						13					
Dibromomethane											
Bromodichloromethane			5			2					
Toluene			31	67		4			23	22	
1,1,2-Trichloroethane			497	120		6					
Tetrachloroethene		140,000	157,540	93,860	1,600	229	423	77	27	26	21[illegible]
Dibromochloromethane											
1,2-Dibromomethane											
Chlorobenzene			5			5			11	9	
1,1,1,2-Tetrachloroethane			287	105		1					
Ethylbenzene			4	14		1					
p- & m-Xylene			4			1					
o-Xylene			4								
Styrene											
Bromoform											
1,1,2,2-Tetrachloroethane		11,000	15,440	1,649		57		71			

*DL = Detection Limit.

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TABLE 3. GROUNDWATER ANALYSIS FOR VOLATILE ORGANIC COMPOUNDS IN WELLS KDHE1, KDHE2, AND KDHE 3 (CONT'D)
CHEMICAL COMMODITIES INC. SITE

Compound	Well Location	KDHE #1			KDHE #2				KDHE #3			
	Date	2/24/89	8/12/89	9/14/89	2/24/89	8/12/89	9/14/89		2/24/89	8/12/89	8/12/89	9/14/89
	DL* ug/L	>4200	10	100	10000	1	50	>330	50	50	250	
n-Propylbenzene												
2-Chlorotoluene												
1,3,5-Trimethylbenzene												
1,2,4-Trimethylbenzene												
1,3-Dichlorobenzene						1						
1,4-dichlorobenzene						1						
1,2-Dichlorobenzene			7			8						
1,2-Dibromo-3-Chloropropane												
1,2,4-Trichlorobenzene												
Hexachlorobutadiene												
Naphthalene												
Acetone		2,500			13,000				240		7	1,510
Carbon Disulfide												
2-Butanone		3,000	3		7,800				220	18	15	
4-Methyl-2-Pentanone			16									
TOTAL VOC		**289,530**	**319,766**	**118,799**	**270,400**	**42,547**	**22,659**		**12,318**	**3,358**	**3,567**	**27,504**

*DL = Detection Limit

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TABLE 4. GROUNDWATER ANALYSIS FOR VOLATILE ORGANIC COMPOUNDS IN WELLS KDHE4, CCI101, EPA1 AND EPA2
CHEMICAL COMMODITIES INC. SITE

Compound	Well Location	KDHE #4			CCI #101			EPA #1			EPA #2
	Date	2/24/89	8/12/89	9/14/89	2/24/89	8/12/89	9/14/89	2/24/89	2/24/89	8/12/89	9/14/89
	DL* ug/L	>5	1	1	>10000	>10	2000	>13000	>23000	>10	500
Dichlorodifluoromethane											
Chloromethane						93				53	
Vinylchloride						3					
Bromomethane						1					
Trichlorofluoromethane											
1,1-Dichloroethene						285	1,520	3,600		527	
Methylene Chloride					4,200	91		8,900	6,300	8	
trans-1,2-Dichloroethene						14		43,000	42,000	6	
1,1-Dichloroethane				4		7				6	
cis-1,2-Dichloroethene						4,220				91	
Chloroform			1	3		254	3,020			1,497	
1,1,1-Trichloroethane				8	1,900	277	6,460	43,000	47,000	1,466	
Carbon Tetrachloride				96	4,500	1,345	42,920	34,000	35,000	6,840	
1,1-Dichloropropene					33,000						
Benzene			1							37	
1,2-Dichloroethane				6	17,000	11,110	20,500	30,000	31,000	13,000	
Trichloroethene		6	4	177	220,000	24,135	268,120	330,000	460,000	92,500	
1,2-Dichloropropane						59	1,680			935	
Dibromomethane											
Bromodichloromethane											
Toluene						5				53	
1,1,2-Trichloroethane						17				104	
Tetrachloroethene		3	1	11	3,700	217	4,760	34,000		1,270	
Dibromochloromethane										700	
1,2-Dibromomethane						39	900			222	
Chlorobenzene						22	1,300			4	
1,1,1,2-Tetrachloroethane				3		1	2,140			4	405
Ethylbenzene						1				4	
p- & m-Xylene						1				4	
o-Xylene											

TABLE 4. GROUNDWATER ANALYSIS FOR VOLATILE ORGANIC COMPOUNDS IN WELLS KDHE4, CCI101, EPA1 AND EPA2 (CONT'D)
CHEMICAL COMMODITIES INC. SITE

Compound	Well Location	KDHE #4			CCI #101			EPA #1			EPA #2
	Date	2/24/89	8/12/89	9/14/89	2/24/89	8/12/89	9/14/89	2/24/89	2/24/89	8/12/89	9/14/89
	DL* ug/L	>5	1	1	>10000	>10	2000	>13000	>23000	>10	500
Styrene											
Bromoform						1				6	
1,1,2,2-Tetrachloroethane					2,500	128				1,323	
n-Propylbenzene											
2-Chlorotoluene											
1,3,5-Trimethylbenzene										3	
1,2,4-Trimethylbenzene						1				4	
1,3-Dichlorobenzene						14				33	
1,4-Dichlorobenzene						9				112	
1,2-Dichlorobenzene				1		8	2,960			148	775
1,2-Dibromo-3-Chloropropane											
1,2,4-Trichlorobenzene						1					
Hexachlorobutadiene				1							
Naphthalene											
Acetone											
Carbon Disulfide											
2-Butanone					8,500						
4-Methyl-2-Pentanone										5	
TOTAL VOC		9	7	309	295,300	42,360	356,280	605,800	701,300	120,961	83,705

*DL = Detection Limit.

TABLE 5. NUMBER OF OCCURRENCES A PARTICULAR CONTAMINANT WAS FOUND IN CHEMICAL COMMODITIES SITE GROUNDWATER

Compound	# Occurrences >1000 ug/L	# Occurrences >10,000 ug/L	# Occurrences >100,000 ug/L
Dichlorofluoromethane	0	0	0
Chloromethane	0	0	0
Vinylchloride	0	0	0
Bromomethane	0	0	0
Trichlorofluoromethane	0	0	0
1,1-Dichloroethane	9	3	0
Methylene Chloride	9	4	0
trans-1,2-Dichloroethene	2	2	0
1,1-Dichloroethane	0	0	0
cis-1,2-Dichloroethene	7	1	0
Chloroform	7	1	0
1,1,1-Trichloroethane	15	9	1
Carbon Tetrachloride	14	10	3
1,1-Dichloropropene	0	0	0
Benzene	0	0	0
1,2-Dichloroethane	13	8	0
Trichloroethene	23	17	9
1,2-Dichloropropane	1	0	0
Dibromomethane	0	0	0
Bromodichloromethane	0	0	0
Toluene	2	0	0
1,1,2-Trichloroethane	0	0	0
Tetrachloroethene	15	6	3
Dibromochloromethane	0	0	0
1,2-Dibromomethane	0	0	0
Chlorobenzene	1	0	0
1,1,1,2-Tetrachloroethane	1	0	0
Ethylbenzene	0	0	0
m-Xylene	0	0	0
Xylene	0	0	0
Styrene	0	0	0
Bromoform	0	0	0
1,1,2,2-Tetrachloroethane	9	4	1
n-Propylbenzene	0	0	0
2-Chlorotoluene	0	0	0
1,3,5-Trimethylbenzene	0	0	0
1,2,4-Trimethylbenzene	0	0	0
1,3-Dichlorobenzene	0	0	0
1,4-Dichlorobenzene	0	0	0
1,2-Dichlorobenzene	3	0	0
1,2,4-Dibromo-3-Chloropropane	0	0	0
Hexachlorobutadiene	0	0	0
Naphthalene	0	0	0
Acetone	6	3	1
Carbon Disulfide	0	0	0
2-Butanone	5	1	0
4-Methyl-2-Pentanone	0	0	0

methylene chloride, trans-1,2-dichloroethene, 1,1,1-trichloroethane, carbon tetrachloride, 1,2-dichloroethane, trichloroethene, tetrachloroethene, 1,1,2,2-tetrachloroethane, acetone, and 2-butanone.

Three additional wells also showed significant contamination: KDHE 2, KDHE 3, EPA 2 and ERT34. These wells are on the west side of the site, adjacent to or near residential homes. The groundwater from KDHE 2 contained 270,400, 42,547, and 22,659 ug/L VOC during 3 separate sampling events. The groundwater in KDHE 3 contained the following concentrations of VOC: 12,318, 3,358, and 3,567 ug/L, while EPA 2 had 83,705 ug/L. ERT34, a borehole, had 25,966 ug/L VOC in its water.

Well KDHE 4 had insignificant levels of VOC contamination in the groundwater. After three sampling events, the groundwater was found to have 9, 7, and 309 ug/L VOC. Even though the latest sample from KDHE 4 contained only 309 ug/L VOC, this concentration was more than 30 times higher than VOC concentrations found in two previous samples.

Table 5 lists all the compounds found in the groundwater as well as the number of times that each individual contaminant was found to have exceeded the concentrations of 1,000, 10,000, and 100,000 ug/L. This table shows that trichloroethene exceeded 100,000 ug/L on nine sampling events, and exceeded 10,000 and 1,000 ug/L on 17 and 23 occurrences, respectively. To date, the total groundwater samples taken at the CCI site is 26. Contaminants other than TCE were also found with relative frequency in the groundwater samples. Compounds with concentrations greater than 1,000 ug/L in more than eight groundwater samples were: 1,1-dichloroethane; methylene chloride; 1,1,1-trichloroethane; carbon tetrachloride; 1,2-dichloroethane; tetrachloroethene; and 1,1,2,2-tetrachloroethane. The sampling of the pure hydrocarbon layer at the bottom of ERT 2 was not included in the Table 5 frequency distribution.

To provide information on the future impact on adjacent areas by contaminated groundwater from the site, the groundwater flow path was characterized. Six sets of water level readings were taken on six separate occasions between August 11 and October 26, 1989, from on-site monitoring wells. These readings by ERT/REAC, Region VII TAT, and U.S. EPA Region VII were used to characterize the groundwater flow path. Also, well casings were surveyed by U.S. EPA Region VII for relative heights. From this data, groundwater elevations were calculated, and 6 potentiometric head contours and flow net diagrams were produced (see Maps 1 thru 6).

These flow net diagrams show that the groundwater on the site generally flows from east to west. A steep groundwater gradient was apparent on the maps in the northeast corner of the site. This gradient was probably due to the "bathtub" effect in the open UST excavation pit. A perched water condition in this pit possibly influenced the nearby wells; therefore, a localized radial flow condition may have existed. Contaminant transport may have been more influenced by migration along the bedrock surface, by surface water transport to topographically low areas, or by migration through more permeable soil than by the direction of groundwater flow itself. Free product has only been found in the bottom of monitoring wells on the eastern side of the property, indicating that the migration of the contaminants through the groundwater has been inhibited. This inhibition can be attributed to the predominantly clay soils on site and their intrinsically low permeability (see Section 4.2.1).

4.2 Soil

4.2.1 Geotechnical characterization

Soil samples were taken from the CCI site for geotechnical characterization. The samples taken were #001 at 0.5 to 2.5 feet and #002 at 2.5 to 3.5 feet. These samples were mainly characterized for particle size distribution and permeability.

Both samples were found to be highly plastic clays with the overwhelming majority of particles below #200 mesh (75 um). In addition, the CCI soils have a low hydraulic and pneumatic permeability. Tables 6 and 7 and Figures 1 and 2 show the particle size distribution for the samples. Sample #001 contained 78.1% of its particles below #200 mesh. Furthermore, 97.8% of sample #002 particles were smaller than #200. Both samples exhibited higher plastic behavior. These characteristics are an example of a soil containing a high clay content.

Table 8 contains the summary of the triaxial permeability tests. The hydraulic permeability of samples 001 and 002 are 3.9×10^{-8} and 3.0×10^{-9} cm/sec. From the hydraulic permeability measurements, the pneumatic permeability was calculated. Soils 001 and 002 exhibited pneumatic permeabilities of 2.6×10^{-9} and 2.0×10^{-10} cm/sec. These permeability values indicate a soil with low permeability.

4.2.2 Contaminant characterization

The results of the soil sample analysis were placed on 12 separate site maps (Maps 7 to 18). The purpose of these maps is to give the reader a complete picture of all the significant contaminants found in the CCI soil. Only the significant contaminant concentrations (those greater than 0.5 mg/kg) were placed next to the sample location on site maps (Maps 7 to 10). These maps also depict the analytical instrument used for a particular soil sample. Therefore, VOC analyses by GC/MS are shown in a blue color than samples analyzed by the Photovac, in green. The Photovac analytical results and the soil boring logs are listed in Appendices A and B, respectively.

Another two sets of maps are present to assist the reader in determining the extent of contamination. These maps contain the isopleths for two contaminant indicators: trichloroethene (Maps 12 to 15) and total volatile organic compounds/Photovac target compounds (Maps 16 to 19). The values used to generate these maps are in Table 9.

Soil samples taken at the surface and to a depth of one foot show contamination in two main areas (see Maps 7, 12, and 16). One area is bounded on the east by the warehouse and on the west by truck trailer H, Shed F, and sample point ERT 20. This area was analyzed for VOC, semi-volatile organics, and heavy metals. Only low amounts of semi-volatiles and moderate amounts of heavy metals were found; however, there were significant quantities of volatile organics present. A VOC contaminated area at this depth is the area bounded on the east by the roadside fence and sample point ERT 29 and on the west by Shed A, Shed B, and sample point PK 877009. At the surface to one foot depth there was no VOC contamination beyond the boundaries of the site with the exception of a minor amount at ERT 3.

TABLE 6. GEOTECHNICAL SOIL CHARACTERISTICS
SAMPLE DEPTH 0.5 TO 2.5 FEET

SOIL DESCRIPTION
dark brown sandy silt or clay

GRAIN SIZE RESULTS

U. S. Standard Sieve Size	Diameter mm	% Finer
1 1/2"	37.500	100.0
3/4"	19.000	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.4
#50	0.300	91.5
#100	0.150	82.4
#200	0.075	78.1
Hydrometer	0.0223	82.3
	0.0166	76.7
	0.0126	68.2
	0.0095	59.8
	0.0071	55.5
	0.0052	50.3
	0.0037	47.5
	0.0027	44.7
	0.0019	41.9
	0.0013	39.5

EFFECTIVE SIZES

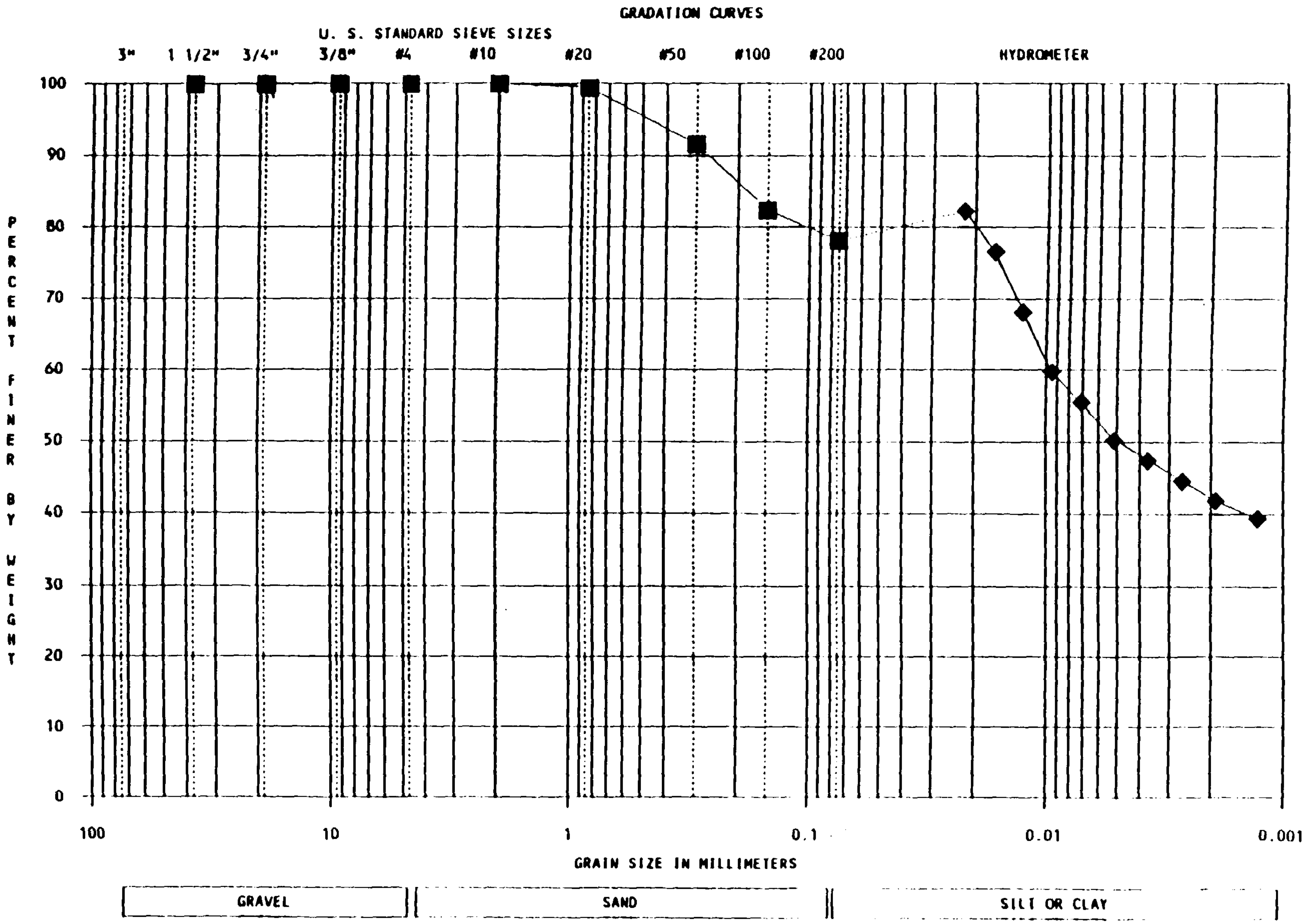
% Finer	Diameter mm
60	0.010
30	0.001
10	0.000
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, %
28.1

SPECIFIC GRAVITY
2.71

COMMENTS:
NA = NOT APPLICABLE
SOIL EXHIBITS VERY COHESIVE AND PLASTIC PROPERTIES AND IS VISUALLY IDENTIFIED AS A HIGHLY PLASTIC CLAY

Figure 1. Soil particle size distribution, depth 0.5 to 2.5 feet



SAMPLE# 001

TABLE 7. GEOTECHNICAL SOIL CHARACTERIZATION
SAMPLE DEPTH 2.5 TO 3.5 FEET

SOIL DESCRIPTION
medium brown slightly sandy silt or clay

GRAIN SIZE RESULTS

U. S. Standard Sieve Size	Diameter mm	% Finer
1 1/2"	37.500	100.0
3/4"	19.000	100.0
3/8"	9.500	100.0
#4	4.750	99.9
#10	2.000	99.7
#20	0.850	99.3
#50	0.300	98.9
#100	0.150	98.4
#200	0.075	97.8
Hydrometer	0.0214	86.7
	0.0163	79.7
	0.0125	69.8
	0.0093	62.7
	0.0072	55.7
	0.0052	50.0
	0.0038	46.2
	0.0027	43.4
	0.0019	40.5
	0.0013	39.6

EFFECTIVE SIZES

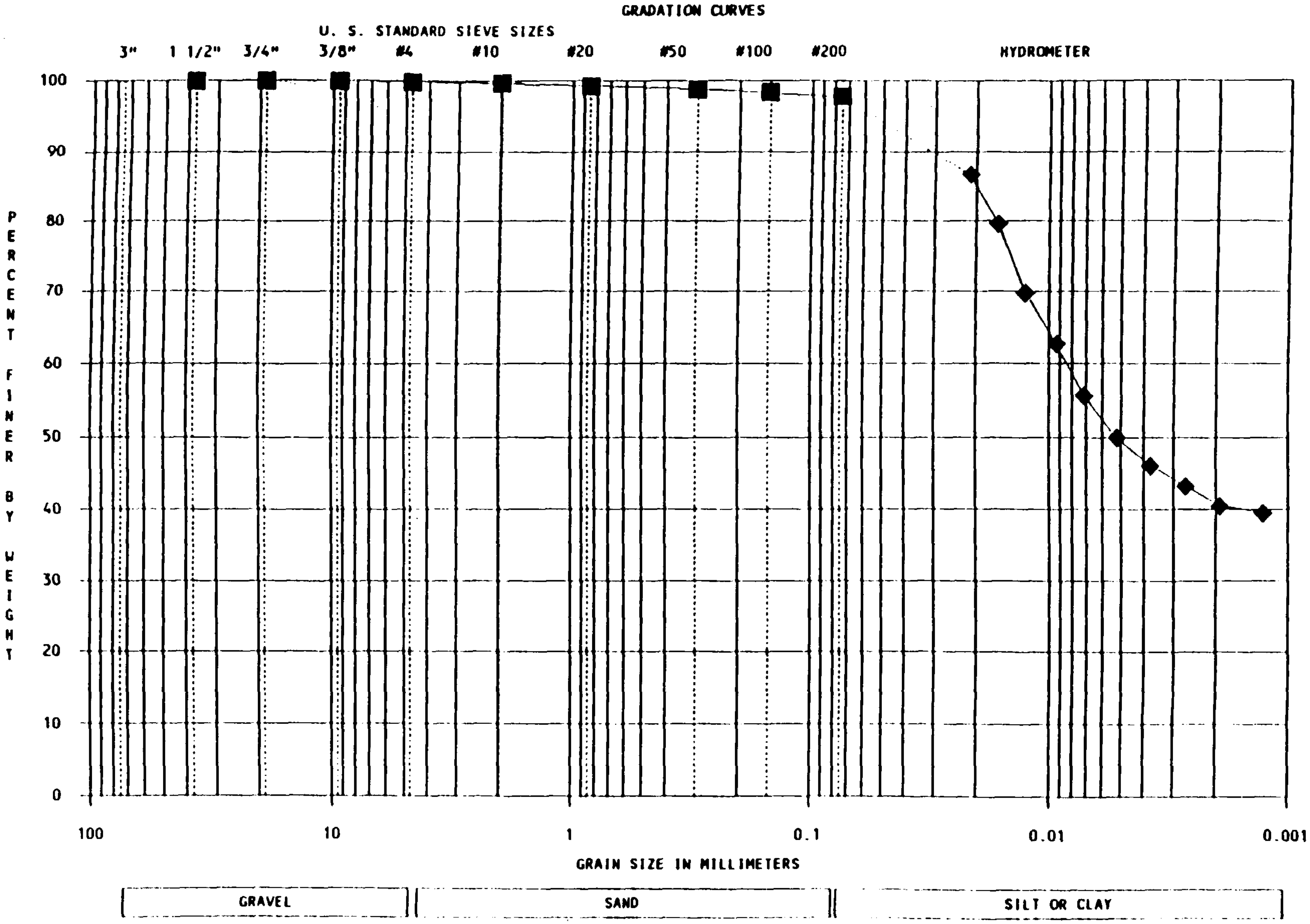
% Finer	Diameter mm
60	0.009
30	0.001
10	0.000
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, %
28.6

SPECIFIC GRAVITY
2.70

COMMENTS:
NA = NOT APPLICABLE
SOIL EXHIBITS VERY COHESIVE AND PLASTIC PROPERTIES AND IS VISUALLY IDENTIFIED AS A PLASTIC CLAY

Figure 2. Soil particle size distribution, depth 2.5 to 3.5 feet



SAMPLE# 002

TABLE 8. SUMMARY OF TRIAXIAL PERMEABILITY TEST RESULTS

ETL Job Number	890801	890801
ETL Sample Number	001	002
USCS Classification	CH	CH
Pre-Permeation Data		
Natural Moisture Content, %	28.1	28.6
Undisturbed Wet Unit Weight, lb/cu. ft.	122	120
Undisturbed Dry Unit Weight, lb/cu. ft.	95.1	93.3
Specific Gravity	2.71	2.7
Void Ratio	0.779	0.806
Degree of Saturation, %	97.8	95.9
Permeability Data		
Hydraulic Permeability, cm/sec	3.9E-08	3.0E-09
Intrinsic Permeability, sq. cm	3.9E-10	3.0E-11
Pneumatic Permeability, cm/sec	2.6E-09	2.0E-10
Post-Permeation Data		
Final Moisture Content, %	32.2	34.0
Molded Wet Unit Weight, lb/cu. ft.	119	117
Molded Dry Unit Weight, lb/cu. ft.	90.2	87.5
Void Ratio	0.876	0.925
Degree of Saturation, %	99.6	99.3

TABLE 9. CHEMICAL COMMODITIES SOIL SAMPLE ANALYSIS (units in mg/Kg)

# Sample	Surface		Five Feet		Ten Feet		Fifteen Feet	
	TCE	PTC/VOC	TCE	PTC/VOC	TCE	PTC/VOC	TCE	PTC/VOC
ERT-1	1.5	[illegible]					13.3	[illegible]
ERT-2	ND	ND	ND	ND	6.7	7.3		
ERT-3	4.2	[illegible]	0.8	1.8	12.6	36.9	4.7	[illegible]
ERT-4	0.6	0.6	0.2	0.2	0.007	0.007	ND	ND
ERT-5	0.2	0.2	ND	ND	ND	ND	0.3	[illegible]
ERT-6	0.07	0.2	0.3	0.3	0.1	0.1	0.2	[illegible]
ERT-7	0.7	0.7	0.6	0.8	0.3	0.3	ND	ND
ERT-8	ND	ND	0.4	0.4	0.8	0.8	0.6	[illegible]
ERT-9	0.7	0.7	ND	ND	0.8	0.8	0.038	[illegible]
ERT-10	0.3	1.4	1.2	3.3	0.1	0.9	0.8	[illegible]
ERT-11			ND	0.1	0.4	2.6	0.07	[illegible]
ERT-12	0.4	0.4	3.9	6.1	1.5	1.5	1.6	[illegible]
ERT-13	1.0	1.0	166	1193	29.2	31.2	27.6	28.9
ERT-14	1.0	1.0	16.9	24.1	5	17	5.3	5.3
ERT-15	1.0	1.1	0.29	20	ND	ND	ND	ND
ERT-16	0.8	10.1	10	36	11.3	17.4	12.1	19.9
ERT-17	1.6	8.0	0.9	3.3	3.0	9.4	ND	[illegible]
ERT-18	ND	0.5	0.6	0.6	2.5	2.5	ND	ND
ERT-19	ND	ND	ND	ND	4.1	4.1	0.4	[illegible]
ERT-20	5.8	652.8	3.0	7.7	11.0	12.5	5.4	[illegible]
ERT-21	0.5	0.5	10.9	16.6	15.9	16.6	8.8	[illegible]
ERT-22	ND	ND	6.78	13.8	2.2	3.2	1.1	[illegible]
ERT-23	0.1	0.3	3.1	3.1	6.5	7.3	7.7	[illegible]
ERT-24	5.4	59.5	6.0	8.2	10.7	12.5	8.7	[illegible]
ERT-25	ND	ND	ND	ND	ND	ND	ND	ND
ERT-26	ND	ND	ND	ND	ND	ND	0.3	0.3
ERT-27	ND	ND	ND	ND	0.001	0.001	ND	ND
ERT-28	ND	ND	ND	ND	ND	ND	1.5	1.5
ERT-29	13	30	0.007	0.008	2	4	19	21
ERT-30			0.001	0.04	ND	0.06		
ERT-31			0.7	1.5	0.2	0.3		
ERT-32			ND	0.01	0.02	0.2		
ERT-33							22.8	39
ERT-34							0.001	[illegible]
PK877005	ND	940						
PK877006								
PK877007								
PK877008	40	380						
PK877009	0.004	62						
PK877010	1	112	1	60				
PK877012	0.019	0.028	ND	6				
PK877014	0.18	4	ND	6				
SHED-L	0.001	0.003						
SHED-A	ND	ND						
SHED-AB	ND	148						
SHED-B	2	4						
YARD-EDC	6	91						
SHED-F	10	171						
RR-BAL	0.001	0.001						
EPA W-1					1	27		
EPA W-2			0.004	2	ND	4		

NOTE: TCE = Trichloroethene
PTC/VOC = Photovac Target Compounds/Volatile Organic Compounds
In samples where both Photovac and GCMS analyses were performed, only the Volatile Organic Compounds from GCMS analysis is presented in table.
ND - Not Detected.

rd:eh/EVNGLSTA/FR-2288

Soil samples at the five-foot depth show slight contamination beyond the boundaries of the site (see Maps 8, 13, and 17). ERT 10, Well EPA 2, ERT 7, and ERT 31 had low concentrations of soil-bound volatile organics (not exceeding 2 mg/kg). At this depth, the grassy area to the west of the boundary formed by the truck trailer H, Shed F, and ERT 20 shows low amounts of VOC; however, the area to the east of this boundary had little VOC contamination. Two other areas containing VOC at this depth is the grassy area north of Sheds A and B and the area just south of the pit by ERT13.

