Document No. 4040-001-600

Feasibility Study Report Koppers Texarkana Site Texarkana, Texas

Volume II - Appendices

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Prepared for

KOPPERS COMPANY, INC.
Pittsburgh, PA

June 1988

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An ENSR Company

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TREATABILITY STUDY REPORT
KOPPERS COMPANY, INC.
TEXARKANA, TEXAS

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Prepared for:

KOPPERS COMPANY, INC.
PREVIOUSLY OPERATED PROPERTY
TEXARKANA, TEXAS

Prepared by:

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PROJECT 157673-08

FEBRUARY 1988

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EXECUTIVE SUMMARY

This document summarizes the results of performance testing conducted by Keystone Environmental Resources, Inc. for the purpose of evaluating the technical feasibility of various treatment processes for the remediation of groundwater and soil contaminated with coal tar related organics. The coal tar organics present in the soil and groundwater originated from the past operations of a former Koppers wood treating and preserving plant.

The technologies examined herein have passed the initial screening process and have been considered for treatability investigation. The technologies considered in the screening where based on the characterization work performed during the remedial investigation. The analytical results from surface water, groundwater and soil samples, were used as the basis to examine the different technologies.

With the exception of the Accelerated Carbon Testing performed by Calgon Carbon Corporation, all treatability work was performed by Keystone Environmental Resources at the Science and Technology Center in Monroeville, PA. Groundwater and soil samples were collected by Keystone Field Service technicians for use in the treatability work. All related analysis were performed by Keystone's Analytical Division.

Following pretreatment for removal of oil and grease associated contaminants, three groundwater methods were evaluated. These included: (i) carbon adsorption, (ii) chemical oxidation, and (iii) biological treatment. Carbon adsorption treatment included carbon adsorption isotherms and Accelerated Carbon Column Testing. Chemical oxidation focused on UV/Ozone Oxidation treatment. The biological treatment alternatives evaluated were: (i) activated sludge, (ii) aeration tank, (iii) fixed film, and (iv) fluidized bed.

In-situ and ex-situ soil treatment technologies were also evaluated. Five soil columns were set up to investigate variations of bioreclamation treatment methodologies. In addition, soil washing was investigated for removal of contaminants from the soil matrix.

With the exception of activated sludge treatment, all other groundwater treatment processes tested were successful for reduction of groundwater contaminants. The two activated sludge treatment reactors were converted to an aeration tank and a fixed film reactor when the data indicated the groundwater organic substrate was to low to support an activated sludge biomass.

Shortly following start-up of the soil columns , plugging occurred and the columns were shut down. Soil washing was completed with preliminary successful results. Complete soil washing results will be issued as an addendum when all results are available.

Pretreatment results showed an 83% reduction of oil and grease with a corresponding removal of 90.7% of total PAH compounds. Carbon adsorbtion isotherms and ACT results show reduction of TOC and naphthalene. UV-Ozone/Oxidation reduced the total PAH concentration 88%. Aeration tank treatment reduced total PAH compounds >99%. Fixed film treatment reduced total PAH compounds >86%. The best treatment was realized with the fluidized bed with >99.9% removal of total PAH compounds.

The data presented in this report can be used in a more detailed evaluation of these and other technologies as needed for Feasibility Study (FS) purposes.

1.0 INTRODUCTION

Presented in this document are the results from treatability work performed as partial fulfillment of the Feasibility Study (FS) for the Koppers Texarkana former wood-treating plant site in Texarkana, Texas.

Koppers and the U.S. EPA have conducted several separate surface and subsurface investigations and collected extensive soil and groundwater quality data at the Texarkana site. The results of these studies have identified the contaminants and extent of contamination. These data were used to select the treatability alternatives for laboratory experimentation best suited for remediation.

The focus of the study is to evaluate cleanup methods for soil and groundwater contamination from creosote compounds used in past wood treating operations. Data compiled during the remedial investigation was used in the evaluation and screening of technologies to be considered for treatability investigation.

The results of the following studies demonstrate the treatability of groundwater and soil at the Texarkana site. This data can be used to determine the most feasible treatment alternatives and for generating cost comparisons of the various treatment alternatives.

All results included with the exception of soil washing which will be issued as an addendum.

Section 2 presents a brief background summary. A summary of each of the technologies is given in Section 3. The procedures and results from the treatability work are presented in Section 4. Section 5 includes a brief summary and conclusion of the results.

2.0 BACKGROUND

2.1 Site History

Wood preserving and treating operations were initiated in 1903 by National Lumber and Creosoting Company. National Lumber and Creosoting Company was acquired in 1931 by the Wood Preserving Corporation (subsidiary of Koppers). Koppers operated the facility from 1939 to 1961. Wood preservatives used at the site included creosote, pentachlorophenol and chromated zinc chloride. The total site occupies some 62 acres. In 1961, Koppers sold the site to Carver Terrace Inc., who developed approximately 33.5 acres for residential housing. Carver Terrace sold the southern half of the property to Bruce Kennedy, a local sand and gravel operator, who to date, has excavated two gravel pits approximately 700 feet long, 25 feet wide, and 15 feet deep.

2.2 Site Description

The Koppers Texarkana site is located in Bowie County, the northeastern most county of Texas, in the city of Texarkana. Texarkana, itself, is actually situated on the Texas-Arkansas state line. The 62-acre Koppers site is located within the Texas boundaries of Texarkana in the southern section of the city about 1 mile from the Texas-Arkansas state line.

Locally, the site is bordered by the Texas and Pacific Railroad to the north, an unnamed tributary to the northwest, Wagner creek to the southwest, Jameson Street to the south, and a drainage ditch to the southeast.

The Koppers Texarkana site is generally flat. There is a drainage ditch to the east and the Wagner Creek stream valley and gravel pits to the south. The site gently slopes from the northeast to the southwest.

The site geology consists of deposits which range from gravels to silts. These deposits are found over the entire site from ground surface to a maximum depth of 24 feet.

Within the site, the area consists of a housing development, a former sand and gravel operation, and a church. The housing development, Carver Terrace Subdivision,

occupies the northern 33-1/2 acres and consists of 79 one-story houses. The Mt. Zion Missionary Baptist Church occupies a 1/2 acre lot just south of West Third Street and west of Tilson Avenue. The remainder of the site, the southern 28 acres, is fenced and owned by Mr. Bruce Kennedy of Kennedy Sand and Gravel Company.

3.0 STUDY OVERVIEW

3.1 Sample Collection

Groundwater and soil samples used in the treatability work were collected at the Texarkana site by Keystone Field Services personnel. Strict QA/QC and chain of custody procedures were followed during sample collection

Groundwater

Groundwater samples used in the treatability work were collected from wells MW-2 MW-4, MW-5. MW-6, MW-7 and OW-5. The samples were bailed and pumped into 55 gallon drums for collection and transport.

Soil

Both shallow and deep samples were collected for use in the treatability work. Shallow samples were collected with the use of a shovel. Deep soil samples (7-8 feet) were collected with the use of a backhoe. A 55 gallon drum and 5 gallon pails were used for sample collection and transport.

3.2 Sample Analysis

Both sample collection and analysis were performed by Keystone Environmental Resources. The methods used for the analysis of water and soil samples were performed in accordance with strict QA/QC and chain of custody procedures. The various analytical methods used in analysis of both water and soil samples are presented in Tables 3-1 and 3-2, respectively.

3.3 Groundwater Treatability

Pretreatment

Prior to further treatment, gravity oil/water separation pretreatment was used for the removal oil and grease and suspended solids. Both cationic and anionic polymers were used to aid the separation and settling of the emulsified components and the

TABLE 3-1

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
ANALYTICAL METHODS

WATER ANALYSIS

Parameter	Method	Detection Limit
BOD_5	EPA 405.1	1 mg/l
Carbon (TOC)	EPA 415.1	1 mg/l
COD	EPA 410.4	10 mg/l
Cyanide, total	EPA 335.3	10 ug/l
Oil & Grease	EPA 413.1	5 mg/l
pH	EPA 150	----
Phenols (total recoverable)	EPA 420.2	5 ug/l
Solids (dissolved)	EPA 160.1	1 mg/l
Solids (suspended)	EPA 160.2	1 mg/l
Solids (total)	EPA 160.3	1 mg/l
Solids (volatile)	EPA 160.4	1 mg/l
Metals	EPA 200.7	CD
Purgeable Aromatics	EPA 602	CD
Phenolics	EPA 604	CD
Polynuclear Aromatic Hydrocarbons	EPA 610	CD
Volatile Organics	EPA 624	CD
Semi-Volatile Organics (AE/BN)	EPA 625	CD

CD - Compound Dependent

TABLE 3-2

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
ANALYTICAL METHODS

SOIL ANALYSIS

Parameter	Method	Detection Limit
pH	EPA 9045	----
Carbon (TOC)	Walkey-Black	1000 mg/kg
Solids (%) @ 105°C	ASTM D2216	----
Metals	----	----
Be, Ed, Cr, Cu, Fe, Ni, Z	EPA 6010	CD
Lead (Pb)	EPA 7421	500 mg/kg
Mercury	EPA 7471	100 ug/kg
Purgeable Halocarbons	EPA 8010	CD
Purgeable Aromatics	EPA 8020	CD
Phenolics	EPA 8040	CD
Polynuclear Aromatic Hydrocarbons	EPA 8310	CD
Petroleum Hydrocarbons	EPA 3540/418.1	100 mg/kg

CD - Compound Dependent

water. PAH reduction is achieved by removing the portion that stays within the oil phase.

3.4 Activated Carbon Adsorption Testing

Activated carbon adsorption was evaluated as a potential treatment alternative. Carbon adsorption isotherm tests and Calgon's Accelerated Carbon Test (ACT) were performed to estimate the applicability of using activated carbon for removal of contaminants in the groundwater at this site. The carbon adsorption isotherm tests were conducted in order to estimate the adsorption capacity of the carbon at different contaminant influent concentrations and the ACT test was performed to determine the carbon usage rate.

Carbon Isotherms

Carbon adsorption isotherms can be used in the laboratory as a relatively simple method to determine the feasibility of using granular activated carbon treatment. By using a set of samples with graduated doses of carbon, the distribution of the adsorbable compound can determined and plotted. This will indicate the amount of compound adsorbed per unit weight of carbon verses the concentration of a particular chemical compound in the applied influent.

Accelerated Carbon Testing

The accelerated carbon treatment was contracted to Calgon Carbon Corporation by Keystone. The purpose of this testing is to determine the carbon use rate for removal of TOC and Naphthalene. The results from this and carbon isotherm testing were used in the development of design data for engineering evaluation purposes.

3.5 UV/Ozone Oxidation

UV/Oxidation using ozone for treatment of the groundwater was investigated. Ozone is a powerful oxidizing agent which has the ability to degrade organic compounds through chemical oxidation. Among the list of chemicals that can be successfully treated are purgeable organics, phenolics, PAH compounds and naphthalene. The use of ultraviolet light in combination with ozone has been shown

to enhance the reactivity of ozone with certain chemical constituents.

Ozone gas is produced in an ozone generator from either compressed air or oxygen. The ozone gas is injected into an enclosed reactor of which the water to be treated is pumped through. Also in the reactor are a number of ultraviolet lamps. The reactor is designed with several chambers separated by baffles to provide intimate contact between the ozone enriched gas stream and the water to be treated.

3.6 Biological Treatment

Activated Sludge

Activated sludge treatment is a proven technology for removal of biodegradable chemical compounds generally present in wood preservative site groundwaters and surface waters. However, it is possible that the organic substrate concentration in the groundwater is to low to sustain a microbial mass and thus maintain an activated sludge treatment process.

The activated sludge process utilizes a biological slurry containing an active mass of bacteria which is contacted with the wastewater in an aeration basin where microbial oxidation and assimilation (treatment) occur. In the basin, the organic components of the wastewater serve as carbon and energy sources for microbial growth. The organic matter is converted into microbial cell tissue and oxidized end products (mainly carbon dioxide). The mixture of the microbial mass and wastewater is referred to as the mixed liquor. The mixed liquor flows from the aeration tank to a settling tank where the biomass is separated from the treated wastewater (effluent). A portion of the settled biomass is recycled to the head of the aeration basin to maintain the desired mass of organisms in the basin. The remaining sludge is removed from the system for final stabilization and ultimate disposal. The sludge is referred to as the waste sludge. The treated effluent is then left for discharge.

Aeration Tank

Aeration tank treatment is similar to activated sludge treatment with the exception that the mixed liquor suspended solids are discharged with the effluent rather than recycled. As with activated sludge treatment, it is possible that the organic substrate

TABLE 3: SUMMARY OF GC601 DATA

Sample: 87090546

Source: TB
Description: QA/QC SAMPLES

Date Collected: 09/24/87
Date Received: 09/25/87

Date Extracted: 10/03/87
Date Analyzed: 10/03/87

Purgeable Halocarbons

1,1,1-Trichloroethane.....	<0.030
1,1,2,2-Tetrachloroethane..	<0.030
1,1,2-Trichloroethane.....	<0.020
1,1-Dichloroethane.....	<0.050
1,1-Dichloroethene.....	<0.050
1,2-Dichlorobenzene.....	<0.150
1,2-Dichloroethane.....	<0.030
1,2-Dichloropropane.....	<0.030
1,3-Dichlorobenzene.....	<0.300
1,4-Dichlorobenzene.....	<0.250
2-Chloroethylvinyl ether...	<0.130
Bromodichloromethane.....	<0.100
Bromoform.....	<0.200
Carbon Tetrachloride.....	<0.100
Chlorobenzene.....	<0.250
Chloroethane.....	<0.250
Chloroform.....	<0.050
Dibromochloromethane.....	<0.100
Methyl Bromide.....	<2.00
Methyl Chloride.....	<0.250
Methylene Chloride.....	<0.050
Tetrachloroethene.....	<0.030
Trichlorofluoromethane.....	<0.050
Trichloroethene.....	<0.100
Vinyl Chloride.....	<0.250
cis-1,3-Dichloropropene....	<0.030
trans-1,2-Dichloroethene...	<0.050
trans-1,3-Dichloropropene..	<0.020

The above results are reported in ug/L .

All GC601 identifications are from retention data only.

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KOPPERS COMPANY, INC.
TEXARKANA, TEXAS
GROUNDWATER QA/QC ANALYSIS

Drum Sample #	T-TX-1	T-TX-2	T-TX-3	T-TX-4	T-TX-5	T-TX-6	T-TX-7
Parameters							
TOC	45.9	46.6	75.5	49.2	49.8	4.20	60.2
COD	145	250	300	300	180	<10.0	200
Phenols (4-AAP)	0.263	0.254	1.23	0.332	0.302	0.008	0.341

Each sample is from 1 or more of the following wells: MW-2, MW-3, MW-4, MW-5, MW-6 and OW-5.

All values reported in units of mg/L.

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concentration in the groundwater is to low to sustain a microbial mass and thus maintain an aeration tank treatment process.

Fixed Film Reactor

The fixed film (or fixed bed) process is similar to aeration tank treatment. The difference is that the reactor is filled with a synthetic packing which provides support for microbial growth and contact between the organic substrate and microbes.

Fluidized Bed

Fluidized bed treatment is a proven technology for removal of biodegradable chemical compounds generally present in wood preservative site groundwaters and surface waters. The process consists of a cylindrical column with a distribution/support plate located in its base. The column is partially filled with a fine grained medium, such as sand. A tank is used as a reservoir from which water is pumped through the column at a high flow rate to provide a stream of water necessary for fluidizing the bed. Growth of the microbes and contact with the organic substrate takes place within the fluidized bed.

3.7 Soil Treatment

Both in situ and ex situ soil treatment were proposed for treatment of soils from the site.

In situ Soil Treatment

The in situ soil treatment methodology investigated is more specifically referred to as in situ bioreclamation. In situ bioreclamation is a method for remediating soils and groundwater aquifers contaminated with biodegradable materials through the addition of water enriched with nutrients and oxygen into the subsurface. This results in the enhanced growth and activity of bacteria which use the contaminants as a source of carbon and energy to convert these materials to carbon dioxide and water.

Field and laboratory studies confirm that naturally occurring bacteria have the ability

to degrade phenolics and petroleum hydrocarbons (PAH compounds). In-situ bioreclamation can be employed in conjunction with soil extraction where significant volumes of soil are contaminated and existing structures make excavation impractical.

Ex situ Soil Treatment

Ex situ soil washing involves the removal of contaminants from the soil substrate, using a washing technique. It is a physical separation procedure for detoxifying contaminated soil that involves the washing of the soil into a liquid medium. The ex situ process is carried out in equipment that is designed for contacting excavated soils with the liquid.

Removal of contaminants from the soil matrix involves both physical displacement of loosely held contaminants and desorption of the contaminants that are more tightly bound to the soil particles.

4.0 TREATABILITY STUDY SPECIFICS AND RESULTS

4.1 Sample Collection

Groundwater Samples

Groundwater samples to be used in the treatability work were collected from wells MW-2, MW-4, MW-5, MW-6, MW-7 and OW-5. The samples were pumped or bailed and placed into 7 - 55 gallon drums for collection and transport. Each of the drums contained samples from 1 or more wells.

An effort was made to collect water and immiscible layers within the wells. For collection of the well samples, bottom fill teflon bailers, top fill stainless steel bailers and peristaltic pumps were used.

Following collection of groundwater samples, a composite sample was made by obtaining an aliquot from each drum, mixing it in a clean jar and distributing it into individual sample jars for QA/QC analytical purposes. The results from this sampling indicate the initial quality of the groundwater to be used in treatability work and can be found in Appendix A. In addition, each drum was sampled for specific indicator parameters when it arrived at the research center in Monroeville. Theses results can also be found in Appendix A.

Upon arrival at the research center in Monroeville, each of the 55 gallon drums were designated with a sample code number. The sample codes are as follows, T-TX-1, T-TX-2, T-TX-3, T-TX-4, T-TX-5, T-TX-6, and T-TX-7.

Soil Samples

Both shallow and deep soil samples were collected for use in the treatability work. Shallow soil samples were collected with the use of a shovel. Deep soil samples (7-8 feet) were collected with the use of a backhoe.

A local contractor was hired to dig the deep sample with a backhoe. The deep sample was obtained at the 7 - 8 feet level, within the saturated soil zone. This sample was used in the in situ (soil column) treatability work.

Shallow soil samples were collected by Keystone field services personnel. A cleaned shovel was used. These samples was placed in 5 gallon pails for transport. The shallow samples were used in the ex-situ (soil washing) treatability work. Deep samples were used for the in-situ (bioreclamation) treatability work.

Upon arrival at the research center in Monroeville, the samples codes were specified for each of the sample containers. The codes and corresponding descriptions are listed below.

Sample Description	Sample Code
Deep sample adjacent to church (55 gallon drum)	T-TX-8
Surface Soil near DW-01 (5 gallon pail)	T-TX-9
Surface soil under creosote contaminated area (5 gallon pail)	T-TX-10
Surface soil from creosote contaminated area (5 gallon pail)	T-TX-11
Surface soil. from heavy naphthalene contamination area (5 gallon pail)	T-TX-12

Health And Safety

The sampling plan for this site was reviewed by the KER Health and Safety Manager prior to the sampling trip. The normal safety level, level D, was required at this site. This is the minimal level of safety, requiring a standard work uniform, steel toed boots, safety goggles and a hard hat.

In addition to the standard safety gear, an HGNU meter for measurement of the presence of organic vapors was issued to the sampling crew. The HGNU meter was used to ensure that the level of vapors around soil and groundwater collection areas were at a safe level.

4.2 Groundwater Treatability

For all treatability work to follow, an equal aliquot of sample was taken from each of the 7 - 55 gallon drums, composited and utilized. An overview of the groundwater treatment steps is presented in Figure 4-1.

Pretreatment

Procedure

Standard jar testing procedures were used to screen several cationic and anionic polymers for the removal of oil & greases and suspended solids from the groundwater prior to further treatment. Composite samples of the groundwater were used in the jar testing evaluation.

The Standard Operating Procedure (SOP) #109, Jar Testing Procedures, was followed in testing this water. These procedures are as follows:

1. Add the cationic polymer first while stirring at 100 rpm. Continue stirring for one minute.

2. Add anionic polymer and stir an additional thirty seconds.

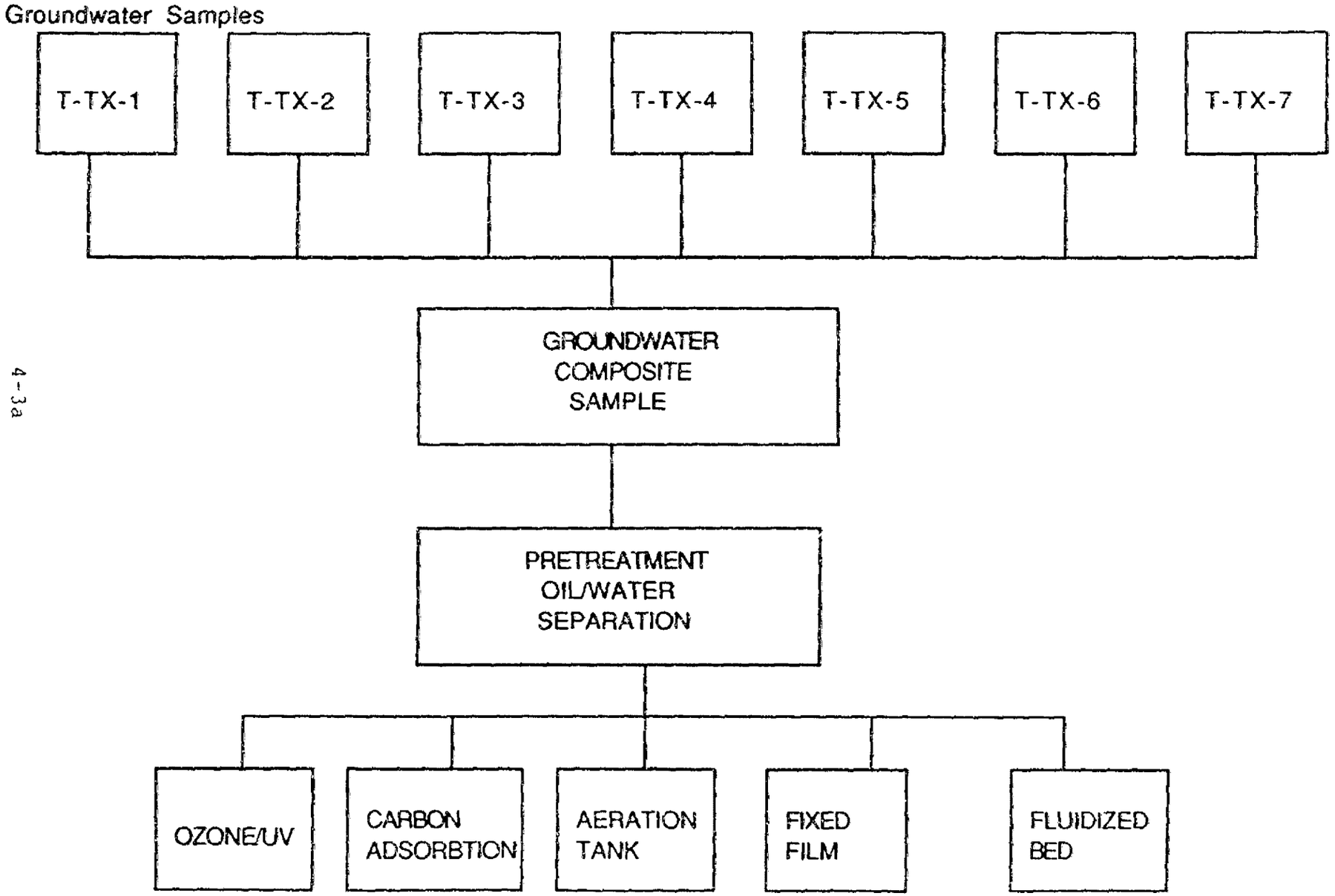
3. Decrease the stirring speed to 20 rpm and stir for twenty minutes.

4. After twenty minutes shut off the stirrer and let the sample sit undisturbed for thirty minutes.

5. Remove the supernatant by siphoning and sample for the desired parameters.

Following the procedures described above, several combination of polymers were evaluated. Polymers that have proven successful for treating water of similar characteristics were targeted. The screening process involved a visible evaluation of the various polymers and their effectiveness to enhance gravity separation and settling of the emulsified compounds in the groundwater. From the visual screening,

FIGURE 4-1
Texarkana, TX
GROUNDWATER TREATMENT OVERVIEW



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the best polymers were used to treat a final sample for analytical testing for confirmation. Both untreated and treated samples were submitted for analysis.

Results

The polymer combination that provided the best results were as follows:

Cationic polymer	300 ppm Amerfloc 10
Anionic polymer	4 ppm Amerfloc 5260

The treatment results are presented in Table 4-1. As indicated, the sample was analyzed for pH, oil & grease and PAH compounds. The pH was in the range of 6.5 - 7.0, so that pH adjustment was not required. Oil & grease removal was greater than 83 % with a corresponding removal of 90.7 % of the total PAH compounds.

Prior to all further treatability work, the groundwater samples were pretreated with this polymer combination. When a sample was needed for treatability, a composite was collected by taking an equal aliquot from each drum and compositing it in a container of sufficient volume required for the specific application. This sample was then pretreated and used in the treatability evaluation.

4.3 Activated Carbon Adsorption

A composite sample of groundwater was pretreated to remove oil & grease prior to activated carbon adsorption. Carbon adsorption isotherm tests and Calgon's Accelerated Carbon Test (ACT) were performed to estimate the applicability of using activated carbon for removal of contaminants in the groundwater. The carbon adsorption isotherm tests were conducted in order to estimate the adsorption capacity of the carbon and the ACT test was done to determine the carbon usage.

TABLE 4-1

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
JAR TESTING RESULTS

Sample Parameter	Untreated	Treated	Percent Removal (%)
pH (units)	6.6	6.8	--
Oil & Grease (mg/l)	82.6	13.9	83.2
PAH Compounds (mg/l)			
Acenaphthene	3370	44.4	98.7
Acenaphthylene	<500	943	NA
Anthracene	845	25.1	97.0
Benzo(a)anthracene	418	0.28	99.9
Benzo(a)pyrene	160	0.17	99.9
Benzo(b)fluoranthene	217	0.22	99.9
Benzo(g,h,i)perylene	123	0.32	99.7
Benzo(k)fluoranthene	88	0.08	99.9
Chrysene	356	0.19	99.9
Dibenz(a,h)anthracene	96	0.31	99.7
Fluoranthene	1550	21.30	98.6
Fluorene	1970	223	88.7
Indeno(1,2,3-c,d)pyrene	563	0.14	99.9
Phenanthrene	4560	208	95.4
Pyrene	1410	2.92	99.8
TOTAL DETECTABLE PAH	15,726	1,469.43	90.7
Carbazole	815	176	78.4
Naphthalene	14,800	7,950	46.3

NA - Not Applicable

Carbon Isotherms

Procedure

A composite groundwater sample was pretreated to remove emulsified oils & grease. In accordance with SOP #104, carbon adsorption isotherms were performed on the water.