Soil samples at the ten-foot depth show little contamination beyond the boundaries of the site (see Maps 9, 14, and 18). Samples outside the boundary found to contain VOC at this depth were ERT 11, Well EPA 1 (a less reliable sample because the drill went through a sewer pipe), ERT 2, and ERT 3. This shows that there was some migration of VOC to both the east and the west. The on-site data indicates an even dispersal of VOC at low concentrations.

Soil samples at the 15-foot depth show no VOC contamination outside the northern, western, or southern boundaries of the site (see Maps 10, 18, and 19). However, the presence of VOC to the east of the site was better defined with an analysis of the extra sampling points. The following soil sample points show low levels of VOC at the 15-foot depth: ERT 1, ERT 2, ERT 33, and ERT 3. As in the ten-foot depth, the analyses of the samples taken on-site indicates an even dispersal of VOC at low concentrations.

Samples taken at a 20-foot depth indicate a substantial amount of VOC contamination may exist at that depth, just on top of the bedrock. Map 8 contrasts these results with the 15 foot sample results for sample points ERT 2, ERT 13, ERT 33, and ERT 34. Soil samples for ERT 2 and 13 were taken with a split spoon at an approximate 20 foot depth. The spoon was driven through the drill tails in the borehole to bedrock and samples were analyzed by Photovac. The results for ERT 2 and 13 indicate a low amount of VOC contamination. For ERT 33 and 34 however, the soils were scraped from the drill bit after it hit bedrock and were analyzed by GC/MS. Results for ERT 33 and 34 indicate a large quantity of volatile organic compounds exist just above the bedrock.

4.3 Building Decontamination

Sweep and chip samples were obtained from the floor of the warehouse's front (north) and back (south) rooms. Wipe sample were taken from the wall of the hallway between the above two rooms. Analysis of the previous samples showed that the floor of the back room contained high concentrations of semi-volatile organics. Table 10, which lists the detected semi-volatile organic compounds, shows that the back room sweep contained 3,506,923 ug/kg of total semi-volatile organics. The majority of these contaminants were phenolic. The chip sample from the back room also contained semi-volatile organics (105,618 ug/kg). Compared to the back room sweep and chip samples, semi-volatile organic levels in the front room chip and sweep samples were over 20 times lower and nearly eight times lower, respectively than the back room samples. Furthermore, both front room samples did not contain the high amounts of phenols found in the back room (Table 10).

Significant quantities of target priority pollutant metals were found in sweep and chip samples from both front and back rooms. Table 11 lists the priority pollutant metals detected. The samples contained the following metals in the highest concentrations: chromium, copper, lead, mercury, and zinc.

TABLE 10. SEMI-VOLATILE COMPOUND ANALYSES OF CHEMICAL COMMODITIES, INC. SITE WAREHOUSE SWEEP, CHIP, AND WIPE SAMPLES

Compounds	Sample Type	Sweep		Chip		Wipe**
	Sample Location	Front Room	Back Room	Front Room	Back Room	Wall
	DL*	3300 ug/Kg	3437 ug/Kg	3402 ug/Kg	3333 ug/Kg	10***
Phenol			339,000		1,634	
1,3-Dichlorobenzene			2,851			
1,4-Dichlorobenzene			12,855			
Benzyl Alcohol		509				
1,2-Dichlorobenzene			240,000		534	
2-Methylphenol		289	360,000		2,170	
4-Methylphenol			1,740,000		9,160	
Hexachloroethane		346				
2,4-Dimethylphenol			676,000		7,435	
Benzoic Acid		5,825				
1,2,4-Trichlorobenzene			591	1,395	1,644	
Naphthalene		1,022	984			
2-Methylnaphthalene		386			307	
Dimethylphthalate		1,207				
Acenaphthene		1,197			90	
Dibenzofuran		792			170	
Diethylphthalate		3,368			2,149	6
Fluorene		1,138	744			
Hexachlorobenzene				1,106		
Phenanthrene		12,593	9,272	831	2,529	
Anthracene		679	1,873		749	
..n-butylphthalate		53,470	69,800	2,241	14,697	3
ranthene		10,706	12,380	968	3,059	
..ene		5,510		435	1,453	
Butylbenzylphthalate		2,115			1,116	1
Benzo(a)anthracene		2,759	3,845			
Bis(2-Ethylhexyl)phthalate		44,920	16,417	6,810	53,900	43
Chrysene		4,729	4,883		1,428	
Benzo(b)fluoranthene		3,774	3,719		1,100	
Benzo(k)fluoranthene		2,146	2,465		565	
Benzo(a)pyrene		2,517	3,040		764	
Indeno(1,2,3-cd)pyrene		2,144	2,767			
Benzo(g,h,i)perylene			3,437		599	
TOTAL SEMI-VOLATILE ORGANICS		164,138	3,506,923	13,786	105,618	53

* DL = Detection Limit

** All wipe concentrations are blank subtracted

*** Units = ug per 100 square centimeter wipe

TABLE 11. TARGET PRIORITY POLLUTANT METAL ANALYSES OF CHEMICAL COMMODITIES SITE WAREHOUSE SWEEP, CHIP, AND WIPE SAMPLES

Compound	Sample Type Sample Location	Sweep Front Room Floor	 Back Room Floor	Chip Front Room Floor	 Back Room Floor	Detection Limit (ug/Kg)	Wipe* Wall Between Rooms	Detection Limit (ug/wipe)
Antimony		330,000	7,800	12,000	4,300	2,000	50	0.3
Arsenic		21,000	24,000	5,100	24,000	2,000	1	0.3
Cadmium		45,000	29,000	260,000	25,000	5,000	2	0.6
Chromium		540,000	1,500,000	40,000	1,300,000	10,000	32	1.3
Copper		1,300,000	9,600,000	140,000	3,100,000	10,000	48	1.3
Lead		1,100,000	2,500,000	340,000	840,000	10,000	138	2.5
Mercury		1,700,000	53,000	48,000	130,000	100	--	--
Nickel		170,000	84,000	38,000	150,000	10,000	12	1.3
Selenium						2,000		0.3
Zinc		4,600,000	1,800,000	2,900,000	1,700,000	10,000	395	1.3
TOTAL TARGET PP METALS		**9,806,000**	**15,597,800**	**7,273,000**	**3,783,000**	----	**678**	--

All concentrations in ug/Kg except wipe samples.

* All concentrations are black corrected; units = ug/100 square centimeter wipe.

The wipe samples of the warehouse wall contained barely detectable amounts of semi-volatile organics and very low quantities of target priority pollutant metals. The values shown in Table 10 and 11 are in micrograms per 100 square centimeters of wall area.

4.4 Remediation Technologies

Two technologies were explored in bench-scale tests as potential remedial options for the soil at CCI. These technologies are: in-situ volatilization (ISV) and low temperature thermal treatment (LT3) (Figure 3 and Photos 1 and 2). The objective of these technologies was to reduce the amount of VOCs in the soil. However, it was essential that the technology chosen clean the soil without discharging fugitive emissions that could impact the surrounding residential neighborhood.

In addition to the two aforementioned remedial technologies, the cost of excavation and off-site incineration was calculated. This information is in Section 5.2

4.4.1 In-situ volatilization

An in-situ treatment technology was explored to reduce or eliminate fugitive vapors from affecting the residential neighbors of the CCI site. The in-situ volatilization process removes VOC contaminants from the soil via a vacuum applied through extraction wells. The volatilized organics can then be treated on the surface with little or no fugitive VOC emissions from a full-scale excavation operation. See Appendix C for the entire report on the ISV and the LT3.

ISV is an applicable radiation technology when the primary contaminants have the following characteristics:

- o a vapor pressure greater than 1-mm of mercury.
- o a Henry's Law constant greater than 100 atmospheres/mole fraction or a dimension less Henry's Law constant greater than 0.01 [4].

The majority of the soil contaminants at the CCI site met these criteria: therefore, bench-scale ISV was investigated with the major objective of the bench-scale investigation to measure the removal efficiency of VOC contaminants.

Bench-scale investigations found that ISV removed 82.8% of the VOC contamination after 42 hours of operation. During the test, nearly 24 pounds of CCI soil was aerated with over 106,000 cubic feet of ambient air. Several of the site's major contaminants had lower removals than VOC. Trichloroethene was reduced 69.9%, tetrachloroethene 72.8%. The reduction of the VOC in the soil is mirrored by the reduction of VOC in the outlet air in the unit. Immediately after start-up, the air-borne VOC concentration was 220 ppm/v. However after three hours, the VOC levels were 4.2; at 42 hours down to 0.3 ppm/v.

4.4.2 Low temperature thermal treatment

Low temperature thermal treatment (LT3) was explored as a potential remedial technology to volatilize the soil-bound VOC contaminants. Approximately 36 pounds of soil was fed into a bench-scale heat screw auger three times, for Passes 1, 2, and 3. The soil retention time during each pass was 20 minutes and the average discharge temperature of the soil after each of the three passes was 237°, 333°, and 408°F, respectively. The bench-scale system was operated at the above temperature to replicate

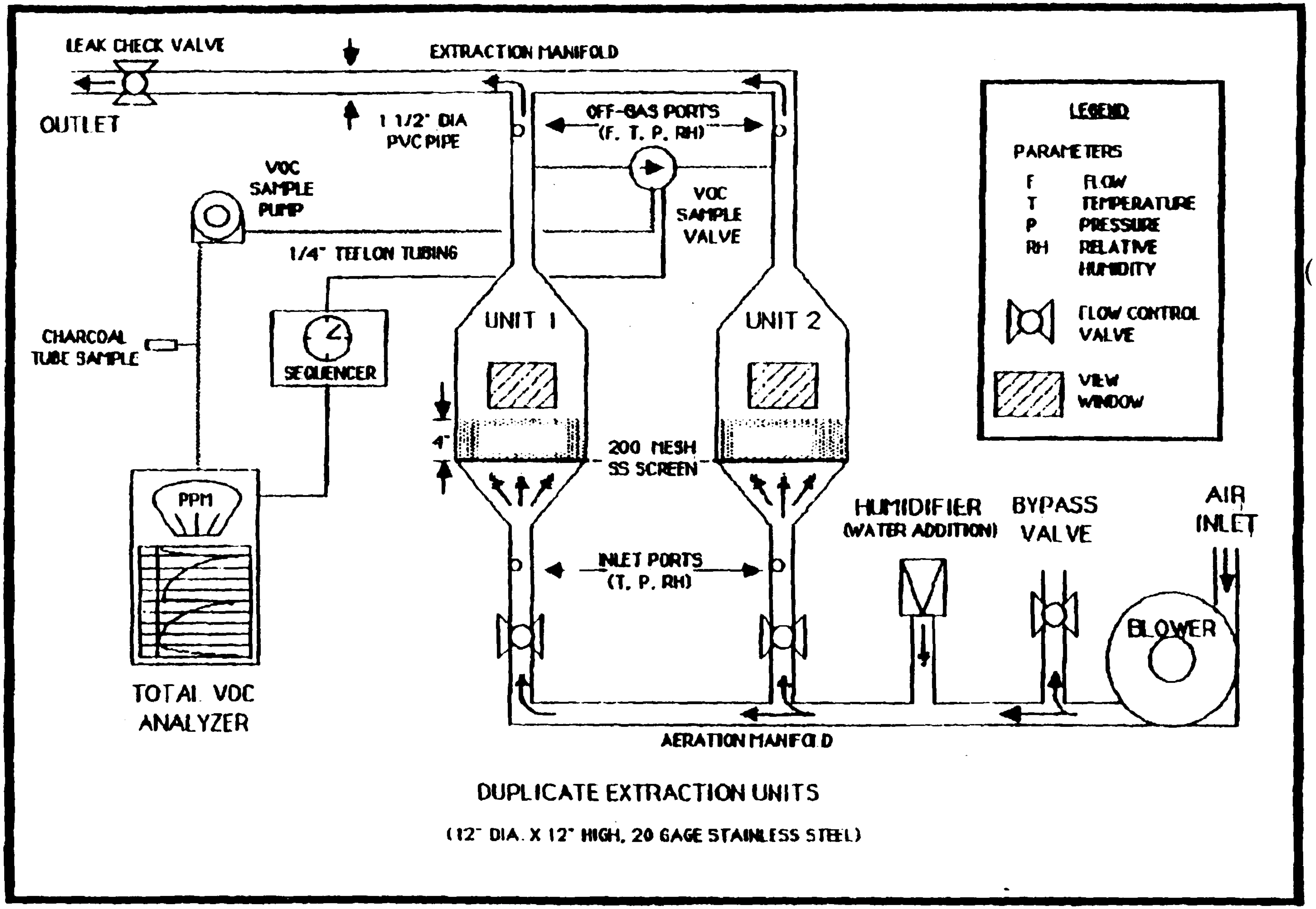


Figure 3. Schematic of the bench-scale in-situ volatilization unit

PHOTO 1. IN-SITU VOLATILIZATION UNIT

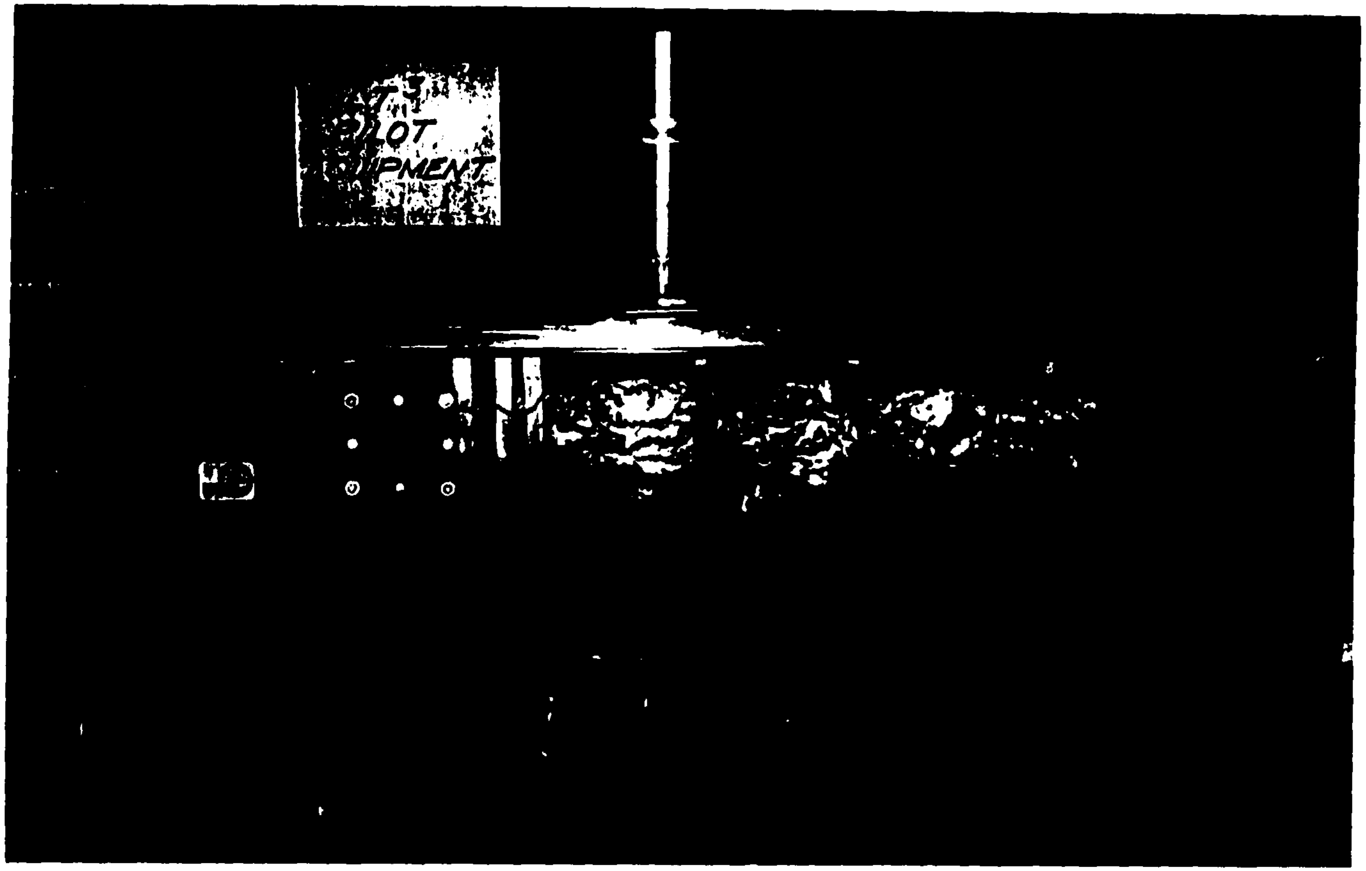


PHOTO 2. LOW TEMPERATURE TREATMENT UNIT

400°F maximum temperature which can be achieved by the full-scale LT3 unit: LT3 removed nearly 90.7% of the soil-bound VOC contaminants, from 226 to 21 mg/Kg (after the 3rd pass). Some widely distributed contaminants had higher removals then the total VOC: trichloroethene, 96.2% and tetrachloroethene, 96.0%. However, some compounds had high residual concentrations in the soil: acetone, 14.7; 2-butanone, 2.2; and 4-Methyl-2-Pentanone, 1.7 mg/kg.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Groundwater

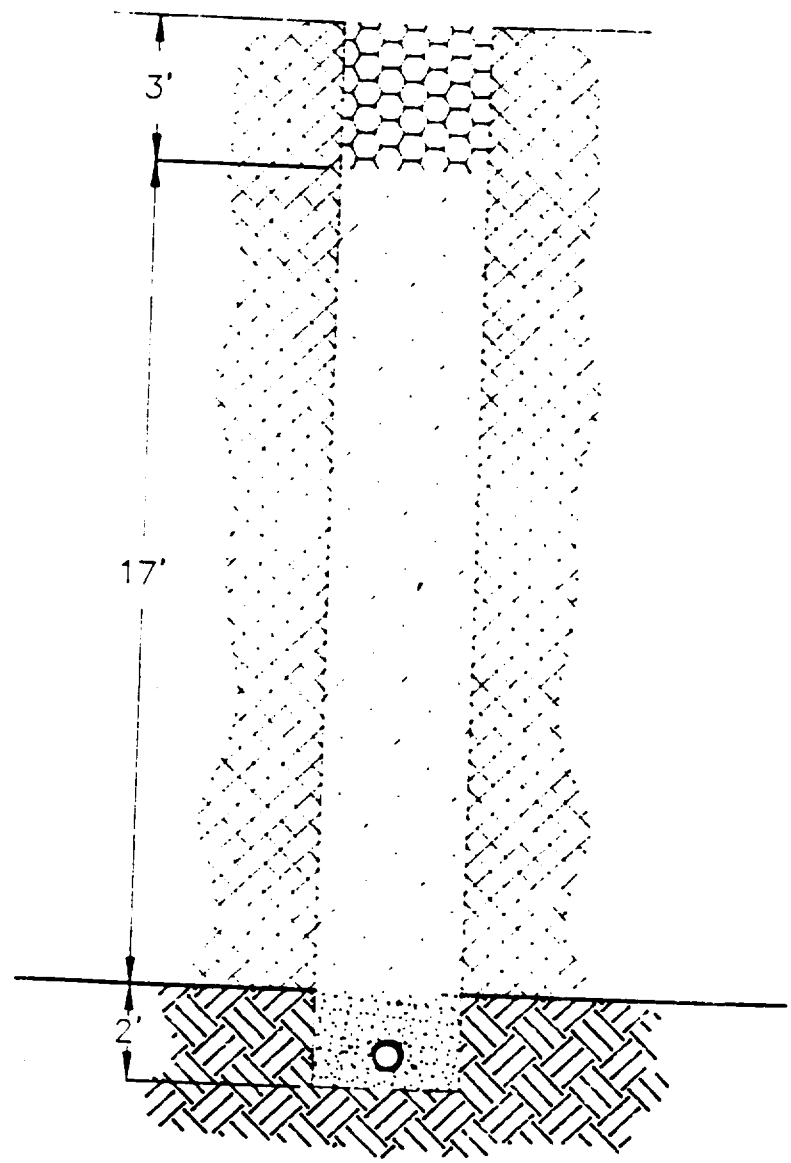
Flow net diagrams (Maps 1 to 6) show that the groundwater flows from east to west; however, sampling indicates that the groundwater contamination maybe moving radially from the site. Wells along all four sides of the sites contain high concentrations of volatile organics. Therefore, an interceptor trench or slurry wall must be installed on the site's perimeter to reduce the threat to the surrounding environment by contaminated groundwater and to capture or contain the pure product along with the groundwater.

Wells along the eastern side of the site contain water with the highest concentrations of volatile organic and several wells contain a pure hydrocarbon phase at the bottom. Well ERT 2 and Borehole ERT 33 contained pure hydrocarbon product at 19 feet (bedrock) and at 15 feet, respectively. Well ERT 1 and Borehole ERT 34 showed traces of this product. ERT 1, ERT 2 and ERT 33, were found to contain the most contaminated groundwater on the site. These wells are all located on the east border of the site along the railroad track. Along the other three sides of the CCI site, wells CCI 101, EPA 1, and KDHE 1 were found to contain high concentrations of volatile organics in their water. In addition, wells KDHE 2, KDHE 3, and EPA 2, all on the west side of the site, contained contaminated water. Well KDHE 4 is relatively contamination free.

To reduce the threat of additional groundwater contamination leaving the site, two remedial options are available. In one option, an interceptor trench installed around the site can stop the offsite flow of contaminated groundwater. The trench is required to encircle the 1,200 foot perimeter of the site (see Map 11 for location). This drain should contain a slotted 6-inch pipe placed in a 12 inch by 12 inch inner trench dug out of the bedrock (approximately 20 feet deep) with clean gravel fill to 5 foot depth. Figure 4 shows a diagram of a proposed interceptor trench. To construct this trench, a 30 to 36 inches wide excavation to 2 feet below the bedrock/soil interface is necessary. First, a 6 inch layer of pea gravel is poured on top of the bedrock; if it is desired to "seal" the bedrock, a thin layer of cement-bentonite grout can be placed on the bedrock under the pea gravel. To insure proper drainage of the trench, the bottom most be sloped 1 percent toward the manhole. Next, a 6 inch perforated (with 0.25 inch maximum perforations) schedule 40 PVC pipe wrapped in geotextile is placed on the pea gravel. The type geotextile should be a 6 ounce per square yard (minimum weight) non-woven needlepunched polyethylene material. Pea gravel should fill the trench to the bedrock/soil interface. The trench can now be filled with AASHTO (American Association of State Highway Transportation Officials) Coarse Aggregate #57 taking care not to drop the first three feet of aggregate too far from the backhoe bucket or the geotextile will tear. Soil from the site should be placed from the 3 foot depth to the surface in thin lifts of 8 inches deep properly compacted with a jumping jack.

Water collected by the trench will run to a collection manhole that would vary in size from 2 feet diameter by 5 feet deep to 4 feet diameter by 3 feet deep containing a minimum of 50 gallons (see Figure 5). More than one manhole may be necessary for collection depending on the grade of the bedrock. Each manhole would contain a small level-actuated pump to pump water to a control tank or tank truck. There is insufficient hydrogeological information to quantify the flow of water into the trench. Existing wells were hand bailed to dryness and took approximately 1 day to recharge; hence, the

Figure 4. Side view of inte. ptor trench



LEGEND

○	6 Inch Perforated (1/4 inch max. perforations) Schedule 40 PVC Pipe
O	Pipe Wrap consisting of 6 oz/yd^3 (min weight) non-woven needlepunched Polyethylene Geotextile
—	Natural Surface or Excavated Trench Side/Bottom
—	Soil/Bedrock Interface
	AASHTO Coarse Aggregate #
	Native Soil (backfilled)
	Native Soil (undisturbed)
	Pea Gravel

expected water volume flowing into the trench should be very low. Therefore, a 25 gallons per minute pedestal type centrifugal pump with 50 feet of discharge head power by explosion proof motor will be sufficient to pump out the trench intermittently. The collected water should be treated offsite at a treatment/storage/disposal facility in compliance with the U.S. EPA regional RCRA requirements.

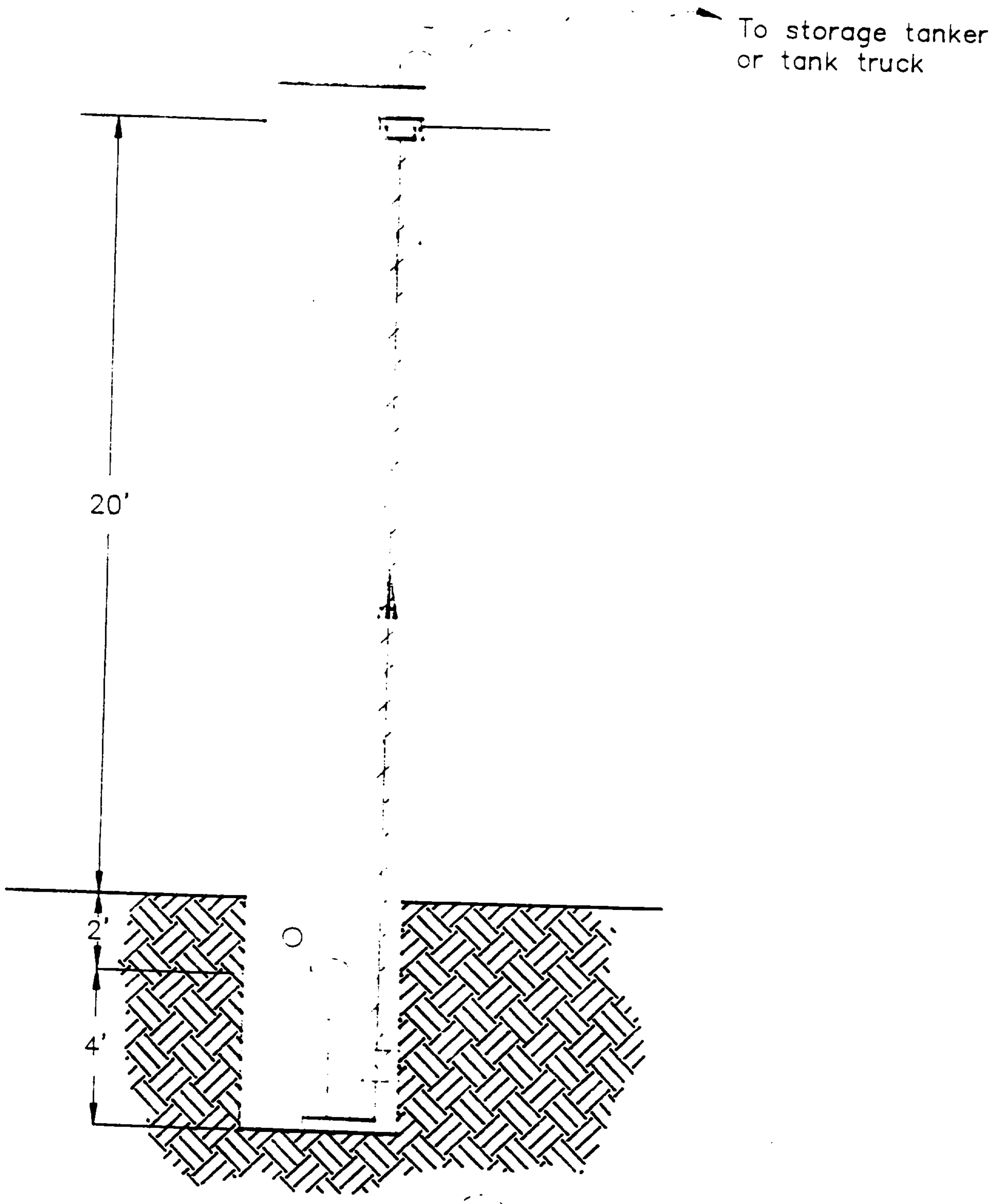
A second option is a slurry wall barrier. Even though the primary groundwater permeability through the clay itself is very low, the secondary permeability through the entire overburden is probably much higher due to desiccation fractures and micro silt lens. This barrier would provide adequate protection from contaminated groundwater for the surrounding community, and cost less than the fully trenched perimeter option. Since the geotechnical characterization found the soil's permeability to be 10^{-9} to 10^{-8} cm/sec, a near perfect situation existed for a soil-bentonite slurry wall. The site's soil mixed with approximately 1% bentonite would provide an adequate groundwater barrier along the perimeter of the site. Care must be taken to insure compatibility of the grout used in the slurry wall with the free hydrocarbon product.

Before an interceptor trench or any additional excavation is performed on or near the site, it is strongly recommended to do additional geotechnical testing and analysis of the soil. The purpose of this testing and analysis is to determine the necessity of sheeting and shoring an excavation and to provide the specifications for contractor's involved in the excavation. The sheeting and shoring may be necessary to prevent one or more of the following calamities due to lateral shifting soil: 1) the settling of the Burlington Northern Railroad tracks with as possible train derailment, 2) the falling of a backhoe into the collapsed trench, and 3) the sliding or tilting of the warehouse building from a shift in the footing. The lateral earth pressures of soil near the railroad tracks may be exacerbated by the frequent use of the tracks with the accompanied ground vibrations and train weight. Any settling of the railroad tracks would cause a huge liability to the Agency. In addition to testing soil, an analysis of the bedrock material is necessary to see if a backhoe can excavate the bedrock with a cutting bucket to the 2 foot depth (Figure 4). The use of a cutting bucket precludes the use of a power ram and, hence, the need for sending a laborer in the trench with the necessary sheeting and shoring to meet health and safety requirements.

The recommended sample types and their associated geotechnical tests including the number of samples required and approximate costs per test are listed:

- Split spoon samples are to be taken every 100 feet along the proposed location of the interceptor trench with blow counts using a 140 pound hammer with a 30 inch fall (Standard Penetration Resistance Test ASTM D1586).
    - Atterberg limits; 6 tests' $60/test;
    - Grain size distribution; 6 tests; $60/test;
    - Natural moisture content; 10 tests; $15/test;
    - Specific gravity; 6 tests; $40/test;
    - Sieve and hydrometer; 6 tests; $10/test.
- Shelby tube samples are to be taken on a as needed basis.
    - Unconsolidated undrained triaxial sheet test (UU test); 3 tests; $300/test;
    - Consolidated isotropic undrained sheet strength test (CIU test); 3 tests; $900/test.
- Bedrock borings.
    - Rock Quality Designation (RQD) test; as needed; performed on-site;
    - Percent recovery; as needed; performed on-site.

Figure 5. Manhole and Sump



LEGEND

○ 6 inch perforated PVC pipe from interceptor trench

Manhole and Sump

Surface

Soil/Bedrock Interface

Flexible Hose

Level activated pedistal type centrifugal pump with explosion proof motor

Check Valve

Pipe to flexible hose quick disconnect

1.5 inch stainless steel pipe with heat tracing

The objective of the geotechnical work is to determine the necessity of sheeting and shoring the interceptor trench. The construction contractor must detail the size of the structural members and the spacing of the sheet piles and cross bracings.

The interceptor trench has two costs associated with it; the cost of the trench system and the cost of the pump and storage system. Three costs were obtained from contractors for the 1,200 foot trench system: $38,500, $124,640, and $66,000. Only the last cost includes 40-hour certified training (OSHA 1910.120 requirements) and protective gear. These prices include no sheeting and shoring one manhole, no enveloping geofabric and on-site disposal of the excess soil. Additional manholes are $5,000 each installed. The installation of the geofabric requires people inside the trench and therefore shoring of the trench. According to one contractor, the cost of the geofabric installed will raise the price an additional $60,000. The estimated cost for the interceptor trench with sheeting and shoring and dewatering is $1,600,000 to $2,000,000 based on a similar site [10]. A non-traditional interceptor trench, called the biopolymer drain method, uses a biodegradable slurry, geotextile, pea gravel, and 30 inch well casings. The contractor estimated cost is $15.00 to $30.00 per foot square or $306,000 to $720,000 for the 1,200 foot run (see Map 11). The cost of the pump and a tanker truck storage system (as shown in Figure 5) is estimated at $3,000 per manhole plus monthly tanker truck rental (estimated at $4,000/per month rental). To eliminate this monthly cost, the existing tanks on the south side of the site may be able to be retrofitted to accept groundwater for storage and transfer. If the existing tanks are used, a pump with more head will be necessary. An overflow pipe should be set-up from the tanker truck back to the trench to prevent spills. The operation and maintenance of this groundwater recovery should be very low.

The contractor estimated cost of the slurry wall option around three sides of the site (850 feet in length) is $4.00 per square foot (length x depth) plus mobilization costs (approximately $30,000). Therefore, the 17,000 square foot proposed slurry wall would cost $115,000 which included a 17% contingency.

5.2 Soil

For the on-site surface samples, the heaviest contamination appears in two areas: 1) to the west of the warehouse, and, 2) the grassy area above Shed A. The former area is probably the location of much of the day-to-day activities of CCI, while the latter area was used to store drums. Below the surface, the VOC concentrations are generally uniform and low; an exception being the grassy area north of Shed A, which contains moderate concentrations of VOC, and the pit at the five-foot depth. The pit area is a significant source of VOC contamination for the site and surrounding area.

At the present time, little contamination has migrated from the CCI site into the residential areas located on the southern, western, and northern sides of the site. Offsite soil samples show no contamination north of the site, and low contamination south of the site near the tanks. On the west side of the CCI site, analyses of offsite samples indicate low concentration of VOC in the five-foot soil from the house just north of the site on Keeler Street, and from the house across Keeler Street (next to ERT 11) at the ten foot depth. These are the only residences that contained contaminated soil. Even though soil contamination has migrated little from the CCI site, Section 4.1 states and Tables 2, 3, and 4 show that the groundwater outside the site contains contaminants.

High concentrations of VOC were found offsite between the railroad track and the eastern site boundary at the 20 foot depth just at bedrock. This corresponds to pure product found in the bottom of Well ERT 2. Pure hydrocarbon product (predominantly trichloroethene and tetrachloroethene) has made its way from the site down into the soil column and appears to be running along the top of the bedrock. Any excavation or on-site remediation must take this interface into consideration when delineating the extent of contamination.

5.3 Building Decontamination

The CCI warehouse building should be decontaminated by either gritblasting or hydroblasting. Both techniques have been used with previous success at Superfund sites. Cleanup standards should be determined by risk assessment calculations; however, after decontamination, all samples should be below detection limits.

Gritblasting is a surface removal technique in which small abrasive particles are sprayed on the contaminated surface. The result is a uniform removal of approximately 0.5 to 1.5 cm of the contaminated surface [5]. The advantage of gritblasting is that it is a well developed technology and a widely used surface-removal technique. Equipment is readily available. The disadvantage is that large amounts of dust and debris are generated. The amount of dust generated can be kept to a minimum by the proper selection of the grit material. Common grit materials are steel pellets, sand, alumina, and glass bead. A simple vacuuming is recommended before and after gritblasting to remove all particulates.

Gritblasting was successfully used at the Tri-State Plating site, Columbus, Indiana under the auspices of the U.S. EPA Region V Remedial Project Manager (RPM), Bill Boland. The grit was used to remove chrome plating vapors from the interior walls. The building was sealed and placed under a negative pressure. The steel bead grit removed all paint and outer surfaces. Based on the success of the Tri-Chrome Plating site, gritblasting is recommended at the CCI site.

Hydroblasting involves the use of high pressure (500 to 15,000 psi) water to remove surface contamination. Hydroblasting removes 0.5 to 1.0 cm of concrete at a rate of 35 m^2/min (1). Chemical additives, such as solvents, surfactants, caustic solutions and acids, and abrasives can be incorporated with the high pressure water to enhance removal. The advantages of hydroblasting are ease of use, its low cost and the accessibility of equipment. The disadvantages of hydroblasting are that it may not be as effective in penetrating the surface as gritblasting and that the water may push the loose contaminants into less accessible areas.

Hydroblasting was successfully used at the United Chrome site, Corvallis, Oregon under the auspices of the U.S. EPA Region X RPM, Warren McPhillips. A high pressure water wash was used to remove chrome dust from a building with exposed trusses and beams. Hydroblasting effectively decontaminated 75% of the building. Plastic was placed on the floors and the contaminated water was vacuumed from the lined floor. Based on the success at the United Chrome site, hydroblasting is recommended as a second remedial option.

The small buildings (except flooring materials) should be placed in a municipal landfill. The concrete flooring of the small buildings should be gritblasted then placed in a municipal landfill; the wooden flooring should be incinerated at hazardous waste.

These building decontamination techniques require waste handling and special personnel protection. For both of the above techniques, waste disposal or treatment must be arranged before commencing operations. In addition, special protective clothing must be worn for gritblasting to protect the workers from the intrusive dust. Personnel should wear PVC hooded suits with the hoods duct-taped to the masks, in addition to the usual glove and boot taping.

Post building decontamination activities should include follow-up contamination testing. Wipe, sweep, and chip samples should be taken from the warehouse as per REAC SOP #2011 and analyzed for the contaminants mentioned in Section 4.3.

The cost of gritblasting all interior walls (approximately 12,000 feet squared) and floors (approximately 7,200 squared) of the warehouse is $44,000. This cost is based on a contractor quote and does not include disposal of the residuals or additional protective gear. A literature price for gritblasting estimates the cost at $127,675 (based on $53,863 per 8,000 feet square)[5]. If the residuals from the gritblasting contain organics, the residuals must be incinerated. See last paragraph in this section for incineration costs.

5.4 Remedial Technologies

Geotechnical testing found the soil at CCI site to have physical characteristics of a dry matrix with low hydraulic and pneumatic permeability. In addition, the highly plastic nature of the soil would not be suitable for remedial techniques such as in-situ biological remediation or in-situ soil flushing where an aqueous solution would be required to permeate through the soil column. Excavation techniques using liquid extractants, such as soil washing and soil leaching, would also fare poorly.

Bench-scale investigation found that ISV was not a viable treatment option. The reduction in VOC was low for an optimistic system such as the bench-scale unit. Less favorable reductions of VOC contaminants would result with a large scale ISV than the bench-scale unit. Therefore, the modest reductions of VOC during the bench-scale tests resulted in an unfavorable recommendation for this technology. The very low hydraulic and pneumatic permeability of the CCI soil also provided little hope for the potential use of ISV, although the scientific literature reports the removal of contaminants in soils with hydraulic conductivities ranging from 10^{-3} to 10^{-4} cm/sec [4]. The CCI site soil ranges 2 to 3 orders of magnitude less permeable. Therefore, the combination of the bench-scale test and the geotechnical test indicate that ISV will not be a viable treatment option at CCI.

Bench-scale tests conducted for LT3 resulted in an approximate 91% removal of VOC's which was less than that required to meet the 1 mg/kg level recommended for the site (> 99.5% removal required). The fact that acetone and 2-butanone exhibited residual concentration higher than in the untreated soil could be the result of either a chemical transformation or laboratory contamination. A sufficient quantity of soil was not available for additional tests to evaluate either of these theories. Thus, the remediation efficiency of LT3 cannot be accurately determined at this time. When the high residual concentration are factored out the removal efficiency is still slightly less than the recommended level. Since CCI is bordered on three sides by residential houses and LT3 is an excavated soil technology, the residents would have to be temporarily relocated or a plastic dome erected over the work area to eliminate or reduce the risks of fugitive VOC emissions during remediation. Since both of these options are costly, the performance of the LT3 system does not appear to warrant this additional treatment cost.

Map 5A contains the areas and volumes of soil that are proposed for excavation and incineration. The areas outlined in black are the maximum proposed for treatment based on the analytical results in Maps 5 through 8. The area in black totals approximately 13,000 yd^3. An alternative minimum amount of soil is also proposed for excavation/incineration. This minimum volume comprise just the highly contaminated soil around the "pit" area. The red lined area on Map 5A which designates the minimum volume totals 1,900 yd^3 of soil.

Incineration costs of the estimated 13,000 cubic yards of contaminated soil at the site ranged from $28,990,875 to $41,934,000. The cost includes soil excavation, trench supports, transportation, incineration, and landfilling. Soil excavation costs were $20,000. This price includes the cost of excavation, stockpiling, and refilling. The trench with the clean soil that lay over contaminated soil and the cost of excavation and loading (onto trucks) the contaminated soil. The cost of supporting the soil when excavated to bedrock (approximately 20 feet) was $496,000. An estimated 775 linear feet would have to be supported between the warehouse and the Burlington railroad and around the pit at a price of $640 per linear foot. The above excavation and support costs were obtained from the Dodge guide [7]. The cost of incineration at a fixed facility, according to a recent U.S. EPA publication, is $28,990,875. The $1375/ton price for the 20,709 tons comprising the 13,000 cubic yards included

transportation, incineration, and landfilling [8]. A price for the same services at a nearby fixed incinerator (currently under construction) is $1.00/pound or $41,418,000 [9]. Estimated incineration costs (based on the two previous estimation methods) for the 1,900 yd^3 minimum volume area are $4,161,713 and $6,053,400. The above costs do not account for clean fill which must replace excavated soil.

A proprietary remedial technology, the Detoxifier® by Toxic Treatments (USA) Inc. of San Francisco, CA, was explored. This technology performs in-situ hot air/steam cleaning of VOC contaminated soil. The technology appears to be applicable to the remediation of this site because it has an in-situ process which involves active mixing of the soil with hot air and steam to volatilize soil-bound VOC's. The vapors are captured at the surface and the organics removed. The chief advantage is that the surrounding community would not be at risk during site remediation. However, a bench-or pilot-scale unit was not available for evaluating the technical and economic feasibility of the technology for the remediation of the Chemical Commodities site. The company estimated the cost of soil remediation at $200 to $300 per cubic yard or $2,600,000 to $3,900,000 for 13,000 cubic yards or $380,000 to $570,000 per cubic yard for 1,900 cubic yard (plus additional mobilization costs for the minimum volume area).

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APPENDIX A

PHOTOVAC RESULTS

PHOTOVAC RESULTS - CHEMICAL COMMODITIES - [illegible]/7-12/89

All Results in mg/kg (ppm)

LOCATION	DEPTH(FT)	SAMPLE	RUN NO.	DCE	MEK	TCE	TOLUENE	PCE	M&P-XYL	O-XYLENE
ERT 1	2	B05271	20	ND	ND	1.48	ND	ND	ND	ND
	15	C05271	25	ND	ND	13.27	0.70	BMDL	ND	ND
	18	F05271	27	ND	ND	4.12	0.20	BMDL	ND	ND
ERT 2	1	A05270	44	ND	ND	ND	ND	ND	ND	ND
	1	A05270(DUP)	45	ND	ND	ND	ND	ND	ND	ND
	1	C05270	73	ND	ND	ND	ND	ND	ND	ND
	5	B05270	46	ND	ND	ND	ND	ND	ND	ND
	10	C05270	47	ND	ND	6.67	ND	1.46	ND	ND
	20	E05270	49	0.14	ND	17.79	ND	7.40	ND	ND
ERT 3	1	E05269	41	ND	ND	4.24	ND	7.58	ND	ND
	5	A05269	35	ND	ND	0.79	ND	0.97	ND	ND
	10	B05269	37	ND	14.36	12.58	BMDL	9.99	ND	ND
	15	C05269	39	ND	ND	4.70	ND	3.56	ND	ND
ERT 4	1	A05268	29	ND	ND	0.58	ND	ND	ND	ND
	5	B05268	31	ND	ND	0.20	ND	ND	ND	ND
	10	C05268	33	ND	ND	0.30	ND	ND	ND	ND
	15	G05268	72	ND	ND	ND	ND	ND	ND	ND
ERT 5	1	A05267	86	ND	ND	0.15	ND	ND	ND	ND
	5	B05267	88	ND	ND	BMDL	ND	ND	ND	ND
	10	C05267	90	ND	ND	BMDL	ND	ND	ND	ND
	15	G05267	92	ND	ND	0.23	ND	ND	ND	ND
	15	G05267(DUP)	94	ND	ND	0.29	ND	ND	ND	ND
ERT 6	1	A05251	280	ND	ND	0.48	ND	ND	ND	ND
	5	C05251	282	ND	ND	0.28	ND	ND	ND	ND
	10	E05251	284	ND	ND	0.11	ND	ND	ND	ND
	15	G05251	286	ND	ND	0.15	ND	ND	ND	ND
ERT 7	1	A04163	270	ND	ND	0.74	ND	ND	ND	ND
	5	C04163	272	ND	ND	2.37	ND	ND	ND	ND
	5	C04163(DUP)	274	ND	ND	2.61	ND	ND	ND	ND
	10	E04163	276	ND	ND	0.29	ND	ND	ND	ND
	15	G04163	278	ND	ND	BMDL	ND	ND	ND	ND
ERT 8	1	A05266	79	ND	ND	ND	ND	ND	ND	ND
	5	B05266	80	ND	ND	0.35	ND	ND	ND	ND
	10	D05266	82	ND	ND	0.76	ND	ND	ND	ND
	15	F05266	84	ND	ND	0.59	ND	ND	ND	ND
ERT 9	1	A05265	74	ND	ND	0.72	ND	ND	ND	ND
	5	C05265	76	ND	ND	ND	ND	ND	ND	ND
	10	E05265	77	0.41	ND	0.78	ND	ND	ND	ND

KEY;
- DCE - cis-1,2-DICHLOROETHYLENE
- MEK - METHYL ETHYL KETONE
- TCE - TRICHLOROETHYLENE
- PCE - TETRACHLOROETHYLENE
- ND - NOT DETECTED
- BMDL - BELOW METHOD DETECTION LIMIT(MDL=0.10 PPM)

All Results in mg/kg (ppm)

LOCATION	DEPTH(FT)	SAMPLE	RUN NO.	DCE	MEK	TCE	TOLUENE	PCE	m&p-XYL	o-XYLENE
ERT 10	1	A04164	261	ND	ND	0.30	ND	1.10	ND	ND
	5	C04164	263	ND	ND	1.22	ND	2.10	BMDL	ND
	10	E04164	265	ND	ND	0.78	ND	1.30	ND	ND
	15	G04164	267	ND	ND	0.82	ND	0.55	ND	ND
ERT 12	1	A05259	117	ND	ND	0.42	ND	ND	ND	ND
	5	C05259	119	1.16	ND	3.85	ND	BMDL	1.08	BMDL
	10	E05259	124	ND	ND	1.47	ND	ND	ND	ND
	15	G05259	126	ND	ND	1.62	ND	0.82	ND	ND
ERT 13	1	A05258	98	ND	ND	1.02	ND	ND	ND	ND
	5	C05258	105	53.82	ND	324.53	ND	15.90	ND	ND
	10	E05258	108	1.02	ND	29.28	ND	0.89	ND	ND
	15	G05258	110	0.25	ND	24.57	ND	0.87	ND	ND
	15	G05258(DUP)	112	0.30	ND	30.56	ND	1.07	ND	ND
	20	I05258	115	BMDL	ND	15.55	ND	0.74	ND	ND
ERT 14	1	A05264	168	ND	ND	0.95	ND	ND	ND	ND
	5	C05264	172	ND	ND	16.86	0.73	0.12	5.77	0.62
	10	E05264	174	ND	ND	7.38	ND	ND	ND	ND
	15	G05264	176	ND	ND	5.32	ND	ND	ND	ND
ERT 15	1	A05263	160	ND	ND	0.99	ND	0.14	ND	ND
	5	C05263	162	0.17	ND	1.16	2.39	2.33	ND	ND
	10	E05263	164	ND	ND	ND	ND	ND	ND	ND
	10	E05263(DUP)	166	ND	ND	ND	ND	ND	ND	ND
	15	G05263	167	ND	ND	ND	ND	ND	ND	ND
ERT 16	1	A05262	148	ND	ND	0.76	1.30	4.99	2.26	0.79
	5	C05262	150	ND	ND	4.28	ND	ND	ND	ND
	10	E05262	152	1.45	ND	11.28	ND	4.66	ND	ND
	15	G05262	154	BMDL	ND	12.12	ND	7.54	0.20	ND
ERT 17	1	A05261	138	0.30	ND	1.56	1.11	4.44	0.54	ND
	5	C05261	140	BMDL	ND	1.04	ND	2.25	ND	ND
	5	C05261(DUP)	142	ND	ND	0.88	ND	2.41	ND	ND
	10	E05261	144	ND	ND	3.04	ND	6.38	ND	ND
	15	G05261	146	ND	ND	BMDL	ND	0.82	ND	ND
ERT 18	1	A05260	246	0.50	ND	BMDL	ND	ND	ND	ND
	5	C05260	248	ND	ND	0.60	ND	ND	ND	ND
	10	E05260	250	ND	ND	2.45	ND	ND	ND	ND
	10	E05260(DUP)	252	ND	ND	2.15	ND	ND	ND	ND
	15	G05260	254	ND	ND	ND	ND	ND	ND	ND
ERT 19	1	A05257	235	ND	ND	ND	ND	ND	ND	ND
	5	C05257	240	ND	ND	ND	ND	ND	ND	ND
	10	E05257	242	ND	ND	4.12	ND	ND	ND	ND
	15	G05257	244	ND	ND	0.37	ND	ND	ND	ND

KEY:
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MEK - METHYL ETHYL KETONE
TCE - TRICHLOROETHYLENE
PCE - TETRACHLOROETHYLENE
ND - NOT DETECTED
BMDL - BELOW METHOD DETECTION LIMIT(MDL=0.10 PPM)

All Results in mg/kg (ppm)

LOCATION	DEPTH(FT)	SAMPLE	RUN NO.	DCE	MEK	TCE	TOLUENE	PCE	M&P-XYL	O-XYLENE
ERT 20	1	A05256	225	ND	ND	5.79	413.33	ND	157.27	76.36
	5	C05256	229	ND	ND	2.98	4.76	ND	ND	ND
	10	E05256	231	ND	ND	10.98	0.18	1.30	ND	ND
	15	G05256	233	ND	ND	5.43	ND	2.35	ND	ND
ERT 21	1	A05255	215	ND	ND	0.48	ND	ND	ND	ND
	5	C05255	217	0.42	ND	10.92	1.33	ND	3.00	0.97
	10	E05255	219	ND	ND	15.94	ND	ND	0.50	0.11
	15	G05255	221	ND	ND	3.80	ND	ND	ND	ND
ERT 22	1	A05254	206	ND	ND	BMDL	ND	ND	ND	ND
	5	C05254	208	0.52	ND	6.78	BMDL	0.41	4.02	0.04
	10	E05254	211	ND	ND	2.24	BMDL	ND	0.78	0.19
	15	G05254	213	ND	ND	1.12	ND	ND	ND	ND
ERT 23	1	A05253	192	ND	ND	0.16	ND	0.14	ND	ND
	5	C05253	194	ND	ND	3.04	ND	BMDL	ND	ND
	5	C05253(DUP)	196	ND	ND	3.28	ND	BMDL	ND	ND
	10	E05253	198	ND	ND	6.51	ND	0.81	ND	ND
	15	G05253	202	ND	ND	7.71	ND	2.75	ND	ND
ERT 24	1	A05252	183	ND	48.72	5.43	0.10	5.26	ND	ND
	5	C05252	185	ND	ND	6.03	0.17	2.02	ND	ND
	10	E05252	187	ND	ND	10.69	BMDL	1.76	ND	ND
	15	G05252	189	ND	ND	3.65	ND	2.57	ND	ND
ERT 25	1	A04169	308	ND	ND	ND	ND	ND	ND	ND
	5	D04169	309	ND	ND	ND	ND	ND	ND	ND
	10	G04169	310	ND	ND	ND	ND	ND	ND	ND
	15	J04169	311	ND	ND	ND	ND	ND	ND	ND
ERT 26	1	A04168	301	ND	ND	ND	ND	ND	ND	ND
	5	D04168	302	ND	ND	ND	ND	ND	ND	ND
	10	G04168	305	ND	ND	ND	ND	ND	ND	ND
	15	J04168	306	ND	ND	0.28	ND	ND	ND	ND
ERT 27	1	A04165	290	ND	ND	ND	ND	ND	ND	ND
	5	C04165	291	ND	ND	ND	ND	ND	ND	ND
	10	E04165	292	ND	ND	ND	ND	ND	ND	ND
	15	G04165	293	ND	ND	ND	ND	ND	ND	ND
ERT 28	1	A04167	294	ND	ND	ND	ND	ND	ND	ND
	1	A04167(DUP)	295	ND	ND	ND	ND	ND	ND	ND
	5	D04167	296	ND	ND	ND	ND	ND	ND	ND
	10	G04167	297	ND	ND	ND	ND	ND	ND	ND
	13	J04167	298	ND	ND	1.47	ND	ND	ND	ND