Ten 400 ml samples were combined with varying doses of carbon and agitated. A one hour contact time was selected for the testing. The samples were allowed to settle and then filtered. The filtrate was submitted for TOC and naphthalene analysis. A pretreatment and 0 dose (control) sample were included for analysis.

Results

The results of the adsorption isotherm testing are summarized and presented in Table 4-2. The adsorbate (naphthalene) was used to indicate the amount of naphthalene adsorbed per unit weight of carbon. As indicated in Table 4-2, the naphthalene was reduced to below detectable limits.

From these results, amount of carbon necessary to adsorbed a given amount of naphthalene can be determined. A conservative estimate indicates that 0.8188 mg naphthalene is adsorbed per 0.4 grams carbon.

Accelerated Carbon Testing

Procedure

A fifteen gallon groundwater sample was pretreated by Keystone for removal of emulsified oils and grease. The sample was shipped to Calgon Carbon Corporation for accelerated carbon testing (ACT) for TOC and naphthalene removal efficiency.

The ACT method is used to determine breakthrough for TOC and naphthalene. The test simulated a 10 gpm flow rate for a 4' diameter adsorber system for a total simulated 2.588 million gallons treated.

TABLE 4-2

TEXARKANA, TX TREATABILITY STUDY
CARBON ADSORPTION ISOTHERMS

Parameter / Sample (grams carbon/400 ml water)	pH	TOC (mg/l)	Naphthalene (mg/l)
Raw*	6.2	44.5	6.20
0	6.9	35.4	2.05
0.2	7.1	3.44	.0054
0.4	7.1	14.2	<0.003
0.8	7.1	6.5	<0.003
2	7.2	81.1	<0.003
4	7.5	1.74	<0.003
10	7.8	2.15	<0.003
20	7.8	24.4	<0.003
40	7.8	2.01	<0.003
80	7.9	2.98	<0.003

(*)Raw is unflocc and unfiltered sample

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Results

The ACT test simulated an adsorber unit with 2000 lbs. of FS-300 carbon. Flow and surface loading rates were 10 gpm and 0.8 gpm/ft^2, respectively. The empty bed contact time (EBCT) was 50 minutes.

The ACT was run for seven days. No naphthalene breakthrough had occurred by the end of the study. At study termination, the simulated performance was 180 days on-line, 2.588 million gallons treated and a 0.8 lb/1000 gallon usage rate. The loading was 0.11 mg naphthalene/g F-300 carbon.

4.4 Ex Situ Soil Treatment (Soil Washing)

Procedure

The soil washing evaluation was performed to investigate the potential applicability for soil excavation and decontamination and also to evaluate different surfactants for possible use with regard to surfactant in situ bioreclamation. The surfactants will be used in bioreclamation for removal of tightly bound contaminants from the soil matrix so that soil microbes can assimilate them more effectively.

A total of five soils were washed to determine the most effective surfactants for each.

Keystone's Standard Operating Procedures were followed for all five runs.

Results

Soil washing results are not yet available and will be submitted as an addendum to this report.

4.5 In Situ Soil Treatment (Soil Column)

Procedure

Five soil columns were set up to determine the effectiveness of in situ soil treatment

on the degradation of soil contaminants. The columns were loaded with soil taken from the area adjacent to the Church, designated as T-TX-8. Three columns were to run aerobically. Two of these columns were to use Hydrogen peroxide (H_2O_2) as the oxygen source (proton donor) with one as a control, and two columns anaerobically, using nitrate (NO_3) as a proton acceptor. Pretreated and nutrient enriched groundwater was pumped into the columns.

Results

Within the first week of operation, the columns plugged sufficiently to restrict flow. It was determined that the soil sample was not as permeable as indicated by previous soil testing. The columns were shut down and dismantled. Because of the operational problems encountered, not enough data was collected to properly evaluate this technology. In-situ soil treatment should remain as an option but will require future field testing if deemed feasible based on FS results.

4.6 UV/Ozone Oxidation - O_3

Procedure

This phase of the study involved the evaluation of chemical oxidation by ozone/ultraviolet light (O_3/UV) for the destruction of groundwater contaminants. A groundwater composite sample was pretreated for removal of oil and grease as described in section 4.2.

Keystones standard Operating Procedure #110 for O_3/UV testing was followed. A bench scale ozonation unit was used for the testing. The unit consisted of an ozone generator and a 3-liter reaction vessel equipped with ultraviolet light.

An initial screening run was performed to determine the optimum O_3 dosage and reaction time based on naphthalene removal. During the screening run, the unit was run in a batch mode with samples taken at the following time intervals (minutes): 0(control), 1, 3, 5, 7, 9, 11, 13, 15, 17, 20.

Results

Samples from the screening run were analyzed for pH, naphthalene and TOC. The results from this testing are presented in Table 4-3. Also presented in this table are the ozone usage rates indicating a 71% utilization rate. These results show that as the ozone dosage (O_3 applied) increase, the naphthalene and TOC values decrease. From these results, the optimum dosage and reaction time was chosen and a final run was performed to generate treated samples for analysis.

Figure 4-2 shows the relationship between the amount of ozone applied and removal of naphthalene. Based on this relationship, the first order reaction rate constant for UV/ozone treated groundwater for $C = C_e - K(O_3 \text{ applied})$;

$$K = -5.54722 \text{ (mg } O_3 \text{ used/l)}^{-1}$$

The correlation coefficient for the fit of this line is $r^2=0.9732$.

As indicated in Table 4-3, the greatest reduction occurred at approximately 7-9 minutes. A 10 minute reaction time was chosen for the final run; this corresponds to an ozone dosage of approximately 244 mg/l. Treated and untreated samples were submitted for the analysis. Table 4-4 shows the analytical results, operating conditions, and percent removals for the treatment run. The results show a good removal for most PAH's and purgeable aromatics. In addition, a sample was analyzed for purgeable halocarbons which can be found in Appendix C.

4.7 Biological Treatment

Activated Sludge

Procedure

The activated sludge unit used in the bench-scale treatability work was a Horizon Ecology bio-oxidation unit equipped with an internal clarifier. Biological solids in the reactor effluent were settled out in the clarifier and returned to the reactor mixed liquor. Sludge was wasted from the system as required to maintain a specified solids retention time. Nutrient addition and pH control were provided to the unit as

TABLE 4-3

KOPPERS COMPANY, INC.
TEXARKANA, TEXAS POP SITE
O_3/UV SCREENING RUN RESULTS

Reaction (minutes)	O_3 Applied (mg O_3/l Sample)	O_3 Used (mg O_3/l Sample)	O_3 Utilization (%)	pH (units)	Naphthalene (mg/l)	TOC (mg/l)
0	0	NC	---	6.0	1.950	27.5
1	24.5	NC	---	6.4	1.850	97.6
3	81.6	NC	---	6.6	1.010	91.8
5	153	NC	---	6.7	0.175	92.8
7	245	174	71	6.7	0.009	89.3
9	220	NC	---	6.6	<0.003	24.2
11	299	NC	---	6.6	<0.003	21.4
13	398	284	71	6.6	<0.003	19.1
15	367	NC	---	6.5	<0.003	13.1
17	462	NC	---	6.5	0.0074	17.9
20	612	473	77	6.5	<0.003	14.6

NC - Not Calculated

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FIGURE 4 - 2

KOPPERS CO., INC.

TEXARKANA, TEXAS

OZONE APPLIED vs. NAPHTHALENE

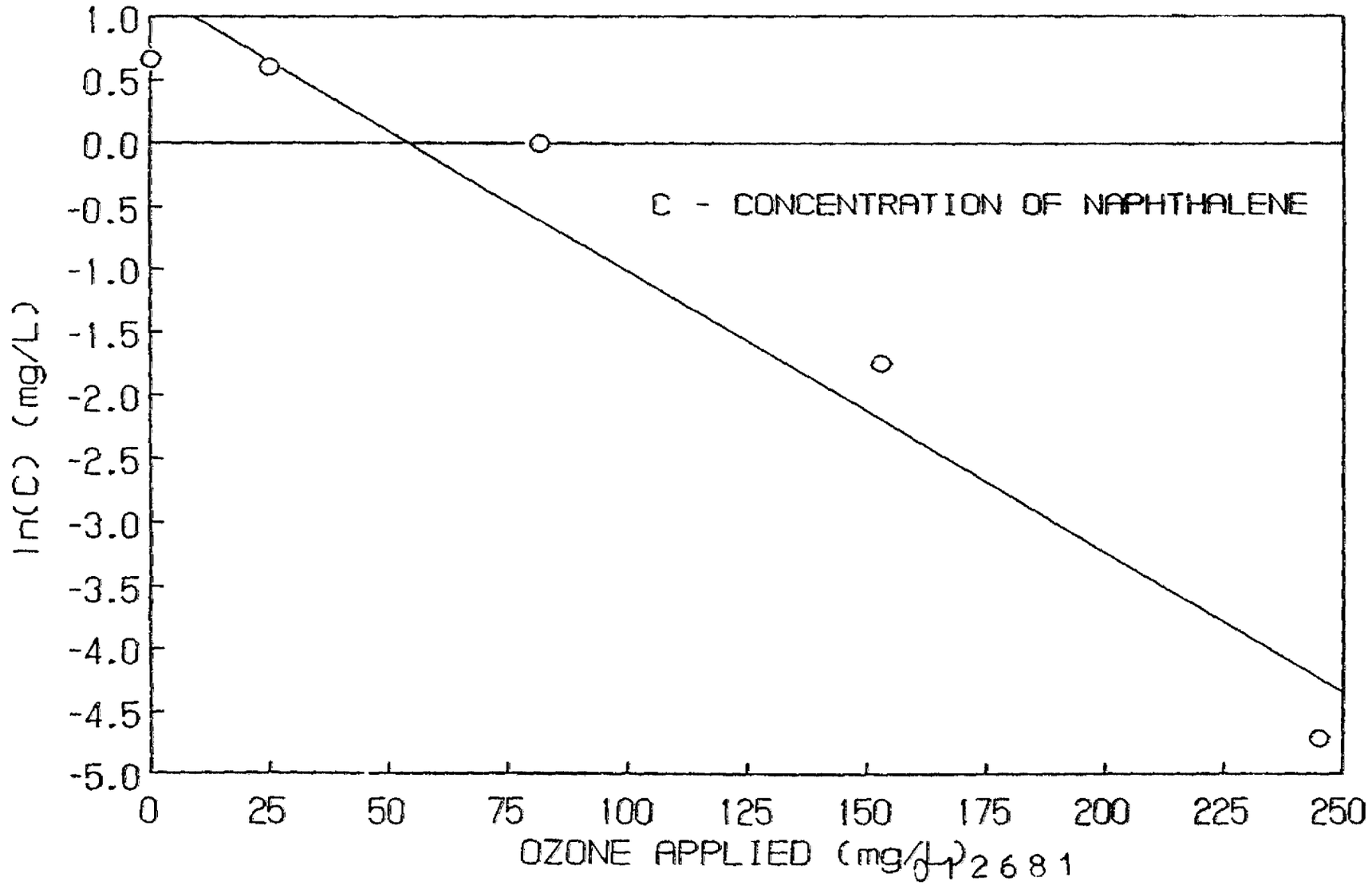

TABLE 4-4

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
UV/OZONE TREATMENT

Reaction Time - 10 minutes
Ozone Applied - 244 mg/l
Ozone Used - 183 mg/l
Ozone Utilization - 75%

	Influent	Effluent	% Removal
pH (units)	6.3	6.9	NA
TOC (mg/l)	23.1	20.5	11.3
Purgeable Aromatics (ug/l)			
Benzene	40.8	20.4	50
Ethyl Benzene	22.2	<20.0	>10
Styrene	<30.0	<30.0	NA
Toluene	77.1	<20.0	>74
Total Xylenes	164.0	<30.0	>82

	# Of Rings	Aqueous Solubility (ug/l)			
PAH Compounds					
Naphthalene	2	31,700	54.60	<2.00	>96
Acenapthylene	3	-	10.0	<2.00	>80
Acenaphthene	3	3,930	33.7	<2.00	>94
Fluorene	3	1,980	3.6	<2.00	>94
Phenanthrene	3	1,290	2.150	0.672	69
Anthracene	3	73	<0.500	<0.500	NA
Fluoranthene	4	260	0.444	0.500	NA
Pyrene	4	135	0.508	0.547	NA
Benzo(a)anthracene	4	14	0.053	<0.020	>62
Chrysene	4	2	<0.150	<0.150	NA
Benzo(a)pyrene	5	3.8	<0.020	<0.020	NA
Benzo(b)fluoranthene	5	-	0.023	0.045	NA
Benzo(k)fluoranthene	5	-	<0.020	0.020	NA
Dibenzo(a,h)anthracene	5	2.49	<0.030	<0.030	NA
Benzo(g,h,i)pyerlyene	6	-	<0.050	<0.050	NA
Indeno(1,2,3-c,d)pyrene	6	-	<0.050	<0.050	NA
Total PAH*			105.898	8.804	92

NA - Not Applicable
(*) - Total PAH value includes < detectable values

necessary to maintain optimum conditions for biological growth. In addition, a temperature controller and heat source were provided to maintain a constant temperature.

The initial set up consisted of two 6.5 liter reactors with internal clarifiers. One unit was operated with granular activated carbon and the other without carbon as a control.

The operation of the activated sludge reactor was to be carried out in two phases. Phase one consisted of startup and seed sludge washout. Phase two consisted of steady state operation to run for 21 days. The units were seeded with an acclimated biological seed sludge at an approximate concentration of 5000 mg/l. Initial influent feed flow was set at .9 ml/min. Within 3 days the feed rate was increased to 2.3 ml/min for an HRT = 2 days. Phase one was scheduled to run for 40 days,for an SRT = 20 days (2 x 20 = 40 days) and phase two only long enough to collect a sufficient number of samples for a statistical evaluation.

Results

The TSS concentration within the activated sludge reactors steadily declined following start-up. An evaluation of the operation of each of the two units indicated that the organic substrate concentration of the influent feed was to low to support an activated sludge biomass.

The activated sludge unit was converted to an aeration tank treatment process and the control unit was converted to a fixed film reactor. Each of these unit were evaluated separately and are presented below.

Aeration Tank

Procedure

The Horizon Ecology bio-oxidation unit was also used for the aeration tank reactor, although no clarifier was used. The volume was maintained at 6.5 liters. The unit was operated as a continuous flow through reactor with no provisions for solids settling or recycle. This unit was operated the same as the activated sludge unit

above, except for the removal of the clarifier and a different flow rate. This aeration tank influent flow rate was maintained at 1.29 ml/min.

Nutrient and pH control were provided to the unit. A temperature controller and a heat source were provided to maintain the reactor at 20 - 21 ^{0}C. The nutrients were added to the influent tank. The influent for this unit was the same as for the other units.

Results

The analytical results for influent sampling are summarized on weekly tables in appendix D. The influent was sampled on a weekly basis and is the same for each of the 3 biological treatment units. In addition to the weekly tables, raw data for PAH compounds are included as well as a statistical summary for the data.

Analytical results for the aeration tank are presented in Appendix E. Daily results are summarized on weekly tables for the mixed liquor and effluent. GC/MS volatiles and semi volatile compounds for the effluent are also included in the appendix. Methylene chloride was detected at 10 ug/l and acetone at 220 ug/l, though these two compounds are used for cleaning the glassware which may account for the presence of these compounds. Priority pollutant metals were analyzed and included in the appendix. Mercury was detected at 0.303 ug/l and zinc at 246 ug/l. A statistical summary comparison with % removals for all biological units operated is presented in Section 4.8.

Fixed Film Reactor

The Horizon Ecology bio-oxidation unit was also used in this application. No provision for solids recycle was provided. The "fixed film" consisted of a bed of bio-rings suspended by wire mesh. The purpose of the fixed film is to provide a growth support media for the bacteria. This allows a larger population of bacteria to stay in the reactor by limiting flushing of the microbes.

Procedure

The activated sludge control unit was converted to a fixed film reactor by removing the internal clarifier and packing it with bio-rings. The bio-rings provided support for biological growth. The volume of this reactor was maintained at 6.5 liters. The influent flow rate was 1.29 ml/min. On November 11, the reactor was re-seeded with biological sludge. Approximately 3000 ml of sludge was drained from the reactor and replaced. The fixed film reactor was allowed to re-acclimate. Influent feed to the unit was from the same source as the other treatment units.

Following re-seeding, the fixed film reactor was operated for 17 days to allow for seed sludge washout prior to steady state sampling. On November 23, the first steady state samples were collected.

Results

The summary of results for the fixed film reactor are presented in Appendix F. Raw data for the mixed liquor and effluent are included. GC/MS volatiles and semi volatile compounds are also included in the appendix. Methylene chloride was detected at 7 ug/l. Priority pollutant metals were analyzed and included in the appendix. Mercury was detected at 1.15 ug/l and zinc at 1430 ug/l. Influent results are presented in Appendix D. A statistical summary comparison and % removals for all biological units operated is presented in Section 4.8.

The metals data is also presented in the appendix. The only compounds detected were mercury at 1.15 ug/l and zinc at 1430 ug/l.

Fluidized Bed Reactor

Procedure

The fluidized bed was constructed using a 1" diameter glass column. The column bed was packed with a fine grained growth support medium. The influent flow rate was maintained at 1.29 ml/min. for an HRT = 3 hours.

Air and nutrients were introduced to the recycle chamber. Ammonium phosphate dibasic was used to supply ammonia nitrogen and phosphate to the bacteria. The D.O. of the unit was measured in the recycle chamber and maintained at 7.0 or above. Sulfuric acid (5%) addition was required to maintain the pH in the 7.0 - 7.5 range with a pH controller as the pH steadily increased once steady state was reached.

Results

The summary of results for the fluidized bed reactor and recycle chamber are presented in Appendix G. Raw data and a statistical summary are included. Daily results are summarized on weekly tables for the recycle chamber and effluent. GC/MS volatiles and semi volatile compounds for the effluent are also included in the appendix. Methylene chloride was detected at 8 ug/l. Priority pollutant metals were analyzed and included in the appendix. Cadmium was detected at 9.10 ug/l and zinc at 125 ug/l. Influent results are presented in Appendix D.

A statistical comparison of all biological units operated is presented in Section 4.8. Overall, the results from the fluidized bed treatment show reduction to below the detection limit for nearly all soluble organics. No PAH compounds were detected in any of the five sets of effluent samples from the reactor.

4.8 Biological Treatment Units Discussion of Results

A statistical comparison of influent and effluent data for each of the three biological treatment processes is presented in Table 4-5. Each of the processes show good reduction for concentrations of conventional parameters.

For the fixed film reactor, 51.6% of the TOC was removed, 48% of the BOD was removed as well as 32% of the COD. In addition, 86% of total PAH compounds were removed as were 57% of the PCP and 93% of phenols (4-AAP).

In the effluent from the fluidized bed, oil & grease was detected at an average concentration of 7.32 mg/l. The concentration of oil & grease in effluent from the aeration tank and fixed film reactors averaged 81.42 and 92.65 respectively. These concentrations indicate an increase in oil & grease levels. The geometric mean

TABLE 4-5
KOPPERS COMPANY, INC.
TEXARKANA, TEXAS TREATABILITY STUDY
STATISTICAL SUMMARY
BIOLOGICAL TREATMENT COMPARISON

Parameters			Influent	Fixed Film		Aeration Tank		Fluidized Bed	
			Mean	Mean	% REM	Mean	% REM	Mean	% REM
Phenols (4-AAP)			0.26	0.019	92.69	0.019	92.69	BDL	>99.99
TOC			25.87	12.53	51.56	14.88	42.48	7.35	71.59
BOD (5)-Total			24.18	12.63	47.76	11.11	54.05	3.31	86.31
COD -Total			72.83	49.6	31.89	48.6	33.26	13.2	81.88
Oil & Grease			6.17	92.65	+	81.42	+	7.32	+
PCP (ug/l)			41.2	17.8	56.79	23.9	41.99	BDL	>99.99
Cyanide -Total			BDL	0.011	NA	BDL	NA	BDL	>99.99
PAH COMPOUNDS (ug/l)	# OF RINGS	AQUEOUS SOLUBILITY							
Acenaphthylene	3	-	293.13	BDL	>99.99	BDL	>99.99	BDL	>99.99
Acenaphthene	3	3,930	182.33	BDL	>99.99	BDL	>99.99	BDL	>99.99
Fluorene	3	1,980	105.57	BDL	>99.99	BDL	>99.99	BDL	>99.99
Phenanthrene	3	1,290	96.67	0.94	99.02	BDL	>99.99	BDL	>99.99
Anthracene	3	73	12.31	0.64	94.80	BDL	>99.99	BDL	>99.99
Fluoranthene	4	260	9.06	1.34	85.20	BDL	>99.99	BDL	>99.99
Pyrene	4	135	8.39	2.29	72.70	0.25	97.02	BDL	>99.99
Benzo(a)anthracene	4	14	0.48	1.59	+	0.14	70.83	BDL	>99.99
Chrysene	4	2	0.45	1.76	+	0.25	44.44	BDL	>99.99
Benzo(a)pyrene	5	3.8	0.19	5.21	+	0.28	+	BDL	>99.99
Benzo(b)fluoranthene	5	-	0.28	8.86	+	0.49	+	BDL	>99.99
Benzo(k)fluoranthene	5	-	0.10	2.11	+	0.13	+	BDL	>99.99
Dibenz(ah)anthracene	5	2.49	0.31	7.72	+	0.46	+	BDL	>99.99
Benzo(g,h,i)perylene	6	-	0.28	11.34	+	0.60	+	BDL	>99.99
Indeno(123-cd)pyrene	6	-	0.20	8.17	+	0.45	+	BDL	>99.99
TOTAL DETECTABLE PAH			364.50	50.18	86.23	2.80	99.23	BDL	>99.99
Carbazole	-	-	112.00	BDL	>99.99	BDL	>99.99	BDL	>99.99
Naphthalene	2	31,700	1296.19	BDL	>99.99	BDL	>99.99	BDL	>99.99

% REM - Indicates % removal
(-) - Indicates an increase of the indicated parameter
BDL - Below Detection Limit

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reveals an oil & grease concentration of 14.95 mg/l for the aeration tank and 16.53 mg/l for the fixed film reactor. This number indicates that a large deviation was experienced for one of the data points, though this number remains comparatively high, it is more representative of the oil & grease concentrations.

The aeration tank reactor showed a reduction of 93% for TOC, 42% for BOD and 33% for the COD effluent concentrations. In addition, total PAH compounds were reduced 99%, PCP 42% and phenols (4-AAP) 93%.

For the fluidized bed reactor, 72% of the TOC, 86% of the BOD and 82% of the COD were removed. No PAH, phenols (4-AAP) or Pentachlorophenol were detected in the effluent for a removal >99.99%.

Acid extractable phenolics are summarized for each of the three biological units in Table 4-6. The results indicate a total reduction of 58.7% for the aeration tank treatment process and 66.5% reduction for the fixed film reactor. The fluidized bed treatment unit demonstrated greater than 99% removal for total phenolics. Phenol was detected in the effluent at 1.56 ug/l and all other compounds were below the detection limit.

TABLE 4-6
KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
BIOLOGICAL TREATMENT PHENOLICS REDUCTION

Acid Extractable Phenolics (ug/l)	Influent	Aeration Tank Effluent	% Removal	Fixed Film Effluent	% Removal	Fluidized Bed Effluent	% Removal
2,3,5,6-Tetrachlorophenol	58.5	19.7	66.3	17.2	70.6	<1.00	>99.9
2,4,6-Trichlorophenol	23.9	4.96	79.2	4.84	79.7	<1.00	>99.9
2,4-Dichlorophenol	4.99	1.75	64.9	1.62	67.5	<0.500	>99.9
2,4-Dimethylphenol	<0.500	<0.500	NA	<0.500	NA	<0.500	NA
2,4-Dinitrophenol	36.8	14	62.0	11.8	67.9	<1.00	>99.9
2-Chlorophenol	<0.500	<0.500	NA	<0.500	NA	<0.500	NA
2-Nitrophenol	2.07	0.75	63.8	<0.500	>99.9	<0.500	>99.9
2-Methyl-4,6-dinitrophenol	21.9	7.39	66.3	6.3	71.2	<1.00	>99.9
4-Nitrophenol	28.7	5.71	80.1	6.28	78.1	<1.00	>99.9
4 Chloro-3-methylphenol	4.14	1	75.8	1	75.8	<0.500	>99.9
Pentachlorophenol	51.4	39.2	23.7	27.1	47.3	<1.00	>99.9
Phenol	2.18	2.32	+	2.42	+	1.56	28.4
Total Detectable Phenolics	234.58	96.78	58.7	78.56	66.5	1.56	99.3

NA - Not Applicable

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5.0 SUMMARY AND CONCLUSIONS

In-situ treatment of soils at this site could prove to be the most cost effective alternative and should remain as an alternative. The in-situ treatment alternative must be further investigated with different soils prior to implementation.

Soil washing results will be forwarded as an adendum when the data becomes available.

The results indicate that activated sludge treatment is not a feasible treatment alternative for this site and should not be considered further.

Activated carbon adsorption showed good results for groundwater treatment. Both carbon adsorbtion isotherms and ACT results show reduction of TOC and naphthalene.

The three biological treatment processes, aeration tank fixed film and fluidized bed showed good results and should be included for further consideration. Aeration tank treatment reduced total PAH compounds >99%. Fixed film treatment reduced total PAH compounds >86% the best treatment was realized with the fluidized bed with >99.9% removal of total PAH compounds.

Analytical results from UV-ozone/Oxidation show good removal rates. Total PAH were reduced 88%. Good removal rates were also realized for individual purgeable aromatic compounds.