KEY:
- DCE - cis-1,2-DICHLOROETHYLENE
- MEK - METHYL ETHYL KETONE
- TCE - TRICHLOROETHYLENE
- PCE - TETRACHLOROETHYLENE
- ND - NOT DETECTED
- BMDL - BELOW METHOD DETECTION LIMIT(MDL=0.10 PPM)

APPENDIX B

WELL AND SOIL BORING LOGS

MONITOR WELL INSTALLATION

Client: EPA Job No.: ______ Date: ______ Well No.: ______

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
0		GRAVEL FILL	
1		DARK GRAY CLAY → MED GRAY HARD PACKED CLAY	
2			
2.5		GRAVEL FILL	
3		MED-DARK GRAY HARD PACKED CLAY	
4			
5			
6			
6.5		LGT GRAY → BRN CLAY	
7			
8			
9			
10		LIGHT TAN - BENTONITE CLAY	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date Drilled: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: 18 Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		DAMP CLAY, but no water zones.	
11			
12			
13			
14			
15		Brown to gray clay; maybe limestone	
17			
18		REGOLITH	
		BEDROCK → FISSILE SHALE?	
		5' 0.010 slot screen 2" diameter 13' PVC csg	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date D. # [illegible] Well No.: [illegible]

Site: [illegible] Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Rd. fill soaked w/ oil	
A		Clay	
1			
2		Tan Gray Clay	
3			
4		B	
5		Tan → Gray mottled clay	
6			
7			
8			
9			
10			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: ____ Job No.: ____ Date ____ Well No.: ____

Site: ____ Elevation: Pad ____ Top of Steel Casing: ____

Total Depth: ____ Casing Size & Type: ____ Screen Size: ____

Comments: ____

Depth	Symbol Stratigraphy	Sample Description	Completion Data
			Bgrino,
11			
12			
13			
14			
15		@ GRAY/RED mottled clay	
16		< 5268 G	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: ______ Date: 8/8 Well No.: [illegible]

Site: [illegible] Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: Boring [illegible]

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Topsoil	
1		C 5267A Dark brown Clay	
2			
3			
4			
5		C 5267B Light brown - gray Clay mottled	
6			
7			
8			
9			
10		C 5267 CDEF Iron stain red Clay	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA
Job No.:
Date Drilled: 3/8
Well No.:

Site:
Elevation: Pad
Top of Steel Casing:

Total Depth:
Casing Size & Type:
Screen Size:

Comments: [illegible]

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Mottled red/brn	
1		Clay	
12			
13			
14			
15			
16		← 5267 G	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: ____ Date: 7/7/87 Well No.: E1

Site: ____ Elevation: Pad ____ Top of Steel Casing: ____

Total Depth: ____ Casing Size & Type: ____ Screen Size: ____

Comments: ____

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11		Tan -> Gray Clay	
12		< D	
13			4" Boring
14		Tan -> Gray Clay	2" Csg
15		5 ft screen	
16		15 ft Csg 1 ft SU GRAVEL PACK TO 13.5' from bottom	
17		2 ft of pellets	
18		< Regolith	
19		< TD 19.5 LS at 19.5	
20			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No: [illegible] Date: 3/9 Well No: [illegible]

Site: [illegible] Elevation: Pad ___ Top of Steel Casing: ___

Total Depth: ___ Casing Size & Type: ___ Screen Size: ___

Comments: ___

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Gravel fill from RR Oil stained muck	4" boring
1		Gray mottled fossiliferous clay	
2			
3			
4			
5		5269 A	
6			
7			
8			
9		Gray mottled clay - fossil.	
10		5269B	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: __________ Job No.: __________ Date: __________ Well No.: __________

Site: __________ Elevation: Pad __________ Top of Steel Casing: __________

Total Depth: __________ Casing Size & Type: __________ Screen Size: __________

Comments: __________

Depth	Symbol Stratigraphy	Sample Description	Completion Data
12		Brown-red hard packed clay	
13			
14			
15		5269 C	
16			
17			
18			
19			
20			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date D... 5/4 Well No.: [illegible]

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments: on N side of site - near [illegible] parking lot

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Topsoil	Boring - no well
1		< 5268A	
		< Gray/brown sandy mottled clay	
2			
3			
4		Red/Gray Clay	
5		< 5268 B	
6			
7			
8			
9			
10		A/A <5268 C, D, E, F	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA-? Job No.: Date Drl: 7 ? Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Black [illegible] / Clay	
1		5251A B	
5		Brn Clay C, D	
		GRAY/BRN CLAY	
10		E, F	
15		G, H	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Grn/Black Clay	
1		4163 A, B	
		Gray Clay	
5		C, D	
10		E, F	
15		G, H	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date Drilled: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
0		Topsoil / Clay	
1		< 5266A	
2			
3			
4			
5		< 5266 B, C GRAY/Brown mottled Clay	
6			
7			
8			
9			
10		< 5266 D, E GRAY brn mottled Iron stain Clay	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- ____ Job No.: ____ Date & [illegible] 1/8 ____ Well No.: [illegible]

Site: ____ Elevation: Pad ____ Top of Steel Casing: ____

Total Depth: ____ Casing Size & Type: ____ Screen Size: ____

Comments: ____

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14		Gray / brown, mottled [illegible]. [illegible] clay.	
15		< 5266 F+6	
16			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- Job No.: ______ Date Drilled: ______ Well No.: [illegible]

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		dark gray, clay	
1		C 5265 A 5 yellow/tan clay	
2			
3			
4		dark stain - odor	
5		5625 CD gray clay w/ black mottled stain	
6			
7		0 Hnu	
8			
9		Clean clay again	
10		C 5265 E slight stain, odor 0 Hnu	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- Job No.: Date Drilled: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14			
15		Red Brn Clay <5265 = ,6	
16			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA   Job No.: ______   Date: 7/9   Well No.: [illegible]

Site: ______   Elevation: Pad ______   Top of Steel Casing: ______

Total Depth: ______   Casing Size & Type: ______   Screen Size: ______

Comments: [illegible]

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Topsoil - Black [illegible] Clay with Topsoil	4" Boring.
1		5259 A, B	
2			
3			
4			
5		5259 C, D Crumbly topsoil / clay / fill material	
6			
7		Clay	
8			
9			
10		MS/MSD 5259 E, F, I, J, K Gray/Brn Clay	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: ______ Job No.: ______ Date: ______ Well No.: ______

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Grey Brn Clay	
11			
12			
13			
14			
15		K5059 G, H	
16			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date: 8/5 Well No.: 52

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Topsoil / fill	Boring
1		< 5258 A, B	
2			
3			
4			
5		5258 C D 150 units HNu	
		Topsoil / fill	
6			
7			
8			
9			
		50-100 units HNu	
10		GRAY / Brn Compact Clay 5258 E, F	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA ______ Job No.: ______ Date: 5 7 Well No.: ______

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14		150 units 1HY4	
15		← 5259 G,H gray brown clay	
16			
17			
18			
19			
20		← 5298 I, J TD=20'	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: ______ Date Drilled: 4/1 Well No.: ______

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
0		Top soil / roots etc	
1		5264 A, B	
2		Hard Packed Clay	
3			
4			
5		← 5264 C, D Gray / Brown Clay	
6			
7			
8			
9			
10		← 5264 E, F [illegible] gray Clay	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No: Date Drilled: [illegible] Well No: [illegible]

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14			
15		F-64 G,H Gray Brown [illegible] Clay T.D = 15'	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- Job No.: Date Dr: 5/7 Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Topsoil / fill - roots etc.	
1		5263 A,B	
2			
3			
4		HNU - 50-75 units	
5		5263 CD Gray Clay	
6			
7			
8			
9			
10		5263 EF Hnu 50-75 units	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date D: 2/9 Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14			
15		< 5263 6,14	
		Red/Gray Clay	
16			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: ______ Job No.: ______ Date ______ Well No.: ______

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Black Stain Topsoil	
1		5262 A, B	
2			
3		100 mm	
4		Brn Clay	
5		C 5262 C	
6			
7			
8			
9			
10		5262 E, F GRAY CLAY	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- Job No.: Date Drilled: Well No.: EK-T-[illegible]

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13		Brn/Grey Clay	
14			
15		5262 G 1t	
		TD=15'	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- Job No.: ______ Date Dr: 7/6 Well No.: ______

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
0		BLACK STAIN TOPSOIL	
1		S261 A"	
2			
3			
4		HNU 40 m.	
5		S261 C D Gray/Black stain soil	
6			
7			
8			
9			
10		S261 E F gray Clay - Clean ?	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA— Job No.: Date Drl.: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14			
15			
16			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- Job No.: ____ Date Dr: ~/~ Well No.: —

Site: ____ Elevation: Pad ____ Top of Steel Casing: ____

Total Depth: ____ Casing Size & Type: ____ Screen Size: ____

Comments: ____

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		gray/tan clay -	
11		brown stain	
		Cohesive	
12			
13			
14			
15		5260 I, J	
		TD = 15	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA | Job No.: | Date Drilled: 7/9 | Well No.: E, T, E

Site: | Elevation: Pad | Top of Steel Casing:

Total Depth: | Casing Size & Type: | Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Pavement	
1		black stain clay 5260 17 3	
2			
3			
4			
5		< 5260 ED	
6		gray brown clay	
7			
8			
9			
10		< 5260 E.F	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA-[illegible] Job No.: ______ Date Drill: [illegible] Well No.: [illegible]

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
0		Fill - Black stained Clay	
1			
2			
3			
4			
5		5157 [illegible] 5.0 [illegible] Black stained Clay	
6			
7			
8			
9			
10		5157 [illegible] Gray/[illegible] Clay	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date D: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14			
15			
16			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA-- Job No.: Date Drilled: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		[illegible]	
1		[illegible]	
2			
3			
4			
5		[illegible]	
6			
7			
8			
9			
10		[illegible]	
		Gray Clay	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA[illegible] Job No.: ______ Date Drl.: ______ Well No.: [illegible]

Site: ______ Elevation: Pad ______ Top of Steel Casing: ______

Total Depth: ______ Casing Size & Type: ______ Screen Size: ______

Comments: ______

Depth	Symbol Stratigraphy	Sample Description	Completion Data
11			
12			
13			
14		[illegible]	
15		[illegible]	
		TD= 1[illegible]'	
16			

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA- Job No: Date Drilled: Well No:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Black [illegible]	
1		< [illegible]	
2			
3		< [illegible] Clay	
4			
5		< CP	
6			
9			
10		< E/F	
14			
15		< G/H	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No.: Date Dr: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Black Topsoil	
1		[illegible]	
		Red/Gray Clay	
5		[illegible] Gray Clay	
10		[illegible] Gray Clay	
15		6, [illegible]	
17.5'		[illegible]	
20		[illegible]	
		TD = 20'	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA Job No: Date Drilled: Well No:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Black Clay, [illegible]	
1		[illegible] A, B	
5		[illegible] Gray Clay	
10		EF	
		[illegible] 100 units	
		GRAY CLAY	
15		< G. H	
		TD = 15'	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: EPA-ERT Job No.: Date Drilled: Well No.:

Site: Elevation: Pad Top of Steel Casing:

Total Depth: Casing Size & Type: Screen Size:

Comments:

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		BLACK CLAY / FILL	
1		CAB Red / Gray Clay w/ lignite	
5		CCD	
10		CEE	
		HNU 75 units	
15		CGH	

WESTON REAC
EDISON, NJ

MONITOR WELL INSTALLATION

Client: __ Job No.: __ Date: __ Well No.: __

Site: __ Elevation: Pad __ Top of Steel Casing: __

Total Depth: __ Casing Size & Type: __ Screen Size: __

Comments: Ear

Depth	Symbol Stratigraphy	Sample Description	Completion Data
		Asphalt gravel [illegible] = 0'	
		[illegible] Br [illegible] [illegible] [illegible] sand, plastic	
5			samples E487 B-E.
			rec = 18", pushed w/ cathead
15			Grab sample from end of auger
20		END OF BORING @ 19'	Refusal @ 19'
25			

Bct ERT 1'&2

WESTON REAC
EDISON, NJ

APPENDIX C

WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY REPORT

Inter-Office Memorandum

WESTON

TO: Robert Evangelista
REAC

FROM: Russell Frye

DATE: 13 October 1989

PROJECT: REAC/CHEMICAL COMMODITIES

W.O. NO.: 3347-02-01-1288

SUBJECT: SUMMARY OF ISV PHASE I AND LT[3] BENCH-SCALE STUDIES TEST DATA AND RESULTS

ACTION:

ISV PHASE I TEST RESULTS

A summary of the ISV Phase I test data and results is presented in Table 1. Figure 1 graphically illustrates the total VOC concentration and percent removal over the time of aeration. Initially the total VOC concentration in the untreated soil was 248 mg/kg. After 2.7 hours or 7,546 cubic feet of aeration, the total VOC concentration in the soil was reduced to 221 mg/kg for 11% removal. After 42 hours or 106,434 cubic feet of aeration, the total VOC concentration in the soil was reduced to 43 mg/kg for a final removal of 83% total VOC's.

Although these results show a potential for ISV treatment, the physical characteristics of the soil are not amenable to the ISV process. The soil type is a cohesive highly plastic clay ranging from 80 to 98% fines with a hydraulic permeability less than 4 x 10^{-4} cm/sec. In general, coarse soils with hydraulic permeabilities greater than 10^{-3} cm/sec are most amenable to ISV treatment.

These results are based on the calculated average VOC concentrations measured for duplicate grab samples collected during the initial, intermediate and final points during the ISV test run. The concentration of each VOC specie measured in each soil sample collected is presented in Table 2 along with the calculated average, and standard deviation. Individual VOC specie removals are also presented. All concentrations are reported in milligram per kilogram of dry soil. Figure 2 illustrates the distribution of VOC specie and concentration at the initial, intermediate (2.7 hours) and final (42 hours) time of aeration.

Only VOC's measured at or above the analytical detection limit of the initial soil sample are reported in Tables 1 and 2 and Figures 1 and 2. The detection limit was 2 mg/kg for the initial soil grab analysis of the ISV Phase I Bench-Scale study. Several other compounds were detected either below (not statistically accurate) the Initial Soil detection limit or were detected in the Intermediate and Final soil samples which were analyzed at a detection limit of 0.1 mg/kg. These compounds were as follows:

cis 1,2 Dichloroethane
Chloroform
1,1,1 - Trichloroethane
1,2 - Dibromo-3-Chloropropane

The original laboratory report presented by the REAC/EPA contract laboratory is included as Attachment 1.

Additionally, the ISV Phase I test run data and graphs illustrating the process temperatures and relative humidity measured and the off-gas total VOC concentration measured as methane during the test run period are included in Attachment 2.

LT^3 TEST RESULTS

A summary of the LT^3 test data and results is presented in Table 3. Figure 3 graphically illustrates the total VOC concentration and percent removal after each pass as a function of retention time and discharge temperature. Initially the total VOC concentration in the untreated soil was 228 mg/kg. After 20 minutes retention time and at a discharge temperature of 237°F (Pass 1) the total VOC concentration was reduced to 48 mg/kg or 79% removal. After 40 minutes retention time at a discharge temperature of 333°F (Pass 2) the total VOC concentration was reduced to 33 mg/kg or 86% removal. After 60 minutes retention time at a discharge temperature of 408°F (Pass 3) the total VOC concentration was reduced to 21 mg/kg or 91% removal.

Note that acetone and 2-butanone increased in concentration after the first pass and may possibly represent laboratory contamination. The processed soil is very dry and hydroscopic and can readily adsorb common laboratory contaminants from the air. Assuming no acetone or 2-Butanone was removed after Pass 1 from the soil a "corrected" total VOC concentration and percent removal was calculated and presented in Table 3 as "Total VOC's corrected" and "Total VOC Removal, % corrected", respectively. This resulted in a final Total VOC concentration of 5 mg/kg or 98% removal. Figure 4 illustrates the corrected total VOC concentration and percent removal as function of retention time and discharge temperature.

These results indicate a good potential for LT^3 treatment of this soil/contaminate matrix. Even though the final total VOC concentration was above 1 mg/kg, the full scale process could be modified to include extended retention times and/or prewashing the soil with suitable solvents.

The results are based on the calculated average VOC concentrations measured for duplicate grab samples collected from the untreated (Initial) soil, and the 1^{st}, 2^{nd} and 3^{rd} pass discharge soils. The concentration of each VOC specie measured in each soil sample collected is presented in Table 4 along with the calculated average and standard deviation. Individual VOC specie removals are also presented. All concentrations are reported in milligrams per kilogram of dry soil. Figure 5 illustrates the distribution of VOC specie and concentration of the initial, 1^{st} Pass, 2^{nd} Pass and 3^{rd} Pass soils.

Only VOC's measured at or above the analytical detection limit of the initial soil sample are reported in Tables 3 and 4 and Figures 3, 4 and 5. The detection limit was 0.1 mg/kg for the initial soil grab analysis of the LT^3 bench-scale study. Several other compounds were detected either below (not statistically accurate) the initial soil detection limit or were detected only the 2^{nd} and 3^{rd} passes which were also analyzed at a detection limit of 0.1 mg/kg. These compounds were as follows:

Benzene
sec-Butylbenzene
p-Isopropyltoluene

Pass 1 was analyzed at a detection limit of 0.001 mg/kg which resulted in the detection (above or below the detection limit) of numerous VOC's. This can be identified in the original laboratory report presented by the REAC/EPA contract laboratory included as Attachment 1.

Additionally, the LT^3 test run data and a graph illustrating process feed rate, soil moisture content, and unit weights measured during the test run are presented in Attachment 3.

TABLE 1

WE[illegible]N ENVIRONMENTAL TECHNOLOGY [illegible]ORATORY

REAC/CHEMICAL COMMODITIES

SUMMARY OF BENCH-SCALE ISV-PHASE 1 TEST RESULTS

Test Data			
Sample	Initial	Intermediate	Final
Date	8/14/89	8/14/89	8/16/89
Time	14:20	17:00	9:00

Aeration Data			
Total Aeration Time, hr	0	2.7	42.2
Total Air Volume, cf	0	7546	106434
Ave. Velocity, fpm	6008	3410	3042
Ave. Flow Rate, wacfm	83	47	42
Ave. Press. Drop, " H2O	2.9	1.2	0.8
Ave. Temperature, F	98	92	90
Ave. Relative Hum., %	45	51	55
Ave. VOC Conc., ppm/v	220	4.2	0.3

Soil Physical Data			
Wet Weight, lb	23.75	22.39	19.23
Dry Weight, lb	19.00	18.70	18.37
Column Diameter, inches	12.0	12.0	12.0
Column Height, inches	6.0	5.9	5.8
Volume, cf	0.393	0.386	0.380
Moisture Content, %	25.0	19.8	4.7
Wet Unit Weight, pcf	60.5	57.9	50.7
Dry Unit Weight, pcf	48.4	48.4	48.4
Specific Gravity	2.7	2.7	2.7
Void Ratio	2.5	2.5	2.5
Degree of Saturation, %	27.2	21.5	5.1

Soil VOC Concentrations, mg/kg			
Methylene Chloride	9.15	9.43	0.35
1,2-Dichloroethane	2.189	0.000	0.135
Trichloroethane	23.450	21.330	7.050
Toluene	54.560	37.460	1.813
Tetrachloroethane	3.523	7.060	0.960
Chlorobenzene	0.639	1.067	0.038
Ethylbenzene	5.585	4.181	0.255
p&m-Xylene	28.422	19.403	1.562
o-Xylene	11.635	7.268	0.760
1,1,2,2-Tetrachloroethane	53.992	65.355	14.200
1,2,4-Trimethylbenzene	1.230	2.815	0.162
1,3-Dichlorobenzene	0.603	0.226	0.172
1,4-Dichlorobenzene	1.497	1.684	0.740
1,2-Dichlorobenzene	17.897	20.645	9.679
Naphthalene	1.100	0.870	0.500
Acetone	10.840	9.080	0.250
2-Butanone	3.259	3.494	0.032
4-Methyl-2-Pentanone	18.445	9.557	3.915
Total VOC's	248.014	220.923	42.570
Total VOC Removal, %	--	10.92	82.84

WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY

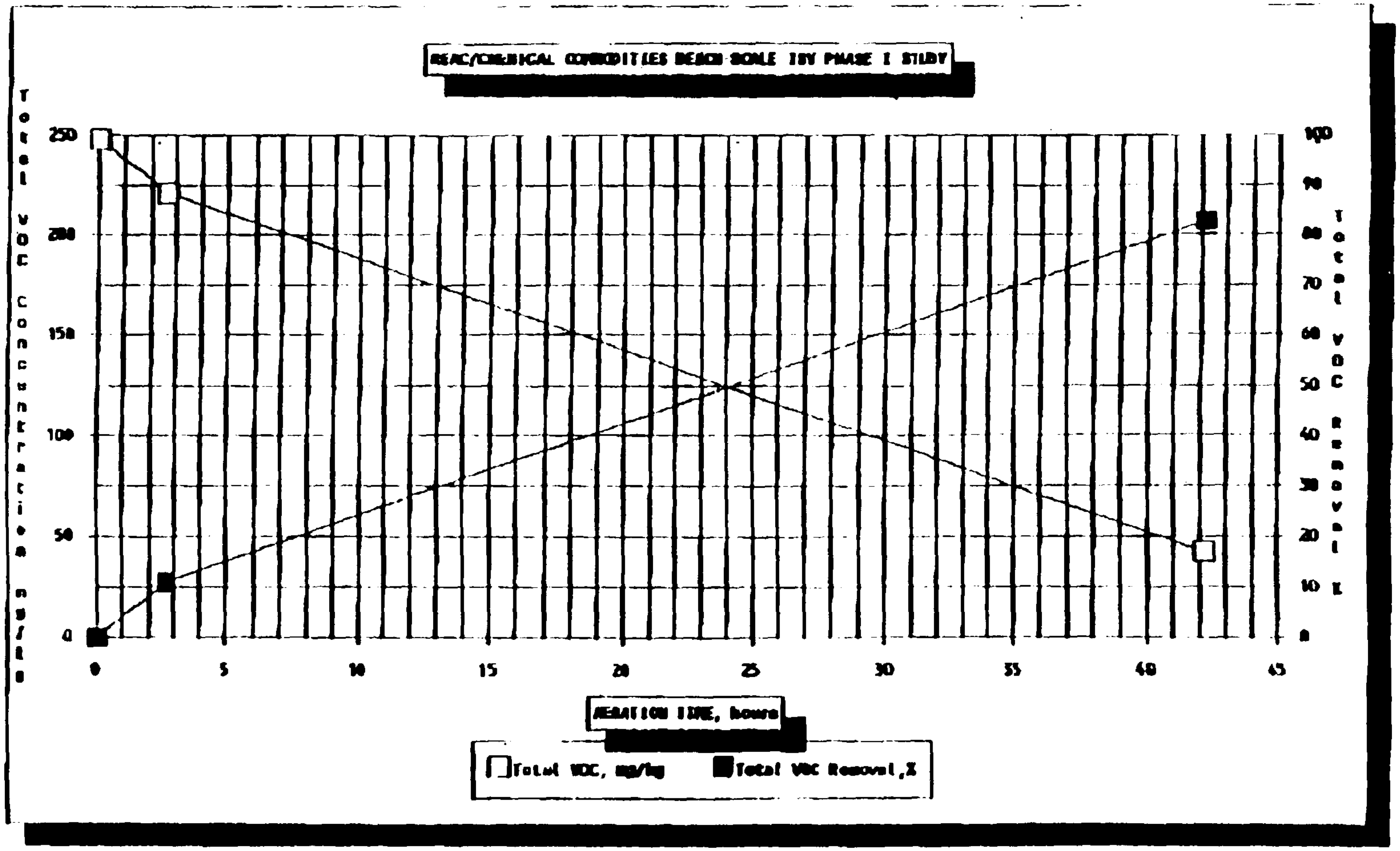


FIGURE 1 : Total VOC Concentration and Removal versus Aeration Time

TABLE 2

WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY

REAC/CHEMICAL COMMODITIES

SUMMARY OF BENCH-SCALE ISV-PHASE 1 VOC ANALYTICAL RESULTS

Volatile Organic Compound	Initial VOC Conc., mg/kg Sample A	Initial Sample B	Initial Average	Initial Stand. Dev.	Intermediate VOC Conc., mg/kg Sample A	Intermediate Sample B	Intermediate Average	Intermediate Stand. Dev.	Interm. Removal %	Final VOC Concentration, mg/kg Sample A	Final Sample B	Final Average	Final Stand. Dev.	Final Removal %
Methylene Chloride	9.220	9.080	9.150	0.099	9.620	9.240	9.430	0.269	-3.06	0.200	0.500	0.350	0.212	96.17
1,2-Dichloroethane	1.811	2.566	2.189	0.534	0.000	0.000	0.000	0.000	100.00	0.165	0.106	0.135	0.043	93.86
Trichloroethene	12.700	34.200	23.450	15.203	20.920	21.744	21.330	0.580	9.04	9.200	6.900	7.050	3.041	69.94
Toluene	11.000	98.120	54.560	41.603	35.440	39.480	37.460	2.857	31.34	2.226	1.400	1.813	0.584	96.68
Tetrachloroethene	3.478	3.568	3.573	0.064	7.130	6.980	7.060	0.112	-100.38	1.201	0.718	0.960	0.342	72.76
Chlorobenzene	0.000	1.278	0.639	0.904	0.947	1.187	1.067	0.170	-66.98	0.045	0.030	0.038	0.011	94.13
Ethylbenzene	1.131	10.039	5.585	6.299	3.859	4.502	4.181	0.455	25.15	0.311	0.199	0.255	0.079	95.43
p/m-Xylene	5.962	50.882	28.422	31.763	17.799	21.007	19.403	2.268	31.73	1.826	1.280	1.562	0.512	94.50
o-Xylene	2.531	20.739	11.635	12.875	6.730	7.806	7.268	0.761	37.53	0.956	0.564	0.760	0.277	93.47
1,1,2,2-Tetrachloroethane	47.710	60.273	53.992	8.865	67.791	62.919	65.355	3.445	-21.05	12.600	15.800	14.200	2.263	73.70
1,2,4-Trimethylbenzene	0.000	2.459	1.230	1.739	2.620	3.009	2.815	0.275	128.91	0.186	0.138	0.162	0.034	86.82
1,3-Dichlorobenzene	0.631	0.575	0.603	0.040	0.452	0.000	0.226	0.320	62.52	0.190	0.153	0.172	0.026	71.56
1,4-Dichlorobenzene	0.598	2.396	1.497	1.271	1.771	1.596	1.684	0.124	-12.46	0.808	0.672	0.740	0.096	50.57
1,2-Dichlorobenzene	6.925	28.868	17.897	15.516	21.363	19.927	20.645	1.015	-15.36	10.518	8.840	9.679	1.187	45.92
Naphthalene	0.640	1.560	1.100	0.651	0.840	0.900	0.870	0.042	20.91	0.600	0.400	0.500	0.141	54.55
Acetone	9.960	11.720	10.840	1.245	8.860	9.300	9.080	0.311	16.24	0.400	0.100	0.250	0.212	97.69
2-Butanone	2.265	4.252	3.259	1.405	4.392	2.596	3.494	1.270	-7.23	0.000	0.063	0.032	0.045	99.08
4-Methyl-2-Pentanone	11.397	25.493	18.445	9.967	9.723	9.391	9.557	0.235	48.19	4.238	3.591	3.915	0.457	78.78
Total VOC's	127.959	368.068	248.014	169.785	220.264	221.580	220.923	0.929	10.92	45.768	39.372	42.570	4.523	82.84