APPENDIX A
(Groundwater QA/QC Sampling Data)

KOPPERS COMPANY, INC.
TEXARKANA, TEXAS
GROUNDWATER QA/QC COMPOSITE SAMPLE ANALYSIS

PARAMETER (mg/l)	Well Composite	Field Blank	Trip Blank
pH (units)	6.7	6.9	8.1
BOD_5	27.5	<1.00	<1.00
COD	158.0	<10.0	<10.0
TOC	54.9	<1.00	<1.00
METALS (ug/l)			
Arsenic	13.7	<10.0	<10.0
Beryllium	<5.00	<5.00	<5.00
Cadmium	<5.00	<5.00	<5.00
Chromium	<10.0	<10.0	<10.0
Copper	<25.0	<25.0	<25.0
Iron	16900	105	246
Lead	<5.00	<5.00	6.00
Mercury	<0.200	<0.200	<0.200
Nickel	<40.0	<40.0	<40.0
Zinc	1160	<20.0	<20.0
Purgeable Aromatics (ug/l)			
Benzene	11.0	<2.00	<2.00
Ethyl Benzene	31.5	<2.00	<2.00
Styrene	43.6	<3.00	<3.00
Toluene	59.2	<2.00	<2.00
Total Xylenes	46.8	<3.00	<3.00

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TABLE 3: SUMMARY OF GC601 DATA

Sample: 87090544

Source: QA/QC
Description: QA/QC SAMPLES

Date Collected: 09/24/87
Date Received: 09/25/87

Date Extracted: 10/05/87
Date Analyzed: 10/05/87

Purgeable Halocarbons

1,1,1-Trichloroethane.....	:<0.030
1,1,2,2-Tetrachloroethane..	:<0.030
1,1,2-Trichloroethane.....	:<0.100
1,1-Dichloroethane.....	:<0.050
1,1-Dichloroethene.....	:<0.050
1,2-Dichlorobenzene.....	:<0.150
1,2-Dichloroethane.....	:<0.050
1,2-Dichloropropane.....	:<0.100
1,3-Dichlorobenzene.....	:<0.300
1,4-Dichlorobenzene.....	:<0.250
2-Chloroethylvinyl ether...	:<0.020
Bromodichloromethane.....	:<0.100
Bromoform.....	:<0.130
Carbon Tetrachloride.....	:<0.030
Chlorobenzene.....	:<0.250
Chloroethane.....	:<0.250
Chloroform.....	:<0.050
Dibromochloromethane.....	:<0.100
Methyl Bromide.....	:<2.00
Methyl Chloride.....	:<0.250
Methylene Chloride.....	:<0.250
Tetrachloroethene.....	:<0.200
Trichlorofluoromethane.....	:<0.050
Trichloroethene.....	:<0.300
Vinyl Chloride.....	:<0.250
cis-1,3-Dichloropropene....	:<0.030
trans-1,2-Dichloroethene...	:<0.050
trans-1,3-Dichloropropene..	:<0.020

The above results are reported in ug/L .

All GC601 identifications are from retention data only.

012693

TABLE 3: SUMMARY OF GC601 DATA

Sample: 87090545

Source: FB
Description: QA/QC SAMPLES

Date Collected: 09/24/87
Date Received: 09/25/87

Date Extracted: 10/03/87
Date Analyzed: 10/03/87

Purgeable Halocarbons

1,1,1-Trichloroethane.....	:<0.030
1,1,2,2-Tetrachloroethane..	:<0.030
1,1,2-Trichloroethane.....	:<0.020
1,1-Dichloroethane.....	:<0.050
1,1-Dichloroethene.....	:<0.050
1,2-Dichlorobenzene.....	:<0.150
1,2-Dichloroethane.....	:<0.030
1,2-Dichloropropane.....	:<0.030
1,3-Dichlorobenzene.....	:<0.300
1,4-Dichlorobenzene.....	:<0.250
2-Chloroethylvinyl ether...	:<0.130
Bromodichloromethane.....	:<0.100
Bromoform.....	:<0.200
Carbon Tetrachloride.....	:<0.100
Chlorobenzene.....	:<0.250
Chloroethane.....	:<0.250
Chloroform.....	:<0.050
Dibromochloromethane.....	:<0.100
Methyl Bromide.....	:<2.00
Methyl Chloride.....	:<0.250
Methylene Chloride.....	:<0.050
Tetrachloroethene.....	:<0.030
Trichlorofluoromethane.....	:<0.050
Trichloroethene.....	:<0.100
Vinyl Chloride.....	:<0.250
cis-1,3-Dichloropropene....	:<0.300
trans-1,2-Dichloroethene...	:<0.050
trans-1,3-Dichloropropene..	:<0.200

The above results are reported in ug/L .

All GC601 identifications are from retention data only.

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APPENDIX 2-A
MAXIMUM AND MINIMUM PCOC CONCENTRATIONS

APPENDIX 2-A

MAXIMUM AND MINIMUM CONCENTRATIONS OF PCOCs IN EACH MEDIUM

Tables summarizing maximum and minimum PCOC concentrations, and their locations, are presented in this Appendix. If a PCOC was analyzed for and not detected in a particular medium, one half of the contract laboratory detection limit was used as a substitute value. For a list of applicable detection limits see Appendix K of the RI Report (ERT 1987). Table A-1 presents the maximum and minimum concentrations of PCOCs, and their locations, in Carver Terrace surface soils. Note that at some Carver Terrace surface soil sampling locations, two samples, one from 0 to 6 inches and the other from 6 to 12 inches, were taken. The arithmetic average of these samples is used in determining maximum and minimum concentrations. Maximum and minimum values in the RI Report (ERT 1987) are not based on the average of these samples and may, therefore, be different than the maximums and minimums reported here.

Table A-2 presents maximum and minimum concentrations of PCOCs in Carver Terrace subsurface soils. Because utility workers were the exposed population and they were not expected to dig deeper than 10 feet, deeper soils were not included in the summary and scenario. Table A-3 summarizes maximum and minimum PCOC concentrations for Kennedy Sand and Gravel surface soils. Table A-4 summarizes maximum and minimum PCOC concentrations in sediments and Table A-5 summarizes maximum and minimum PCOC concentrations is seeps. The concentration of PCOCs in the groundwater well used to evaluate the hypothetical future groundwater scenario is presented in Table A-6.

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TABLE A-1

Summary of maximum and minimum PCOC concentrations in Carver Terrace surface soils

PCOC	MAXIMUM CONCENTRATION	LOCATION	MINIMUM CONCENTRATION	LOCATION
PCP	16000 (ug/kg)	B1-L4	800 (ug/kg)	MANY
PGT. CARC. PAH	2020950 (ug/kg)	B6-L7	960 (ug/kg)	MANY
TOTAL PAH	2.5446e8 (ug/kg)	NW-NAPH	2560 (ug/kg)	MANY
TCDD/TCDF TE's	0.000767 (ug/kg)	1550F-01	3.8E-08 (ug/kg)	2268F-6
ARSENIC	53.35 (mg/kg)	B2-L9	1 (mg/kg)	MANY
CHROMIUM	57.5 (mg/kg)	B2-L9	1 (mg/kg)	MANY
COPPER	101 (mg/kg)	B2-L3	2.5 (mg/kg)	MANY
ZINC	3370 (mg/kg)	CHURCH	2 (mg/kg)	MANY
LEAD	238.05 (mg/kg)	B5-L2	2.5 (mg/kg)	PACE
MERCURY	0.355 (mg/kg)	B2-L14	0.1 (mg/kg)	MANY

STATISTICAL SUMMARY OF PCOCs IN SUBSURFACE SOIL SAMPLES (2 TO 10 FEET) FROM THE CARVER TERRACE SUBDIVISION

	UNITS	MAXIMUM CONC	MAXIMUM LOCATION	MINIMUM CONC	MINIMUM LOCATION
DETECTED PCOCs					
PENTACHLOROPHENOL	UG/KG	4000	SL11	800	MANY
ACENAPHTHENE	UG/KG	7500	SL82	160	MANY
ACENAPHTHYLENE	UG/KG	890	SL82	160	MANY
ANTHRACENE	UG/KG	1300	SL82	160	MANY
BENZO(GHI)PERYLENE	UG/KG	160	MANY	160	MANY
FLUORANTHENE	UG/KG	3300	SL82	160	MANY
FLUORENE	UG/KG	5900	SL82	160	MANY
2-METHYLNAPHTHALENE	UG/KG	14000	SL82	160	MANY
NAPHTHALENE	UG/KG	37000	SL82	160	MANY
PHENANTHRENE	UG/KG	10000	SL82	160	MANY
PYRENE	UG/KG	3600	SL82	160	MANY
BENZO(A)ANTHRACENE	UG/KG	750	SL82	160	MANY
BENZO(A)PYRENE	UG/KG	470	SL82	160	MANY
BENZO(B)FLUORANTHENE	UG/KG	830	SL82	80	MANY
CHRYSENE	UG/KG	1100	SL82	160	MANY
DIBENZO(A,H)ANTHRACENE	UG/KG	160	MANY	160	MANY
INDENO(1,2,3-CD)PYRENE	UG/KG	160	MANY	160	MANY
ARSENIC	MG/KG	8.7	SL12	1	MANY
CHROMIUM	MG/KG	1	MANY	1	MANY
COPPER	MG/KG	2.6	MANY	2.6	MANY
ZINC	MG/KG	920	SL12	1	MANY
TOTAL PCB	UG/KG	87000	SL82	350	MANY
POTENTIALLY DETECTABLE TO FAI	UG/KG	750	SL82	80	MANY
SUBTOTAL					

012698

STATISTICAL SUMMARY OF PCOCs IN SURFACE SOIL RESULTS (0-2 FEET) FROM KENNEDY BAND AND GRAVEL

	UNITS	MAXIMUM CONC	MAXIMUM LOCATION	MINIMUM CONC	MINIMUM LOCATION
DETECTED PCOCs					
PENTACHLOROPHENOL	UG/KG	800	MANY	800	MANY
ACENAPHTHENE	UG/KG	160	MANY	160	MANY
ACENAPHTHYLENE	UG/KG	4600	SL56	160	MANY
ANTHRACENE	UG/KG	160	MANY	160	MANY
BENZO(GHI)PERYLENE	UG/KG	160	MANY	160	MANY
FLUORANTHENE	UG/KG	29000	SL55	160	MANY
FLUORENE	UG/KG	160	MANY	160	MANY
2-METHYLNAPHTHALENE	UG/KG	160	MANY	160	MANY
NAPHTHALENE	UG/KG	160	MANY	160	MANY
PHENANTHRENE	UG/KG	160	MANY	160	MANY
PYRENE	UG/KG	69000	SL58	160	MANY
BENZO(A)ANTHRACENE	UG/KG	160	MANY	160	MANY
BENZO(A)PYRENE	UG/KG	10000	SL56	160	MANY
BENZO(B&K)FLUORANTHENES	UG/KG	220000	SL58	160	MANY
CHRYSENE	UG/KG	5000	SL56	140	MANY
DIBENZO(A,H)ANTHRACENE	UG/KG	160	MANY	160	MANY
INDENO(1,2,3-CD)PYRENE	UG/KG	19000	SL56	160	MANY
ARSENIC	MG/KG	14.9	SL58	1	MANY
CHROMIUM	MG/KG	12	SL58	1	MANY
COPPER	MG/KG	9.68	SL58	2.5	MANY
LEAD	MG/KG	NA	NA	NA	NA
MERCURY	MG/KG	NA	NA	NA	NA
ZINC	MG/KG	35.2	SL55	30.2	SL58
TOTAL PAH	UG/KG	291240	SL58	2560	MANY
POTENTIALLY CARCINOGENIC PAH	UG/KG	220800	SL58	960	MANY

(saksg-sl)

012699

STATISTICAL SUMMARY OF PCOCs FOUND IN SEDIMENT SAMPLES THROUGHOUT THE SITE.

DETECTED PCOCs	UNITS	MINIMUM CONC	MINIMUM LOCATION	MAXIMUM CONC	MAXIMUM LOCATION
BENZENE	UG/KG	2.5	MANY	21	SD09
TOLUENE	UG/KG	2.5	MANY	39	SD09
TOTAL XYLENES	UG/KG	2.5	MANY	170	SD09
ACENAPHTHENE	UG/KG	160	MANY	19000	SD09
ACENAPHTHYLENE	UG/KG	160	MANY	160	MANY
ANTHRACENE	UG/KG	160	MANY	16000	SD09
BENZO(GHI)PERYLENE	UG/KG	160	MANY	160	MANY
FLUORANTHENE	UG/KG	160	MANY	29000	SD09
FLUORENE	UG/KG	160	MANY	15000	SD09
NAPHTHALENE	UG/KG	160	MANY	67000	SD09
2-METHYLNAPHTHALENE	UG/KG	160	MANY	27000	SD09
PHENANTHRENE	UG/KG	160	MANY	32000	SD09
PYRENE	UG/KG	160	MANY	30000	SD09
BENZO(A)ANTHRACENE	UG/KG	160	MANY	1100	SD21
BENZO(A)PYRENE	UG/KG	160	MANY	160	MANY
BENZO(B)FLUORANTHENE	UG/KG	160	MANY	14000	SD09
CHRYSENE	UG/KG	160	MANY	17000	SD08
DIBENZO(A,H)ANTHRACENE	UG/KG	160	MANY	160	MANY
INDENO(1,2,3-CD)PYRENE	UG/KG	160	MANY	160	MANY
ARSENIC	MG/KG	1	MANY	10	SD01
CHROMIUM	MG/KG	1	MANY	62	SD07
COPPER	MG/KG	2.5	MANY	7.46	SD15
MERCURY	MG/KG	0.1	MANY	0.9	SD15
LEAD	MG/KG	0.5	SD01	160	SD07
ZINC	MG/KG	2	MANY	365	SD09
TOTAL PAH		2560	MANY	250120	SD09
POTENTIALLY CARCINOGENIC PAH		960	MANY	17800	SD08

(sussdat)

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DETECTED PCOCs	UNITS	MINIMUM CONC	MINIMUM LOCATION	MAXIMUM CONC	MAXIMUM LOCATION
ETHYLBENZENE	UG/KG	1300	SD12-002	5400	SW10-001
TOLUENE	UG/KG	500	SD12-002	2900	SW10-001
TOTAL XYLENES	UG/KG	3600	SD12-002	5600	SW10-001
ACENAPHTHENE	UG/KG	1300^0	SD12-002	130000	SD12-002
ACENAPHTHYLENE	UG/KG	160	SD12-002	160	SD12-002
ANTHRACENE	UG/KG	46000	SD12-002	46000	SD12-002
BENZO(GHI)PERYLENE	UG/KG	160	SD12-002	160	SD12-002
FLUORANTHENE	UG/KG	100000	SD12-002	100000	SD12-002
FLUORENE	UG/KG	120000	SD12-002	120000	SD12-002
2-METHYLNAPHTHALENE	UG/KG	170000	SW12-001	170000	SD12-002
NAPHTHALENE	UG/KG	400000	SD12-002	400000	SD12-002
PHENANTHRENE	UG/KG	310000	SD12-002	310000	SD12-002
PYRENE	UG/KG	100000	SD12-002	100000	SD12-002
BENZO(A)ANTHRACENE	UG/KG	25000	SD12-002	25000	SD12-002
BENZO(B)FLUORANTHENE	UG/KG	22000	SD12-002	22000	SD12-002
CHRYSENE	UG/KG	27000	SD12-002	27000	SD12-002
INDENO(1,2,3-CD)PYRENE	UG/KG	160	SD12-002	160	SD12-002
ARSENIC	MG/KG	1	MANY	1	MANY
CHROMIUM	MG/KG	1	MANY	1	MANY
COPPER	MG/KG	2.5	MANY	2.5	MANY
MERCURY	MG/KG	0.1	SW10-001	0.12	SD12-002
LEAD	MG/KG	0.5	SD12-002	12	SW10-001
ZINC	MG/KG	20.7	SD12-002	22	SW10-001
TOTAL PAH	UG/KG	1450480	SD12-002	1450480	SD12-002
POTENTIALLY CARCINOGENIC PAH	UG/KG	74160	SD12-002	74160	SD12-002

(subseeps)

Table A-6

Summary of PCOC Concentrations in the Groundwater Well (MW03-002) Used for Hypothetical Future Scenario.

PCOC	CONCENTRATION (ug/l)
POT. CARC. PAH	NA
TOTAL PAH	NA
BENZENE	36
ETHYLBENZENE	37
TOLUENE	2.5
TOTAL XYLENES	25
ARSENIC	NA
CHROMIUM	5
COPPER	12.5
ZINC	5600
LEAD	NA
MERCURY	NA

NA: Indicates that the PCOC was not analyzed for.

APPENDIX B
(Carbon Adsorbtion ACT Results)

012703

CONFIDENTIAL

CALGON CARBON CORPORATION

Technical Service Report No. 1187-38

Feasibility Testing for the Removal of Naphthalene and TOC from Groundwater

012704

Prepared For:

Keystone Environmental
Monroeville, PA

Author: T. P. Hartig 6630

Date: January 14, 1988

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KEYWORDS:
Groundwater
Napthalene
Wood Preservative
FS-300
ACT

012704

INTRODUCTION

The site of a former wood preservative plant in Texarkana, Texas is contaminated with napthalene and coal tar compounds. Clean-up procedures have been undertaken by Keystone Evnironmental Resources. This study will determine the applicability of activated carbon for decontaminating the groundwater around the plant.

SUMMARY AND CONCLUSIONS

An ACT was performed, with 100 ppb breakthrough of napthalene as the objective.

- The groundwater sample for the ACT differed from the reported characterization. It contained 10 ppb of napthalene and 20 ppm of TOC, versus a reported 2 ppm napthalene and 36 ppm TOC.
- No napthalene breakthrough had occurred by the time of study termination.
- At study termination the simulated performance was 180 days on-line, 2.588 million gallons treated, and a 0.8 lb/1000 gallon usage rate. The loading was 0.11 mg napthalene/g F-300.

RECOMMENDATIONS

The water used for the ACT differed from the reported characterization. Spiking the filtered groundwater to achieve the reported 2 ppm concentration of napthalene and running another ACT is proposed.

DISCUSSION

The ACT simulated a Model 3 adsorber with 2000 lbs of FS-300. Flow and surface loading rates were 10 gpm and 0.8 gpm/sq.ft., respectively. The EBCT was 50 minutes. See Table 2.

The groundwater sample was brown and very hazy. This required a prefiltration step through glass fiber pads. The filtrate was amber and slightly hazy. The sample had the odor of creosote. No napthalene odor was detected.

The ACT was run for seven days. Pump failure resulted in study termination. No napthalene breakthrough was detected, but five individual compound breakthroughs were detected by TOC. See Figure 1.

All ACT effluents were water white and odorless.

012705

TABLE 1

Keystone Environmental
Texarkana, Texas Site
ACT Data

Effluent Sample	Simul. Gallons	Simul. Days	TOC mg/l	Napthalene ug/l
Influent	--	--	20	10
1	17,139	1.19	1.5	<1
4	119,977	8.33	1	<1
6	188,536	13.10	2	<1
8	257,094	17.85	1.5	<1
10	325,652	22.60	2.5	<1
13	428,490	29.75	3.0	<1
16	531,328	36.90	2.5	<1
18	634,165	44.03	2.5	<1
20	702,724	48.79	3.5	<1
22	771,282	53.55	3.5	<1
24	839,840	58.31	3.5	<1
26	908,399	63.07	6.5	<1
30	1,045,515	72.60	6.5	<1
34	1,182,632	82.11	6.5	<1
40	1,388,308	96.40	10.0	<1
44	1,525,424	105.90	10.0	<1
48	1,662,541	115.4	13.5	<1
52	1,799,658	125.0	14.0	<1
56	1,936,775	134.0	14.5	<1
68	2,313,846	161.0	14.5	<1
72	2,450,963	170.0	18.5	<1
75	2,553,800	177.3	18.0	<1
76	2,558,080	180.0	18.0	<1 θ

θCarbon Usage Rate 0.77 lbs/1000 gallons
Loading 0.11 mg napthalene/g F-300

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TABLE 2

Keystone Environmental
Texarkana, Texas Site

ACT Simulation Conditons

Vessel: Model 3

Carbon: FS-300

Flow Rate: 10 gpm

SLR: 0.80 gpm/sq. ft.

EBCT: 45 Min

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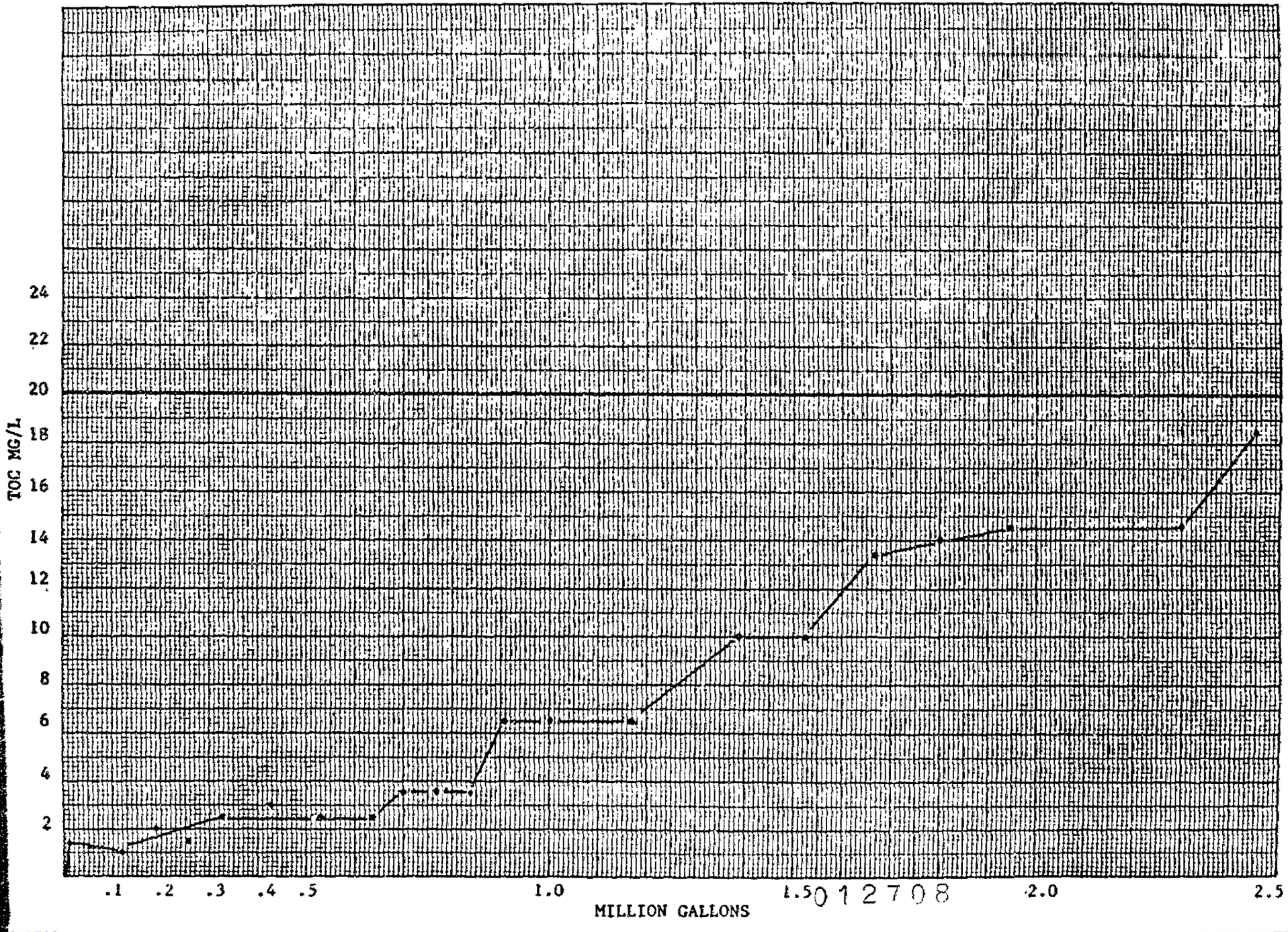
FIGURE 1
TOC BREAKTHROUGH



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APPENDIX 2-B
GEOMETRIC MEAN CONCENTRATIONS

APPENDIX 2-B

SUMMARY OF DATA USED TO ESTIMATE GEOMETRIC MEAN PCOC CONCENTRATIONS IN CARVER TERRACE SURFACE SOILS, KENNEDY SAND AND GRAVEL SURFACE SOILS, AND SEDIMENTS

Carver Terrace

The following steps were performed to estimate the geometric mean concentration of PCOCs.

1. For each PCOC in Carver Terrace surface soils, the lowest measured value was identified and used to replace any sampling points at which the PCOC was not detected. The lowest measured values in Carver Terrace surface soils are shown in Table B-1.
2. Once all substitutions were completed, total PAH and potentially carcinogenic PAH were summed for each sampling point.
3. At sampling points where two soil samples were taken (one from 0 to 6 inches and the second from 6 to 12 inches), results of the two samples were averaged for all PCOCs.
4. These data were then used to estimate the geometric mean concentration of PCOCs in Carver Terrace surface soils.
5. When estimating current PCOC concentrations in Carver Terrace surface soils, areas covered by sod were assumed to have PCOC concentrations equal to the lowest measured value. (The following sampling points are covered by sod: B2-L9; B2-L8; B2-L7; PACE; STATION 10; STATION 9; B4-L12; B6-L6; B6-L7; B4-L22; B6-L8; B2-L6; B2-L5; B2-L4; B2-L2; B2-L3; STATION 7; 2022; 2026; SL83-001; and, SL90-001.) PCOC concentrations for each sampling point are shown in Table B-2. The geometric mean concentration of each PCOC is also shown in Table B-2.

Table B-1

Minimum Measured PCOC Concentrations at Carver Terrace

PCOC	MINIMUM CONCENTRATION
PCP	1200 (ug/kg)
ACENAPHTHENE	490 (ug/kg)
ACENAPTHYLENE	260 (ug/kg)
ANTHRACENE	280 (ug/kg)
B(A)ANTHRACENE	200 (ug/kg)
B(A)PYRENE	340 (ug/kg)
B(B&K)FLUORANTHENES	240 (ug/kg)
B(GHI)PERYLENE	390 (ug/kg)
CHRYSENE	320 (ug/kg)
DIB(AH)ANTHRACENE	400 (ug/kg)
FLUORANTHENE	330 (ug/kg)
FLUORENE	470 (ug/kg)
I(CD123)PYRENE	350 (ug/kg)
2METHYLNAPHTHALENE	460 (ug/kg)
NAPHTHALENE	490 (ug/kg)
PHENANTHRENE	220 (ug/kg)
PYRENE	390 (ug/kg)
ARSENIC	2.5 (mg/kg)
CHROMIUM	2 (mg/kg)
COPPER	1 (mg/kg)
ZINC	6 (mg/kg)
LEAD	2.5 (mg/kg)
MERCURY	0.16 (mg/kg)

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TABLE B-2

CONCENTRATION OF PCOCs IN CARVER TERRACE SURFACE SOILS ASSUMING THAT CONCENTRATIONS IN SODDED AREAS ARE EQUAL TO THE LOWEST VALUE MEASURED. THESE VALUES ARE USED IN THE CURRENT SCENARIO. ORGANIC PCOCS ARE IN UG/KG AND INORGANIC PCOCS ARE IN MG/KG.