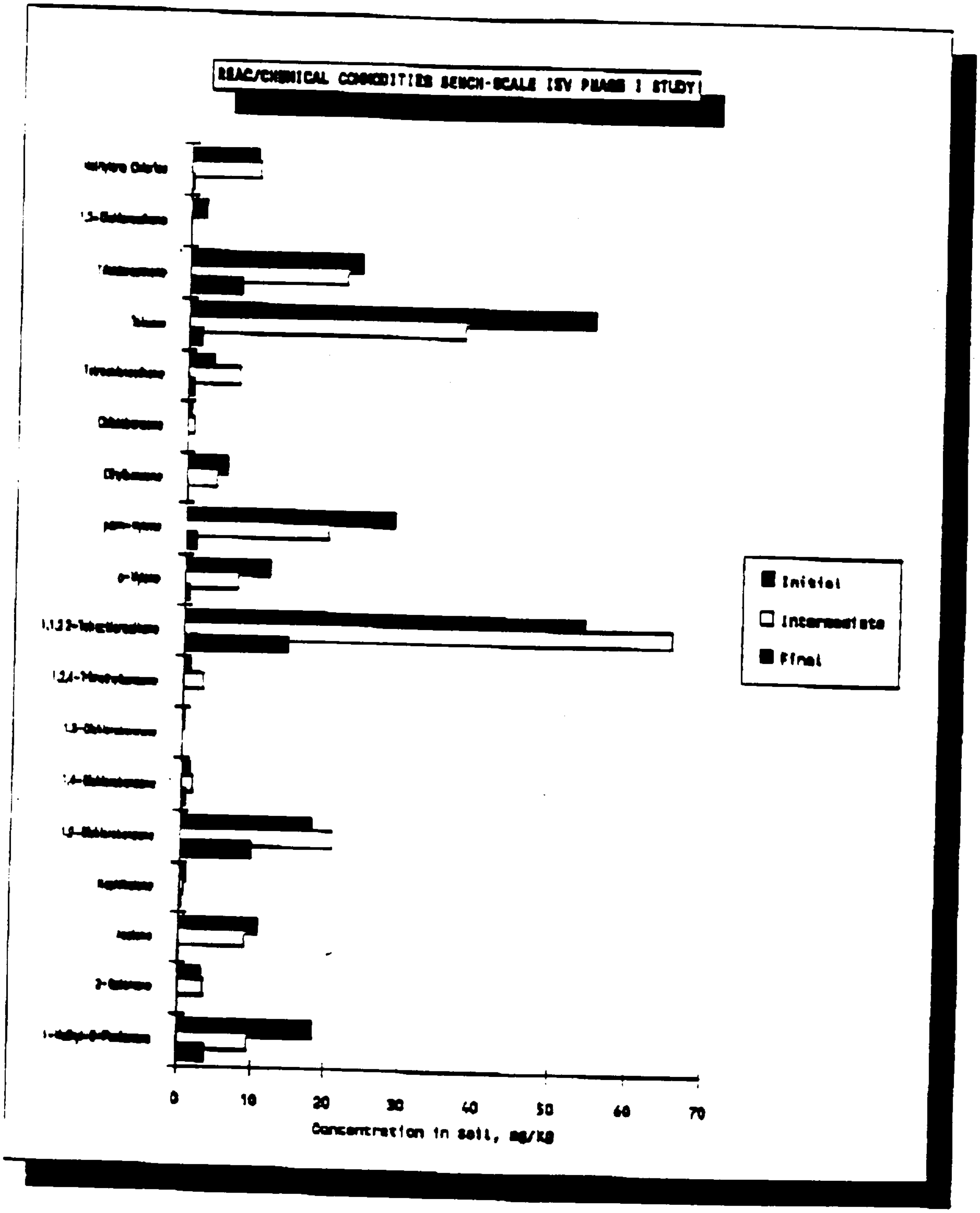


FIGURE 2 : VOC Distribution by Specie and Concentration

TABLE 3

WE _N ENVIRONMENTAL TECHNOLOGY LABORATORY

REAC/CHEMICAL COMMODITIES SUMMARY OF BENCH-SCALE LT3 TEST RESULTS				
Test Data				
Sample	Initial	Pass 1	Pass 2	Pass 3
Average Discharge Temp., F	--	237	333	408
Pass Retention Time, minutes	--	20	20	20
Total Retention Time, minutes	0	20	40	60
Operations Data				
Average Screw Speed, rpm	1.8	1.7	1.7	--
Total Feed Weight, lbs	35.9	27.0	22.8	--
Total Feed Time, minutes	80	40	30	--
Average Feed Rate, lb/hr	26.9	40.5	45.6	--
Soil Physical Data				
Moisture Content, %	26.1	2.3	0.0	0.0
Total Solids, %	79.3	97.8	100.0	100.0
Wet Unit Weight, pcf	62.0	64.9	67.5	68.9
Dry Unit Weight, pcf	49.2	63.4	67.5	68.9
Soil VOC Concentrations, mg/kg				
Methylene Chloride	0.73	0.016	0.38	0.305
1,2-Dichloroethane	1.523	0.017	0.000	0.000
Trichloroethene	17.300	14.700	10.150	0.650
Toluene	43.100	6.200	1.604	0.400
Tetrachloroethene	5.059	0.027	1.407	0.201
Chlorobenzene	0.511	0.002	0.008	0.000
Ethylbenzene	6.889	0.047	0.229	0.054
p&m-Xylene	31.200	4.650	1.350	0.300
o-Xylene	15.063	0.120	0.947	0.241
Isopropylbenzene	0.200	0.003	0.016	0.241
1,1,2,2-Tetrachlorcethane	65.150	18.500	1.972	0.000
n-Propylbenzene	0.266	0.004	0.000	0.000
1,3,5-Trimethylbenzene	0.435	0.006	0.065	0.034
1,2,4-Trimethylbenzene	1.388	0.017	0.185	0.073
1,3-Dichlorobenzene	0.290	0.001	0.000	0.000
1,4-Dichlorobenzene	1.107	0.006	0.000	0.000
1,2-Dichlorobenzene	11.342	0.078	0.599	0.245
Naphthalene	2.550	0.066	0.250	0.055
Acetone	0.400	0.375	7.700	14.650
2-Butanone	0.150	0.112	1.950	2.150
4-Methyl-2-Pentanone	22.850	2.930	3.354	1.700
Total VOC's	228.972	47.916	33.130	21.296
Total VOC's Corrected	227.501	47.936	23.034	5.046
Total VOC Removal, %	--	79.073	85.531	90.699
Total VOC Removal, % Corrected	--	78.929	89.875	97.782

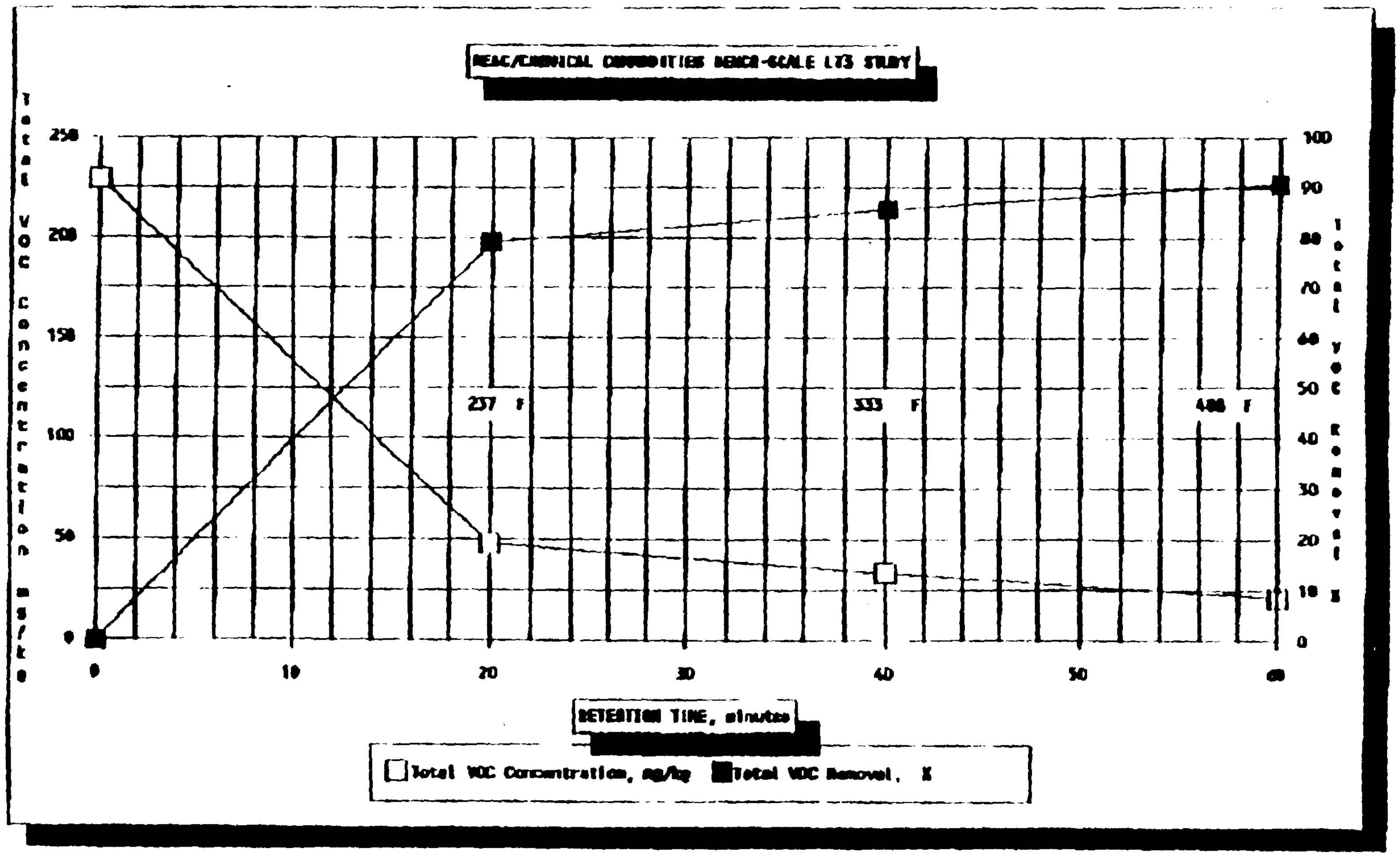


FIGURE 5 : Total VOC Concentration and Removal versus Retention Time

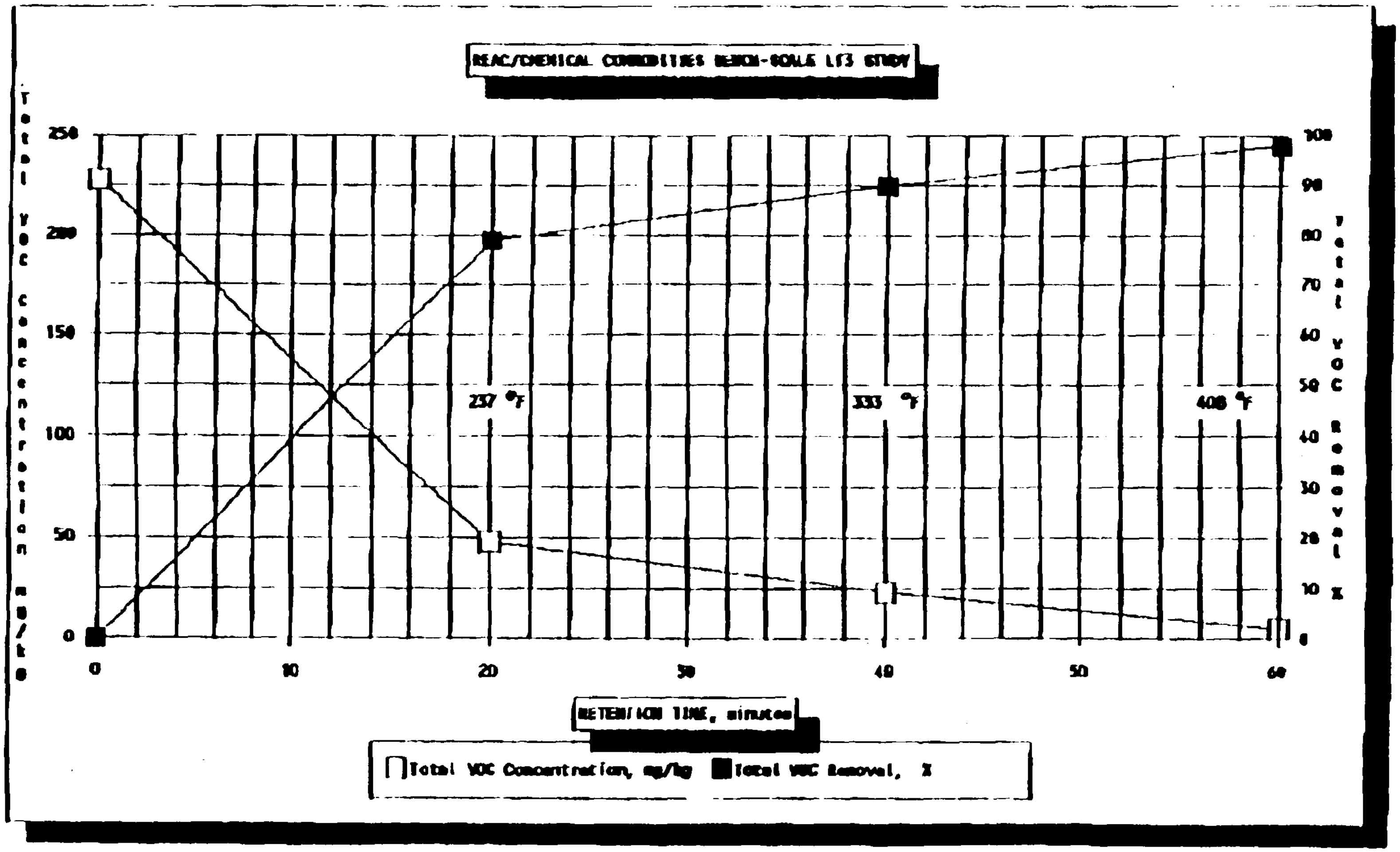


FIGURE 6 : Corrected Total VOC Concentration and Removal versus Retention Time

TABLE 4

WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY

REAC/CHEMICAL COMMODITIES

SUMMARY OF BENCH-SCALE LT3 VOC ANALYTICAL RESULTS

Volatile Organic Compound	Initial Soil VOC Conc., mg/kg Sample A	Initial Sample B	Initial Average	Initial Stand. Dev.	Pass 1 Soil VOC Conc., mg/kg Sample A	Pass 1 Sample B	Pass 1 Average	Pass 1 Stand. Dev.	Pass 1 Removal %	Pass 2 VOC Conc., mg/kg Sample A	Pass 2 Sample B	Pass 2 Average	Pass 2 Stand. Dev.	Pass 2 Removal %	Pass 3 VOC Conc., mg/kg Sample A	Pass 3 Sample B	Pass 3 Average	Pass 3 Stand. Dev.	Pass 3 Removal %
Methylene Chloride	0.660	0.800	0.730	0.099	0.016	0.016	0.016	0.000	97.81	0.400	0.300	0.350	0.071	52.05	0.360	0.250	0.305	0.078	58.22
trans-1,2-Dichloroethene	0.078	0.152	0.115	0.052	0.004	0.005	0.005	0.001	96.09	0.000	0.246	0.123	0.174	-6.96	0.000	0.000	0.000	0.000	100.00
cis-1,2-Dichloroethene	0.603	0.902	0.753	0.211	0.027	0.026	0.027	0.001	96.40	0.183	1.326	0.754	0.807	-0.13	0.000	0.000	0.000	0.000	100.00
Chloroform	0.260	0.440	0.350	0.156	0.012	0.012	0.012	0.000	96.57	0.140	0.100	0.120	0.028	65.71	0.000	0.000	0.000	0.000	100.00
1,1,1-Trichloroethane	0.319	0.188	0.254	0.093	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	100.00
1,2-Dichloroethane	1.435	1.611	1.523	0.124	0.018	0.015	0.017	0.002	98.92	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	100.00
Trichloroethene	17.800	16.800	17.300	0.707	11.000	18.400	14.700	5.233	15.03	4.800	15.500	10.150	7.566	41.33	0.600	0.700	0.650	0.071	96.24
Toluene	45.200	41.000	43.100	2.970	6.600	5.800	6.200	0.566	85.61	1.700	1.500	1.600	0.136	96.28	0.400	0.400	0.400	0.000	99.07
Tetrachloroethene	6.443	3.674	5.059	1.958	0.029	0.025	0.027	0.003	99.47	0.788	2.025	1.407	0.875	72.20	0.203	0.198	0.201	0.004	96.04
Chlorobenzene	0.591	0.431	0.511	0.113	0.002	0.002	0.002	0.000	99.65	0.000	0.015	0.008	0.011	98.53	0.000	0.000	0.000	0.000	100.00
Ethylbenzene	7.450	6.520	6.985	0.793	0.042	0.051	0.047	0.006	99.33	0.274	0.184	0.229	0.064	96.60	0.054	0.053	0.054	0.001	99.22
p&m-Xylene	36.200	26.200	31.200	7.071	5.200	4.100	4.650	0.778	85.10	1.600	1.100	1.350	0.354	95.67	0.300	0.300	0.300	0.000	99.04
o-Xylene	16.111	14.014	15.063	1.483	0.109	0.131	0.120	0.016	99.20	1.222	0.672	0.947	0.389	93.71	0.256	0.225	0.241	0.022	98.40
Isopropylbenzene	0.233	0.164	0.200	0.047	0.002	0.003	0.003	0.001	98.75	0.031	0.000	0.016	0.022	92.23	0.256	0.225	0.241	0.022	-20.55
1,1,2,2-Tetrachloroethane	73.300	57.000	65.150	11.526	21.400	15.600	18.500	4.101	71.60	0.776	3.168	1.972	1.691	96.97	0.000	0.000	0.000	0.000	100.00
n-Propylbenzene	0.317	0.215	0.266	0.072	0.005	0.004	0.004	0.001	98.48	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	100.00
1,3,5-Trimethylbenzene	0.526	0.344	0.435	0.128	0.005	0.006	0.006	0.001	98.74	0.071	0.059	0.065	0.008	85.06	0.034	0.033	0.034	0.001	92.30
1,2,4-Trimethylbenzene	1.636	1.140	1.388	0.351	0.016	0.018	0.017	0.001	98.78	0.205	0.165	0.185	0.028	86.67	0.075	0.072	0.073	0.001	94.78
1,3-Dichlorobenzene	0.375	0.204	0.290	0.121	0.000	0.002	0.001	0.001	99.72	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	100.00
1,4-Dichlorobenzene	1.467	0.747	1.107	0.509	0.006	0.006	0.006	0.000	99.47	0.000	0.000	0.000	0.000	100.00	0.000	0.000	0.000	0.000	100.00
1,2-Dichlorobenzene	14.457	8.227	11.342	4.405	0.075	0.080	0.078	0.004	99.32	0.656	0.541	0.599	0.081	94.72	0.271	0.219	0.245	0.037	97.84
Naphthalene	2.700	2.400	2.550	0.212	0.061	0.071	0.066	0.007	97.41	0.300	0.200	0.250	0.071	90.20	0.070	0.040	0.055	0.021	97.84
Acetone	0.500	0.300	0.400	0.141	0.300	0.450	0.375	0.106	4.25	7.100	8.300	7.700	0.849	-1825	14.900	14.400	14.650	0.354	-3563
2-Butanone	0.200	0.100	0.150	0.071	0.106	0.118	0.112	0.008	25.33	2.000	1.900	1.950	0.071	-1200	2.100	2.200	2.150	0.071	1333
4-Methyl-2-Pentanone	26.000	19.700	22.850	4.455	3.160	2.700	2.930	0.325	87.18	3.743	2.964	3.354	0.551	85.32	1.822	1.578	1.700	0.173	92.56
Total VOC's	254.839	203.105	228.972	36.581	48.192	47.641	47.916	0.390	79.07	25.989	40.271	33.130	10.099	85.53	21.699	20.895	21.296	0.570	90.70