SAMPLE LOCATION	PCP	TOTAL PAH	CARC. PAH	ARSENIC	CHROMIUM	COPPER	ZINC	LEAD	MERCURY
B3-L12	1200	5520	1850	2.5	5	6.5	33	34.85	0.22
B3-L13	1200	5550	1880	2.95	11	25.5	84.5	106.05	0.13
B3-L14	1200	59010	42400	3.3	11	25	105	91.75	0.355
B2-L9	1200	5520	1850	2.5	2	1	6	2.5	0.16
B2-L8	1200	5520	1850	2.5	2	1	6	2.5	0.16
B2-L7	1200	5520	1850	2.5	2	1	6	2.5	0.16
PACE	1200	5520	1850	2.5	2	1	6	2.5	0.16
CHURCH	1200	5520	1850	2.5	2	1	6		
SL58-001									
B4-L1	1200	44140	15705	23.25	18	10	260	21.95	0.16
B4-L20	1200	9835	4420	2.5	10.5	8	92	47.95	0.16
STATION 9	1200	5520	1850	2.5	2	1	6		
B4-L12	1200	5520	1850						
B6-L6	1200	5520	1850						
B6-L7	1200	5520	1850						
B4-L22	1200	5520	1850						
B6-L8	1200	5520	1850						
SL03-001				2.5	2	1	332		
SL03-014				2.5	2	1	424		
B4-L15	1200	29770	15300	3	9	12	552	57.7	0.16
B4-L1	1200	7095	3145	2.5	4	2	342	4.2	0.16
STATION 8	1200	26800	18400	2.5	7	4	114		
B4-L17	1200	2446450	561090						
B1-L4	16000	180140	84800						
SL87-001									
B1-L18	1200	188130	103385	2.55	9	8	35	79.4	0.235
B1-L10	14600	33820	18125	2.6	12	3	33	41.6	0.16
B1-L20	1200	11025	5015	2.5	5	4	24	22.95	0.305
B6-L3	1200	16070	7675	2.5	4	9	13	27.25	0.16
B6-L4	1200	10590	4675	2.5	6	2	6	29.8	0.16
B6-L12	1200	5520	1850	2.5	9	3.5	217.5	17.45	0.16
B2-L6	1200	5520	1850	2.5	2	1	6	2.5	0.16
B2-L5	1200	5520	1850	2.5	2	1	6	2.5	0.16
B2-L4	1200	5520	1850	2.5	2	1	6	2.5	0.16
B2-L2	1200	5520	1850	2.5	2	1	6	2.5	0.16
B2-L3	1200	5520	1850	2.5	2	1	6	2.5	0.16
B5-L2	1200	250050	126750	2.9	6.5	10	1433	238.05	0.16
STATION 7	1200	5520	1850	2.5	2	1	6		
B5-L23	1200	138330	67090						
B5-L13	1200	144810	91920						
B1-L21	1200	1804210	1009400						
NW-NAPH	1200	5520	1850						
B5-L22	1200	162990	77750						
B5-L19	1200	5520	1850						
SL36-001	1200	6280	2610	2.5	2	1	6		
SL55-001									
SL56-001									
SL56-003									
SL85-001									
SL83-001									
SL84-001	1200	117100	70600						
SL90-001	1200	61480	38400						
GEOMETRIC MEAN	1.35E+03	1.81E+04	7.31E+03	2.77E+00	3.94E+00	2.57E+00	2.99E+01	1.35E+01	1.77E-01

6. When estimating future PCOC concentrations in Carver Terrace surface soils, sod is assumed to not have an effect on PCOC concentrations. The geometric mean concentration of each PCOC, is also shown in Table B-3. These geometric mean concentrations of PAHs are then used to estimate future concentrations and the effect of degradation using half lives reported in the scientific literature (see Appendices 2-C and 2-F).

TABLE B-3

CONCENTRATION OF PCOCs IN CARVER TERRACE SURFACE SOILS ASSUMING THAT SODDING OF AN AREAS HAS NO EFFECT ON PCOC CONCENTRATIONS. ONCE DEGRADATION OF PAHs AND PCDD/PCDF IS ACCOUNTED FOR, THESE VALUES ARE USED IN THE FUTURE SCENARIO. ORGANIC PCOCS ARE IN UG/KG AND INORGANIC PCOCS ARE IN MG/KG.

SAMPLE LOCATION	PCP	TOTAL PAH	CARC. PAH	ARSENIC	CHROMIUM	COPPER	ZINC	LEAD	MERCURY
B3-L12	1200	5520	1850	2.5	5	6.5	33	34.85	0.205
B3-L13	1200	5550	1880	2.35	11	25.5	84.5	106.05	0.16
B3-L14	1200	59010	42400	3.3	11	25	105	91.75	0.355
B2-L9	1200	12180	4325	53.35	57.5	18.5	242	101.75	0.16
B2-L8	1200	13163305	1451040	17	31	30.5	535	43.95	0.16
B2-L7	1200	2434520	381920	10.15	14.5	16	205	32.5	0.34
PACE	1200	1861935	1052040	8.85	10.5	12	40.5	50.6	0.16
CHURCH	1200	672710	442000	2.5	42	92	3370		
SL58-001									
B4-L1	1200	44140	15705	23.25	18	10	260	21.95	0.16
B4-L20	1200	9835	4420	2.5	10.5	8	92	47.95	0.16
STATION 9	1200	48310	32800	2.5	6	27	326		
B4-L12	1200	235700	144750						
B6-L6	1200	112700	73750						
B6-L7	1200	4523900	2020950						
B4-L22	1200	37790	21700						
B6-L8	1200	20540	11520						
SL03-001				2.5	2	1	332		
SL03-014				2.5	2	1	424		
B4-L15	1200	29770	15300	3	9	12	552	57.7	0.16
B4-L1	1200	7095	3145	2.5	4	2	342	4.2	0.19
STATION 8	1200	26800	18400	2.5	7	4	114		
B4-L17	1200	2446450	561090						
B1-L4	16000	180140	84800						
SL87-001									
B1-L18	1200	188130	103385	2.55	9	8	35	76.4	0.22
B1-L10	14600	33820	18125	2.6	12	3	33	41.6	0.16
B1-L20	1200	11025	5015	2.5	5	4	24	22.35	0.29
B6-L3	1200	16070	7675	2.5	4	3	13	27.25	0.16
B6-L4	1200	10590	4675	2.5	6	2	6	29.8	0.16
B6-L12	1200	5520	1850	2.5	9	3.5	217.5	17.45	0.16
B2-L6	1200	2552160	537665	10.4	19.5	12	342	53.15	0.16
B2-L5	1200	4566610	721495	5.65	3	79	1072.5	77.8	0.16
B2-L4	1200	652935	249015	3.5	6.5	55.5	93.5	34.3	0.16
B2-L2	1200	50050	25550	2.5	5	10.5	338	30.35	0.16
B2-L3	1200	3704135	884925	4.95	14.5	101	280.5	27.9	0.16
B5-L2	1200	250050	126750	2.9	6.5	10	1433	238.05	0.16
STATION 7	1200	125250	79900	2.5	6	26	120		
B5-L23	1200	138330	67090						
B5-L13	1200	144810	91920						
B1-L21	1200	1804210	1009400						
NW-NORM	1200	2.4E+08	1850						
B5-L22	1200	162390	77750						
B5-L19	1200	1506460	1024400						
SL36-001	1200	6280	2610	2.5	2	1	6		
SL55-001									
SL56-001									
SL56-003									
SL85-001							0		
SL83-001									
SL84-001	1200	117100	70600						
SL90-001	17000	61480	38400						
GEOMETRIC MEAN		1.44E+03	1.46E+05	4.35E+04	3.38E+00	6.13E+00	9.77E+00	1.42E+02	4.22E+01	0.181371

012714

Kennedy Sand and Gravel

The following steps were performed to estimate the geometric mean concentration of PCOCs.

1. For each PCOC in Kennedy Sand and Gravel surface soils, the lowest measured value was identified and used to replace any sampling points at which the PCOC was not detected. If a PCOC was not detected in any surface soil samples, the method detection limit was used in place of no detects and J valves.
2. Once all substitutions were completed, total PAH and potentially carcinogenic PAH were summed for each sampling point.
3. These data were then used to estimate the geometric mean concentration of PCOCs in Kennedy Sand and Gravel surface soils.
4. When estimating current PCOC concentrations in Kennedy Sand and Gravel surface soils degradation of PAHs was not accounted for. The geometric mean concentration of each PCOC is also shown in Table B-4.
5. When estimating future PCOC concentrations in Kennedy Sand and Gravel surface soils, degradation of PAHs is assumed to occur. The future geometric mean concentration of each PCOC, is shown in Table B-4. The same method was used to calculate Kennedy Sand and Gravel degradation as was used for Carver Terrace (see Appendix 2-C).

TABLE B-4

GEOMETRIC MEAN PCOC CONCENTRATIONS IN KENNEDY SAND AND GRAVEL

CONCENTRATION OF PCOCs IN KENNEDY SAND AND GRAVEL SURFACE SOILS ASSUMING THAT NON-DETECTS AND J VALUES ARE EQUAL TO THE LOWEST VALUE MEASURED OR ONE HALF THE METHOD DETECTION LIMIT IF THE PCOC WAS NOT DETECTED ANYWHERE ON KENNEDY SAND AND GRAVEL PROPERTY. TWO GEOMETRIC MEANS ARE PRESENTED. ONE NOT ACCOUNTING FOR DEGRAGDATION AND THE OTHER TAKING DEGRADATION OF PAHs INTO ACCOUNT (HALF LIFE OF 1385 DAYS IS ASSUMED). ORGANIC PCOCS ARE IN UG/KG AND INORGANIC PCOCS ARE IN MG/KG.

GEOMETRIC MEAN WITH NO ACCOUNT FOR DEGRADATION OF PAH

SAMPLE LOCATION	PCP	TOTAL PAH	CARC. PAH	ARSENIC	CHROMIUM	COPPER	ZINC
SL58-001	8.00E+02	3.58E+05	2.54E+05	1.49E+01	1.20E+01	9.68E+00	3.02E+01
SL87-001	8.00E+02	9.57E+04	5.63E+04				
SL55-001	8.00E+02	1.99E+05	1.17E+05	1.49E+01	1.20E+01	9.68E+00	3.52E+01
SL56-001	8.00E+02	9.57E+04	5.63E+04	1.49E+01	1.20E+01	9.68E+00	3.45E+01
SL56-003	8.00E+02	9.58E+04	5.64E+04	1.49E+01	1.20E+01	9.68E+00	3.47E+01
GEOMETRIC MEAN W/O DEGRADATION	8.00E+02	1.44E+05	8.82E+04	1.49E+01	1.20E+01	9.68E+00	3.36E+01

GEOMETRIC MEAN ACCOUNTING FOR DEGRADATION OF PAH

SAMPLE LOCATION	PCP	TOTAL PAH	CARC. PAH	ARSENIC	CHROMIUM	COPPER	ZINC
SL58-001	8.00E+02	2.55E+04	1.81E+04	1.49E+01	1.20E+01	9.68E+00	3.02E+01
SL87-001	8.00E+02	6.82E+03	4.01E+03				
SL55-001	8.00E+02	1.42E+04	8.36E+03	1.49E+01	1.20E+01	9.68E+00	3.52E+01
SL56-001	8.00E+02	6.82E+03	4.01E+03	1.49E+01	1.20E+01	9.68E+00	3.45E+01
SL56-003	8.00E+02	6.83E+03	4.02E+03	1.49E+01	1.20E+01	9.68E+00	3.47E+01
GEOMETRIC MEAN WITH DEGRADATION	8.00E+02	1.03E+04	6.29E+03	1.49E+01	1.20E+01	9.68E+00	3.36E+01

ONE HALF OF THE METHOD DETECTION LIMIT USED IN PLACE OF NO DETECTS AND J VALUES.

Sediments

The following steps were performed to estimate the geometric mean concentration of PCOCs.

1. For each PCOC in sediments, the lowest measured value was identified and used to replace any sampling points at which the PCOC was not detected. If a PCOC was not detected in any sediment samples, the method detection limit was used in instead.
2. Once all substitutions were completed, total PAH and potentially carcinogenic PAH were summed for each sampling point.
3. These data were then used to estimate the geometric mean concentration of PCOCs in sediments. The geometric mean concentration of each PCOC is also shown in Table B-5.

TABLE B-5

GEOMETRIC MEAN CONCENTRATION OF PCOCs IN SEDIMENTS

CONCENTRATION OF PCOCS IN SEDIMENT SAMPLES ASSUMING THAT PCOC CONCENTRATIONS IN SAMPLES WHERE NO PCOCS WERE DETECTED ARE EQUAL TO THE LOWEST VALUE MEASURED IN ANY SEDIMENT SAMPLE ARE SHOWN. IF A PCOC WAS NOT DETECTED IN ANY SEDIMENT SAMPLE THE METHOD DETECTION LIMIT WAS SUBSTITUTED FOR NON DETECTS AND J VALUES. ORGANIC PCOCS ARE IN UG/KG AND INORGANIC PCOCS ARE IN MG/KG. DEGRADTION IS NOT ACCOUNTED FOR.

	PCOC											
SAMPLE NUMBER	BENZENE	TOLUENE	TOTAL XYLENES	TOTAL PAH	POTEN. CARCIN. PAH	ARSENIC	CHROMIUM	COPPER	ZINC	LEAD	MERCURY
SD01-001	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04						
SD01-001 MS						4.30E+00	5.21E+00	7.46E+00	2.50E+01	8.30E+00	1.60E-01
SD01-001 MSD						1.00E+01	5.21E+00	7.46E+00	1.80E+01	1.50E+01	1.60E-01
SD01-002	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	8.00E+00	5.21E+00	7.46E+00	6.80E+00	2.30E+00	1.60E-01
SD04-001	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	1.30E+01	1.40E+01	1.60E-01
SD04-002	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	6.80E+00		1.60E-01
SD05-001	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	9.60E+00	3.20E+00	1.60E-01
SD05-002	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	1.25E+01		1.60E-01
SD06-001	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	6.80E+00	7.20E+00	1.60E-01
SD06-002	2.10E+01	3.30E+01	1.70E+02	1.17E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	1.83E+01		1.60E-01
SD21-003	2.10E+01	3.90E+01	1.70E+02	1.25E+05	1.62E+04						
SD22-003	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04						
SD23-003	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04						
SD24-003	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04						
SD03-001	2.10E+01	3.30E+01	1.70E+02			4.30E+00	5.21E+00	7.46E+00	4.40E+01	4.40E+01	1.60E-01
SD03-002	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	5.79E+01		1.60E-01
SD15-001	2.10E+01	3.90E+01	1.70E+02			4.80E+00	5.21E+00	7.46E+00	8.20E+01	1.10E+02	3.00E-01
SD15-002	2.10E+01	3.30E+01	1.70E+02	1.17E+05	1.62E+04	4.30E+00	1.12E+01	7.46E+00	1.36E+02		2.10E-01
SD07-001	2.10E+01	3.90E+01	1.70E+02			7.80E+00	6.20E+01	7.46E+00	1.10E+02	1.60E+02	6.00E-01
SD07-002	2.10E+01	3.30E+01	1.70E+02	1.15E+05	1.62E+04	4.30E+00	5.21E+00	7.46E+00	6.33E+01		3.80E-01
SD08-001	2.10E+01	3.30E+01	1.70E+02			4.30E+00	2.60E+01	7.46E+00	3.10E+02	5.00E+01	7.00E-01
SD08-002	2.10E+01	3.30E+01	1.70E+02	1.31E+05	3.23E+04	4.30E+00	1.43E+01	7.46E+00	1.10E+02		6.20E-01
SD09-001	2.10E+01	3.90E+01	1.70E+02			4.30E+00	3.60E+01	7.46E+00	3.10E+02	2.30E+00	1.60E-01
SD09-002	2.10E+01	3.30E+01	1.70E+02	2.53E+05	1.62E+04	4.30E+00	1.69E+01	7.46E+00	3.65E+02		1.30E-01
SD19-001						4.30E+00	7.26E+00	7.46E+00	1.13E+02	8.88E+00	8.50E-01
SD20-001						4.30E+00	8.31E+00	7.46E+00	1.20E+02	7.93E+00	1.60E-01
GEOMETRIC MEAN	2.10E+01	3.30E+01	1.70E+02	1.22E+05	1.63E+04	4.77E+00	8.30E+00	7.46E+00	4.45E+01	1.37E+01	2.44E-01

012718

APPENDIX C
(UV/Ozone Oxidation Results)

012719

SPECTRIX MONROEVILLE

TABLE 3: SUMMARY OF GC601 DATA

Sample: 87110145

Source: OU FINAL INF
Description: TREATABILITY STUDY

Date Collected: 11/09/87
Date Received: 11/09/87

Date Extracted: 11/23/87
Date Analyzed: 11/23/87

Purgeable Halocarbons

1,1,1-Trichloroethane	<3.00
1,1,2,2-Tetrachloroethane	<3.00
1,1,2-Trichloroethane	<2.00
1,1-Dichloroethane	<5.00
1,1-Dichloroethene	<5.00
1,2-Dichlorobenzene	<15.0
1,2-Dichloroethane	<3.00
1,2-Dichloropropane	<3.00
1,3-Dichlorobenzene	<30.0
1,4-Dichlorobenzene	<25.0
2-Chloroethylvinyl ether	<13.0
Bromodichloromethane	<10.0
Bromoform	<20.0
Carbon Tetrachloride	<10.0
Chlorobenzene	25.0
Chloroethane	<25.0
Chloroform	<5.00
Dibromochloromethane	<10.0
Methyl Bromide	<50.0
Methyl Chloride	<25.0
Methylene Chloride	<5.00
Tetrachloroethene	<3.00
Trichlorofluoromethane	5.00
Trichloroethene	<10.0
Vinyl Chloride	<25.0
Cis-1,3-Dichloropropene	30.0
trans-1,2-Dichloroethene	5.00
trans-1,3-Dichloropropene	30.0

The above results are reported in ug/L

All GC601 identifications are from retention date bas...

012720

TABLE 3: SUMMARY OF GC601 DATA

Sample: 87110146

Source OU FINAL EFF
Description TREATABILITY STUDY

Date Collected: 11/09/87
Date Received 11/09/87

Date Extracted: 11/23/87
Date Analyzed 11/23/87

Purgeable Halocarbons

1,1,1-Trichloroethane	<3.00
1,1,2,2-Tetrachloroethane	<3 00
1,1,2-Trichloroethane	<2 00
1,1-Dichloroethane	<5 00
1,1-Dichloroethene	<5 00
1,2-Dichlorobenzene	<15 0
1,2-Dichloroethane	<3.00
1,2-Dichloropropane	<3.00
1,3-Dichlorobenzene	<30.0
1,4-Dichlorobenzene	<25.0
2-Chloroethylvinyl ether	<13 0
Bromodichloromethane	<10 0
Bromoform	<20 0
Carbon Tetrachloride	<10 0
Chlorobenzene	<25 0
Chloroethane	<25.0
Chloroform	<5 00
Dibromochloromethane	<10 0
Methyl Bromide	<50 0
Methyl Chloride	<25 0
Methylene Chloride	<5 00
Tetrachloroethene	<3 00
Trichlorofluoromethane	<5 00
Trichloroethene	<10 0
Vinyl Chloride	<25 0
cis-1,3-Dichloropropene	<30 0
trans-1,2-Dichloroethene	<5 00
trans-1,3-Dichloropropene	30.0

The above results are reported in ug/L.

All GC601 identifications are from retention data only.

012721

012721

APPENDIX 2-C
CALCULATION OF CARVER TERRACE HALF LIVES

APPENDIX 2-C

ESTIMATION OF AVERAGE PAH AND TCDD/TCDF CONCENTRATION IN CARVER TERRACE SURFACE SOILS FOR THE NEXT 70 YEARS

The future scenario at Carver Terrace assumes that PAHs and TCDD/TCDF in the surface soil degrade. Thus exposure of residents will decrease with time. The following steps were performed to estimate the average concentration of PAHs and TCDD/TCDF in Carver Terrace surface soils for the future exposure scenario, i.e. the next 70 years.

1. The geometric mean concentration of PAH in Carver Terrace surface soils, assuming no sod was in place, presented in Table B-3 of Appendix 2-B was used to estimate the 70 year average concentration. TCDD/TCDF equivalent concentrations were taken from the RI report.
2. The upper 95 percentile of half-lives reported in the literature for benzo(a)pyrene was used in this risk assessment. This value was equal to 1385 days (see Appendix 2-F). The half-life of benzo(a)pyrene was assumed to be representative of other PAHs. A half-life of 12 years was used for TCDD/TCDF (EPA 1986).
3. Annual decay of PAHs and TCDD/TCDF was calculated using the following formula:

$$C_t = C_o \times e^{-kt}$$

Where C is equal to PCOC concentration at the time specified by the subscript; t is equal to the time period during which the PCOC is decaying; and, k is equal to the half-life of the PCOC.

4. The concentration at the end of each year of the 70 year period was calculated.

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5. The average soil concentration for the 70 year period was then derived by summing the concentration at the end of each year and dividing by 70, the total number of years. Initial concentration, concentrations at the end of each of the years, and the average concentration for total PAH and for potentially carcinogenic PAH and 2,3,7,8-TCDD toxic equivalents are shown in Table C-1.

MAXIMUM M/D SCD

COMPOUND	INITIAL CONC.	HALF-LIFE	TIME (YEARS)	CONC. AT TIME T
TCDD/ TCDF PCB (mg/kg)	7.67E-04	1.20E+01	0	7.67E-04
	7.67E-04	1.20E+01	1	7.24E-04
	7.67E-04	1.20E+01	2	6.83E-04
	7.67E-04	1.20E+01	3	6.45E-04
	7.67E-04	1.20E+01	4	6.09E-04
	7.67E-04	1.20E+01	5	5.75E-04
	7.67E-04	1.20E+01	6	5.42E-04
	7.67E-04	1.20E+01	7	5.12E-04
	7.67E-04	1.20E+01	8	4.83E-04
	7.67E-04	1.20E+01	9	4.56E-04
	7.67E-04	1.20E+01	10	4.31E-04
	7.67E-04	1.20E+01	11	4.06E-04
	7.67E-04	1.20E+01	12	3.84E-04
	7.67E-04	1.20E+01	13	3.62E-04
	7.67E-04	1.20E+01	14	3.42E-04
	7.67E-04	1.20E+01	15	3.23E-04
	7.67E-04	1.20E+01	16	3.04E-04
	7.67E-04	1.20E+01	17	2.87E-04
	7.67E-04	1.20E+01	18	2.71E-04
	7.67E-04	1.20E+01	19	2.56E-04
	7.67E-04	1.20E+01	20	2.42E-04
	7.67E-04	1.20E+01	21	2.28E-04
	7.67E-04	1.20E+01	22	2.15E-04
	7.67E-04	1.20E+01	23	2.03E-04
	7.67E-04	1.20E+01	24	1.92E-04
	7.67E-04	1.20E+01	25	1.81E-04
	7.67E-04	1.20E+01	26	1.71E-04
	7.67E-04	1.20E+01	27	1.61E-04
	7.67E-04	1.20E+01	28	1.52E-04
	7.67E-04	1.20E+01	29	1.44E-04
	7.67E-04	1.20E+01	30	1.36E-04
	7.67E-04	1.20E+01	31	1.28E-04
	7.67E-04	1.20E+01	32	1.21E-04
	7.67E-04	1.20E+01	33	1.14E-04
	7.67E-04	1.20E+01	34	1.08E-04
	7.67E-04	1.20E+01	35	1.02E-04
	7.67E-04	1.20E+01	36	9.59E-05
	7.67E-04	1.20E+01	37	9.05E-05
	7.67E-04	1.20E+01	38	8.53E-05
	7.67E-04	1.20E+01	39	8.07E-05
	7.67E-04	1.20E+01	40	7.61E-05
	7.67E-04	1.20E+01	41	7.19E-05
	7.67E-04	1.20E+01	42	6.78E-05
	7.67E-04	1.20E+01	43	6.40E-05
	7.67E-04	1.20E+01	44	6.04E-05
	7.67E-04	1.20E+01	45	5.70E-05
	7.67E-04	1.20E+01	46	5.38E-05
	7.67E-04	1.20E+01	47	5.08E-05
	7.67E-04	1.20E+01	48	4.80E-05
	7.67E-04	1.20E+01	49	4.53E-05
	7.67E-04	1.20E+01	50	4.27E-05
	7.67E-04	1.20E+01	51	4.03E-05
	7.67E-04	1.20E+01	52	3.81E-05
	7.67E-04	1.20E+01	53	3.59E-05
	7.67E-04	1.20E+01	54	3.39E-05
	7.67E-04	1.20E+01	55	3.20E-05
	7.67E-04	1.20E+01	56	3.02E-05
	7.67E-04	1.20E+01	57	2.85E-05
	7.67E-04	1.20E+01	58	2.69E-05
	7.67E-04	1.20E+01	59	2.54E-05
	7.67E-04	1.20E+01	60	2.40E-05
	7.67E-04	1.20E+01	61	2.26E-05
	7.67E-04	1.20E+01	62	2.14E-05
	7.67E-04	1.20E+01	63	2.02E-05
	7.67E-04	1.20E+01	64	1.90E-05
	7.67E-04	1.20E+01	65	1.80E-05
	7.67E-04	1.20E+01	66	1.70E-05
	7.67E-04	1.20E+01	67	1.60E-05
	7.67E-04	1.20E+01	68	1.51E-05
	7.67E-04	1.20E+01	69	1.43E-05
	7.67E-04	1.20E+01	70	1.35E-05

AVERAGE: 1.81E-04

GEOMETRIC MEAN M/D SCD

COMPOUND	INITIAL CONC.	HALF-LIFE	TIME (YEARS)	CONC. AT TIME T
TCDD/ TCDF PCB (mg/kg)	7.73E-06	1.20E+01	0	7.73E-06
	7.73E-06	1.20E+01	1	7.30E-06
	7.73E-06	1.20E+01	2	6.89E-06
	7.73E-06	1.20E+01	3	6.50E-06
	7.73E-06	1.20E+01	4	6.14E-06
	7.73E-06	1.20E+01	5	5.79E-06
	7.73E-06	1.20E+01	6	5.47E-06
	7.73E-06	1.20E+01	7	5.16E-06
	7.73E-06	1.20E+01	8	4.87E-06
	7.73E-06	1.20E+01	9	4.60E-06
	7.73E-06	1.20E+01	10	4.34E-06
	7.73E-06	1.20E+01	11	4.10E-06
	7.73E-06	1.20E+01	12	3.87E-06
	7.73E-06	1.20E+01	13	3.65E-06
	7.73E-06	1.20E+01	14	3.44E-06
	7.73E-06	1.20E+01	15	3.25E-06
	7.73E-06	1.20E+01	16	3.07E-06
	7.73E-06	1.20E+01	17	2.90E-06
	7.73E-06	1.20E+01	18	2.73E-06
	7.73E-06	1.20E+01	19	2.58E-06
	7.73E-06	1.20E+01	20	2.44E-06
	7.73E-06	1.20E+01	21	2.30E-06
	7.73E-06	1.20E+01	22	2.17E-06
	7.73E-06	1.20E+01	23	2.05E-06
	7.73E-06	1.20E+01	24	1.93E-06
	7.73E-06	1.20E+01	25	1.82E-06
	7.73E-06	1.20E+01	26	1.72E-06
	7.73E-06	1.20E+01	27	1.63E-06
	7.73E-06	1.20E+01	28	1.53E-06
	7.73E-06	1.20E+01	29	1.45E-06
	7.73E-06	1.20E+01	30	1.37E-06
	7.73E-06	1.20E+01	31	1.29E-06
	7.73E-06	1.20E+01	32	1.22E-06
	7.73E-06	1.20E+01	33	1.15E-06
	7.73E-06	1.20E+01	34	1.09E-06
	7.73E-06	1.20E+01	35	1.02E-06
	7.73E-06	1.20E+01	36	9.67E-07
	7.73E-06	1.20E+01	37	9.12E-07
	7.73E-06	1.20E+01	38	8.61E-07
	7.73E-06	1.20E+01	39	8.13E-07
	7.73E-06	1.20E+01	40	7.67E-07
	7.73E-06	1.20E+01	41	7.24E-07
	7.73E-06	1.20E+01	42	6.84E-07
	7.73E-06	1.20E+01	43	6.45E-07
	7.73E-06	1.20E+01	44	6.09E-07
	7.73E-06	1.20E+01	45	5.75E-07
	7.73E-06	1.20E+01	46	5.43E-07
	7.73E-06	1.20E+01	47	5.12E-07
	7.73E-06	1.20E+01	48	4.83E-07
	7.73E-06	1.20E+01	49	4.56E-07
	7.73E-06	1.20E+01	50	4.31E-07
	7.73E-06	1.20E+01	51	4.07E-07
	7.73E-06	1.20E+01	52	3.84E-07
	7.73E-06	1.20E+01	53	3.62E-07
	7.73E-06	1.20E+01	54	3.42E-07
	7.73E-06	1.20E+01	55	3.23E-07
	7.73E-06	1.20E+01	56	3.05E-07
	7.73E-06	1.20E+01	57	2.87E-07
	7.73E-06	1.20E+01	58	2.71E-07
	7.73E-06	1.20E+01	59	2.56E-07
	7.73E-06	1.20E+01	60	2.42E-07
	7.73E-06	1.20E+01	61	2.28E-07
	7.73E-06	1.20E+01	62	2.15E-07
	7.73E-06	1.20E+01	63	2.03E-07
	7.73E-06	1.20E+01	64	1.92E-07
	7.73E-06	1.20E+01	65	1.81E-07
	7.73E-06	1.20E+01	66	1.71E-07
	7.73E-06	1.20E+01	67	1.61E-07
	7.73E-06	1.20E+01	68	1.52E-07
	7.73E-06	1.20E+01	69	1.44E-07
	7.73E-06	1.20E+01	70	1.36E-07

AVERAGE: 1.82E-06

MINIMUM M/D SCD

COMPOUND	INITIAL CONC.	HALF-LIFE	TIME (YEARS)	CONC. AT TIME T
TCDD/ TCDF PCB (mg/kg)	1.80E-08	1.20E+01	0	1.80E-08
	1.80E-08	1.20E+01	1	1.69E-08
	1.80E-08	1.20E+01	2	1.59E-08
	1.80E-08	1.20E+01	3	1.50E-08
	1.80E-08	1.20E+01	4	1.41E-08
	1.80E-08	1.20E+01	5	1.33E-08
	1.80E-08	1.20E+01	6	1.25E-08
	1.80E-08	1.20E+01	7	1.17E-08
	1.80E-08	1.20E+01	8	1.10E-08
	1.80E-08	1.20E+01	9	1.03E-08
	1.80E-08	1.20E+01	10	9.69E-09
	1.80E-08	1.20E+01	11	9.11E-09
	1.80E-08	1.20E+01	12	8.56E-09
	1.80E-08	1.20E+01	13	8.04E-09
	1.80E-08	1.20E+01	14	7.56E-09
	1.80E-08	1.20E+01	15	7.11E-09
	1.80E-08	1.20E+01	16	6.68E-09
	1.80E-08	1.20E+01	17	6.28E-09
	1.80E-08	1.20E+01	18	5.90E-09
	1.80E-08	1.20E+01	19	5.55E-09
	1.80E-08	1.20E+01	20	5.21E-09
	1.80E-08	1.20E+01	21	4.90E-09
	1.80E-08	1.20E+01	22	4.61E-09
	1.80E-08	1.20E+01	23	4.33E-09
	1.80E-08	1.20E+01	24	4.07E-09
	1.80E-08	1.20E+01	25	3.83E-09
	1.80E-08	1.20E+01	26	3.60E-09
	1.80E-08	1.20E+01	27	3.39E-09
	1.80E-08	1.20E+01	28	3.18E-09
	1.80E-08	1.20E+01	29	2.99E-09
	1.80E-08	1.20E+01	30	2.81E-09
	1.80E-08	1.20E+01	31	2.64E-09
	1.80E-08	1.20E+01	32	2.48E-09
	1.80E-08	1.20E+01	33	2.33E-09
	1.80E-08	1.20E+01	34	2.19E-09
	1.80E-08	1.20E+01	35	2.06E-09
	1.80E-08	1.20E+01	36	1.93E-09
	1.80E-08	1.20E+01	37	1.82E-09
	1.80E-08	1.20E+01	38	1.71E-09
	1.80E-08	1.20E+01	39	1.61E-09
	1.80E-08	1.20E+01	40	1.51E-09
	1.80E-08	1.20E+01	41	1.42E-09
	1.80E-08	1.20E+01	42	1.34E-09
	1.80E-08	1.20E+01	43	1.26E-09
	1.80E-08	1.20E+01	44	1.18E-09
	1.80E-08	1.20E+01	45	1.11E-09
	1.80E-08	1.20E+01	46	1.05E-09
	1.80E-08	1.20E+01	47	9.85E-10
	1.80E-08	1.20E+01	48	9.28E-10
	1.80E-08	1.20E+01	49	8.74E-10
	1.80E-08	1.20E+01	50	8.23E-10
	1.80E-08	1.20E+01	51	7.75E-10
	1.80E-08	1.20E+01	52	7.30E-10
	1.80E-08	1.20E+01	53	6.87E-10
	1.80E-08	1.20E+01	54	6.47E-10
	1.80E-08	1.20E+01	55	6.09E-10
	1.80E-08	1.20E+01	56	5.74E-10
	1.80E-08	1.20E+01	57	5.40E-10
	1.80E-08	1.20E+01	58	5.09E-10
	1.80E-08	1.20E+01	59	4.79E-10
	1.80E-08	1.20E+01	60	4.51E-10
	1.80E-08	1.20E+01	61	4.25E-10
	1.80E-08	1.20E+01	62	4.00E-10
	1.80E-08	1.20E+01	63	3.77E-10
	1.80E-08	1.20E+01	64	3.55E-10
	1.80E-08	1.20E+01	65	3.34E-10
	1.80E-08	1.20E+01	66	3.15E-10
	1.80E-08	1.20E+01	67	2.96E-10
	1.80E-08	1.20E+01	68	2.79E-10
	1.80E-08	1.20E+01	69	2.62E-10
	1.80E-08	1.20E+01	70	2.47E-10

AVERAGE: 6.37E-09

TABLE C-1: DETERMINING CONCENTRATIONS OVER A 70 YEAR PERIOD [illegible]

TABLE E-2

DETERMINING AVERAGE CONCENTRATIONS OVER A 70 YEAR PERIOD FOR TOTAL PAHs IN CARVER TERRACE SURFACE SOILS

ARITHMETIC MEAN W/O SOD

COMPOUND	INITIAL CONC.	HALF LIFE	TIME (YEARS)	CONC. AT TIME T
TOTAL PAHs (mg/kg)	2.5E+05	3.8E+00	0	2.5E+05
	2.5E+05	3.8E+00	1	1.1E+05
	2.5E+05	3.8E+00	2	5.7E+04
	2.5E+05	3.8E+00	3	2.9E+04
	2.5E+05	3.8E+00	4	1.5E+04
	2.5E+05	3.8E+00	5	7.7E+03
	2.5E+05	3.8E+00	6	3.9E+03
	2.5E+05	3.8E+00	7	2.0E+03
	2.5E+05	3.8E+00	8	1.0E+03
	2.5E+05	3.8E+00	9	5.2E+02
	2.5E+05	3.8E+00	10	2.7E+02
	2.5E+05	3.8E+00	11	1.4E+02
	2.5E+05	3.8E+00	12	7.2E+01
	2.5E+05	3.8E+00	13	3.7E+01
	2.5E+05	3.8E+00	14	1.9E+01
	2.5E+05	3.8E+00	15	9.8E+00
	2.5E+05	3.8E+00	16	5.1E+00
	2.5E+05	3.8E+00	17	2.6E+00
	2.5E+05	3.8E+00	18	1.3E+00
	2.5E+05	3.8E+00	19	6.9E-01
	2.5E+05	3.8E+00	20	3.6E-01
	2.5E+05	3.8E+00	21	1.9E-01
	2.5E+05	3.8E+00	22	9.8E-02
	2.5E+05	3.8E+00	23	5.1E-02
	2.5E+05	3.8E+00	24	2.6E-02
	2.5E+05	3.8E+00	25	1.4E-02
	2.5E+05	3.8E+00	26	7.1E-03
	2.5E+05	3.8E+00	27	3.7E-03
	2.5E+05	3.8E+00	28	1.9E-03
	2.5E+05	3.8E+00	29	1.0E-03
	2.5E+05	3.8E+00	30	5.3E-04
	2.5E+05	3.8E+00	31	2.8E-04
	2.5E+05	3.8E+00	32	1.4E-04
	2.5E+05	3.8E+00	33	7.4E-05
	2.5E+05	3.8E+00	34	3.8E-05
	2.5E+05	3.8E+00	35	2.0E-05
	2.5E+05	3.8E+00	36	1.0E-05
	2.5E+05	3.8E+00	37	5.4E-06
	2.5E+05	3.8E+00	38	2.8E-06
	2.5E+05	3.8E+00	39	1.5E-06
	2.5E+05	3.8E+00	40	7.7E-07
	2.5E+05	3.8E+00	41	4.0E-07
	2.5E+05	3.8E+00	42	2.1E-07
	2.5E+05	3.8E+00	43	1.1E-07
	2.5E+05	3.8E+00	44	5.7E-08
	2.5E+05	3.8E+00	45	3.0E-08
	2.5E+05	3.8E+00	46	1.5E-08
	2.5E+05	3.8E+00	47	7.9E-09
	2.5E+05	3.8E+00	48	4.1E-09
	2.5E+05	3.8E+00	49	2.1E-09
	2.5E+05	3.8E+00	50	1.1E-09
	2.5E+05	3.8E+00	51	5.7E-10
	2.5E+05	3.8E+00	52	3.0E-10
	2.5E+05	3.8E+00	53	1.6E-10
	2.5E+05	3.8E+00	54	8.2E-11
	2.5E+05	3.8E+00	55	4.3E-11
	2.5E+05	3.8E+00	56	2.2E-11
	2.5E+05	3.8E+00	57	1.1E-11
	2.5E+05	3.8E+00	58	6.0E-12
	2.5E+05	3.8E+00	59	3.1E-12
	2.5E+05	3.8E+00	60	1.6E-12
	2.5E+05	3.8E+00	61	8.4E-13
	2.5E+05	3.8E+00	62	4.4E-13
	2.5E+05	3.8E+00	63	2.3E-13
	2.5E+05	3.8E+00	64	1.2E-13
	2.5E+05	3.8E+00	65	6.2E-14
	2.5E+05	3.8E+00	66	3.2E-14
	2.5E+05	3.8E+00	67	1.7E-14
	2.5E+05	3.8E+00	68	8.7E-15
	2.5E+05	3.8E+00	69	4.5E-15
	2.5E+05	3.8E+00	70	2.3E-15

AVERAGE: 1.3E+04

GEOMETRIC MEAN W/O SOD

COMPOUND	INITIAL CONC.	HALF LIFE	TIME (YEARS)	CONC. AT TIME T
TOTAL PAHs (mg/kg)	1.4E+02	3.8E+00	0	1.4E+02
	1.4E+02	3.8E+00	1	6.9E+01
	1.4E+02	3.8E+00	2	3.4E+01
	1.4E+02	3.8E+00	3	1.7E+01
	1.4E+02	3.8E+00	4	8.4E+00
	1.4E+02	3.8E+00	5	4.2E+00
	1.4E+02	3.8E+00	6	2.1E+00
	1.4E+02	3.8E+00	7	1.0E+00
	1.4E+02	3.8E+00	8	5.2E-01
	1.4E+02	3.8E+00	9	2.6E-01
	1.4E+02	3.8E+00	10	1.3E-01
	1.4E+02	3.8E+00	11	6.4E-02
	1.4E+02	3.8E+00	12	3.2E-02
	1.4E+02	3.8E+00	13	1.6E-02
	1.4E+02	3.8E+00	14	7.9E-03
	1.4E+02	3.8E+00	15	3.9E-03
	1.4E+02	3.8E+00	16	2.0E-03
	1.4E+02	3.8E+00	17	9.8E-04
	1.4E+02	3.8E+00	18	4.9E-04
	1.4E+02	3.8E+00	19	2.4E-04
	1.4E+02	3.8E+00	20	1.2E-04
	1.4E+02	3.8E+00	21	5.9E-05
	1.4E+02	3.8E+00	22	2.9E-05
	1.4E+02	3.8E+00	23	1.5E-05
	1.4E+02	3.8E+00	24	7.3E-06
	1.4E+02	3.8E+00	25	3.7E-06
	1.4E+02	3.8E+00	26	1.8E-06
	1.4E+02	3.8E+00	27	9.2E-07
	1.4E+02	3.8E+00	28	4.6E-07
	1.4E+02	3.8E+00	29	2.3E-07
	1.4E+02	3.8E+00	30	1.1E-07
	1.4E+02	3.8E+00	31	5.7E-08
	1.4E+02	3.8E+00	32	2.8E-08
	1.4E+02	3.8E+00	33	1.4E-08
	1.4E+02	3.8E+00	34	7.1E-09
	1.4E+02	3.8E+00	35	3.5E-09
	1.4E+02	3.8E+00	36	1.8E-09
	1.4E+02	3.8E+00	37	8.9E-10
	1.4E+02	3.8E+00	38	4.4E-10
	1.4E+02	3.8E+00	39	2.2E-10
	1.4E+02	3.8E+00	40	1.1E-10
	1.4E+02	3.8E+00	41	5.5E-11
	1.4E+02	3.8E+00	42	2.7E-11
	1.4E+02	3.8E+00	43	1.4E-11
	1.4E+02	3.8E+00	44	6.9E-12
	1.4E+02	3.8E+00	45	3.4E-12
	1.4E+02	3.8E+00	46	1.7E-12
	1.4E+02	3.8E+00	47	8.6E-13
	1.4E+02	3.8E+00	48	4.3E-13
	1.4E+02	3.8E+00	49	2.1E-13
	1.4E+02	3.8E+00	50	1.1E-13
	1.4E+02	3.8E+00	51	5.3E-14
	1.4E+02	3.8E+00	52	2.6E-14
	1.4E+02	3.8E+00	53	1.3E-14
	1.4E+02	3.8E+00	54	6.5E-15
	1.4E+02	3.8E+00	55	3.2E-15
	1.4E+02	3.8E+00	56	1.6E-15
	1.4E+02	3.8E+00	57	7.9E-16
	1.4E+02	3.8E+00	58	3.9E-16
	1.4E+02	3.8E+00	59	1.9E-16
	1.4E+02	3.8E+00	60	9.5E-17
	1.4E+02	3.8E+00	61	4.7E-17
	1.4E+02	3.8E+00	62	2.3E-17
	1.4E+02	3.8E+00	63	1.2E-17
	1.4E+02	3.8E+00	64	5.8E-18
	1.4E+02	3.8E+00	65	2.9E-18
	1.4E+02	3.8E+00	66	1.4E-18
	1.4E+02	3.8E+00	67	7.2E-19
	1.4E+02	3.8E+00	68	3.6E-19
	1.4E+02	3.8E+00	69	1.8E-19
	1.4E+02	3.8E+00	70	8.9E-20

AVERAGE: 1.4E+02

MINIMUM W/O SOD

COMPOUND	INITIAL CONC.	HALF LIFE	TIME (YEARS)	CONC. AT TIME T
TOTAL PAHs (mg/kg)	2.5E+00	3.8E+00	0	2.5E+00
	2.5E+00	3.8E+00	1	1.2E+00
	2.5E+00	3.8E+00	2	5.9E-01
	2.5E+00	3.8E+00	3	2.8E-01
	2.5E+00	3.8E+00	4	1.4E-01
	2.5E+00	3.8E+00	5	6.7E-02
	2.5E+00	3.8E+00	6	3.2E-02
	2.5E+00	3.8E+00	7	1.5E-02
	2.5E+00	3.8E+00	8	7.4E-03
	2.5E+00	3.8E+00	9	3.5E-03
	2.5E+00	3.8E+00	10	1.7E-03
	2.5E+00	3.8E+00	11	8.1E-04
	2.5E+00	3.8E+00	12	3.8E-04
	2.5E+00	3.8E+00	13	1.8E-04
	2.5E+00	3.8E+00	14	8.6E-05
	2.5E+00	3.8E+00	15	4.1E-05
	2.5E+00	3.8E+00	16	1.9E-05
	2.5E+00	3.8E+00	17	9.2E-06
	2.5E+00	3.8E+00	18	4.4E-06
	2.5E+00	3.8E+00	19	2.1E-06
	2.5E+00	3.8E+00	20	1.0E-06
	2.5E+00	3.8E+00	21	4.9E-07
	2.5E+00	3.8E+00	22	2.3E-07
	2.5E+00	3.8E+00	23	1.1E-07
	2.5E+00	3.8E+00	24	5.4E-08
	2.5E+00	3.8E+00	25	2.6E-08
	2.5E+00	3.8E+00	26	1.2E-08
	2.5E+00	3.8E+00	27	5.9E-09
	2.5E+00	3.8E+00	28	2.8E-09
	2.5E+00	3.8E+00	29	1.3E-09
	2.5E+00	3.8E+00	30	6.4E-10
	2.5E+00	3.8E+00	31	3.0E-10
	2.5E+00	3.8E+00	32	1.5E-10
	2.5E+00	3.8E+00	33	7.1E-11
	2.5E+00	3.8E+00	34	3.4E-11
	2.5E+00	3.8E+00	35	1.6E-11
	2.5E+00	3.8E+00	36	7.8E-12
	2.5E+00	3.8E+00	37	3.7E-12
	2.5E+00	3.8E+00	38	1.8E-12
	2.5E+00	3.8E+00	39	8.5E-13
	2.5E+00	3.8E+00	40	4.1E-13
	2.5E+00	3.8E+00	41	2.0E-13
	2.5E+00	3.8E+00	42	9.6E-14
	2.5E+00	3.8E+00	43	4.6E-14
	2.5E+00	3.8E+00	44	2.2E-14
	2.5E+00	3.8E+00	45	1.1E-14
	2.5E+00	3.8E+00	46	5.2E-15
	2.5E+00	3.8E+00	47	2.5E-15
	2.5E+00	3.8E+00	48	1.2E-15
	2.5E+00	3.8E+00	49	5.7E-16
	2.5E+00	3.8E+00	50	2.7E-16
	2.5E+00	3.8E+00	51	1.3E-16
	2.5E+00	3.8E+00	52	6.1E-17
	2.5E+00	3.8E+00	53	2.9E-17
	2.5E+00	3.8E+00	54	1.4E-17
	2.5E+00	3.8E+00	55	6.6E-18
	2.5E+00	3.8E+00	56	3.1E-18
	2.5E+00	3.8E+00	57	1.5E-18
	2.5E+00	3.8E+00	58	7.1E-19
	2.5E+00	3.8E+00	59	3.4E-19
	2.5E+00	3.8E+00	60	1.6E-19
	2.5E+00	3.8E+00	61	7.8E-20
	2.5E+00	3.8E+00	62	3.7E-20
	2.5E+00	3.8E+00	63	1.8E-20
	2.5E+00	3.8E+00	64	8.5E-21
	2.5E+00	3.8E+00	65	4.0E-21
	2.5E+00	3.8E+00	66	1.9E-21
	2.5E+00	3.8E+00	67	9.1E-22
	2.5E+00	3.8E+00	68	4.3E-22
	2.5E+00	3.8E+00	69	2.0E-22
	2.5E+00	3.8E+00	70	9.6E-23

AVERAGE: 1.8E+00

012726

TABLE [illegible]-3

DETERMINING ALLOWABLE CONCENTRATIONS OVER A 70 YEAR PERIOD FOR POTENTIALLY CARCINOGENIC PAHs IN CARVER TERRACE SURFACE SOILS

MAXIMUM W/O 500

COMPOUND	INITIAL CONC.	HALF-LIFE	TIME (YEARS)	CONC. AT TIME t
POT.	[illegible]	[illegible]	0	[illegible]
CARCIN.	[illegible]	[illegible]	1	1.68E+03
PAH	[illegible]	[illegible]	2	1.40E+03
(mg/kg)	[illegible]	[illegible]	3	[illegible]
	[illegible]	[illegible]	4	9.74E+02
	[illegible]	[illegible]	5	[illegible]
	[illegible]	[illegible]	6	6.76E+02
	[illegible]	[illegible]	7	[illegible]
	[illegible]	[illegible]	8	4.70E+02
	[illegible]	[illegible]	9	[illegible]
	[illegible]	[illegible]	10	[illegible]
	[illegible]	[illegible]	11	2.72E+02
	[illegible]	[illegible]	12	2.26E+02
	[illegible]	[illegible]	13	[illegible]
	[illegible]	[illegible]	14	[illegible]
	[illegible]	[illegible]	15	1.31E+02
	[illegible]	[illegible]	16	[illegible]
	[illegible]	[illegible]	17	[illegible]
	[illegible]	[illegible]	18	7.58E+01
	[illegible]	[illegible]	19	[illegible]
	[illegible]	[illegible]	20	[illegible]
	[illegible]	[illegible]	21	[illegible]
	[illegible]	[illegible]	22	[illegible]
	[illegible]	[illegible]	23	[illegible]
	[illegible]	[illegible]	24	[illegible]
	[illegible]	[illegible]	25	[illegible]
	[illegible]	[illegible]	26	1.76E+01
	[illegible]	[illegible]	27	[illegible]
	[illegible]	[illegible]	28	1.22E+01
	[illegible]	[illegible]	29	[illegible]
	[illegible]	[illegible]	30	[illegible]
	[illegible]	[illegible]	31	[illegible]
	[illegible]	[illegible]	32	[illegible]
	[illegible]	[illegible]	33	[illegible]
	[illegible]	[illegible]	34	[illegible]
	[illegible]	[illegible]	35	[illegible]
	[illegible]	[illegible]	36	[illegible]
	[illegible]	[illegible]	37	[illegible]
	[illegible]	[illegible]	38	[illegible]
	[illegible]	[illegible]	39	[illegible]
	[illegible]	[illegible]	40	1.37E+00
	[illegible]	[illegible]	41	1.14E+00
	[illegible]	[illegible]	42	9.53E-01
	[illegible]	[illegible]	43	7.94E-01
	[illegible]	[illegible]	44	6.61E-01
	[illegible]	[illegible]	45	[illegible]
	[illegible]	[illegible]	46	4.59E-01
	[illegible]	[illegible]	47	[illegible]
	[illegible]	[illegible]	48	[illegible]
	[illegible]	[illegible]	49	[illegible]
	[illegible]	[illegible]	50	[illegible]
	[illegible]	[illegible]	51	[illegible]
	[illegible]	[illegible]	52	[illegible]
	[illegible]	[illegible]	53	[illegible]
	[illegible]	[illegible]	54	1.07E-01
	[illegible]	[illegible]	55	[illegible]
	[illegible]	[illegible]	56	[illegible]
	[illegible]	[illegible]	57	6.18E-02
	[illegible]	[illegible]	58	5.15E-02
	[illegible]	[illegible]	59	[illegible]
	[illegible]	[illegible]	60	[illegible]
	[illegible]	[illegible]	61	[illegible]
	[illegible]	[illegible]	62	[illegible]
	[illegible]	[illegible]	63	2.07E-02
	[illegible]	[illegible]	64	[illegible]
	[illegible]	[illegible]	65	1.44E-02
	[illegible]	[illegible]	66	[illegible]
	[illegible]	[illegible]	67	[illegible]
	[illegible]	[illegible]	68	[illegible]
	[illegible]	[illegible]	69	[illegible]
	[illegible]	[illegible]	70	[illegible]

AVERAGE: [illegible]

GEOMETRIC MEAN W/O 500

COMPOUND	INITIAL CONC.	HALF-LIFE	TIME (YEARS)	CONC. AT TIME t
POT.	4.95E+01	3.80E+00	0	4.95E+01
CARCIN.	4.95E+01	3.80E+00	1	4.12E+01
PAH	4.95E+01	3.80E+00	2	3.44E+01
(mg/kg)	4.95E+01	3.80E+00	3	2.86E+01
	4.95E+01	3.80E+00	4	2.39E+01
	4.95E+01	3.80E+00	5	1.99E+01
	4.95E+01	3.80E+00	6	1.66E+01
	4.95E+01	3.80E+00	7	1.38E+01
	4.95E+01	3.80E+00	8	1.15E+01
	4.95E+01	3.80E+00	9	9.59E+00
	4.95E+01	3.80E+00	10	7.99E+00
	4.95E+01	3.80E+00	11	6.66E+00
	4.95E+01	3.80E+00	12	5.55E+00
	4.95E+01	3.80E+00	13	[illegible]
	4.95E+01	3.80E+00	14	3.85E+00
	4.95E+01	3.80E+00	15	3.21E+00
	4.95E+01	3.80E+00	16	2.68E+00
	4.95E+01	3.80E+00	17	2.23E+00
	4.95E+01	3.80E+00	18	1.86E+00
	4.95E+01	3.80E+00	19	1.55E+00
	4.95E+01	3.80E+00	20	1.29E+00
	4.95E+01	3.80E+00	21	1.07E+00
	4.95E+01	3.80E+00	22	8.96E-01
	4.95E+01	3.80E+00	23	7.46E-01
	4.95E+01	3.80E+00	24	[illegible]
	4.95E+01	3.80E+00	25	5.18E-01
	4.95E+01	3.80E+00	26	4.32E-01
	4.95E+01	3.80E+00	27	3.60E-01
	4.95E+01	3.80E+00	28	3.00E-01
	4.95E+01	3.80E+00	29	2.50E-01
	4.95E+01	3.80E+00	30	2.08E-01
	4.95E+01	3.80E+00	31	1.74E-01
	4.95E+01	3.80E+00	32	1.45E-01
	4.95E+01	3.80E+00	33	1.20E-01
	4.95E+01	3.80E+00	34	1.00E-01
	4.95E+01	3.80E+00	35	8.37E-02
	4.95E+01	3.80E+00	36	6.97E-02
	4.95E+01	3.80E+00	37	5.81E-02
	4.95E+01	3.80E+00	38	4.84E-02
	4.95E+01	3.80E+00	39	4.03E-02
	4.95E+01	3.80E+00	40	3.36E-02
	4.95E+01	3.80E+00	41	2.80E-02
	4.95E+01	3.80E+00	42	2.33E-02
	4.95E+01	3.80E+00	43	1.94E-02
	4.95E+01	3.80E+00	44	1.62E-02
	4.95E+01	3.80E+00	45	1.35E-02
	4.95E+01	3.80E+00	46	1.12E-02
	4.95E+01	3.80E+00	47	9.35E-03
	4.95E+01	3.80E+00	48	7.81E-03
	4.95E+01	3.80E+00	49	6.51E-03
	4.95E+01	3.80E+00	50	5.43E-03
	4.95E+01	3.80E+00	51	4.52E-03
	4.95E+01	3.80E+00	52	3.77E-03
	4.95E+01	3.80E+00	53	3.14E-03
	4.95E+01	3.80E+00	54	2.62E-03
	4.95E+01	3.80E+00	55	2.18E-03
	4.95E+01	3.80E+00	56	1.82E-03
	4.95E+01	3.80E+00	57	1.51E-03
	4.95E+01	3.80E+00	58	1.26E-03
	4.95E+01	3.80E+00	59	1.05E-03
	4.95E+01	3.80E+00	60	8.76E-04
	4.95E+01	3.80E+00	61	7.30E-04
	4.95E+01	3.80E+00	62	6.08E-04
	4.95E+01	3.80E+00	63	5.07E-04
	4.95E+01	3.80E+00	64	4.22E-04
	4.95E+01	3.80E+00	65	3.52E-04
	4.95E+01	3.80E+00	66	2.93E-04
	4.95E+01	3.80E+00	67	2.44E-04
	4.95E+01	3.80E+00	68	2.04E-04
	4.95E+01	3.80E+00	69	1.70E-04
	4.95E+01	3.80E+00	70	1.41E-04