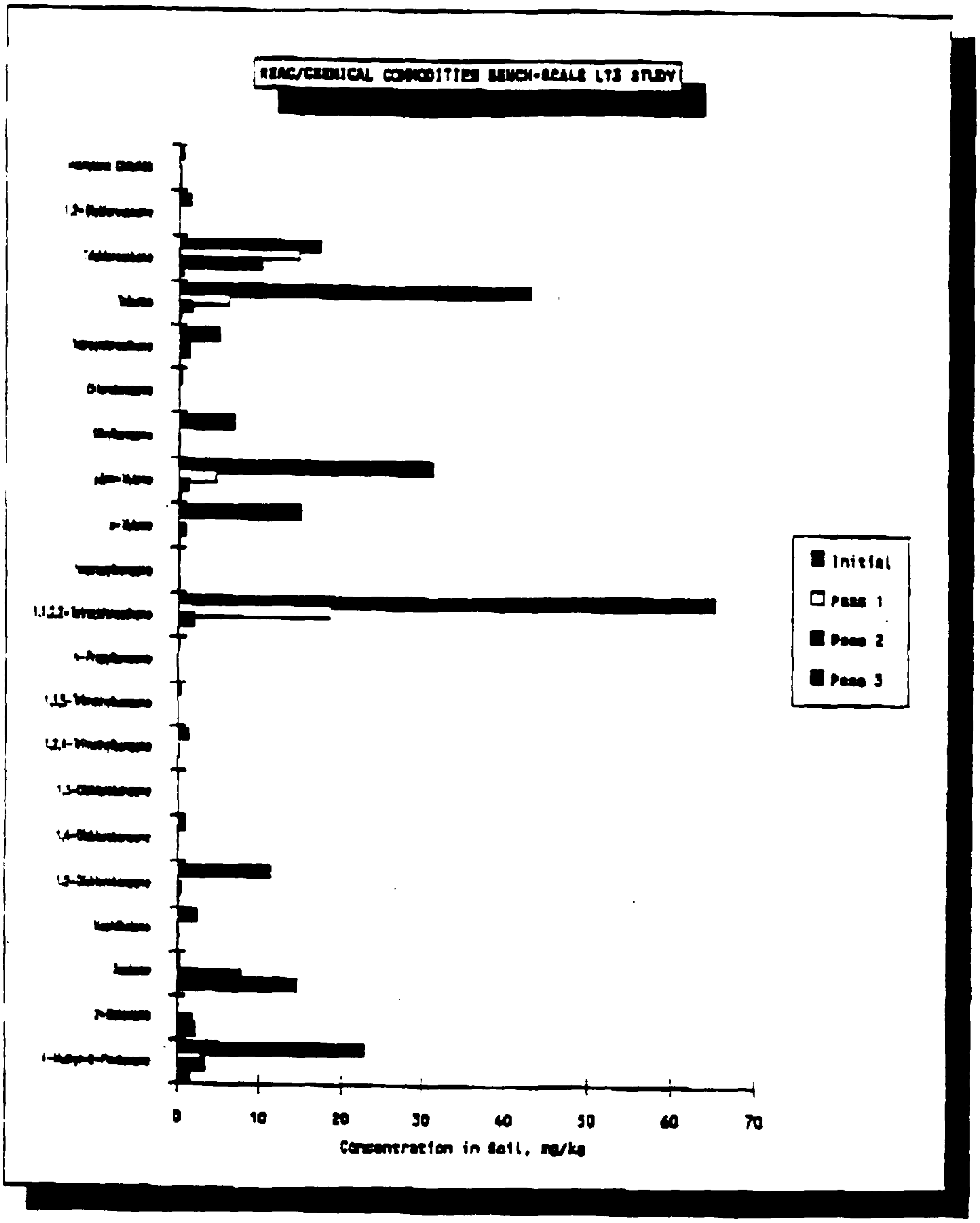


FIGURE 5 : VOC Distribution by Specie and Concentration

ATTACHMENT 2

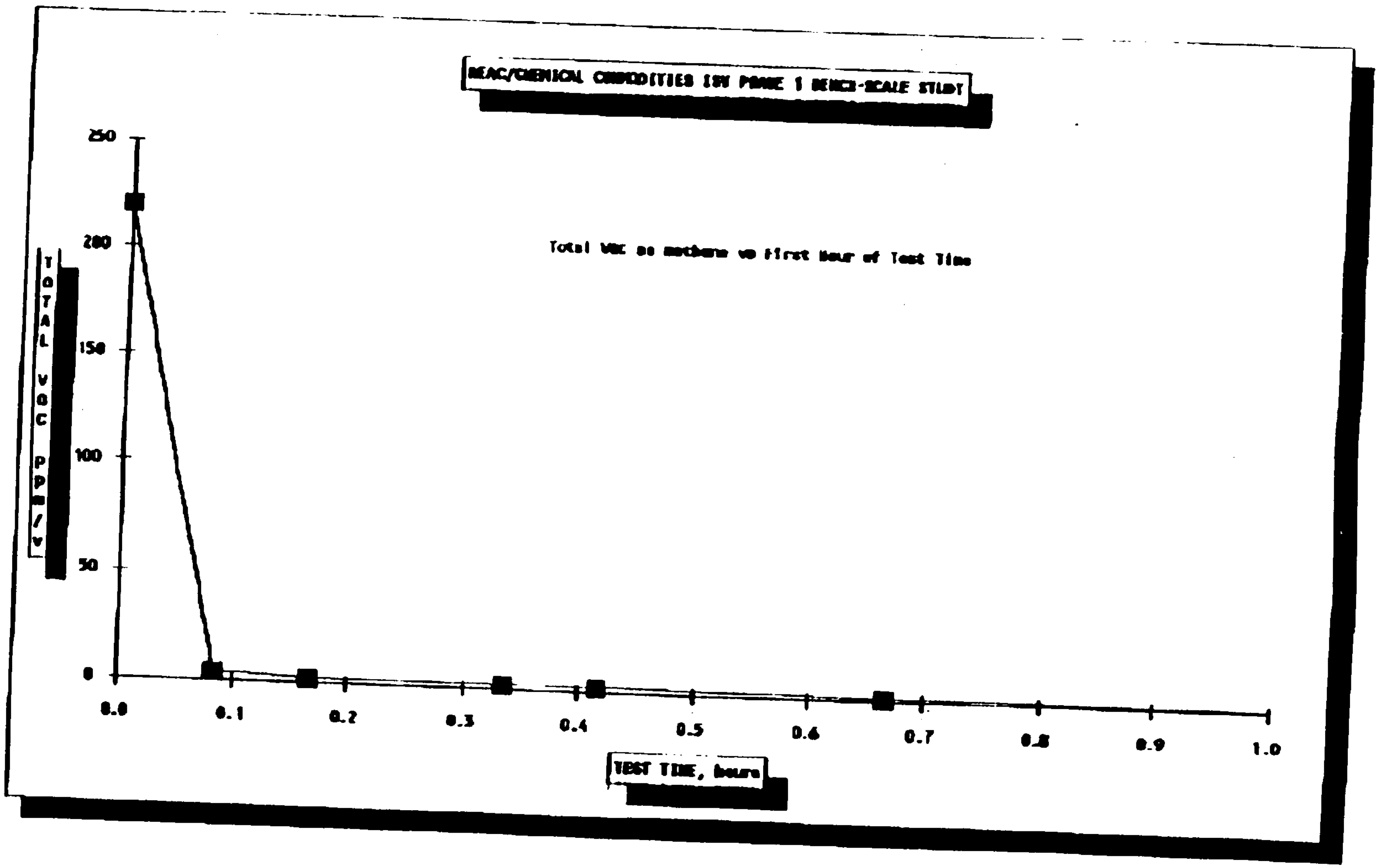
ISV PHASE I TEST DATA

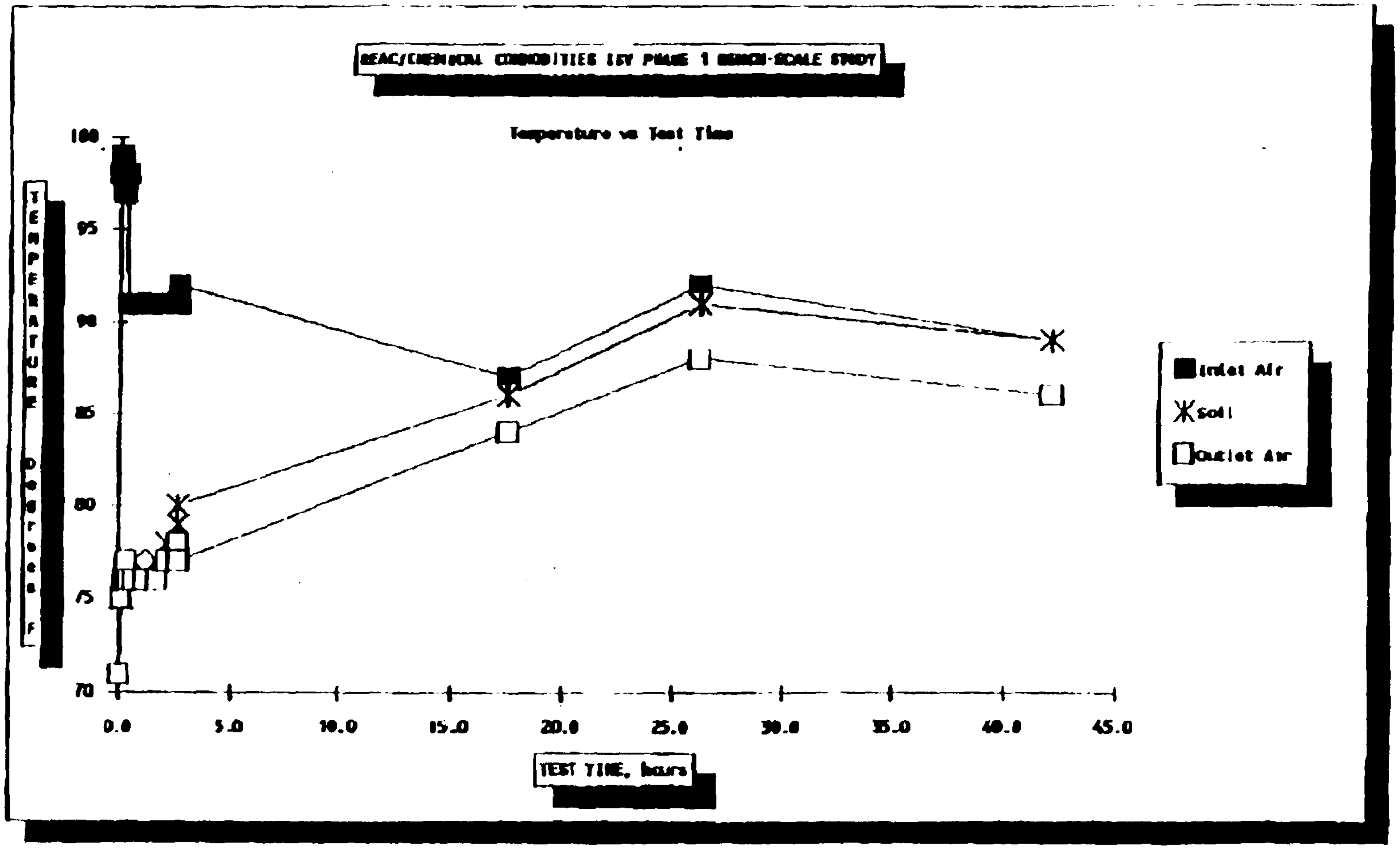
WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY

IN SITU VOLATILIZATION TREATMENT PHASE 1 BENCH-SCALE STUDY					
PROJECT	CHEMICAL COMM.	PROJECT SAMPLE #	003	SOIL SAMPLE WT., LB	23.75
JOB NUMBER	890801	ETL SAMPLE NUMBER	003	SOIL COLUMN HT., INCHES	6.00
W. O. NUMBER	3347-02-01-1288	TEST RUN	ONE		

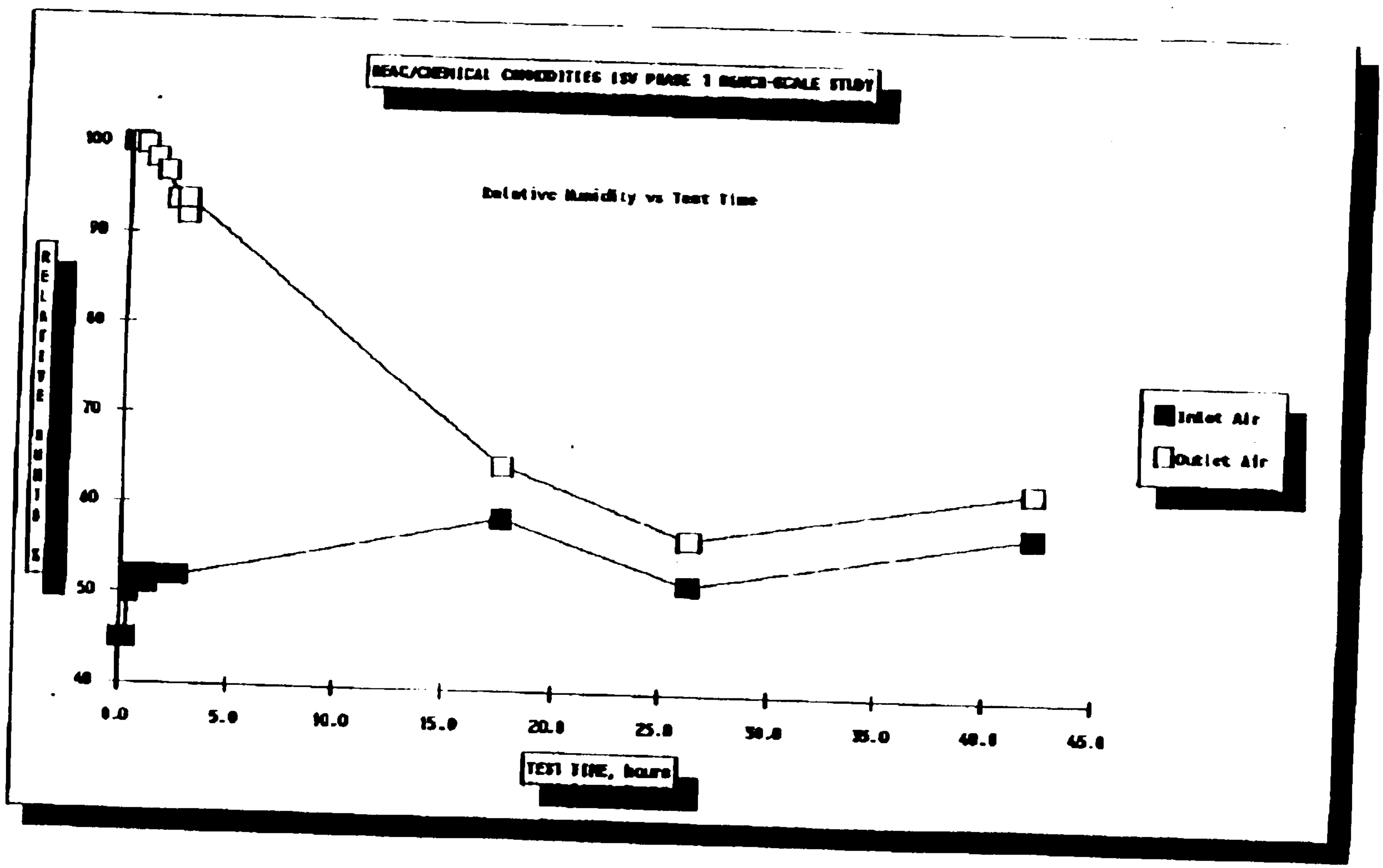
TEST DATA												
	Outlet Air Data					Inlet Air Data				Soil Data		
Date Time	Total VOC ppm/v	HW Vel. fpm	Static Press " H2O	Temp. F	Relat. Humid. %	Total VOC ppm/v	Static Press " H2O	Temp. F	Relat. Humid. %	Press. Drop " H2O	Temp. F	Observations
8/14/89 14:20	220	6008	10.6	71	100	1	13.5	98	45	2.9	75	220pk dwn 12
8/14/89 14:25	4	6010	10.7	75	100	1	14.0	99	45	3.3	75	
8/14/89 14:30	2	6013	10.5	76	100	1	14.5	97	45	4.0	75	
8/14/89 14:40	2	6000	10.5	77	100	1	14.5	98	45	4.0	77	
8/14/89 14:45	2	3060	2.7	76	100	1	4.0	91	50	1.3	77	
8/14/89 15:00	1	3057	2.8	76	100	0	4.0	91	52	1.2	77	
8/14/89 15:30	1	2940	3.0	76	98	0	4.0	91	51	1.0	76	
8/14/89 16:00	0	3000	3.4	76	97	0	4.0	91	52	0.6	77	
8/14/89 16:30	0	2990	3.0	77	94	0	3.5	91	52	0.5	78	
8/14/89 17:00	0	2880	3.4	78	92	0	4.0	91	52	0.6	79	stop & sample
8/14/89 17:30	0	3069	3.3	77	94	0	4.0	92	52	0.7	80	restart
8/15/89 08:20	0	2954	3.3	84	65	0	4.0	87	59	0.7	86	
8/15/89 17:05	0	3002	3.2	88	57	0	4.0	92	52	0.8	91	
8/16/89 09:00	0	3085	3.2	86	63	0	4.0	89	58	0.8	89	stop &sample

WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY




REAC/CHEMICAL COMMODITIES ISV PHASE 1 BENCH-SCALE STUDY
Temperature vs Test Time
TEMPERATURE Degrees F
100
95
90
85
80
75
70
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
TEST TIME, hours
Inlet Air
Soil
Outlet Air

WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY



ATTACHMENT 3

LT^3 TEST DATA

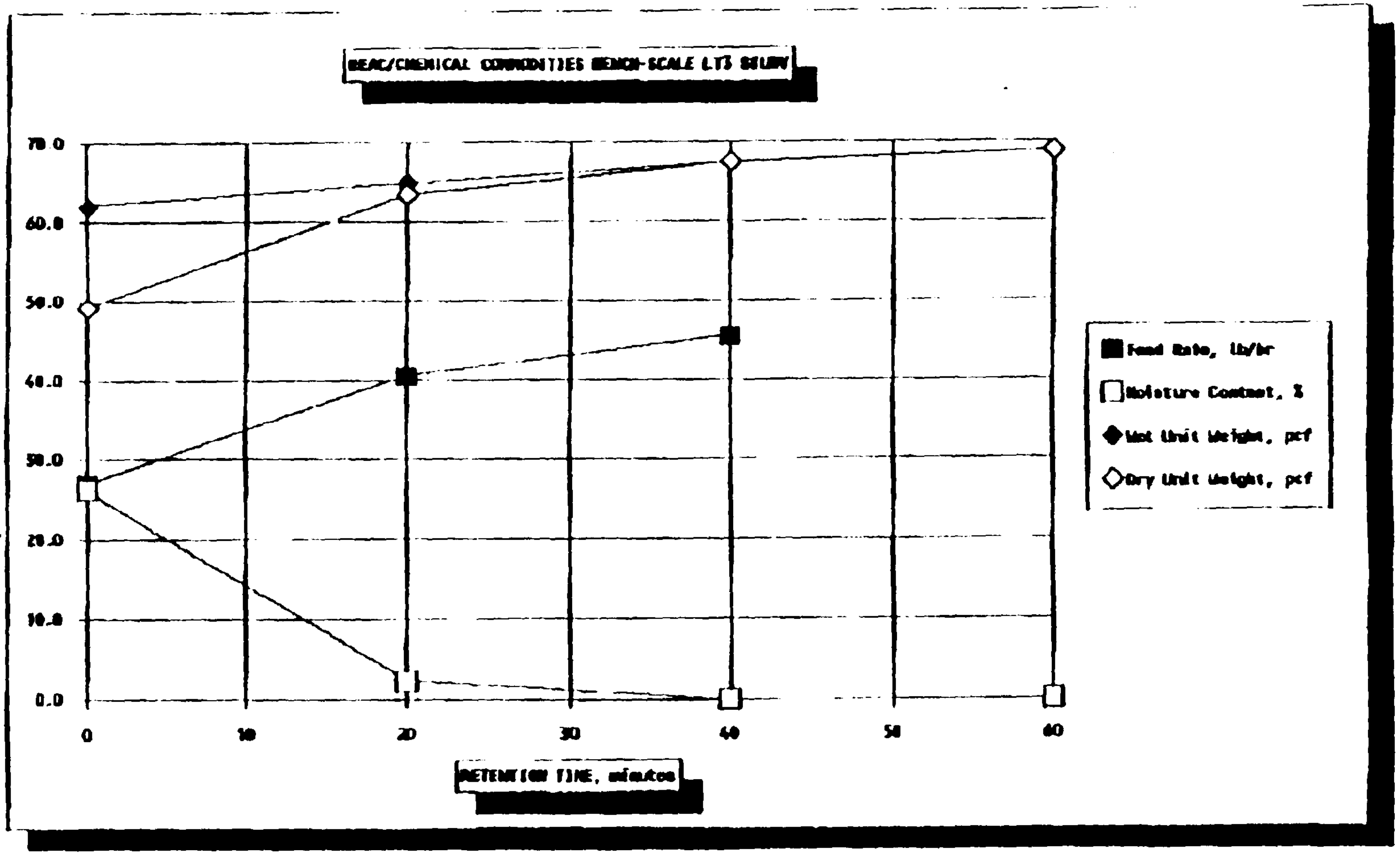
WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY

LOW TEMPERATURE THERMAL TREATMENT (LT3) BENCH-SCALE STUDY TEST DATA

PROJECT	REAC/CHEMCOMM	PROJECT SAMPLE NAME	SITE SOIL BUCKET	TEST RUN	ONE
JOB NUMBER	890801	ETL SAMPLE NUMBER	004	TEST DATE	8/16/89
W.O. NUMBER	3347-01-01-1288			OPERATOR	RWF/DGS

Clock Time 24 hr	Test Time min	Temperature, F: Feed Soil	Exit Soil	Skin	Cont. Set.	Screw rpm	Feed Soil Data: Pass #	Weight, lbs: Initial	Final	Net	Exit Pass #	Notes
12:55	-5			605	525	2.0						
13:00	0	53		620	525	2.0	0	41.800				
13:10	10	53	248	592	450	1.8	0	36.845	36.845	4.955		
13:20	20	56	257	503	450	1.7	0	32.420	32.420	4.425	1	PASS 1 EXITS RT=20
13:30	30	57	281	501	450	1.7	0	28.880	28.880	3.540	1	
13:40	40	57	267	502	450	1.7	0	24.500	24.500	4.380	1	SAMPLE FEED
13:50	50	59	254	524	450	1.7	0	20.180	20.180	4.320	1	
14:00	60	66	209	565	450	1.7	0	15.490	15.490	4.690	1	
14:10	70	65	198	502	475	1.7	0	10.850	10.850	4.640	1	SAMPLED PASS 1
14:20	80	170	214	572	475	1.7	1	14.720	5.910	4.940	1	FEED PASS 1
14:30	90	168	203	534	475	1.7	1	15.720	7.745	6.975	1	
14:40	100	170	285	532	475	1.7	1	12.680	8.900	6.820	2	PASS 2 EXITS
14:50	110	140	327	484	475	1.7	1	8.860	5.860	6.820	2	SAMPLED PASS 2
15:00	120	254	344	538	475	1.7	2	10.730	2.450	6.410	2	FEED PASS 2
15:10	130	279	374	574	425	1.7	2	10.800	2.900	7.830	2	
15:20	140	263	402	530	425	1.7	2	10.205	3.600	7.200	3	PASS 3 EXITS
15:30	150	270	413	487	425	1.7	2		2.445	7.760	3	
15:40	160	286		458	425	1.7					3	
15:50	170	286		531	425	1.7					3	

WESTON ENVIRONMENTAL TECHNOLOGY LABORATORY



PHYSICAL PARAMETERS VERSUS RETENTION TIME

APPENDIX D

FISCAL YEAR 1989 WORK PLAN

rd:eh/EVNGLSTA/FR-2288

WESTON
MANAGERS DESIGNERS/CONSULTANTS
REAC SUPPORT ORGANIZATION
GSA RARITAN DEPOT
WOODBRIDGE AVENUE
BUILDING 209 BAY F
EDISON, NJ 08837
PHONE 201-632-9200

DATE: August 24, 1989

TO: Andre Zownir, EPA Work Assignment Manager

FROM: Robert Evangelista, REAC Task Leader

THRU: Craig Moylan, REAC Section Chief

SUBJECT: DOCUMENT TRANSMITTAL UNDER WORK ASSIGNMENT # 1288

Attached please find the following document(s) prepared under this work assignment:

QUALITY ASSURANCE WORK PLAN FOR
PHASE I OF ENGINEERING STUDY FOR THE CHEMICAL COMMODITIES, INC. SITE

cc: Central File WA # 1288 (w/attachment)
W. Scott Butterfield
B. Cibulskis

rd/WP-288

QUALITY ASSURANCE

Work Plan

PHASE I OF ENGINEERING STUDY FOR THE CHEMICAL COMMODITIES, INC. SITE
OLATHE, KANSAS

Prepared by
Roy F. Weston, Inc.

August, 1989

EPA Work Assignment No. 0-288
Weston Work Order No. 3347-01-01-1288
EPA Contract No.: 68-03-3482

APPROVALS

Roy F. Weston, Inc.		EPA	
Robert Evangelista Task Leader	(Date)	Andre Zownir Work Assignment Manager	(Date)
W. Scott Butterfield Project Manager	(Date)	Robert Cibulskis Project Officer	(Date)
		William J. Bailey Contracting Officer	(Date)

rd/WP-288

EXHIBIT C

Hazardous Substance List (HSL) and Contract Required Detection Limits (CRDL)**

Volatiles	CAS Number	Detection Limits* Low Water[a] ug/L	Low Soil/Sediment ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. trans-1,2-Dichloroethene	156-60-5	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. trans-1,3-Dichloropropene	10061-02-6	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. cis-1,3-Dichloropropene	10061-01-5	5	5

(continued

Volatiles	CAS Number	Detection Limits* Low Water[a] ug/L	Low Soil/Sediment[b] ug/Kg
26. 2-Chloroethyl Vinyl Ether	110-75-8	10	10
27. Bromoform	75-25-2	5	5
28. 2-Hexanone	591-78-6	10	10
29. 4-Methyl-2-pentanone	108-10-1	10	10
30. Tetrachloroethene	127-18-4	5	5
31. Toluene	108-88-3	5	5
32. Chlorobenzene	108-90-7	5	5
33. Ethyl Benzene	100-41-4	5	5
34. Styrene	100-42-5	5	5
35. Total Xylenes		5	5

[a]Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water CRDL.

[b]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Soil/Sediment CRDL.

Semi-Volatiles	CAS Number	Detection Limits*	
		Low Water[b]	Low Soil/Sediment[c]
		ug/L	ug/Kg
36. Phenol	108-95-2	10	330
37. bis(2-Chloroethyl) ether	111-44-4	10	330
38. 2-Chlorophenol	95-57-8	10	330
39. 1,3-Dichlorobenzene	541-73-1	10	330
40. 1,4-Dichlorobenzene	106-46-7	10	330
41. Benzyl Alcohol	100-51-6	10	330
42. 1,2-Dichlorobenzene	95-50-1	10	330
43. 2-Methylphenol	95-48-7	10	330
44. bis(2-Chloroisopropyl) ether	39638-32-9	10	330
45. 4-Methylphenol	106-44-5	10	330
46. N-Nitroso-Dipropylamine	621-64-7	10	330
47. Hexachloroethane	67-72-1	10	330
48. Nitrobenzene	98-95-3	10	330
49. Isophorone	78-59-1	10	330
50. 2-Nitrophenol	88-75-5	10	330
51. 2,4-Dimethylphenol	105-67-9	10	330
52. Benzoic Acid	65-85-0	50	1600
53. bis(2-Chloroethoxy) methane	111-91-1	10	330
54 2,4-Dichlorophenol	120-83-2	10	330
55. 1,2,4-Trichlorobenzene	120-82-1	10	330
56. Naphthalene	91-20-3	10	330
57. 4-Chloroaniline	106-47-8	10	330
58. Hexachlorobutadiene	87-68-3	10	330
59. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
60. 2-Methylnaphthalene	91-57-6	10	330
61. Hexachlorocyclopentadiene	77-47-4	10	330
62. 2,4,6-Trichlorophenol	88-06-2	10	330
63. 2,4,5-Trichlorophenol	95-95-4	50	1600

(continued)

Semi-Volatiles	CAS Number	Detection Limits* Low Water[b] ug/L	Low Soil/Sediment[c] ug/Kg
64. 2-Chloronaphthalene	91-58-7	10	330
65. 2-Nitroaniline	88-74-4	50	1600
66. Dimethyl Phthalate	131-11-3	10	330
67. Acenaphthylene	208-96-8	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. 2,6-Dinitrotoluene	606-20-2	10	330
75. Diethylphthalate	84-66-2	10	330
76. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
77. Fluorene	86-73-7	10	330
78. 4-Nitroaniline	100-01-6	50	1600
79. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
80. N-nitrosodiphenylamine	86-30-6	10	330
81. 4-Bromophenyl Phenyl ether	101-55-3	10	330
82. Hexachlorobenzene	118-74-1	10	330
83. Pentachlorophenol	87-86-5	50	1600
84. Phenanthrene	85-01-8	10	330
85. Anthracene	120-12-7	10	330
86. Di-n-butylphthalate	84-74-2	10	330
87. Fluoranthene	206-44-0	10	330
88. Pyrene	129-00-0	10	330
89. Butyl Benzyl Phthalate	85-68-7	10	330
90. 3,3'-Dichlorobenzidine	91-94-1	20	660
91. Benzo(a)anthracene	56-55-3	10	330
92. bis(2-ethylhexyl)phthalate	117-81-7	10	330
93. Chrysene	218-01-9	10	330
94. Di-n-octyl Phthalate	117-84-0	10	330
95. Benzo(b)fluoranthene	205-99-2	10	330
96. Benzo(k)fluoranthene	207-08-9	10	330
97. Benzo(a)pyrene	50-32-8	10	330

(continued)

Semi-Volatiles	CAS Number	Detection Limits*	
		Low Water^c μg/L	Low Soil/Sediment^d μg/Kg
98. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
99. Dibenz(a,h)anthracene	53-70-3	10	330
100. Benzo(g,h,i)perylene	191-24-2	10	330

[c]Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 times the individual Low Water CRDL.

[d]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

Pesticides	CAS Number	Detection Limits* Low Water[d] ug/L	Low Soil/Sediment[f] ug/Kg
101. alpha-BHC	319-84-6	0.05	8.0
102. beta-BHC	319-85-7	0.05	8.0
103. delta-BHC	319-86-8	0.05	8.0
104. gamma-BHC (Lindane)	58-89-9	0.05	8.0
105. Heptachlor	76-44-8	0.05	8.0
106. Aldrin	309-00-2	0.05	8.0
107. Heptachlor Epoxide	1024-57-3	0.05	8.0
108. Endosulfan I	959-98-8	0.05	8.0
109. Dieldrin	60-57-1	0.10	16.0
110. 4,4'-DDE	72-55-9	0.10	16.0
111. Endrin	72-20-8	0.10	16.0
112. Endosulfan II	33213-65-9	0.10	16.0
113. 4,4'-DDD	72-54-8	0.10	16.0
114. Endosulfan Sulfate	1031-07-8	0.10	16.0
115. 4,4'-DDT	50-29-3	0.10	16.0
116. Endrin Ketone	53494-70-5	0.10	16.0
117. Methoxychlor	72-43-5	0.5	80.0
118. Chlordane	57-74-9	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. AROCLOR-1016	12674-11-2	0.5	80.0
121. AROCLOR-1221	11104-28-2	0.5	80.0
122. AROCLOR-1232	11141-16-5	0.5	80.0
123. AROCLOR-1242	53469-21-9	0.5	80.0
124. AROCLOR-1248	12672-29-6	0.5	80.0
125. AROCLOR-1254	11097-69-1	1.0	160.0
126. AROCLOR-1260	11096-82-5	1.0	160.0

[d] Medium Water Contract Required Detection Limits (CRDL) for Pesticide HSL Compounds are 100 times the individual Low Water CRDL.

[f] Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Pesticide HSL compounds are 15 times the individual Low Soil/Sediment CRDL.

*Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

** Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

Parameter	Detection Limit Units: mg/kg	Detection Limit Units: ug/l
Antimony	1.0	5.0
Arsenic	1.0	5.0
Beryllium	1.0	5.0
Cadmium	1.0	5.0
Chromium	10	10
Copper	5.0	25
Lead	10	5.0
Mercury	0.1	0.2
Nickel	8.0	40
Selenium	1.0	5.0
Silver	2.0	10
Thallium	1.0	5.0
Zinc	4.0	20
Iron	10.0	100
Cyanide	1.0	10

1.0 OBJECTIVE

The Chemical Commodities Inc. site (CCI) is located outside of Kansas City, Kansas. The U.S. EPA Environmental Response Team (ERT) has asked the Response, Engineering, and Analytical Contractor (REAC) to study the feasibility of in-situ soil remediation and on-site building decontamination.

This engineering study has six objectives: 1) to determine the extent of soil contamination; 2) to determine the soil characteristics that will impact remediation efforts; 3) to explore viable remediation technologies for both the contaminated soil and buildings; 4) to perform bench-scale engineering studies for obtaining performance data on viable soil remediation alternatives; 5) to determine the contamination of the site buildings; and 6) to explore the remedial options for these buildings.

2.0 PROJECT SCOPE

The scope of project is to characterize, sample, and analyze soil and to sample and analyze the buildings and groundwater at CCI as requested by the U.S. EPA Work Assignment Manager.

A review of technologies will be performed to determine viable treatment options for the soil and buildings. Hands-on bench-scale engineering tests will provide performance data on potential remedial technologies for contaminated soil.

3.0 TECHNICAL APPROACH

The technical approach involves 3 site visist to install monitoring wells, to bore holes within and adjacent to the site for analysis, to sample groundwater in new and existing wells, to sample soils for physical characteristics, to sample buildings, and to obtain soil samples for bench-scale engineering tests. These samples will be analyzed for VOAs, BNAs, and pp metal with VOA analyses predominating. Three potential remedial technologies will be bench-scale tested for feasibility. Finally, building decontamination methods will be evaluated.

Soil and groundwater samples were collected from the CCI site at locations determined by the Work Assignment Manager and Task Leader. The following Weston/REAC Standard Operating Procedures will be followed for all field activities: General Field Sampling Guidelines (2001); Sample Documentation (2002); Sample Packaging and Shipping (2004); Groundwater Well Sampling (2007); Wipe, Chip, and Sweep Sampling (2011); and Soil Sampling (2012).

During the first site visit (July, 1989), 6 soil samples were collected from locations inside or near storage sheds within the CCI site and were analyzed by Weston/REAC for volatile organic compounds (VOAs), semi-volatile organic compounds (BNAs), and priority pollutant metals (pp Metals). These soil samples were taken at

approximately 1.5 to 2 foot depth with hand augers based on direction provided by the U.S. EPA Work Assignment Manager. Two additional soil samples were characterized by Weston's Environmental Technology Laboratory (ETL) for the following physical parameters:

o Particle size distribution
o Permeability (disturbed soil).

During the second site visit (August, 1989), an EPA drill rig bored holes at 28 locations, designated ERT 1 to ERT 29 (ERT 11 not taken). These boreholes were placed, if possible, on grid points of 50 foot centers as directed by the U.S. EPA Work Assignment Manager. Grab samples were taken from each hole at four depths: 1, 5, 10, and 15 feet. Samples were placed into 40 ml VOA vials for on-site headspace analysis via a Photovac gas chromatograph (provided by the ERT TAT). A total of 108 soil samples were analyzed by the Photovac onsite and a total of 18 samples were analyzed by GCMS for confirmation.

Also during the second site visit, two additional wells were installed on the perimeter of the site at locations designated by the EPA On-Scene Coordinator (OSC). Groundwater samples were taken from the 6 existing wells as well as the two (2) newly installed wells. These samples were properly packaged and shipped to Weston/REAC laboratory for VOA and BNA analysis on the new well samples and VOA analysis on all samples. For the Well ERT2, VOA sample was taken from the mid level of the water column and from the bottom of the well (to recover product).

Decontamination of sampling tools included: 1) Liquinox[R] soap and water wash; 2) H_2O rinse; 3) distilled/deionized H_2O rinse; and, 4) air dry.

The third site visit (September, 1989) will include the following activities: 1) additional soil and/or groundwater sampling and analysis as directed by the EPA Work Assignment Manager; 2) large quantity environmental soil samples (approximately 50 gallons) for Toxic Treatments, Inc. bench-scale tests; and 3) sampling and analyses of buildings. The buildings will be wipe and core sampled as directed by the EPA Work Assignment Manager.

Potential remedial treatment technologies for both contaminated soil and buildings will initially be evaluated by reviewing current literature, reading recent U.S. EPA documents, exploring databases, and communicating with technical contacts. For soil contaminated with volatile organic compounds, a hands-on bench scale engineering tests were performed by Weston's Environmental Testing Laboratory (ETL), Lionville, Pennsylvania, for in-situ volatilization (ISV) and low temperature thermal treatment (LT3). Hands-on bench-scale engineering tests will be performed by Toxic Treatments, Inc. (TTI) San Francisco, California, for in-situ steam/hot air stripping of soil. Sampling and analysis of all bench-scale test soils will be provided by Weston/REAC.

4.0 PROJECT MANAGEMENT AND REPORTING

The REAC Task Leader will maintain contact with the EPA Work Assignment Manager to keep him informed about the technical and financial progress of this project. Activities under this project will be summarized in appropriate format for inclusion in REAC monthly and annual reports. An interim report containing the site technology recommendations and bench-scale engineering study results will be prepared.

5.0 PROJECT SCHEDULE

A project schedule sheet is attached. An exploration of viable treatment technologies will commence upon the approval of this work plan. Sampling was conducted upon request from the Work Assignment Manager. Analyses of the samples was performed immediately following the two site visits. For the samples from the first site visit, VOA and BNA chemical analyses were completed within 7 calendar days following laboratory receipt of samples. Heavy metal analyses will be completed in 28 days. For the samples from the second site visit, VOA analyses were completed in 7 days following the laboratory receipt. For the hands-on bench-scale engineering tests, VOA analyses will be completed in 7 days following the laboratory receipt of samples. For the third site visit, VOA analyses will be completed 14 days following the laboratory receipt of samples; BNA and heavy metal analyses will be completed 21 days following the receipt of samples. The interim report will be submitted 14 days following the receipt of the final laboratory analyses. If all analyses are completed before September 22, 1989, the final report will be delivered on October 6, 1989.

6.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

EPA Work Assignment Manager: Andre P. Zownir

Provide overall direction to REAC staff concerning project sampling needs and remediation objectives.

REAC Task Leader: Robert Evangelista

Primary point of contact with EPA Work Assignment Manager. Responsible for completion of Quality Assurance Work Plan (QAWP), Health and Safety Plan (HSP), and interim report. Responsible for field sampling and field adherence to the QAWP and HSP and records any deviations from the QAWP. Responsible for treatment technology exploration and management of bench-scale engineering studies

REAC Geologist: Kenneth Tyson

Responsible for installing two wells on-site, providing the well logging information, and bailing and sampling all the wells.

REAC Health and Safety Officer: Martin O'Neill

Responsible for approval of site Health and Safety Plan and general health and safety coordination.

REAC O&A Section Chief: Craig Moylan

Responsible for providing technical manpower as needed and QA review.

REAC QA Officer: John Mateo

Responsible for auditing and guiding project, review of final report before release to EPA, and proposing corrective action, if necessary, for non-conformity to the QAWP.

7.0 MANPOWER AND COST PROJECTIONS

The estimated costs (including labor, travel, materials and equipment, and analytical) to complete this project are depicted in the attached cost summary sheet.

8.0 DELIVERABLES

For the first site visit, VOA and BNA analytical results were available to the Work Assignment Manager seven calendar days following the receipt of the samples by REAC laboratory. Heavy metals analysis will be available in twenty-eight days.

For the second site visit, the VOA analytical results were available to the Work Assignment Manager seven days following the receipt of the samples by Weston/REAC laboratory.

For the third site visit, VOA analytical results will be available fourteen days following the receipt of the samples by the Weston/REAC laboratory. BNA and heavy metal analytical results will be available in 21 days.

For the engineering studies, the VOA analytical results will be available to the Work Assignment Manager seven days following the receipt of the samples by the Weston/REAC laboratory.

The interim report will be submitted to the Work Assignment Manager 14 days after the completion of the final analyses. This report will include recommendations on remedial alternatives and the sampling and analyses results.

9.0 QUALITY ASSURANCE

9.1 First Site Visit

As identified in Section 1.0, the objective of this project/event does require analyte specificity for all samples. The results will have confirmed identification and/or associated confidence limits. Results will be representative, comparable,

and complete. The QA level of control defined by this criteria is QA-2. The following QA/QC protocols will be addressed: chain of custody documentation, sample holding time documentation, collection and evaluation of blanks, matrix spike samples, and instrument calibration documentation. Table 9.1 and 9.2 are completed to reflect the appropriate QA/QC protocols identified above.

Numbers of samples to be collected for this project/event are entered onto Tables 9.1 Field Sampling Summary and Table 9.2 QA/QC Analysis and Objectives Summary to facilitate ready identification of analytical parameters desired, type, volume and number of containers needed, preservation requirements, number of samples required and associated number, and type of QA/QC control samples required based on QA level desired.

Specific data review activities for QA-2 should be performed by the following tiered approach:

1. a. For any one data package, review all data elements for 10% of samples.
   b. For the remaining 90% of the samples within the same data package, review holding times, blank contamination, spike (surrogate/matrix) recovery, detection capability, and confirmed identification thoroughly.
2. For every tenth data package, review all data quality elements for all samples.

All project deliverables will receive an internal peer QC review prior to release to EPA, as per guidelines established in the REAC Quality Assurance Program Plan.

9.2 Second Site Visit

As identified in Section 1.0, the objective of this project/event does require analyte specificity for a minimum of 15% of the samples. The results will have confirmed identification and/or associated confidence limits. Results will be representative, comparable, and complete. The QA level of control defined by this criteria is QA-2. The following QA/QC protocols will be addressed: chain of custody documentation, sample holding time documentation, collection and evaluation of blanks, matrix spike samples, and instrument calibration documentation. Table 9.1 and 9.2 are completed to reflect the appropriate QA/QC protocols identified above.

Numbers of samples to be collected for this project/event are entered onto Tables 9.1 Field Sampling Summary and Table 9.2 QA/QC Analysis and Objectives Summary to facilitate ready identification of analytical parameters desired, type, volume and number of containers needed, preservation requirements, number of samples required and associated number, and type of QA/QC control samples required based on QA level desired.

Specific data review activities for QA-2 should be performed by the following tiered approach:

1. a. For any one data package, review all data elements for 10% of samples.
   b. For the remaining 90% of the samples within the same data package, review holding times, blank contamination, spike (surrogate/matrix) recovery, detection capability, and confirmed identification thoroughly.
2. For every tenth data package, review all data quality elements for all samples.

All project deliverables will receive an internal peer QC review prior to release to EPA, as per guidelines established in the REAC Quality Assurance Program Plan.

9.3 Third Site Visit

As identified in Section 1.0, the objective of this project/event does require analyte specificity for all samples. The results will have confirmed identification and/or associated confidence limits. Results will be representative, comparable, and complete. The QA level of control defined by this criteria is QA-2. The following QA/QC protocols will be addressed: chain of custody documentation, sample holding time documentation, collection and evaluation of blanks, matrix spike samples, and instrument calibration documentation. Table 9.1 and 9.2 are completed to reflect the appropriate QA/QC protocols identified above.

Numbers of samples to be collected for this project/event are entered onto Tables 9.1 Field Sampling Summary and Table 9.2 QA/QC Analysis and Objectives Summary to facilitate ready identification of analytical parameters desired, type, volume and number of containers needed, preservation requirements, number of samples required and associated number, and type of QA/QC control samples required based on QA level desired.

Specific data review activities for QA-2 should be performed by the following tiered approach:

1. a. For any one data package, review all data elements for 10% of samples.
   b. For the remaining 90% of the samples within the same data package, review holding times, blank contamination, spike (surrogate/matrix) recovery, detection capability, and confirmed identification thoroughly.
2. For every tenth data package, review all data quality elements for all samples.

All project deliverables will receive an internal peer QC review prior to release to EPA, as per guidelines established in the REAC Quality Assurance Program Plan.

9.4 Bench-Scale Engineering Studies

As identified in Section 1.0, the objective of this project/event does require analyte specificity for all samples. The results will have confirmed identification and/or associated confidence limits. Results will be representative, comparable, and complete. The QA level of control defined by this criteria is QA-2. The following QA/QC protocols will be addressed: chain of custody documentation, sample holding time documentation, collection and evaluation of blanks, matrix spike samples, and instrument calibration documentation. Table 9.1 and 9.2 are completed to reflect the appropriate QA/QC protocols identified above.

Numbers of samples to be collected for this project/event are entered onto Tables 9.1 Field Sampling Summary and Table 9.2 QA/QC Analysis and Objectives Summary to facilitate ready identification of analytical parameters desired, type, volume and number of containers needed, preservation requirements, number of samples required and associated number, and type of QA/QC control samples required based on QA level desired.

Specific data review activities for QA-2 should be performed by the following tiered approach:

1. a. For any one data package, review all data elements for 10% of samples.
   b. For the remaining 90% of the samples within the same data package, review holding times, blank contamination, spike (surrogate/matrix) recovery, detection capability, and confirmed identification thoroughly.
2. For every tenth data package, review all data quality elements for all samples.

All project deliverables will receive an internal peer QC review prior to release to EPA, as per guidelines established in the REAC Quality Assurance Program Plan.

REAC PROJECT SUMMARY SCHEDULE
CHEMICAL COMMODITIES SITE
EPA WORK ASSIGNMENT NO. 0 288

LEGEND
>>> ACTIVITY DURATION FORECAST
C COMPLETED TASK

TASK NO.	AUGUST 1988	SEPTEMBER 1988	OCTOBER 1988	NOVEMBER 1988	DECEMBER 1988	JANUARY 1989	FEBRUARY 1989	MARCH 1989	APRIL 1989	MAY 1989	JUNE 1989	JULY 1989	AUGUST 1989
1. DEVELOP / REVISE WORK PLAN												C	>>
2. PREPARE / REVISE H & S PLAN												C	>>
3. INITIAL SITE VISIT & SAMPLING												C	
4. SAMPLE ANALYSES													C
5. SECOND SITE VISIT & SAMPLING													C
6. SAMPLE ANALYSES													C
7. DATA EVALUATION													>>
8. TREATMENT TECHNOLOGY EVALUATION												>>>	>>>>>>>>>>
9. BENCH SCALE ENGINEERING STUDY													C
10. ENGINEERING STUDY ANALYSIS													>>
11. ENGINEERING STUDY SOLE SOURCE													>>
12. ORGANIZE ANALYTICAL DATA													>>
13. AUTOCAD SITE MAP													>>

REAC PROJECT COST SUMMARY
CHEMICAL COMMODITIES SITE
EPA WORK ASSIGNMENT NO. 0 288
WESTON WORK ORDER NO. 3347-01-01-1288

LABOR PLAN (HOURS PER MONTH) FY89

DESCRIPTION		SEP 88	OCT 88	NOV 88	DEC 88	JAN 89	FEB 89	MAR 89	APR 89	MAY 89	JUN 89	JUL 89	AUG 89	TOTAL HOURS
S&A	30 $/HR											20	260	280
O&A	30 $/HR											70	400	470
SUPPORT	30 $/HR											5	10	15
QA/QC,H&S,MGT.	50 $/HR											5	15	20
WESTON H.O.	50 $/HR												85	85
TOTAL HRS		0	0	0	0	0	0	0	0	0	0	100	770	870
CUMULATIVE HRS		0	0	0	0	0	0	0	0	0	0	100	870	

DOLLAR PLAN

DESCRIPTION		SEP 88	OCT 88	NOV 88	DEC 88	JAN 89	FEB 89	MAR 89	APR 89	MAY 89	JUN 89	JUL 89	AUG 89	TOTAL DOLLARS
S&A	30 $/HR											600	7800	8400
O&A	30 $/HR											2100	12000	14100
SUPPORT	30 $/HR											150	300	450
QA/QC,H&S,MGT.	50 $/HR											250	750	1000
WESTON H.O.	50 $/HR											0	4250	4250
TRAVEL												1000	2800	3800
FIELD SUPPLIES												100	500	600
SHIPPING												200	1200	1400
MISC. EXPENSES												100	400	500
SUBTOTAL $		0	0	0	0	0	0	0	0	0	0	4500	30000	34500
CUMULATIVE $		0	0	0	0	0	0	0	0	0	0	4500	34500	
DISTRIBUTIVE	0.25	0	0	0	0	0	0	0	0	0	0	1125	7500	8625
FEE	0.014	0	0	0	0	0	0	0	0	0	0	79	525	604
TOTAL DOLLARS		0	0	0	0	0	0	0	0	0	0	5704	38025	43729
CUM. DOLLARS		0	0	0	0	0	0	0	0	0	0	5704	43729	

FIRST SITE VISIT

Table 9.1: Field Sampling Summary

Analytical Parameter	Level of Sensitivity[1]	Matrix*	Container Type and Volume (# containers rq'd)	Preservative	Holding Times	QC Extra's: Subtotal Samples	Rinsate Blanks[2]	Trip Blanks[3] (VOA's)	QC Positives[4]	Matrix Spikes[5]	Tot Fie Sampl
VOA		S	40ml vial (1)	4°C	7 day	6					6
VOA		W	40ml vial (3)	4°C**	7 day						
BNA		S	8oz glass (1)	4°C	7/40d	6					6
BNA		W	32oz amber glass (2)	4°C	7/40d						
PEST/PCB		S	8oz glass (1)	4°C	7/40d						
PEST/PCB		W	32oz amber glass (2)	4°C**	7/40d						
P.P. METALS		S	8oz glass (1)	4°C	6 mon	6					6
P.P METALS		W	1 liter glass or polyethylene (1)	HNO_3 pH<2 4°C	6 mon						
CYANIDE		S	8oz glass (1)	4°C	14 day						

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_2$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for analytical method to be used.
2. Only required if dedicated sampling tools are not used. One blank required per parameter per 20 samples.
3. One trip blank required per cooler used to ship VOA samples. Each trip blank consists of two 430 ml vials filled with distilled/c
4. Performance check samples; optional for QA-2, mandatory for QA-3 level. One per parameter.
5. For QA-2: one matrix spike duplicate per lot of 10 samples; therefore, collect two additional environmental sample volumes (water environmental samples. For solid matrix, one additional volume per 10 environmental samples. For QA-3: two matrix spike duplica environmental samples; therefore, collect four additional volumes of environmental samples for every 10 samples. Collect two addi environmental sample for solid matrix spikes.

FIRST SITE VISIT

Table 9.2: QA/QC Analysis and Objectives Summary

Analytical Parameter	Matrix*	Analytical Method Ref.	Spikes: Matrix[1]	Spikes: Surrogate[2]	QA/QC: Detection Limits[3]	QA/QC: QA Objective[4]
VOA	S	8240/SW-846	2	YES	see attached sheet	QA-2
VOA	W	624/CLP				
BNA	S	8250 or 8270/ SW-846	1	YES	see attached sheet	QA-2
BNA	W	625/CLP				
PEST	S	8080/SW-846				
PCB	S	8080/SW-846				
PEST	W	608				
PCB	W	608				
P.P. METALS	S	SW-846	1	YES	see attached sheet	QA-2
P.P. METALS	W	EPA-600/CFR 40				
CYANIDE	S	SW-846				
CYANIDE	W	SW-846				

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air.

1. For QA-2: one matrix spike duplicate analysis per lot of 10 samples. For QA-3: two matrix spike duplicate analyses per lot of 10 samples.
2. Surrogate spikes analysis to be run (enter yes) for each sample in QA-1 and QA-2.
3. To be determined by the person arranging the analysis.
4. Enter QA Objective desired: QA-1, QA-2, or QA-3.

SECOND SITE VISIT

Table 9.1: Field Sampling Summary

Analytical Parameter	Level of Sensitivity[1]	Matrix*	Container Type and Volume (# containers rq'd)	Preservative	Holding Times	QC Extra's: Subtotal Samples	Rinsate Blanks[2]	Trip Blanks[3] (VOA's)	QC Positives[4]	Matrix Spikes[5]	Total Field Samples
VOA		S	40ml vial (1)	4°C	7 day	18	–	–	–	1	1[illegible]
VOA		W	40ml vial (3)	4°C**	7 day	9	–	1	–	2	1[illegible]
BNA		S	8oz glass (1)	4°C	7/40d						
BNA		W	32oz amber glass (2)	4°C	7/40d	2	–	–	–	1	3
PEST/PCB		S	8oz glass (1)	4°C	7/40d						
PEST/PCB		W	32oz amber glass (2)	4°C**	7/40d						
P.P. METALS		S	8oz glass (1)	4°C	6 mon						
P.P METALS		W	1 liter glass or polyethylene (1)	HNO_3 pH<2 4°C	6 mon						
CYANIDE		S	8oz glass (1)	4°C	14 day						

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_3$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for analytical method to be used.
2. Only required if dedicated sampling tools are not used. One blank required per parameter per 20 samples.
3. One trip blank required per cooler used to ship VOA samples. Each trip blank consists of two 430 ml vials filled with distilled
4. Performance check samples; optional for QA-2, mandatory for QA-3 level. One per parameter.
5. For QA-2: one matrix spike duplicate per lot of 10 samples; therefore, collect two additional environmental sample volumes (wate environmental samples. For solid matrix, one additional volume per 10 environmental samples. For QA-3: two matrix spike duplic environmental samples; therefore, collect four additional volumes of environmental samples for every 10 samples. Collect two add environmental sample for solid matrix spikes.

SECOND SITE VISIT

Table 9.2: QA/QC Analysis and Objectives Summary

Analytical Parameter	Matrix*	Analytical Method Ref.	Spikes		QA/QC	
			Matrix[1]	Surrogate[2]	Detection Limits[3]	QA Objective[4]
VOA	S	8240/SW-846	1	YES	see attached sheets	QA-2
VOA	W	624/CLP	2	YES	see attached sheet	QA-2
BNA	S	8250 or 8270/ SW-846				
BNA	W	625/CLP	1	YES	see attached sheet	QA-1
PEST	S	8080/SW-846				
PCB	S	8080/SW-846				
PEST	W	608				
PCB	W	608				
P.P. METALS	S	SW-846				
P.P. METALS	W	EPA-600/CFR 40				
CYANIDE	S	SW-846				
CYANIDE	W	SW-846				

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air.

1. For QA-2: one matrix spike duplicate analysis per lot of 10 samples. For QA-3: two matrix spike duplicate analyses per lot of 10 samples.
2. Surrogate spikes analysis to be run (enter yes) for each sample in QA-1 and QA-2.
3. To be determined by the person arranging the analysis.
4. Enter QA Objective desired: QA-1, QA-2, or QA-3.

THIRD SITE VISIT

Table 9.1: Field Sampling Summary

Analytical Parameter	Level of Sensitivity[1]	Matrix*	Container Type and Volume (# containers rq'd)	Preservative	Holding Time	Subtotal Samples	QC Extra's: Rinsate Blanks[2]	QC Extra's: Trip Blanks[3] (VOA's)	QC Extra's: QC Positives[4]	QC Extra's: Matrix Spikes[5]	Total Field Sample
VOA		S	40ml vial (1)	4°C	7 day	6	-	-	-	1	-
VOA		W	40ml vial (3)	4°C**	7 day	2	-	1	-	1	4
BNA		S	8oz glass (1)	4°C	7/40d						
BNA		W	32oz amber glass (2)	4°C	7/40d						
PEST/PCB		S	8oz glass (1)	4°C	7/40d						
PEST/PCB		W	32oz amber glass (2)	4°C**	7/40d						
P.P. METALS		S	8oz glass (1)	4°C	6 mon						
P.P METALS		W	1 liter glass or polyethylene (1)	HNO_3 pH<2 4°C	6 mon						
CYANIDE		S	8oz glass (1)	4°C	14 day						

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_3$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for analytical method to be used.
2. Only required if dedicated sampling tools are not used. One blank required per parameter per 20 samples.
3. One trip blank required per cooler used to ship VOA samples. Each trip blank consists of two 430 ml vials filled with distilled/
4. Performance check samples; optional for QA-2, mandatory for QA-3 level. One per parameter.
5. For QA-2: one matrix spike duplicate per lot of 10 samples; therefore, collect two additional environmental sample volumes (water environmental samples. For solid matrix, one additional volume per 10 environmental samples. For QA-3: two matrix spike duplic environmental samples; therefore, collect four additional volumes of environmental samples for every 10 samples. Collect two addi environmental sample for solid matrix spikes.

THIRD SITE VISIT

Table 9.1: Field Sampling Summary (continued)

Analytical Parameter	Level of Sensitivity[1]	Matrix*	Container Type and Volume (# containers rq'd)	Preservative	Holding Times	QC Extra's: Subtotal Samples	Rinsate Blanks[2]	Trip Blanks[3] (VOA's)	QC Positives[4]	Matrix Spikes[5]	Tot Fie Samp
CYANIDE		W	1 liter polyethylene (1)	NaOH to pH >12 4°C	14 day						
PHENOL		S	8oz glass (1)	4°C	28 day						
PHENOL		W	1 liter amber glass (1)	H_2SO_4 to pH < 2 4°C	28 day						
CHIPS/CORES:											
BNA		solid	4oz glass	no		3	-	-	-	1	4
pp metals		solid	4oz glass	no		3	-	-	-	1	4
WIPES:											
BNA		particulate with wipe	4oz glass	no		3	-	1	-	1	5
pp metals		particulate with wipe	4oz glass	no		3	-	1	-	1	5

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_3$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis for analytical method to be used.
2. Only required if dedicated sampling tools are not used. One blank required per parameter per 20 samples.
3. One trip blank required per cooler used to ship VOA samples. Each trip blank consists of two 430 ml vials filled with distilled/(
4. Performance check samples; optional for QA-2, mandatory for QA-3 level. One per parameter.
5. For QA-2: one matrix spike duplicate per lot of 10 samples; therefore, collect two additional environmental sample volumes (water environmental samples. For solid matrix, one additional volume per 10 environmental samples. For QA-3: two matrix spike duplics environmental samples; therefore, collect four additional volumes of environmental samples for every 10 samples. Collect two addi environmental sample for solid matrix spikes.

THIRD SITE VISIT

Table 9.2: QA/QC Analysis and Objectives Summary

Analytical Parameter	Matrix*	Analytical Method Ref.	Spikes: Matrix[1]	Spikes: Surrogate[2]	QA/QC: Detection Limits[3]	QA/QC: QA Objective[4]
VOA	S	8240/SW-846	1	YES	see attached sheet	QA-2
VOA	W	624/CLP	1	YES	see attached sheet	QA-2
BNA	S	8250 or 8270/ SW-846				
BNA	W	625/CLP				
PEST	S	8080/SW-846				
PCB	S	8080/SW-846				
PEST	W	608				
PCB	W	608				
P.P. METALS	S	SW-846				
P.P. METALS	W	EPA-600/CFR 40				
CY[illegible]	S	SW-846				
CY[illegible]	W	SW-846				

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air.