AVERAGE: [illegible]

MINIMUM W/O 500

COMPOUND	INITIAL CONC.	HALF-LIFE	TIME (YEARS)	CONC. AT TIME t
POT.	9.60E-01	3.80E+00	0	9.60E-01
CARCIN.	9.60E-01	3.80E+00	1	8.00E-01
PAH	9.60E-01	3.80E+00	2	6.67E-01
(mg/kg)	9.60E-01	3.80E+00	3	5.55E-01
	9.60E-01	3.80E+00	4	4.63E-01
	9.60E-01	3.80E+00	5	3.86E-01
	9.60E-01	3.80E+00	6	3.21E-01
	9.60E-01	3.80E+00	7	2.68E-01
	9.60E-01	3.80E+00	8	2.23E-01
	9.60E-01	3.80E+00	9	1.86E-01
	9.60E-01	3.80E+00	10	1.55E-01
	9.60E-01	3.80E+00	11	1.29E-01
	9.60E-01	3.80E+00	12	1.08E-01
	9.60E-01	3.80E+00	13	8.97E-02
	9.60E-01	3.80E+00	14	7.47E-02
	9.60E-01	3.80E+00	15	6.23E-02
	9.60E-01	3.80E+00	16	5.19E-02
	9.60E-01	3.80E+00	17	[illegible]
	9.60E-01	3.80E+00	18	3.60E-02
	9.60E-01	3.80E+00	19	3.00E-02
	9.60E-01	3.80E+00	20	2.50E-02
	9.60E-01	3.80E+00	21	2.08E-02
	9.60E-01	3.80E+00	22	1.74E-02
	9.60E-01	3.80E+00	23	1.45E-02
	9.60E-01	3.80E+00	24	1.21E-02
	9.60E-01	3.80E+00	25	1.01E-02
	9.60E-01	3.80E+00	26	[illegible]
	9.60E-01	3.80E+00	27	[illegible]
	9.60E-01	3.80E+00	28	[illegible]
	9.60E-01	3.80E+00	29	[illegible]
	9.60E-01	3.80E+00	30	4.04E-03
	9.60E-01	3.80E+00	31	3.37E-03
	9.60E-01	3.80E+00	32	[illegible]
	9.60E-01	3.80E+00	33	2.34E-03
	9.60E-01	3.80E+00	34	1.95E-03
	9.60E-01	3.80E+00	35	1.62E-03
	9.60E-01	3.80E+00	36	[illegible]
	9.60E-01	3.80E+00	37	1.13E-03
	9.60E-01	3.80E+00	38	9.39E-04
	9.60E-01	3.80E+00	39	[illegible]
	9.60E-01	3.80E+00	40	[illegible]
	9.60E-01	3.80E+00	41	[illegible]
	9.60E-01	3.80E+00	42	[illegible]
	9.60E-01	3.80E+00	43	3.77E-04
	9.60E-01	3.80E+00	44	3.14E-04
	9.60E-01	3.80E+00	45	[illegible]
	9.60E-01	3.80E+00	46	2.18E-04
	9.60E-01	3.80E+00	47	[illegible]
	9.60E-01	3.80E+00	48	[illegible]
	9.60E-01	3.80E+00	49	[illegible]
	9.60E-01	3.80E+00	50	[illegible]
	9.60E-01	3.80E+00	51	8.77E-05
	9.60E-01	3.80E+00	52	[illegible]
	9.60E-01	3.80E+00	53	[illegible]
	9.60E-01	3.80E+00	54	[illegible]
	9.60E-01	3.80E+00	55	4.23E-05
	9.60E-01	3.80E+00	56	3.52E-05
	9.60E-01	3.80E+00	57	2.94E-05
	9.60E-01	3.80E+00	58	2.45E-05
	9.60E-01	3.80E+00	59	2.04E-05
	9.60E-01	3.80E+00	60	1.70E-05
	9.60E-01	3.80E+00	61	1.42E-05
	9.60E-01	3.80E+00	62	1.18E-05
	9.60E-01	3.80E+00	63	[illegible]
	9.60E-01	3.80E+00	64	8.19E-06
	9.60E-01	3.80E+00	65	6.83E-06
	9.60E-01	3.80E+00	66	5.69E-06
	9.60E-01	3.80E+00	67	4.74E-06
	9.60E-01	3.80E+00	68	3.95E-06
	9.60E-01	3.80E+00	69	3.29E-06
	9.60E-01	3.80E+00	70	2.74E-06

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AVERAGE: [illegible]

APPENDIX 2-D
ORGANLEPTIC THRESHOLDS FOR TASTE

APPENDIX D
(Biological Treatment Influent Results)

Appendix D

ORGANLEPTIC THRESHOLDS FOR TASTE FOR ORGANIC PCOCS

PCOC	THRESHOLD (ug/liter)	REFERENCE
PAH	20	b
BENZENE	500	c
ETHYL BENZENE	140	c
TOLUENE	250	b
o,m-XYLENE	300	c

a: Organoleptic thresholds have not been derived for all PAH. However, a threshold of 20 ug/liter is reported for acenapthene and has been used here to represent all PAH.

b: Sax, N.I., ed. 1986. Hazardous Chemicals Information Annual No. 1. Van Norstrand Reinhold Information Services, New York, N.Y..

c: Verschueren, K.. 1983. Handbook of Environmental Data on Organic Chemicals, Second Edition. Van Norstrand Reinhold Company, New York, N.Y..

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KOPPERS COMPANY, INC.
Texarkana, TX Treatability Study
Statistical Summary
Influent (All Data)

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
Acenaphthylene	3	293.13	373.99	435.99	1022.26	151.75	4.22	42.40	723.00	930.90
Acenaphthene	3	182.33	109.04	88.57	458.23	162.80	1.77	100.00	306.00	335.07
Fluorene	3	105.57	42.44	.14	210.99	100.35	1.48	71.20	153.00	163.62
Phenanthrene	3	96.67	43.65	11.78	205.11	90.89	1.52	69.20	147.00	153.83
Anthracene	3	13.31	5.64	1.71	38.33	11.49	1.63	6.83	18.10	21.13
Fluoranthene	6	9.06	5.23	3.56	14.55	7.69	1.92	3.41	16.90	17.53
Pyrene	6	8.39	6.03	2.06	14.72	6.84	2.02	3.01	19.50	16.55
Benzo(a)anthracene	6	.48	.25	.22	.75	.42	1.90	.14	.81	.94
Chrysene	6	.45	.23	.21	.69	.40	1.70	.21	.80	.78
Benzo(a)pyrene	6	.19	.13	.05	.32	.15	2.13	.07	.34	.39
Benzo(b)fluoranthene	6	.28	.19	.08	.48	.22	2.18	.08	.52	.60
Benzo(k)fluoranthene	6	.10	.06	.04	.16	.08	2.00	.04	.16	.19
Dibenz(ah)anthracene	3	.31	.06	.18	.45	.31	1.21	.25	.35	.39
Benzo(g,h,i)perylene	5	.28	.17	.07	.49	.23	2.29	.06	.46	.54
Indeno(123-cd)pyrene	4	.20	.08	.06	.33	.17	1.84	.07	.25	.38
TOTAL DETECTABLE PAH	6	364.50	533.99	195.88	924.88	78.90	9.56	8.00	1384.00	1356.95
Carbazole	1	112.00	.00	112.00	112.00	112.00	.00	112.00	112.00	.00
Naphthalene	4	1296.19	2463.00	2622.44	5214.81	138.18	13.75	9.74	4990.00	3754.25

Note: Negative number ( ) for 95% lower CI indicates a 0 parameter level.
Note: "0" indicates entry Below Detectable Level (BDL) of respective parameters.

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012732

KOPPERS COMPANY, INC.
Texarkana, TX Treatability Study
Influent PAH Data

	Rings	Sol.	SAMPLING DATE 30 Oct 87	02 Nov-87	16 Nov 87	23 Nov 87	30 Nov 87
Acenaphthylene	3		723	48.4	<2.00	114	2.00
Acenaphthene	3	3930	306	100	<2.00	141	*
Fluorene	3	1980	153	71.2	<0.200	92.5	*
Phenanthrene	3	1290	147	69.2	0.500	73.8	<0.500
Anthracene	3	73	18.1	6.83	<0.500	12	<0.500
Fluoranthene	4	260	16.9	11.2	3.720	11.8	7.32
Pyrene	4	135	19.5	8.98	3.250	8.77	6.81
Benzo(a)anthracene	4	14	0.32	0.659	0.145	0.811	0.631
Chrysene	4	2	0.207	0.518	0.248	0.8	0.593
Benzo(a)pyrene	5	3.8	0.068	0.082	0.080	0.332	0.338
Benzo(b)fluoranthene	5		0.122	0.15	0.081	0.518	0.477
Benzo(k)fluoranthene	5		0.035	0.06	0.039	0.158	0.144
Dibenz(ah)anthracene	5	2.49	<0.030	<0.030	<0.030	0.347	0.347
Benzo(g,h,i)perylene	6	-	0.050	0.065	0.145	0.457	0.412
Indeno(123 cd)pyrene	6		<0.050	<0.050	0.070	0.249	0.243
TOTAL DETECTABLE PAH			1384	311	8	458	17
Carbazole			100	<2.00	<2.00	112	<1.00
Naphthalene	2	31700	4990	60	<2.00	125	0.74

Notes: Negative number ( ) for 95% Lower CI indicates a 0 parameter level.
Notes: "<" indicates entry below Detectable Level (DDL) of respective parameters.
* Denotes interference.

012732

ROLLINS COMPANY, INC
Texarkana, TX Treatability Study
Influent PAH Data

	SAMPLING DATE 08 Dec 87
Acenaphthylene	2.00
Acenaphthene	<2.00
Fluorene	<0.200
Phenanthrene	0.500
Anthracene	0.500
Fluoranthene	3.410
Pyrene	3.010
Benzo(a)anthracene	0.335
Chrysene	0.322
Benzo(a)pyrene	0.328
Benzo(b)fluoranthene	0.349
Benzo(k)fluoranthene	0.138
Dibenz(ah)anthracene	0.250
Benzo(g,h,i)perylene	0.331
Indeno(123-cd)pyrene	0.218
TOTAL DETECTABLE PAH	9
Carbazole	<2.00
Naphthalene	<2.00

Note: Negative number ( ) for 95% Lower CI indicates a 0 parameter level.
Note: "0" indicates entry Below Detectable Level (BDL) of respective parameters.
* Denotes interference.

012733

012733

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	16-Oct-87	17-Oct-87	18-Oct-87	19-Oct-87	20-Oct-87	21-Oct-87	22-Oct-
pH (units)	6.5	5.8	-	6	-	-	-
Total PO4-Hach	<1	4.5	-	3.3	-	-	-
NH3-N Chemetrics	2.4	2.4	-	<1	-	-	-
TSS	20	12	-	18	-	-	-
VSS	-	7	-	10	-	-	-
FSS	-	5	-	8	-	-	-
Phenols (4-AAP)	-	-	-	-	0.358	-	-
TOC	-	-	-	-	38.1	-	-
BOD(5)-Total	-	-	-	-	31	-	-
COD-Total	-	-	-	-	112	-	-
Oil & Grease	-	-	-	-	<6	-	-
TDS	-	-	-	-	188	-	-
TDFS	-	-	-	-	120	-	-
TDVS	-	-	-	-	68	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	1384.25	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	0	0	-	0	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012734

012735

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	23-Oct-87	24-Oct-87	25-Oct-87	26-Oct-87	27-Oct-87	28-Oct-87	29-Oct-87
pH (units)	-	-	-	6.25	6.15	-	-
Total PO4-Hach	-	5.7	-	5.6	-	-	-
NH3-N Chemetrics	-	4	-	3.2	-	-	-
TSS	-	-	-	240	-	-	-
VSS	-	-	-	228	-	-	-
FSS	-	-	-	12	-	-	-
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	-	-	30.7	-
BOD(5)-Total	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	0	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012735

012736

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	30-Oct-87	31-Oct-87	01-Nov-87	02-Nov-87	03-Nov-87	04-Nov-87	05-Nov-87
pH (units)	-	-	-	6.8	-	-	-
Total PO4-Hach	-	-	-	4.67	-	-	-
NH3-N Chemetrics	-	-	-	4	-	-	-
TSS	-	-	-	16	-	-	-
VSS	-	-	-	14	-	-	-
FSS	-	-	-	2	-	-	-
Phenols (4-AAP)	-	-	-	0.401	-	-	-
TOC	-	-	-	29.7	-	-	-
BOD(5)-Total	-	-	-	14.3	-	-	-
COD-Total	-	-	-	80	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	175	-	-	-
TDFS	-	-	-	119	-	-	-
TDVS	-	-	-	56	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	311.344	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012736

012737

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY

WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	06-Nov-87	07-Nov-87	08-Nov-87	09-Nov-87	10-Nov-87	11-Nov-87	12-Nov-87
pH (units)	-	-	-	6.7	-	-	-
Total PO4-Hach	-	-	-	5	-	-	-
NH3-N Chemetrics	-	-	-	4.8	-	-	-
TSS	-	-	-	17	-	-	-
VSS	-	-	-	9	-	-	-
FSS	-	-	-	8	-	-	-
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	-	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012737

012738

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY

WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	13-Nov-87	14-Nov-87	15-Nov-87	16-Nov-87	17-Nov-87	18-Nov-87	19-Nov-87
pH (units)	-	-	-	7	-	-	-
Total PO4-Hach	-	-	-	4.7	-	-	-
NH3-N Chemetrics	-	-	-	4.8	-	-	-
TSS	-	-	-	45	-	-	-
VSS	-	-	-	21	-	-	-
FSS	-	-	-	24	-	-	-
Phenols (4-AAP)	-	-	-	0.125	-	-	-
TOC	-	-	-	18.1	-	-	-
BOD(5)-Total	-	-	-	5.75	-	-	-
COD-Total	-	-	-	40	-	-	-
Oil & Grease	-	-	-	7.05	-	-	-
TDS	-	-	-	185	-	-	-
TDFS	-	-	-	139	-	-	-
TDVS	-	-	-	46	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	7.778	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012738

012739

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY

WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	20-Nov-87	21-Nov-87	22-Nov-87	23-Nov-87	24-Nov-87	25-Nov-87	26-Nov-87
pH (units)	-	-	-	6.9	-	-	-
Total PO4-Hach	-	-	-	5	-	-	-
NH3-N Chemetrics	-	-	-	4.8	-	-	-
TSS	-	-	-	15	-	-	-
VSS	-	-	-	8	-	-	-
FSS	-	-	-	7	-	-	-
Phenols (4-AAP)	-	-	-	0.354	-	-	-
TOC	-	-	-	21.3	-	-	-
BOD(5)-Total	-	-	-	15.5	-	-	-
COD-Total	-	-	-	65	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	161	-	-	-
TDFS	-	-	-	123	-	-	-
TDVS	-	-	-	38	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	457.542	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012739

012740

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	27-Nov-87	28-Nov-87	29-Nov-87	30-Nov-87	01-Dec-87	02-Dec-87	03-Dec-87
pH (units)	-	-	-	7	-	-	-
Total PO4-Hach	-	-	-	4	-	-	-
NH3-N Chemetrics	-	-	-	4.8	-	-	-
TSS	-	-	-	25	-	-	-
VSS	-	-	-	9	-	-	-
FSS	-	-	-	16	-	-	-
Phenols (4-AAP)	-	-	-	0.213	-	-	-
TOC	-	-	-	21.4	-	-	-
BOD(5)-Total	-	-	-	11	-	-	-
COD-Total	-	-	-	80	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	158	-	-	-
TDFS	-	-	-	112	-	-	-
TDVS	-	-	-	46	-	-	-
PCP (ug/L)	-	-	-	41.2	-	-	-
Total Cyanide	-	-	-	<0.01	-	-	-
Total Det. PAH(ug/L)	-	-	-	17.315	-	-	-
Metals	-	-	-	*	-	-	-
Phenolics (EPA 604)	-	-	-	*	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012741

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE						
	04-Dec-87	05-Dec-87	06-Dec-87	07-Dec-87	08-Dec-87	09-Dec-87	10-Dec-87
pH (units)	-	-	-	7.2	-	-	-
Total PO4-Hach	-	-	-	5.6	-	-	-
NH3-N Chemetrics	-	-	-	6.4	-	-	-
TSS	-	-	-	21	-	-	-
VSS	-	-	-	8	-	-	-
FSS	-	-	-	13	-	-	-
Phenols (4-AAP)	-	-	-	-	0.124	-	-
TOC	-	-	-	-	21.8	-	-
BOD(5)-Total	-	-	-	-	67.5	-	-
COD-Total	-	-	-	-	60	-	-
Oil & Grease	-	-	-	-	<6	-	-
TDS	-	-	-	-	163	-	-
TDFS	-	-	-	-	115	-	-
TDVS	-	-	-	-	48	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	8.591	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-
Phenolics (EPA 624)	-	-	-	-	-	-	-
Vol. Org. (EPA 625)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012741

012742

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
BIOLOGICAL TREATMENT INFLUENT DATA

	SAMPLING DATE	
	11-Dec-87	12-Dec-87
pH (units)	-	-
Total PO4-Hach	-	-
NH3-N Chemetrics	-	-
TSS	-	-
VSS	-	-
FSS	-	-
Phenols (4-AAP)	-	-
TOC	-	-
BOD(5)-Total	-	-
COD-Total	-	-
Oil & Grease	-	-
TDS	-	-
TDFS	-	-
TDVS	-	-
PCP (ug/L)	-	-
Total Cyanide	-	-
Total Det. PAH(ug/L)	-	-
Metals	-	-
Phenolics (EPA 604)	-	-
Phenolics (EPA 624)	-	-
Vol. Org. (EPA 625)	-	-
Phenols-Chemetrics	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012742

SPECTRIX DC # --- 8

INST ID 51EF SAMPLE NUMBER: TEX. INF

ORGANICS ANALYSIS DATA SHEET (PAGE 1)

LABORATORY NAME: SPECTRIX
LAB SAMPLE ID NO.: 871200402
SAMPLE MATRIX: WATER
DATA RELEASE AUTHORIZED BY: MB

CASE NO.: --
QC REPORT NO.: --
CONTRACT NO.: 12-01-87
DATE SAMPLE RECEIVED: 12-01-87

VOLATILES

CONCENTRATION: LOW
DATE ANALYZED: 12/08/87

DATAFILE: SU12004V02
DILUTION FACTOR: 1.00

	CAS #	COMPOUND	UG/L	
C010		CHLOROMETHANE	10	U
C015		BROMOMETHANE	10	U
C020		VINYL CHLORIDE	10	U
C025		CHLOROETHANE	10	U
C030		METHYLENE CHLORIDE	5	..... 4 J
C035		ACETONE	10	U
C040		CARBON DISULFIDE	5	U
C045		1,1-DICHLOROETHENE	5	U
C050		1,1-DICHLOROETHANE	5	U
C055		TRANS-1,2-DICHLOROETHENE	5	U
C060		CHLOROFORM	5	U
C065		1,2-DICHLOROETHANE	5	U
C110		2-BUTANONE	10	U
C115		1,1,1-TRICHLOROETHANE	5	U
C120		CARBON TETRACHLORIDE	5	U
C125		VINYL ACETATE	10	U
C130		BROMODICHLOROMETHANE	5	U
C140		1,2-DICHLOROPROPANE	5	U
C170		CIS-1,3-DICHLOROPROPENE(Z)	5	U
C150		TRICHLOROETHENE	5	U
C155		DIBROMOCHLOROMETHANE	5	U
C160		1,1,2-TRICHLOROETHANE	5	U
C165		BENZENE	5	U
C145		TRANS-1,3-DICHLOROPROPENE(E)	5	U
C175		2-CHLOROETHYLVINYLETHER	10	U
C180		BROMOFORM	5	U
C205		4-METHYL-2-PENTANONE	10	U
C210		2-HEXANONE	10	U
C220		TETRACHLOROETHENE	5	U
C225		1,1,2,2-TETRACHLOROETHANE	5	U
C230		TOLUENE	5	U
C235		CHLOROBENZENE	5	U
C240		ETHYLBENZENE	5	U
C245		STYRENE	5	U
C250		TOTAL XYLENES	5	U

012743

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

012743

NST ID: 4510 SAMPLE NUMBER: TEX INF

ORGANICS ANALYSIS DATA SHEET

LABORATORY NAME: SPECTRIX CASE NO.: ---
LAB SAMPLE ID NO.: 87120040Z QC REPORT NO.: ---
SAMPLE MATRIX: WATER CONTRACT NO.: ---
DATA RELEASE AUTHORIZED BY: [signature] DATE SAMPLE RECEIVED: 12/1/87

SEMIVOLATILES

CONCENTRATION: LOW DATAFILE: 9U12004C02
DATE EXTRACTED: 12/2/87
DATE ANALYZED: 12/14/87 DILUTION FACTOR: 4.0

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND
C315	PHENOL	40 U	
C325	BIS(2-CHLOROETHYL)ETHER	40 U	
C330	2-CHLOROPHENOL	40 U	
C335	1,3-DICHLOROBENZENE	40 U	
C340	1,4-DICHLOROBENZENE	40 U	
C345	BENZYL ALCOHOL	40 U	
C350	1,2-DICHLOROBENZENE	40 U	
C355	2-METHYLPHENOL	40 U	
C360	BIS(2-CHLOROISOPROPYL)ETHER	40 U	
C365	4-METHYLPHENOL	40 U	
C370	N-NITROSODIPROPYLAMINE	40 U	
C375	HEXACHLOROETHANE	40 U	
C410	NITROBENZENE	40 U	
C415	ISOPHORONE	40 U	
C420	2-NITROPHENOL	40 U	
C425	2,4-DIMETHYLPHENOL	40	45
C430	BENZOIC ACID	200 U	
C435	BIS(2-CHLOROETHOXY)METHANE	40 U	
C440	2,4-DICHLOROPHENOL	40 U	
C445	1,2,4-TRICHLOROBENZENE	40 U	
C450	NAPHTHALENE	40 U	
C455	4-CHLOROANILINE	40 U	
C460	HEXACHLOROBUTADIENE	40 U	
C465	P-CHLORO-M-CRESOL	40 U	
C470	2-METHYLNAPHTHALENE	40 U	
C510	HEXACHLOROCYCLOPENTADIENE	40 U	
C515	2,4,6-TRICHLOROPHENOL	40 U	
C520	2,4,5-TRICHLOROPHENOL	200 U	
C525	2-CHLORONAPHTHALENE	40 U	
C530	2-NITROANILINE	200 U	
C535	DIMETHYL PHTHALATE	40 U	
C540	ACENAPHTHYLENE	40 U	
C545	3-NITROANILINE	200 U	
C550	ACENAPHTHENE	40	29 J
C555	2,4-DINITROPHENOL	200 U	
C560	4-NITROPHENOL	200 U	
C565	DIBENZOFURAN	40 U	
C570	2,4-DINITROTOLUENE	40 U	
C575	2,6-DINITROTOLUENE	40 U	

012744

012744

SPECTRIX DC # ---- 9

SAMPLE NUMBER: TEX INF

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET, CONTINUED

DATAFILE: 9U12004C02

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND
C580	DIETHYL PHTHALATE	40 U	
C585	4-CHLOROPHENYL PHENYL ETHER	40 U	
C590	FLUORENE	40 U	
C595	4-NITROANILINE	200 U	
C610	4,6-DINITRO-2-METHYLPHENOL	200 U	
C615	N-NITROSODIPHENYLAMINE	40 U	
C625	4-BROMOPHENYL PHENYL ETHER	40 U	
C630	HEXACHLOROBENZENE	40 U	
C635	PENTACHLOROPHENOL	200	43 J
C640	PHENANTHRENE	40 U	
C645	ANTHRACENE	40 U	
C650	DI-N-BUTYL PHTHALATE	40 U	
C655	FLUORANTHENE	40	10 J
C715	PYRENE	40	9 J
C720	BUTYL BENZYL PHTHALATE	40 U	
C725	3,3'-DICHLOROBENZIDINE	80 U	
C730	BENZO(A)ANTHRACENE	40 U	
C735	BIS(2-ETHYLHEXYL)PHTHALATE	40 U	
C740	CHRYSENE	40 U	
C760	DI-N-OCTYL PHTHALATE	40 U	
C765	BENZO(B)FLUORANTHENE	40 U	
C770	BENZO(K)FLUORANTHENE	40 U	
C775	BENZO(A)PYRENE	40 U	
C780	INDENO(1,2,3-CD)PYRENE	40 U	
C785	DIBENZO(A,H)ANTHRACENE	40 U	
C790	BENZO(GHI)PERYLENE	40 U	

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

012745

012745

ST ID: 515F

SPECTRIX DC # --- 8

SAMPLE NUMBER: TEX. INF.

ORGANICS ANALYSIS DATA SHEET - PAGE 4

BORATORY NAME: SPECTRIX HOUSTON

CASE NO. : --

C REPORT NO : --

ANALYST: RB

DATAFILE: 5U12004V02

B. TENTATIVELY IDENTIFIED COMPOUNDS

S #	VOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT
				UG/L

NO NON-HSL COMPOUNDS FOUND > 10% OF NEAREST INT. STD.

012746

J = ESTIMATED VALUE - A 1:1 RESPONSE FACTOR IS ASSUMED

012746

SAMPLE: TEX INF

ORGANICS ANALYSIS DATA SHEET - PAGE 5

LABORATORY NAME: SPECTRIX CORPORATION

CASE NO.: ---

DC REPORT NO.: ---

ANALYST: CEB

DATAFILE: 9U12004C02

B. TENTATIVELY IDENTIFIED COMPOUNDS

CAS #	SEMIVOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT UG/L
108-48-5	PYRIDINE, 2,6-DIMETHYL-	359	797	46
529-29-1	BENZONITRILE, 2-METHYL-	627	880	28
498-81-7	CYCLOHEXANEMETHANOL, .ALPHA.,.ALPHA.,4-TR	719	752	41
99-93-4	ETHANONE, 1-(4-HYDROXYPHENYL)-	735	768	22
95-15-8	BENZO[B]THIOPHENE	766	893	26
527-60-6	PHENOL, 2,4,6-TRIMETHYL-	783	857	36
1515-95-3	BENZENE, 1-ETHYL-4-METHOXY-	821	806	50
119-65-3	ISOQUINOLINE	836	842	24
83-33-0	1H-INDEN-1-ONE, 2,3-DIHYDRO-	854	799	56
91-63-4	QUINOLINE, 2-METHYL-	883	844	61
	UNKNOWN-DOESN'T MATCH ANY LIBRARY SPECTRA	922		38
	UNKNOWN-DOESN'T MATCH ANY LIBRARY SPECTRA	1186		29
491-30-5	1(2H)-ISOQUINOLINONE	1239	870	210
	UNKNOWN-DOESN'T MATCH ANY LIBRARY SPECTRA	1287		31
	UNKNOWN-DOESN'T MATCH ANY LIBRARY SPECTRA	1333		29

ESTIMATED VALUE - A 1:1 RESPONSE FACTOR IS ASSUMED

012747

012747

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
BIOLOGICAL TREATMENT INFLUENT METALS DATA

Parameter (ug/l)	Influent
Antimony	<60.0
Arsenic	<10.0
Beryllium	<5.00
Cadmium	<5.00
Chromium	<10.0
Copper	<25.0
Lead	<5.00
Mercury	<0.200
Nickel	<40.0
Selenium	<5.00
Silver	<10.0
Thallium	<10.0
Zinc	461

012748

012748

APPENDIX E
(Aeration Tank Treatment Results)

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
STATISTICAL SUMMARY
AERATION TANK MIXED LIQUOR DATA

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
pH (units)	51	7.34	.32	7.25	7.43	7.33	1.05	6.20	7.70	7.76
Temperature (Deg C)	51	21.97	1.34	21.59	22.35	21.93	1.06	18.00	26.00	23.68
Flowrate (mls/min)	45	1.30	.04	1.28	1.31	1.29	1.03	1.18	1.40	1.35
TSS	50	222.96	562.71	60.22	385.70	41.67	5.14	5.00	2940.00	328.06
VSS	50	199.08	515.68	49.94	348.22	31.16	5.70	4.00	2660.00	279.53
FSS	50	23.88	49.25	9.64	38.12	8.85	3.44	.00	280.00	41.96
Dissolved Oxygen	49	9.08	.52	8.93	9.23	9.07	1.06	8.00	11.20	9.71
Caustic Usage (mls)	50	.25	.41	.13	.37	.90	1.29	.00	1.50	1.24
D. O. Uptake	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Microscopic Observ.	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

All values are in mg/L unless otherwise noted.
Note: Flowrate indicates influent flow to unit.

012750

012750

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
STATISTICAL SUMMARY
AERATION TANK EFFLUENT DATA

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
pH (units)	51	7.00	.27	6.92	7.07	6.99	1.04	6.15	7.40	7.34
Phenols-Chemetrics	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Total PO4-Hach	50	3.43	.66	3.24	3.62	3.37	1.21	2.00	5.30	4.28
NH3-N Chemetrics	50	1.00	.03	.99	1.00	1.00	1.03	.80	1.00	1.04
TSS	50	201.87	497.87	57.88	345.86	39.48	4.97	6.00	2400.00	297.89
VSS	50	182.40	459.94	49.38	315.42	31.38	5.29	6.00	2240.00	256.15
FSS	50	19.47	39.66	8.00	30.94	6.96	3.57	.00	180.00	34.55
Phenols (4-AAP)	5	.02	.00	.01	.02	.02	1.15	.01	.02	.02
TOC	8	14.88	3.28	12.14	17.61	14.57	1.25	10.50	20.80	19.20
BOD(5)-Total	5	11.11	9.22	-.34	22.55	7.19	3.42	1.00	24.90	33.88
BOD(5)-Soluble	5	3.78	3.63	-.72	8.28	2.71	2.43	1.20	9.88	8.29
COD-Total	5	48.60	9.61	36.67	60.53	47.80	1.23	35.00	60.00	62.08
COD-Soluble	5	33.00	5.70	25.92	40.08	32.59	1.20	25.00	40.00	40.87
Oil & Grease	5	81.42	166.92	-125.80	288.64	14.95	6.16	6.00	380.00	147.67
TDS	5	177.80	22.48	149.90	205.70	176.72	1.13	155.00	214.00	206.08
TDFS	5	121.80	17.92	99.55	144.05	120.78	1.15	100.00	150.00	144.80
TDVS	5	56.00	6.96	47.35	64.65	55.63	1.14	45.00	64.00	65.58
PCP (ug/L)	1	23.90	.00	23.90	23.90	23.90	.00	23.90	23.90	.00
Total Cyanide	1	.01	.00	.01	.01	.01	.00	.01	.01	.00
Total Det. PAH(ug/L)	5	2.80	1.30	1.18	4.41	2.51	1.73	1.24	3.95	5.01
Metals	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Phenolics (EPA 604)	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

All values are in mg/L unless otherwise noted.

012751

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[redacted]
Texarkana, TX Treatability Study
Statistical Summary
Aeration Tank PAH Data

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% UL VALUE
Acenaphthylene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Acenaphthene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Fluorene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Phenanthrene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Anthracene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Fluoranthene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Pyrene	2	.25	.01	.15	.36	.25	1.05	.25	.26	.27
Benzo(a)anthracene	5	.14	.07	.05	.23	.12	1.90	.05	.22	.27
Chrysene	3	.25	.04	.16	.35	.25	1.17	.21	.28	.30
Benzo(a)pyrene	5	.28	.16	.09	.47	.24	1.93	.11	.45	.55
Benzo(b)fluoranthene	5	.49	.27	.15	.82	.40	2.26	.11	.72	1.10
Benzo(k)fluoranthene	5	.13	.06	.06	.21	.12	1.76	.05	.20	.24
Dibenz(ah)anthracene	5	.46	.23	.18	.74	.41	1.81	.19	.69	.86
Benzo(g,h,i)perylene	5	.60	.25	.28	.91	.55	1.59	.31	.91	.99
Indeno(123 cd)pyrene	5	.45	.20	.20	.70	.40	1.76	.16	.68	.82
TOTAL DETECTABLE PAH	5	2.80	1.30	1.18	4.41	2.51	1.73	1.24	3.95	5.01
Carbazole	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Naphthalene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

Note: Negative number ( ) for 95% Lower CI indicates a 0 parameter level.
Note: "0" indicates entry Below Detectable Level (BDL) of respective parameters.

012752

012752

KOPPERS COMPANY, INC.
Texarkana, TX Treatability Study
Aeration Tank PAH Data

	Rings	Sol.	SAMPLING DATE 23-Nov-87	30-Nov-87	04-Dec 87	08 Dec 87	12 Dec 87
Acenaphthylene	3	-	<2.00	<2.00	<2.00	<2.00	<2.00
Acenaphthene	3	3930	<2.00	<2.00	<2.00	<2.00	<2.00
Fluorene	3	1980	<0.200	<0.200	<0.200	<0.200	<0.200
Phenanthrene	3	1290	<0.500	<0.500	<0.500	<0.500	<0.500
Anthracene	3	73	<0.500	<0.500	<0.500	<0.500	<0.500
Fluoranthene	4	260	<0.200	<0.200	<0.200	<0.200	<0.200
Pyrene	4	135	<0.200	0.246	<0.200	<0.200	0.262
Benzo(a)anthracene	4	14	0.180	0.225	0.068	0.171	0.054
Chrysene	4	2	0.207	0.276	<0.150	0.27	<0.150
Benzo(a)pyrene	5	3.8	0.398	0.453	0.126	0.315	0.112
Benzo(b)fluoranthene	5	-	0.718	0.649	0.297	0.654	0.107
Benzo(k)fluoranthene	5	-	0.159	0.165	0.084	0.202	0.052
Dibenz(ah)anthracene	5	2.49	0.694	0.579	0.25	0.6	0.186
Benzo(g,h,i)perylene	6	-	0.914	0.725	0.368	0.662	0.308
Indeno(123-cd)pyrene	6	-	0.682	0.491	0.352	0.563	0.161
TOTAL DETECTABLE PAH	-	-	3.952	3.809	1.545	3.437	1.242
Carbazole	-	-	<2.00	<2.00	<2.00	<2.00	<2.00
Naphthalene	2	31700	<2.00	<2.00	<2.00	<2.00	<2.00

012753

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE						
	23-Oct-87	24-Oct-87	25-Oct-87	26-Oct-87	27-Oct-87	28-Oct-87	29-Oct-
pH (units)	6.75	6.2	6.45	6.9	6.85	6.9	7
Temperature (Deg C)	20	21	21	21	21	21	21
Flowrate (mls/min)	-	-	-	1.29	1.29	1.29	1.29
TSS	2940	2260	1420	940	760	-	660
VSS	2660	2120	1260	860	740	-	570
FSS	280	140	160	80	20	-	90
Dissolved Oxygen	-	8.8	9.1	9	8.8	-	9
Caustic Usage (mls)	1	0.5	1	0.5	0	0	1
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012754

012754

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY

WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE						
	30-Oct-87	31-Oct-87	01-Nov-87	02-Nov-87	03-Nov-87	04-Nov-87	05-Nov-
pH (units)	6.9	7	6.9	7.3	7	7.2	7.5
Temperature (Deg C)	21	22	21	21	23	23	23
Flowrate (mls/min)	1.29	1.29	1.29	1.29	1.29	1.29	1.29
TSS	410	210	146	110	50	52	68
VSS	350	187	130	96	44	46	55
FSS	60	23	16	14	6	6	13
Dissolved Oxygen	8	8.9	9	9.4	9	8.95	9
Caustic Usage (mls)	0	0	0	0	0	1	1
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012755

012755

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE						
	06-Nov-87	07-Nov-87	08-Nov-87	09-Nov-87	10-Nov-87	11-Nov-87	12-Nov-8
pH (units)	7.3	7.4	7.4	7.3	7.3	7.4	7.4
Temperature (Deg C)	21	21.5	22	24	23	18	19
Flowrate (mls/min)	1.24	1.28	1.29	1.29	1.29	1.29	1.29
TSS	75	202	91	49	21	24	12
VSS	61	170	72	43	16	18	9
FSS	14	32	19	6	5	6	3
Dissolved Oxygen	9.1	8.9	9	9	9.3	9.5	10
Caustic Usage (mls)	0.5	0.5	1.5	0	0	0	0
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	-	-	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012756

012756

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE						
	13-Nov-87	14-Nov-87	15-Nov-87	16-Nov-87	17-Nov-87	13-Nov-87	19-Nov-
pH (units)	7.4	7.5	7.4	7.4	7.5	7.6	7.5
Temperature (Deg C)	21	25	25	26	24	23	21
Flowrate (mls/min)	1.29	1.3	1.28	1.28	1.29	1.29	1.29
TSS	14	51	69	15	29	9	8
VSS	11	41	51	10	24	9	5
FSS	3	10	18	5	5	0	3
Dissolved Oxygen	9.6	9	9.2	8.9	9	8.9	8.6
Caustic Usage (mls)	0	0	1	-	0	0	0
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012757

012757

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY

WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE						
	20-Nov-87	21-Nov-87	22-Nov-87	23-Nov-87	24-Nov-87	25-Nov-87	26-Nov-
pH (units)	7.5	7.6	7.5	7.7	7.7	7.55	7.5
Temperature (Deg C)	22	22	22	22	22	22	23
Flowrate (mls/min)	1.29	1.4	1.3	1.29	-	1.29	1.34
TSS	18	24	19	21	57	54	40
VSS	11	16	12	15	34	33	26
FSS	7	8	7	6	23	21	14
Dissolved Oxygen	10.8	9.5	9.3	11.2	9.4	9.2	8.7
Caustic Usage (mls)	0	1	0	0	0	0	0
D. O. Uptake	-	-	-	-	-	*	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012758

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE						
	27-Nov-87	28-Nov-87	29-Nov-87	30-Nov-87	01-Dec-87	02-Dec-87	03-Dec-
pH (units)	7.6	7.6	7.55	7.6	7.6	7.5	7.6
Temperature (Deg C)	22	22	22	22	22	22	22
Flowrate (mls/min)	1.38	1.32	1.29	1.29	1.27	1.27	1.22
TSS	45	28	30	9	9	8	11
VSS	35	17	18	6	7	4	7
FSS	10	11	12	3	2	4	4
Dissolved Oxygen	8.9	8.75	9	8.4	8.9	8.7	9.2
Caustic Usage (mls)	0	0	0.5	0.5	0	0	0
D. O. Uptake	-	-	-	-	*	-	-
Microscopic Observ.	*	*	*	-	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012759

012759

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE						
	04-Dec-87	05-Dec-87	06-Dec-87	07-Dec-87	08-Dec-87	09-Dec-87	10-Dec-
pH (units)	7.6	7.4	7.4	7.5	7.4	7.6	7.6
Temperature (Deg C)	22	22	22	22	22	22	22
Flowrate (mls/min)	-	1.18	-	1.38	1.39	1.4	1.29
TSS	11	9	11	7	8	9	13
VSS	8	5	7	5	6	7	9
FSS	3	4	4	2	2	2	4
Dissolved Oxygen	9	9.15	9.2	9	9	8.5	8.85
Caustic Usage (mls)	0	0	0.5	0	0.5	0	0
D. O. Uptake	-	*	-	-	*	-	-
Microscopic Observ.	*	*	*	*	*	*	-

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012760

012760

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY

WEEKLY DATA SHEETS
AERATION TANK MIXED LIQUOR DATA

	SAMPLING DATE	
	11-Dec-87	12-Dec-87
pH (units)	7.4	7.55
Temperature (Deg C)	22	22
Flowrate (mls/min)	1.29	1.22
TSS	7	5
VSS	4	4
FSS	3	1
Dissolved Oxygen	8.7	8.6
Caustic Usage (mls)	0	0
D. O. Uptake	-	-
Microscopic Observ.	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012761

012761

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE						
	23-Oct-87	24-Oct-87	25-Oct-87	26-Oct-87	27-Oct-87	28-Oct-87	29-Oct-
pH (units)	6.8	6.15	6.2	6.6	6.6	6.7	7
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	-	4.3	4.3	4.3	4.3	4	4.3
NH3-N Chemetrics	-	<1	<1	<1	<1	<1	<1
TSS	120	2400	2040	1600	900	-	630
VSS	108	2240	1860	1440	880	-	560
FSS	12	160	180	160	20	-	70
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	-	-	11.7	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012762

012762

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE						
	30-Oct-87	31-Oct-87	01-Nov-87	02-Nov-87	03-Nov-87	04-Nov-87	05-Nov-
pH (units)	7	6.7	7.1	7.1	6.9	6.7	7
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	3.7	3.5	3.8	3.5	3.2	3	3.2
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	420	370	196	118	82	54	70
VSS	380	335	180	102	56	48	60
FSS	40	35	16	16	6	6	10
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	17.1	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012763

012763

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE						
	06-Nov-87	07-Nov-87	08-Nov-87	09-Nov-87	10-Nov-87	11-Nov-87	12-Nov-
pH (units)	6.9	6.8	6.8	6.9	6.9	6.95	7
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	3	2.1	3.3	3.2	3.2	3.1	3
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	94.5	240	138	64	30	21	19
VSS	77	204	113	53	24	16	15
FSS	17.5	36	25	11	6	5	4
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	-	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012764

012764

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE						
	13-Nov-87	14-Nov-87	15-Nov-87	16-Nov-87	17-Nov-87	18-Nov-87	19-Nov-8
pH (units)	7.2	7	6.9	7.1	7	7.3	7.15
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	3.2	3	3	2.9	3.1	4.3	3.6
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	14	32	47	18	23	6	10
VSS	11	24	37	13	21	6	7
FSS	3	8	10	5	2	0	3
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	10.5	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012765

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE						
	20-Nov-87	21-Nov-87	22-Nov-87	23-Nov-87	24-Nov-87	25-Nov-87	26-Nov-
pH (units)	7.1	7.4	7.2	7.4	7.4	7.2	7.25
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	3.2	3	3.2	3	3.2	3	3.3
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	16	19	17	10	37	31	28
VSS	10	12	10	7	22	18	19
FSS	6	7	7	3	15	13	9
Phenols (4-AAP)	-	-	-	0.018	-	-	-
TOC	-	-	-	12.7	-	-	-
BOD(5)-Total	-	-	-	8.7	-	-	-
BOD(5)-Soluble	-	-	-	2.3	-	-	-
COD-Total	-	-	-	48	-	-	-
COD-Soluble	-	-	-	40	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	164	-	-	-
TDFS	-	-	-	119	-	-	-
TDVS	-	-	-	45	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	3.952	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012766

012766

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE						
	27-Nov-87	28-Nov-87	29-Nov-87	30-Nov-87	01-Dec-87	02-Dec-87	03-Dec-
pH (units)	7.1	7.25	7.2	7.1	7.4	7.2	7
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	2	2.6	3	3.3	3	3	3
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	32	14	21	9	14	9	12
VSS	22	9	15	7	10	8	11
FSS	10	5	6	2	4	1	1
Phenols (4-AAP)	-	-	-	0.019	-	-	-
TOC	-	-	-	15	-	-	-
BOD(5)-Total	-	-	-	15	-	-	-
BOD(5)-Soluble	-	-	-	4.25	-	-	-
COD-Total	-	-	-	60	-	-	-
COD-Soluble	-	-	-	30	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	178	-	-	-
TDFS	-	-	-	120	-	-	-
TDVS	-	-	-	58	-	-	-
PCP (ug/L)	-	-	-	23.9	-	-	-
Total Cyanide	-	-	-	<0.01	-	-	-
Total Det. PAH(ug/L)	-	-	-	3.809	-	-	-
Metals	-	-	-	*	-	-	-
Phenolics (EPA 604)	-	-	-	*	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012767

012767

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE						
	04-Dec-87	05-Dec-87	06-Dec-87	07-Dec-87	08-Dec-87	09-Dec-87	10-Dec-
pH (units)	7.3	6.6	6.9	7.15	7.15	7.15	7
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	3.2	3	3	4.3	4.6	4.6	4.1
NH3-N Chemetrics	<1	<1	<1	0.8	<1	<1	<1
TSS	9	16	13	7	10	11	8
VSS	7	11	10	6	9	9	6
FSS	2	5	3	1	1	2	2
Phenols (4-AAP)	0.017	-	-	-	0.014	-	-
TOC	15.4	-	-	-	20.8	-	-
BOD(5)-Total	<1	-	-	-	24.9	-	-
BOD(5)-Soluble	1.2	-	-	-	9.88	-	-
COD-Total	45	-	-	-	55	-	-
COD-Soluble	25	-	-	-	35	-	-
Oil & Grease	380	-	-	-	<6	-	-
TDS	155	-	-	-	214	-	-
TDFS	100	-	-	-	150	-	-
TDVS	55	-	-	-	64	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	1.545	-	-	-	3.437	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values.are in mg/L unless otherwise noted.
* See data in appendix.

012768

012768

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
AERATION TANK EFFLUENT DATA

	SAMPLING DATE	
	11-Dec-87	12-Dec-87
pH (units)	6.9	7
Phenols-Chemetrics	-	-
Total PO4-Hach	4.2	5.3
NH3-N Chemetrics	<1	<1
TSS	8	6
VSS	6	6
FSS	2	0
Phenols (4-AAP)	-	0.014
TOC	-	15.8
BOD(5)-Total	-	5.93
BOD(5)-Soluble	-	1.27
COD-Total	-	35
COD-Soluble	-	35
Oil & Grease	-	9.1
TDS	-	178
TDFS	-	120
TDVS	-	58
PCP (ug/L)	-	-
Total Cyanide	-	-
Total Det. PAH(ug/L)	-	1.242
Metals	-	-
Phenolics (EPA 604)	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012769

SPECTRIX DC # --- 8

INST ID 51E= SAMPLE NUMBER: AERATION TANK EFF.

ORGANICS ANALYSIS DATA SHEET (PAGE 1)

LABORATORY NAME: SPECTRIX
LAB SAMPLE ID NO.: 871200404
SAMPLE MATRIX: WATER
DATA RELEASE AUTHORIZED BY: MB

CASE NO.: --
QC REPORT NO.: --
CONTRACT NO.: 12-01-87
DATE SAMPLE RECEIVED: 12-01-87

VOLATILES

CONCENTRATION: LOW
DATE ANALYZED: 12/08/87

DATAFILE: 5U12004V04A
DILUTION FACTOR: 1.00

CAS #	COMPOUND	UG/L
C010	CHLOROMETHANE	10 U
C015	BROMOMETHANE	10 U
C020	VINYL CHLORIDE	10 U
C025	CHLOROETHANE	10 U
C030	METHYLENE CHLORIDE	5 10
C035	ACETONE	10 220
C040	CARBON DISULFIDE	5 U
C045	1,1-DICHLOROETHENE	5 U
C050	1,1-DICHLOROETHANE	5 U
C055	TRANS-1,2-DICHLOROETHENE	5 U
C060	CHLOROFORM	5 U
C065	1,2-DICHLOROETHANE	5 U
C110	2-BUTANONE	10 U
C115	1,1,1-TRICHLOROETHANE	5 U
C120	CARBON TETRACHLORIDE	5 U
C125	VINYL ACETATE	10 U
C130	BROMODICHLOROMETHANE	5 U
C140	1,2-DICHLOROPROPANE	5 U
C170	CIS-1,3-DICHLOROPROPENE(Z)	5 U
C150	TRICHLOROETHENE	5 U
C155	DIBROMOCHLOROMETHANE	5 U
C160	1,1,2-TRICHLOROETHANE	5 U
C165	BENZENE	5 U
C145	TRANS-1,3-DICHLOROPROPENE(E)	5 U
C175	2-CHLOROETHYLVINYLETHER	10 U
C180	BROMOFORM	5 U
C205	4-METHYL-2-PENTANONE	10 U
C210	2-HEXANONE	10 U
C220	TETRACHLOROETHENE	5 U
C225	1,1,2,2-TETRACHLOROETHANE	5 U
C230	TOLUENE	5 U
C235	CHLOROBENZENE	5 U
C240	ETHYLBENZENE	5 U
C245	STYRENE	5 U
C250	TOTAL XYLENES	5 U

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

012770

012770

NST ID: 4510 SAMPLE NUMBER: AERATION TANK EFF

ORGANICS ANALYSIS DATA SHEET

LABORATORY NAME: SPECTRIX CASE NO.: ---
AB SAMPLE ID NO.: 871200404 QC REPORT NO.: ---
AMPLE MATRIX: WATER CONTRACT NO.: ---
ATA RELEASE AUTHORIZED BY: [signature] DATE SAMPLE RECEIVED: 12/1/87

SEMIVOLATILES

CONCENTRATION: LOW DATAFILE: 9U12004C04
ATE EXTRACTED: 12/2/87
ATE ANALYZED: 12/14/87 DILUTION FACTOR: 4.0

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND
C315	PHENOL	40 U	
C325	BIS(2-CHLOROETHYL)ETHER	40 U	
C330	2-CHLOROPHENOL	40 U	
C335	1,3-DICHLOROBENZENE	40 U	
C340	1,4-DICHLOROBENZENE	40 U	
C345	BENZYL ALCOHOL	40 U	
C350	1,2-DICHLOROBENZENE	40 U	
C355	2-METHYLPHENOL	40 U	
C360	BIS(2-CHLOROISOPROPYL)ETHER	40 U	
C365	4-METHYLPHENOL	40 U	
C370	N-NITROSODIPROPYLAMINE	40 U	
C375	HEXACHLOROETHANE	40 U	
C410	NITROBENZENE	40 U	
C415	ISOPHORONE	40 U	
C420	2-NITROPHENOL	40 U	
C425	2,4-DIMETHYLPHENOL	40 U	
C430	BENZOIC ACID	200 U	
C435	BIS(2-CHLOROETHOXY)METHANE	40 U	
C440	2,4-DICHLOROPHENOL	40 U	
C445	1,2,4-TRICHLOROBENZENE	40 U	
C450	NAPHTHALENE	40 U	
C455	4-CHLOROANILINE	40 U	
C460	HEXACHLOROBUTADIENE	40 U	
C465	P-CHLORO-M-CRESOL	40 U	
C470	2-METHYLNAPHTHALENE	40 U	
C510	HEXACHLOROCYCLOPENTADIENE	40 U	
C515	2,4,6-TRICHLOROPHENOL	40 U	
C520	2,4,5-TRICHLOROPHENOL	200 U	
C525	2-CHLORONAPHTHALENE	40 U	
C530	2-NITROANILINE	200 U	
C535	DIMETHYL PHTHALATE	40 U	
C540	ACENAPHTHYLENE	40 U	
C545	3-NITROANILINE	200 U	
C550	ACENAPHTHENE	40 U	
C555	2,4-DINITROPHENOL	200 U	
C560	4-NITROPHENOL	200 U	
C565	DIBENZOFURAN	40 U	
C570	2,4-DINITROTOLUENE	40 U	
C575	2,6-DINITROTOLUENE	40 U	

012771

SPECTRIX DC # ---- 8

SAMPLE NUMBER: AERATION TANK

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET, CONTINUED

DATAFILE: 9012004C04

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND (MICROGRAMS / LITER)
C580	DIETHYL PHTHALATE	40 U	
C585	4-CHLOROPHENYL PHENYL ETHER	40 U	
C590	FLUORENE	40 U	
C595	4-NITROANILINE	200 U	
C610	4,6-DINITRO-2-METHYLPHENOL	200 U	
C615	N-NITROSODIPHENYLAMINE	40 U	
C625	4-BROMOPHENYL PHENYL ETHER	40 U	
C630	HEXACHLOROBENZENE	40 U	
C635	PENTACHLOROPHENOL	200 U	
C640	PHENANTHRENE	40 U	
C645	ANTHRACENE	40 U	
C650	DI-N-BUTYL PHTHALATE	40 U	
C655	FLUORANTHENE	40 U	
C715	PYRENE	40 U	
C720	BUTYL BENZYL PHTHALATE	40 U	
C725	3,3'-DICHLOROBENZIDINE	80 U	
C730	BENZO(A)ANTHRACENE	40 U	
C735	BIS(2-ETHYLHEXYL)PHTHALATE	40 U	
C740	CHRYSENE	40 U	
C760	DI-N-OCTYL PHTHALATE	40 U	
C765	BENZO(B)FLUORANTHENE	40 U	
C770	BENZO(K)FLUORANTHENE	40 U	
C775	BENZO(A)PYRENE	40 U	
C780	INDENO(1,2,3-CD)PYRENE	40 U	
C785	DIBENZO(A,H)ANTHRACENE	40 U	
C790	BENZO(GHI)PERYLENE	40 U	

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

012772

012772

LIMST ID 5:EF

SPECTRIX DC # --- 8

SAMPLE NUMBER: AERATION TANK EFF.