1. For QA-2: one matrix spike duplicate analysis per lot of 10 samples. For QA-3: two matrix spike duplicate analyses per lot of 10 samples.
2. Surrogate spikes analysis to be run (enter yes) for each sample in QA-1 and QA-2.
3. To be determined by the person arranging the analysis.
4. Enter QA Objective desired: QA-1, QA-2, or QA-3.

THIRD SITE VISIT

Table 9.2: QA/QC Analysis and Objectives Summary (continued)

Analytical Parameter	Matrix*	Analytical Method Ref.	Spikes: Matrix[1]	Spikes: Surrogate[2]	QA/QC: Detection Limits[3]	QA/QC: QA Objective[4]
PHENOL	S	8040/SW-846				
PHENOL	W	604/CFR 40				
CHIP/CORE:						
BNA	solid	SW-846	1	YES	see attached sheet	QA-2
pp metals	solid	SW-846	1	YES	see attached sheet	QA-2
WIPES:						
BNA	particulate with wipe	SW-846	1	YES	see attached sheet	QA-2
pp metals	particulate with wipe	SW-846	1	YES	see attached sheet	QA-2

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air.

1. For QA-2: one matrix spike duplicate analysis per lot of 10 samples. For QA-3: two matrix spike duplicate analyses per lot of 10 samples.
2. Surrogate spikes analysis to be run (enter yes) for each sample in QA-1 and QA-2.
3. To be determined by the person arranging the analysis.
4. Enter QA Objective desired: QA-1, QA-2, or QA-3.

BENCH - SCALE TESTS

Table 9.1: Field Sampling Summary

Analytical Parameter	Level of Sensitivity[1]	Matrix*	Container Type and Volume (# containers rq'd)	Preservative	Holding Times	QC Extra's: Subtotal Samples	QC Extra's: Rinsate Blanks[2]	QC Extra's: Trip Blanks[3] (VOA's)	QC Extra's: QC Positives[4]	QC Extra's: Matrix Spikes[5]	To... Sam...
VOA		S	40ml vial (1)	4°C	7 day	34	-	-	-	3	37
VOA		W	40ml vial (3)	4°C**	7 day						
BNA		S	8oz glass (1)	4°C	7/40d						
BNA		W	32oz amber glass (2)	4°C	7/40d						
PEST/PCB		S	8oz glass (1)	4°C	7/40d						
PEST/PCB		W	32oz amber glass (2)	4°C**	7/40d						
P.P. METALS		S	8oz glass (1)	4°C	6 mon						
P.P METALS		W	1 liter glass or polyethylene (1)	HNO_3 pH<2 4°C	6 mon						
CYANIDE		S	8oz glass (1)	4°C	14 day						

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air

** If residual chlorine is present, preserve with 0.008% $Na_2S_2O_3$.

1. The concentration level, specific or generic, that is needed in order to make an evaluation. This level will provide a basis f... analytical method to be used.
2. Only required if dedicated sampling tools are not used. One blank required per parameter per 20 samples.
3. One trip blank required per cooler used to ship VOA samples. Each trip blank consists of two 430 ml vials filled with distillec...
4. Performance check samples; optional for QA-2, mandatory for QA-3 level. One per parameter.
5. For QA-2: one matrix spike duplicate per lot of 10 samples; therefore, collect two additional environmental sample volumes (wat... environmental samples. For solid matrix, one additional volume per 10 environmental samples. For QA-3: two matrix spike dupli... environmental samples; therefore, collect four additional volumes of environmental samples for every 10 samples. Collect two ad... environmental sample for solid matrix spikes.

BENCH-SCALE TESTS

Table 9.2: QA/QC Analysis and Objectives Summary

Analytical Parameter	Matrix*	Analytical Method Ref.	Spikes: Matrix[1]	Spikes: Surrogate[2]	QA/QC: Detection Limits[3]	QA/QC: QA Objective[4]
VOA	S	8240/SW-846	3	YES		QA-2
VOA	W	624/CLP				
SNA	S	8250 or 8270/ SW-846				
SNA	W	625/CLP				
PEST	S	8080/SW-846				
PCB	S	8080/SW-846				
PEST	W	608				
PCB	W	608				
P.P. METALS	S	SW-846				
P.P. METALS	W	EPA-600/CFR 40				
CYANIDE	S	SW-846				
CYANIDE	W	SW-846				

* Matrix: S-Soil, W-Water, O-Oil, DS-Drum Solid, DL-Drum Liquid, TS-Tank Solid, TL-Tank Liquid, X-Other, A-Air.

1. For QA-2: one matrix spike duplicate analysis per lot of 10 samples. For QA-3: two matrix spike duplicate analyses per lot of 10 samples.
2. Surrogate spikes analysis to be run (enter yes) for each sample in QA-1 and QA-2.
3. To be determined by the person arranging the analysis.
4. Enter QA Objective desired: QA-1, QA-2, or QA-3.

EXHIBIT C

Hazardous Substance List (HSL) and
Contract Required Detection Limits (CRDL)**

Volatiles	CAS Number	Detection Limits* Low Water[a] ug/L	Low Soil/Sediment ug/Kg
1. Chloromethane	74-87-3	10	10
2. Bromomethane	74-83-9	10	10
3. Vinyl Chloride	75-01-4	10	10
4. Chloroethane	75-00-3	10	10
5. Methylene Chloride	75-09-2	5	5
6. Acetone	67-64-1	10	10
7. Carbon Disulfide	75-15-0	5	5
8. 1,1-Dichloroethene	75-35-4	5	5
9. 1,1-Dichloroethane	75-35-3	5	5
10. trans-1,2-Dichloroethene	156-60-5	5	5
11. Chloroform	67-66-3	5	5
12. 1,2-Dichloroethane	107-06-2	5	5
13. 2-Butanone	78-93-3	10	10
14. 1,1,1-Trichloroethane	71-55-6	5	5
15. Carbon Tetrachloride	56-23-5	5	5
16. Vinyl Acetate	108-05-4	10	10
17. Bromodichloromethane	75-27-4	5	5
18. 1,1,2,2-Tetrachloroethane	79-34-5	5	5
19. 1,2-Dichloropropane	78-87-5	5	5
20. trans-1,3-Dichloropropene	10061-02-6	5	5
21. Trichloroethene	79-01-6	5	5
22. Dibromochloromethane	124-48-1	5	5
23. 1,1,2-Trichloroethane	79-00-5	5	5
24. Benzene	71-43-2	5	5
25. cis-1,3-Dichloropropene	10061-01-5	5	5

(continued)

Volatiles	CAS Number	Detection Limits* Low Water[a] ug/L	Low Soil/Sediment[b] ug/Kg
26. 2-Chloroethyl Vinyl Ether	110-75-8	10	10
27. Bromoform	75-25-2	5	5
28. 2-Hexanone	591-78-6	10	10
29. 4-Methyl-2-pentanone	108-10-1	10	10
30. Tetrachloroethene	127-18-4	5	5
31. Toluene	108-88-3	5	5
32. Chlorobenzene	108-90-7	5	5
33. Ethyl Benzene	100-41-4	5	5
34. Styrene	100-42-5	5	5
35. Total Xylenes		5	5

[a]Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Water CRDL.

[b]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 times the individual Low Soil/Sediment CRDL.

Semi-Volatiles	CAS Number	Detection Limits* Low Water[c] ug/L	Low Soil/Sediment ug/Kg
36. Phenol	108-95-2	10	330
37. bis(2-Chloroethyl) ether	111-44-4	10	330
38. 2-Chlorophenol	95-57-8	10	330
39. 1,3-Dichlorobenzene	541-73-1	10	330
40. 1,4-Dichlorobenzene	106-46-7	10	330
41. Benzyl Alcohol	100-51-6	10	330
42. 1,2-Dichlorobenzene	95-50-1	10	330
43. 2-Methylphenol	95-48-7	10	330
44. bis(2-Chloroisopropyl) ether	39638-32-9	10	330
45. 4-Methylphenol	106-44-5	10	330
46. N-Nitroso-Dipropylamine	621-64-7	10	330
47. Hexachloroethane	67-72-1	10	330
48. Nitrobenzene	98-95-3	10	330
49. Isophorone	78-59-1	10	330
50. 2-Nitrophenol	88-75-5	10	330
51. 2,4-Dimethylphenol	105-67-9	10	330
52. Benzoic Acid	65-85-0	50	1600
53. bis(2-Chloroethoxy) methane	111-91-1	10	330
54 2,4-Dichlorophenol	120-83-2	10	330
55. 1,2,4-Trichlorobenzene	120-82-1	10	330
56. Naphthalene	91-20-3	10	330
57. 4-Chloroaniline	106-47-8	10	330
58. Hexachlorobutadiene	87-68-3	10	330
59. 4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
60. 2-Methylnaphthalene	91-57-6	10	330
61. Hexachlorocyclopentadiene	77-47-4	10	330
62. 2,4,6-Trichlorophenol	88-06-2	10	330
63. 2,4,5-Trichlorophenol	95-95-4	50	1600

(continued)

Semi-Volatiles	CAS Number	Detection Limits* Low Water[c] ug/L	Low Soil/Sediment ug/Kg
64. 2-Chloronaphthalene	91-58-7	10	330
65. 2-Nitroaniline	88-74-4	50	1600
66. Dimethyl Phthalate	131-11-3	10	330
67. Acenaphthylene	208-96-8	10	330
68. 3-Nitroaniline	99-09-2	50	1600
69. Acenaphthene	83-32-9	10	330
70. 2,4-Dinitrophenol	51-28-5	50	1600
71. 4-Nitrophenol	100-02-7	50	1600
72. Dibenzofuran	132-64-9	10	330
73. 2,4-Dinitrotoluene	121-14-2	10	330
74. 2,6-Dinitrotoluene	606-20-2	10	330
75. Diethylphthalate	84-66-2	10	330
76. 4-Chlorophenyl Phenyl ether	7005-72-3	10	330
77. Fluorene	86-73-7	10	330
78. 4-Nitroaniline	100-01-6	50	1600
79. 4,6-Dinitro-2-methylphenol	534-52-1	50	1600
80. N-nitrosodiphenylamine	86-30-6	10	330
81. 4-Bromophenyl Phenyl ether	101-55-3	10	330
82. Hexachlorobenzene	118-74-1	10	330
83. Pentachlorophenol	87-86-5	50	1600
84. Phenanthrene	85-01-8	10	330
85. Anthracene	120-12-7	10	330
86. Di-n-butylphthalate	84-74-2	10	330
87. Fluoranthene	206-44-0	10	330
88. Pyrene	129-00-0	10	330
89. Butyl Benzyl Phthalate	85-68-7	10	330
90. 3,3'-Dichlorobenzidine	91-94-1	20	660
91. Benzo(a)anthracene	56-55-3	10	330
92. bis(2-ethylhexyl)phthalate	117-81-7	10	330
93. Chrysene	218-01-9	10	330
94. Di-n-octyl Phthalate	117-84-0	10	330
95. Benzo(b)fluoranthene	205-99-2	10	330
96. Benzo(k)fluoranthene	207-08-9	10	330
97. Benzo(a)pyrene	50-32-8	10	330

(continued)

Semi-Volatiles	CAS Number	Detection Limits* Low Water[c] ug/L	Low Soil/Sediment[d] ug/Kg
98. Indeno(1,2,3-cd)pyrene	193-39-5	10	330
99. Dibenz(a,h)anthracene	53-70-3	10	330
100. Benzo(g,h,i)perylene	191-24-2	10	330

[c]Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 times the individual Low Water CRDL.

[d]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 times the individual Low Soil/Sediment CRDL.

Pesticides	CAS Number	Detection Limits* Low Water[e] ug/L	Low Soil/Sediment[f] ug/Kg
101. alpha-BHC	319-84-6	0.05	8.0
102. beta-BHC	319-85-7	0.05	8.0
103. delta-BHC	319-86-8	0.05	8.0
104. gamma-BHC (Lindane)	58-89-9	0.05	8.0
105. Heptachlor	76-44-8	0.05	8.0
106. Aldrin	309-00-2	0.05	8.0
107. Heptachlor Epoxide	1024-57-3	0.05	8.0
108. Endosulfan I	959-98-8	0.05	8.0
109. Dieldrin	60-57-1	0.10	16.0
110. 4,4'-DDE	72-55-9	0.10	16.0
111. Endrin	72-20-8	0.10	16.0
112. Endosulfan II	33213-65-9	0.10	16.0
113. 4,4'-DDD	72-54-8	0.10	16.0
114. Endosulfan Sulfate	1031-07-8	0.10	16.0
115. 4,4'-DDT	50-29-3	0.10	16.0
116. Endrin Ketone	53494-70-5	0.10	16.0
117. Methoxychlor	72-43-5	0.5	80.0
118. Chlordane	57-74-9	0.5	80.0
119. Toxaphene	8001-35-2	1.0	160.0
120. AROCLOR-1016	12674-11-2	0.5	80.0
121. AROCLOR-1221	11104-28-2	0.5	80.0
122. AROCLOR-1232	11141-16-5	0.5	80.0
123. AROCLOR-1242	53469-21-9	0.5	80.0
124. AROCLOR-1248	12672-29-6	0.5	80.0
125. AROCLOR-1254	11097-69-1	1.0	160.0
126. AROCLOR-1260	11096-82-5	1.0	160.0

[e]Medium Water Contract Required Detection Limits (CRDL) for Pesticide HSL Compounds are 100 times the individual Low Water CRDL.

[f]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Pesticide HSL compounds are 15 times the individual Low Soil/Sediment CRDL.

*Detection limits listed for soil/sediment are based on wet weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

** Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

QUALITY ASSURANCE

Work Plan

REVISION I
PHASE I OF ENGINEERING STUDY FOR THE CHEMICAL COMMODITIES, INC., SITE

Prepared by
Roy F. Weston, Inc.

November, 1989

EPA Work Assignment No. 1-288
Weston Work Order No. 3347-11-01-2288
EPA Contract No.: 68-03-3482

APPROVALS

Roy F. Weston, Inc.		EPA	
Robert Evangelista / Task Leader	Nov 27 1989 (Date)	Andre Zownir Work Assignment Manager	(Date)
W. Scott Butterfield Project Manager	11/25/89 (Date)	Robert Cibulskis Project Officer	(Date)
		William J. Bailey Contracting Officer	(Date)

eh/WP-2288.R1

1.0 OBJECTIVE

The Chemical Commodities Inc. site (CCI) is located outside of Kansas City, Kansas. The U.S. EPA Environmental Response Team (ERT) has asked the Response Engineering Analytical Contractor (REAC) to study the feasibility of in-situ soil remediation and on-site building decontamination.

This engineering study has eight objectives: 1) to determine the extent of soil contamination; 2) to determine the soil characteristics that will impact remediation efforts; 3) to explore viable remediation technologies for the contaminated soil; 4) to perform bench-scale engineering studies for obtaining performance data on viable soil remediation alternatives; 5) to determine the contamination of the site buildings; 6) to explore the remedial options for these buildings; 7) to propose alternatives and costs for methods to prevent contaminated groundwater from leaving the site; and 8) to determine the treatment cost of remedial options.

2.0 PROJECT SCOPE

The scope of the project is to characterize, sample, and analyze soil, and to sample and analyze the buildings and groundwater at CCI as requested by the U.S. EPA Work Assignment Manager.

A review of technologies was performed to determine viable treatment options for the soil and buildings. Hands-on bench-scale engineering tests provided performance data on potential remedial technologies for contaminated soil. Costs will be obtained from vendor bids and from the literature.

3.0 TECHNICAL APPROACH

Potential remedial treatment technologies for both contaminated soil and buildings were evaluated by reviewing current literature, reading recent U.S. EPA documents, exploring databases, and communicating with technical contacts. In previous work for soil contaminated with volatile organic compounds, hands-on bench scale engineering tests were performed by Weston's Environmental Testing Laboratory (ETL), Lionville, Pennsylvania, for in-situ volatilization (ISV) and low temperature thermal treatment (LT3).

A September, 1989, site visit included the following activities: 1) additional soil and groundwater sampling and analysis as directed by the EPA Work Assignment Manager, 2) large quantity environmental soil sample collection (approximately 50 gallons) for hands-on bench-scale engineering tests, and 3) sampling and analyses of buildings. The buildings were wipe and core/chip sampled as directed by the EPA Work Assignment Manager. These samples were analyzed for VOAs, BNAs, and priority pollutant metals. VOA analyses were performed on all samples, and BNA and priority pollutant metal analyses were performed on select samples. The delineation of soil for treatment and volume of contaminated soil were estimated. Finally, building decontamination methods were evaluated.

Soil samples were collected from the CCI site at locations determined by the Work Assignment Manager and Task Leader. The following Weston/REAC Standard Operating Procedures were followed for all field activities: General Field Sampling Guidelines (2001); Sample Documentation (2002); Sample Packaging and Shipping (2004); Groundwater Well Sampling (2007); Wipe, Chip, and Sweep Sampling (2011); and Soil Sampling (2012).

Decontamination of sampling tools included: 1) Liquinox soap and water wash, 2) water rinse, 3) distilled/deionized water rinse, and 4) air dry.

Costs for remedial options were determined by vendor bids and environmental literature.

The Task Leader and Work Assignment Manager will meet with a representative from T... Treatments (USA), Inc. on December 4, 1989.

4.0 PROJECT MANAGEMENT AND REPORTING

The REAC Task Leader will maintain contact with the EPA Work Assignment Manager to keep him informed about the technical and financial progress of this project. Activities under this project will be summarized in appropriate format for inclusion in REAC monthly and annual reports. A report containing the site technology recommendations and bench-scale engineering study results will be prepared.

5.0 PROJECT SCHEDULE

A project schedule sheet is attached (Attachment 1). An exploration of viable treatment technologies commenced. Sampling was conducted upon request from the Work Assignment Manager. The draft report was submitted following the receipt of the final laboratory analyses. The first draft report was delivered on October 17, 1989. A second draft report was submitted to the Work Assignment manager for review on November 16, 1989. A final report will follow after the comments of the Work Assignment Manager on the second draft report are addressed.

6.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

EPA Work Assignment Manager: Andre P. Zownir

Provide overall direction to REAC staff concerning project sampling needs and remediation objectives.

REAC Task Leader: Robert Evangelista

Primary point of contact with EPA Work Assignment Manager. Responsible for completion of Quality Assurance Work Plan (QAWP), Health and Safety Plan (HSP), and interim report. Responsible for field sampling and field adherence to the QAWP and HSP and records any deviations from the QAWP. Responsible for treatment technology exploration and management of bench-scale engineering studies.

REAC Health and Safety Officer: Martin O'Neill

Responsible for approval of site Health and Safety Plan and general health and safety coordination.

REAC O&A Section Chief: Craig Moylan

Responsible for providing technical manpower as needed and QA review.

REAC QA Officer: John Mateo

Responsible for auditing and guiding project, review of final report before release to EPA, and proposing corrective action, if necessary, for non-conformity to the QAWP.

7.0 MANPOWER AND COST PROJECTIONS

The estimated costs (including labor, travel, materials, and equipment, and analytical) to complete this project are depicted in the attached Project Cost Summary sheet (Attachment 2).

8.0 DELIVERABLES

For the planned September site visit, preliminary VOA analytical results were available October ??, 1989 following the receipt of the samples by the Weston REAC laboratory. Preliminary BNA and heavy metal analytical results were available October 13, 1989.

For the in-situ volatilization and low temperature thermal treatment engineering studies, the preliminary VOA analytical results were available to the Work Assignment Manager on August 23, 1989.

The draft report was submitted to the Work Assignment Manager after the completion of the analyses. This report included recommendations on remedial alternatives and their respective costs and the sampling and analyses results. AutoCad maps will be drawn for the potentiometric head (flow net diagrams), the analytical results, the contaminant isopleths (both trichloroethene and total volatile organics), and the delineation of the interceptor trench and contaminated soil.

9.0 QUALITY ASSURANCE

The detection limits for analytes were placed in Attachment 3.

9.1 Site Visit - September, 1989

As identified in Section 1.0, the objective of this project/event does require analyte specificity for all samples. The results will have confirmed identification and/or associated confidence limits. Results will also be representative, comparable, and complete. The QA level of control defined by this criteria is QA-2. The following QA/QC protocols will be addressed: chain of custody documentation, sample holding time documentation, collection and evaluation of blanks, matrix spike samples, and instrument calibration documentation. Table 9.1 and 9.2 are completed to reflect the appropriate QA/QC protocols identified above.

Numbers of samples to be collected for this project/event are entered onto Tables 9.1 Field Sampling Summary and Table 9.2 QA/QC Analysis and Objectives Summary to facilitate ready identification of analytical parameters desired, type, volume and number of containers needed, preservation requirements, number of samples required and associated number, and type of QA/QC control samples required based on QA level desired.

Specific data review activities for QA-2 should be performed by the following tiered approach:

1. a. For any one data package, review all data elements for 10% of samples.
   b. For the remaining 90% of the samples within the same data package, review holding times, blank contamination, spike (surrogate/matrix) recovery, detection capability, and confirmed identification thoroughly.
2. For every tenth data package, review all data quality elements for all samples.

All project deliverables will receive an internal peer QC review prior to release to EPA as per guidelines established in the REAC Quality Assurance Program Plan.

9.2 Bench-Scale Engineering Study

As identified in Section 1.0, the objective of this project/event does require analyte specificity for all samples. The results will have confirmed identification and/or associated confidence limits. Results will be representative, comparable, and complete. The QA level of control defined by

this criteria is QA-2. The following QA/QC protocols will be addressed: chain of custody documentation, sample holding time documentation, collection and evaluation of blanks, matrix spike samples, and instrument calibration documentation. Table 9.1 and 9.2 are completed to reflect the appropriate QA/QC protocols identified above.

Numbers of samples to be collected for this project/event are entered onto Tables 9.1 Field Sampling Summary and Table 9.2 QA/QC Analysis and Objectives Summary to facilitate ready identification of analytical parameters desired, type, volume and number of containers needed, preservation requirements, number of samples required and associated number, and type of QA/QC control samples required based on QA level desired.

Specific data review activities for QA-2 should be performed by the following tiered approach:

1. a. For any one data package, review all data elements for 10% of samples.
   b. For the remaining 90% of the samples within the same data package, review holding times, blank contamination, spike (surrogate/matrix) recovery, detection capability, and confirmed identification thoroughly.

2. For every tenth data package, review all data quality elements for all samples.

All project deliverables will receive an internal peer QC review prior to release to EPA, as per guidelines established in the REAC Quality Assurance Program Plan.

APPENDIX 1

REAC PROJECT SUMMARY SCHEDULE
CHEMICAL COMMODITIES SITE
EPA WORK ASSIGNMENT NO. 0 288
REV. 1

LEGEND
\>>> ACTIVITY DURATION FORECAST
C COMPLETED TASK

TASK NO.	SEPTEMBER 1989	OCTOBER 1989	NOVEMBER 1989	DECEMBER 1989	JANUARY 1990	FEBRUARY 1990	MARCH 1990	APRIL 1990	MAY 1990	JUNE 1990	JULY 1990	AUGUST 1990
1. THIRD SITE VISIT	C											
2. BENCH SCALE ENGINEERING STUDY	C											
3. SAMPLE ANALYSIS		C										
4. DATA REVIEW		C										
5. TREATMENT TECHNOLOGY EVALUATION		C										
6. DRAFT REPORT		C										
7. REMEDIAL COST ESTIMATE		>>>	>>>									
8. FINAL REPORT		>>	>>>>>>>>>>									
9. MEET WITH TOXIC TREATMENTS, INC. REPRESENTATIVES AT BLDG. 18				>								

REAC PROJECT COST SUMMARY
CHEMICAL COMMODITIES SITE
EPA WORK ASSIGNMENT NO. 1 288
WESTON WORK ORDER NO. 3147-11-01-2288
REV.1 17-NOV-89

LABOR PLAN (HOURS PER MONTH)

DESCRIPTION		SEP 89	OCT 89	NOV 89	DEC 89	JAN 90	FEB 90	MAR 90	APR 90	MAY 90	JUN 90	JUL 90	AUG 90	TOTAL HOURS
S&A	30 $/MH	260	175	5										440
O&A	30 $/MH	260	135	150	40									585
SUPPORT	30 $/MH	15	70	40	5									130
QA/QC,H&S,MGT.	50 $/MH	5	5	5	5									20
WESTON H.O.	50 $/MH		150	60										210
TOTAL MHS		540	535	260	50	0	0	0	0	0	0	0	0	1385
CUMULATIVE MHS		540	1075	1335	1385	1385	1385	1385	1385	1385	1385	1385	1385	

DOLLAR PLAN

DESCRIPTION		SEP 89	OCT 89	NOV 89	DEC 89	JAN 90	FEB 90	MAR 90	APR 90	MAY 90	JUN 90	JUL 90	AUG 90	TOTAL DOLLARS
S&A	30 $/MH	7800	5250	150	0									13200
O&A	30 $/MH	7800	4050	4500	1200									17550
SUPPORT	30 $/MH	450	2100	1200	150									3900
QA/QC,H&S,MGT.	50 $/MH	250	250	250	250									1000
WESTON H.O.	50 $/MH	0	7500	3000	0									10500
TRAVEL		2900		150										3050
FIELD SUPPLIES		800												800
SHIPPING		1400		700										2100
MISC. EXPENSES		300	100	100										500
SUBTOTAL $		21700	19250	10050	1600	0	0	0	0	0	0	0	0	52600
CUMULATIVE $		21700	40950	51000	52600	52600	52600	52600	52600	52600	52600	52600	52600	
DISTRIBUTIVE	0.25	5425	4813	2511	400	0	0	0	0	0	0	0	0	13150
FEE	0.014	380	337	176	28	0	0	0	0	0	0	0	0	921
TOTAL DOLLARS		27505	24399	12738	2028	0	0	0	0	0	0	0	0	66700
CUM. DOLLARS			51904	64643	66671	66671	66671	66671	66671	66671	66671	66671	66671	

ATTACHMENT 3

DETECTION LIMIT OF ANALYTES

Parameter	Detection Limit Units: mg/kg	Detection Limit Units: ug/l
Antimony	1.0	5.0
Arsenic	1.0	5.0
Beryllium	1.0	5.0
Cadmium	1.0	5.0
Chromium	10	10
Copper	5.0	25
Lead	10	5.0
Mercury	0.1	0.2
Nickel	8.0	40
Selenium	1.0	5.0
Silver	2.0	10
Thallium	1.0	5.0
Zinc	4.0	20
Iron	10.0	100
Cyanide	1.0	10

APPENDIX E

FISCAL YEAR 1990 WORK PLAN

Unfilmed Document Target

UNFILMED DOCUMENT

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