ORGANICS ANALYSIS DATA SHEET - PAGE 4

LABORATORY NAME. SPECTRIX HOUSTON CASE NO. : --

QC REPORT NO : -- ANALYST: SC DATAFILE: 5U12004V04A

B. TENTATIVELY IDENTIFIED COMPOUNDS

CAS #	VOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT
				UG/L

NO NON-HSL COMPOUNDS FOUND > 10% OF NEAREST INT. STD.

J = ESTIMATED VALUE - A 1:1 RESPONSE FACTOR IS ASSUMED

012773

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SAMPLE: AERATION TANK EFF

ORGANICS ANALYSIS DATA SHEET - PAGE 5

LABORATORY NAME: SPECTRIX CORPORATION CASE NO.: ---

DC REPORT NO.: --- ANALYST: CEB DATAFILE: 9U12004C04

B. TENTATIVELY IDENTIFIED COMPOUNDS

CAS #	SEMIVOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT UG/L

NO NON-HSL COMPOUNDS FOUND > 10% OF NEAREST INT. STD.

ESTIMATED VALUE - A 1:1 RESPONSE FACTOR IS ASSUMED

012774

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
AERATION TANK METALS DATA

Parameter (ug/l)	Aeration Tank
Antimony	<60.0
Arsenic	<10.0
Beryllium	<5.00
Cadmium	<5.00
Chromium	<10.0
Copper	<25.0
Lead	<5.00
Mercury	0.303
Nickel	<40.0
Selenium	<5.00
Silver	<10.0
Thallium	<10.0
Zinc	246

012775

012775

APPENDIX 2-E
HISTORIC USE DATA

APPENDIX 2-E

HISTORIC USE AREA SURFACE SOIL DATA

Four historic use areas identified for the Koppers Texarkana Site are: (1) process area, (2) drip track area, (3) treated lumber storage areas, and (4) untreated lumber storage areas. Figure E-1 presents the locations of the four above-mentioned areas within the site boundaries. It is estimated that the process area covers approximately 4.1 acres, the drip track area covers approximately 4.3 acres, the treated lumber areas cover approximately 9.4 acres, and the untreated lumber areas cover approximately 44.2 acres.

Table E-1 presents a listing of the number of surface soils analyzed for individual potential contaminants of concern (PCOCs) per historic use area. Table E-2 lists the number of surface soil samples analyzed per acre for each historic use area. This table was developed by dividing the number of samples (Table 1) by the approximate size of each historic use area. Table E-2 indicates that an average of 2.1 surface soil samples per acre were analyzed within the drip track area, 0.40 samples per acre were analyzed within the treated lumber storage areas, 0.43 samples per acre were analyzed within the untreated lumber storage areas.

TABLE E-1

NUMBER OF SURFACE SOIL SAMPLES ANALYZED WITHIN EACH HISTORIC USE AREA

	Number of Surface Soil Samples Analyzed				
PCOCs	Process Area	Drip Track Area	Treated Lumber Areas	Untreated Lumber Areas	Totals
Arsenic	9	5	3	18	35
Chromium	9	5	3	18	35
Copper	9	5	3	18	35
Lead	7	2	2	12	23
Mercury	7	2	2	12	23
Total PAH	9	8	6	25	48
Potentially Carcinogenic PAH	9	8	6	25	48
Pentachlorophenol	9	8	6	25	48
Zinc	9	5	3	19	36
Approximate Size of Each Area (Acres	4.1	4.3	9.4	44.2	62.0

TABLE E-2

NUMBER OF SURFACE SAMPLES ANALYZED PER ACRE FOR EACH HISTORIC USE AREA

PCOCs	Number of Surface Soil Samples Analyzed/Acre			
	Process Area	Drip Track Area	Treated Lumber Areas	Untreated Lumber Areas
Arsenic	2.19	1.16	0.32	0.41
Chromium	2.19	1.16	0.32	0.41
Copper	2.19	1.16	0.32	0.41
Lead	1.71	0.47	0.21	0.27
Mercury	1.71	0.47	0.21	0.27
Total PAH	2.19	1.86	0.64	0.57
Potentially Carcinogenic PAH	2.19	1.86	0.64	0.57
Pentachlorophenol	2.19	1.86	0.64	0.57
Zinc	2.19	1.16	0.32	0.43

012779

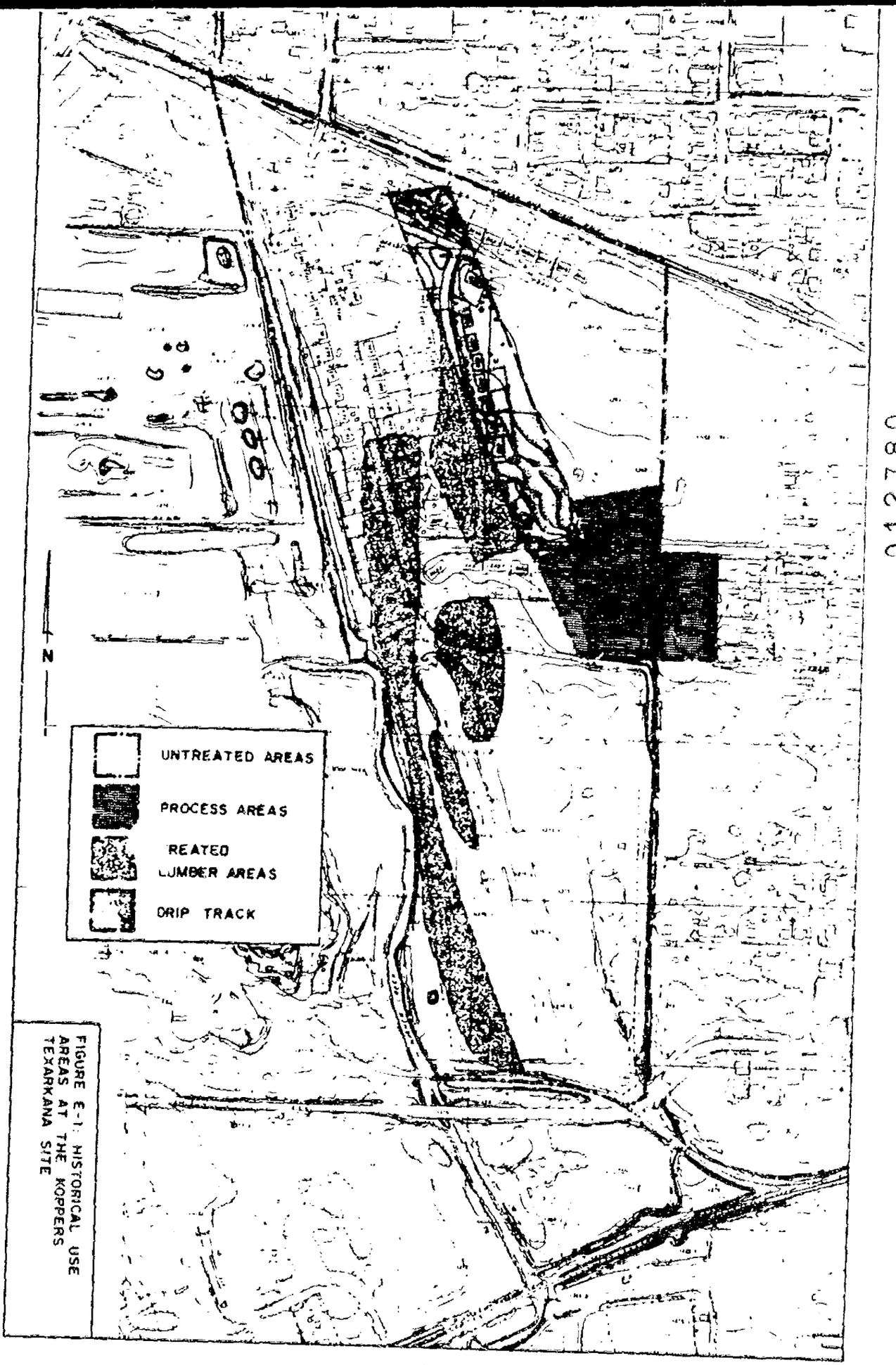

FIGURE E-1: HISTORICAL USE AREAS AT THE KOPPERS TEXARKANA SITE

012780

012780

APPENDIX F
(Fixed Film Treatment Results)

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
STATISTICAL SUMMARY
FIXED FILM MIXED LIQUOR DATA

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
pH (units)	50	7.26	.34	7.16	7.35	7.25	1.05	6.25	7.70	7.70
Temperature (Deg C)	50	21.64	1.17	21.30	21.98	21.61	1.05	21.00	25.00	23.06
Flowrate (mls/min)	43	1.28	.07	1.26	1.30	1.28	1.06	1.00	1.45	1.38
TSS	49	550.45	972.32	266.39	834.50	99.03	7.50	3.00	3770.00	1254.73
VSS	49	500.04	893.63	238.97	761.11	84.21	7.93	2.00	3390.00	1143.36
FSS	49	50.41	84.19	25.81	75.00	13.26	5.59	1.00	380.00	115.89
Dissolved Oxygen	49	9.17	.41	9.05	9.29	9.16	1.04	8.50	10.80	9.68
Caustic Usage (mls)	50	.44	1.04	.14	.74	.89	1.54	.00	7.00	1.53
D. O. Uptake	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Microscopic Observ.	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

All values are in mg/L unless otherwise noted.
Note: Flowrate indicates influent flow to unit.

012782

012782

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
STATISTICAL SUMMARY
FIXED FILM EFFLUENT DATA

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
pH (units)	50	6.99	.31	6.90	7.08	6.99	1.05	6.15	7.60	7.40
Phenols-Chemetrics	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Total PO4-Hach	49	3.88	.79	3.65	4.11	3.81	1.22	3.00	5.70	4.90
NH3-N Chemetrics	49	1.36	.95	1.08	1.64	1.19	1.56	1.00	4.80	2.09
TSS	49	553.56	1009.85	258.54	848.58	96.05	7.82	5.00	4800.00	1282.69
VSS	49	500.88	921.74	231.60	770.16	82.40	8.09	4.00	4310.00	1147.32
FSS	49	52.68	92.13	25.77	79.59	12.63	6.03	.00	490.00	121.53
Phenols (4-AAP)	5	.02	.00	.01	.02	.02	1.23	.01	.02	.02
TOC	8	12.53	2.61	10.35	14.72	12.23	1.29	6.77	15.50	16.85
BOD(5)-Total	5	12.63	8.65	1.89	23.37	8.66	3.28	1.20	22.50	38.76
BOD(5)-Soluble	5	2.87	2.23	.10	5.64	2.27	2.16	1.00	6.50	5.98
COD-Total	5	49.60	14.77	31.26	67.94	48.12	1.30	40.00	75.00	67.13
COD-Soluble	5	27.00	9.75	14.90	39.10	24.84	1.67	10.00	35.00	47.40
Oil & Grease	5	92.65	190.28	-143.58	328.87	16.43	6.35	6.00	433.00	168.90
TDS	5	186.40	28.32	151.24	221.56	184.64	1.17	146.00	226.00	224.57
TDFS	5	125.80	26.20	93.27	158.33	123.81	1.22	100.00	169.00	158.46
TDVS	5	60.60	10.62	47.41	73.79	59.83	1.20	46.00	72.00	75.17
PCP (ug/L)	1	17.80	.00	17.80	17.80	17.80	.00	17.80	17.80	.00
Total Cyanide	1	.01	.00	.01	.01	.01	.00	.01	.01	.00
Total Det. PAH(ug/L)	5	50.17	87.12	-57.98	158.33	17.53	4.51	4.11	205.59	117.04
Metals	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Phenolics (EPA 604)	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

All values are in mg/L unless otherwise noted.

012783

KOPPERS COMPANY, INC.
Texarkana, TX Treatability Study
Statistical Summary
Fixed Film PAH Data

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
Acenaphthylene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Acenaphthene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Fluorene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Phenanthrene	1	.94	.00	.94	.94	.94	.00	.94	.94	.00
Anthracene	1	.64	.00	.64	.64	.64	.00	.64	.64	.00
Fluoranthene	3	1.34	1.67	2.81	5.49	.73	3.97	.22	3.26	4 13
Pyrene	5	2.39	4 21	2.94	7.52	.72	4 60	.26	9.82	4.89
Benzo(a)anthracene	5	1.59	2.66	1.71	4.88	.58	4.50	.15	6.31	3.86
Chrysene	5	1.76	2.88	1.82	5.34	.71	4.11	.18	6.90	4.29
Benzo(a)pyrene	5	5.21	9.24	-6.26	16.68	1.72	4.69	.40	21.70	12.03
Benzo(b)fluoranthene	5	8.86	15.37	10.23	27.95	3.14	4.46	.76	36.30	20.62
Benzo(k)fluoranthene	5	2.11	3.54	2.28	6.50	.82	4.21	.18	8.42	5.02
Dibenz(ah)anthracene	5	7.72	13.06	-8.50	23.94	2.85	4.35	.78	31.00	18.19
Benzo(g,h,i)perylene	5	11.34	19.88	13.34	36.02	3.82	4.63	.94	46.80	26.35
Indeno(123 cd)pyrene	5	8.17	14.20	9.46	25.79	2.79	4.71	.53	33.50	19.67
TOTAL DETECTABLE PAH	5	50.18	87.11	57.98	158.33	17.54	4.51	4.12	205.59	117.03
Carbazole	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Naphthalene	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

Note: Negative number ( ) for 95% Lower CI indicates a 0 parameter level.
Note: "0" indicates entry Below Detectable Level (BDL) of respective parameters.

012784

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KOPPERS COMPANY, INC.
Texarkana, TX Treatability Study
Fixed Film PAH Data

	Rings	Sol	SAMPLING DATE 23 Nov 87	30 Nov 87	04 Dec 87	08 Dec 87	12 Dec 87
Acenaphthylene	3	-	<2.00	<2.00	<2.00	<2.00	<2.00
Acenaphthene	3	3930	<2.00	<2.00	<2.00	<2.00	<2.00
Fluorene	3	1980	<0.200	<0.200	<0.200	<0.200	<0.200
Phenanthrene	3	1290	0.938	<0.500	<0.500	<0.500	<0.500
Anthracene	3	73	0.642	<0.500	<0.500	<0.500	<0.500
Fluoranthene	4	260	3.26	0.543	0.217	<0.200	<0.200
Pyrene	4	135	9.82	0.772	0.290	0.326	0.262
Benzo(a)anthracene	4	14	6.31	0.878	0.190	0.415	0.150
Chrysene	4	2	6.90	0.897	0.286	0.552	0.180
Benzo(a)pyrene	5	3.8	21.70	2.04	0.683	1.23	0.400
Benzo(b)fluoranthene	5	-	36.30	3.34	1.39	2.56	0.705
Benzo(k)fluoranthene	5	-	8.42	0.788	0.413	0.766	0.176
Dibenz(ah)anthracene	5	2.49	31.00	3.70	1.00	2.13	0.776
Benzo(g,h,i)perylene	6	-	46.80	4.85	1.43	2.67	0.940
Indeno(123-cd)pyrene	6	-	33.50	3.18	1.28	2.35	0.526
TOTAL DETECTABLE PAH	-	-	205.59	20.99	7.18	13.00	4.12
Carbazole	-	-	<2.00	<2.00	<2.00	<2.00	<2.00
Naphthalene	2	31700	<2.00	<2.00	<2.00	<2.00	<2.00

012785

012785

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE						
	23-Oct-87	24-Oct-87	25-Oct-87	26-Oct-87	27-Oct-87	28-Oct-87	29-Oct-
pH (units)	6.6	6.25	6.5	6.85	6.6	6.9	6.6
Temperature (Deg C)	21	21.5	21	21	21	21	21
Flowrate (mls/min)	-	-	-	-	-	1.29	1.29
TSS	3420	2680	1780	1240	900	-	290
VSS	3160	2560	1640	1160	800	-	270
FSS	260	120	140	80	100	-	20
Dissolved Oxygen	-	8.9	9.3	8.8	8.9	8.95	9
Caustic Usage (mls)	1	1	1	0	0	1	0
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012786

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE						
	30-Oct-87	31-Oct-87	01-Nov-87	02-Nov-87	03-Nov-87	04-Nov-87	05-Nov-8
pH (units)	7.4	7.4	7.5	7	7.4	7.6	7.7
Temperature (Deg C)	21	21	21	21	22	23	23
Flowrate (mls/min)	1.29	1.29	1.29	1.29	1.29	1.22	1.29
TSS	170	78	38	20	22	24	48
VSS	150	72	30	16	18	22	36
FSS	20	6	8	4	4	2	10
Dissolved Oxygen	9	9.1	9	9.6	9.3	9.1	9.1
Caustic Usage (mls)	1	0	0	0	0	0.5	0.5
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012787

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE						
	06-Nov-87	07-Nov-87	08-Nov-87	09-Nov-87	10-Nov-87	11-Nov-87	12-Nov-
pH (units)	7.6	-	6.95	7	7.1	7	6.9
Temperature (Deg C)	21	-	21	23	22	21	21
Flowrate (mls/min)	1.29	-	1.29	1.29	1.29	1.29	1.29
TSS	26	-	3770	3280	1840	1600	1280
VSS	20	-	3390	3040	1680	1440	1030
FSS	6	-	380	240	160	160	250
Dissolved Oxygen	9.3	-	8.6	8.5	8.9	8.8	9.4
Caustic Usage (mls)	0	-	7	2	1	0	1
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	-	-	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012788

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE						
	13-Nov-87	14-Nov-87	15-Nov-87	16-Nov-87	17-Nov-87	18-Nov-87	19-Nov-
pH (units)	7.1	7.2	7.1	7.1	7.2	7.45	7.2
Temperature (Deg C)	21	25	25	25	24	24	21.5
Flowrate (mls/min)	1.29	1.3	1.29	1.3	1.3	1.29	1.29
TSS	1500	610	430	208	298	246	270
VSS	1360	560	390	176	262	224	230
FSS	140	50	40	32	36	22	40
Dissolved Oxygen	9.4	9.3	9.1	9	9.1	8.7	8.9
Caustic Usage (mls)	0	0	0	0	0	0	0.5
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012789

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE						
	20-Nov-87	21-Nov-87	22-Nov-87	23-Nov-87	24-Nov-87	25-Nov-87	26-Nov-8
pH (units)	7.2	7.5	7.3	7.7	7.65	7.4	7.6
Temperature (Deg C)	22	21	21	21	22	21	23
Flowrate (mls/min)	1.29	1.3	1.3	1.29	1.29	1.29	1.34
TSS	206	75	76	64	60	66	42
VSS	174	65	64	54	52	54	36
FSS	32	10	12	10	8	12	6
Dissolved Oxygen	10.2	9.8	10	10.8	9.6	9.5	8.7
Caustic Usage (mls)	0.5	0	0.5	0	0	0.5	0
D. O. Uptake	-	-	-	-	-	*	-
Microscopic Observ.	*	*	*	*	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012790

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE						
	27-Nov-87	28-Nov-87	29-Nov-87	30-Nov-87	01-Dec-87	02-Dec-87	03-Dec-8
pH (units)	7.5	7.4	7.4	7.6	7.5	7.5	7.4
Temperature (Deg C)	21	21	21	21	21	21	21
Flowrate (mls/min)	1.275	1.22	-	1.36	1.45	1	1.29
TSS	65	40	38	18	7	19	9
VSS	60	36	32	14	5	15	8
FSS	5	4	6	4	2	4	1
Dissolved Oxygen	9.2	9	9.2	8.9	9	9	9.75
Caustic Usage (mls)	0	0.5	0	0.5	0	0	0.5
D. O. Uptake	-	-	-	-	*	-	-
Microscopic Observ.	*	*	*	-	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012791

012791

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE						
	04-Dec-87	05-Dec-87	06-Dec-87	07-Dec-87	08-Dec-87	09-Dec-87	10-Dec-
pH (units)	7.5	7.3	7.4	7.5	7.45	7.5	7.5
Temperature (Deg C)	21	21	21	21	21	21	22
Flowrate (mls/min)	1.32	1.04	-	1.29	1.29	1.29	1.38
TSS	27	30	24	8	5	9	6
VSS	22	23	20	6	4	7	5
FSS	5	7	4	2	1	2	1
Dissolved Oxygen	9.1	9.3	9.35	9	9.1	8.8	9
Caustic Usage (mls)	0	0.5	0	0	0	0	0.5
D. O. Uptake	-	*	-	-	*	-	-
Microscopic Observ.	*	*	*	*	*	*	-

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012792

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM MIXED LIQUOR DATA

	SAMPLING DATE	
	11-Dec-87	12-Dec-87
pH (units)	7.3	7.5
Temperature (Deg C)	21	21
Flowrate (mls/min)	1.24	1.22
TSS	3	7
VSS	2	6
FSS	1	1
Dissolved Oxygen	9	9
Caustic Usage (mls)	0.5	0
D. O. Uptake	-	-
Microscopic Observ.	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012793

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE						
	23-Oct-87	24-Oct-87	25-Oct-87	26-Oct-87	27-Oct-87	28-Oct-87	29-Oct-
pH (units)	6.4	6.15	6.25	6.55	6.4	6.4	6.9
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	-	5.7	5	5.3	4.6	4.6	4.6
NH3-N Chemetrics	-	<1	<1	<1	<1	<1	<1
TSS	860	3180	2320	1420	1040	-	430
VSS	780	2980	2100	1340	1000	-	380
FSS	80	200	220	80	40	-	50
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	-	-	6.77	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012794

012794

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE						
	30-Oct-87	31-Oct-87	01-Nov-87	02-Nov-87	03-Nov-87	04-Nov-87	05-Nov-8
pH (units)	7.3	7	7.3	7.2	7.2	7.2	7.6
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	5	3.3	3.5	3.2	3	3.1	3.2
NH3-N Chemetrics	1	2.4	2.4	4.8	4	4	4
TSS	260	46	52	22	20	36	81
VSS	230	33	46	16	16	32	58
FSS	30	13	6	6	4	4	23
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	14.2	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012795

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE						
	06-Nov-87	07-Nov-87	08-Nov-87	09-Nov-87	10-Nov-87	11-Nov-87	12-Nov-
pH (units)	7	-	6.8	6.8	6.8	6.6	6.7
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	3.3	-	3.3	4	3.8	4.1	4.2
NH3-N Chemetrics	3.2	-	<1	<1	<1	<1	<1
TSS	34.5	-	4800	3130	2140	1840	1070
VSS	27.5	-	4310	2900	1940	1660	870
FSS	7	-	490	230	200	180	200
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	-	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012796

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE						
	13-Nov-87	14-Nov-87	15-Nov-87	16-Nov-87	17-Nov-87	18-Nov-87	19-Nov-
pH (units)	6.8	6.8	6.7	6.8	6.8	7	7.1
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	4.4	4.2	4	4	4.1	4	3.3
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	1020	800	580	232	296	172	372
VSS	920	700	520	200	270	160	314
FSS	100	100	60	32	26	12	58
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	-	-	-	13.7	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012797

012797

ROPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE						
	20-Nov-87	21-Nov-87	22-Nov-87	23-Nov-87	24-Nov-87	25-Nov-87	26-Nov-8
pH (units)	7	7.1	7.1	7.4	7.15	7.05	7.1
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	4	5	4.2	3	3	3	3
NH3-N Chemetrics	<1	1	<1	<1	<1	<1	<1
TSS	234	125	68	55	66	60	48
VSS	198	110	58	47	53	48	44
FSS	36	15	10	8	13	12	4
Phenols (4-AAP)	-	-	-	9.016	-	-	-
TOC	-	-	-	11.6	-	-	-
BOD(5)-Total	-	-	-	19	-	-	-
BOD(5)-Soluble	-	-	-	2.5	-	-	-
COD-Total	-	-	-	43	-	-	-
COD-Soluble	-	-	-	<10	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	226	-	-	-
TDFS	-	-	-	169	-	-	-
TDVS	-	-	-	57	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	205.59	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012798

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE						
	27-Nov-87	28-Nov-87	29-Nov-87	30-Nov-87	01-Dec-87	02-Dec-87	03-Dec-
pH (units)	7	7.2	7.1	7.2	7.25	7.3	7.2
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	5	3.3	3	3	3	3.3	3
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	40	26	31	14	10	9	12
VSS	36.7	22	24	12	8	7	11
FSS	3.3	4	7	2	2	2	1
Phenols (4-AAP)	-	-	-	0.019	-	-	-
TOC	-	-	-	13	-	-	-
BOD(5)-Total	-	-	-	22.5	-	-	-
BOD(5)-Soluble	-	-	-	6.5	-	-	-
COD-Total	-	-	-	75	-	-	-
COD-Soluble	-	-	-	35	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	186	-	-	-
TDFS	-	-	-	128	-	-	-
TDVS	-	-	-	58	-	-	-
PCP (ug/L)	-	-	-	17.8	-	-	-
Total Cyanide	-	-	-	0.011	-	-	-
Total Det. PAH(ug/L)	-	-	-	20.988	-	-	-
Metals	-	-	-	*	-	-	-
Phenolics (EPA 604)	-	-	-	*	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012799

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KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE						
	04-Dec-87	05-Dec-87	06-Dec-87	07-Dec-87	08-Dec-87	09-Dec-87	10-Dec-8
pH (units)	7.4	6.9	7.1	7.3	7.3	7.35	7.25
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	3	3.2	3	5.3	4.6	4.3	4
NH3-N Chemetrics	<1	<1	<1	<1	<1	<1	<1
TSS	13	8	10	5	6	10	10
VSS	11	7	8	4	5	8	9
FSS	2	1	2	1	1	2	1
Phenols (4-AAP)	0.017	-	-	-	0.015	-	-
TOC	12.3	-	-	-	15.5	-	-
BOD(5)-Total	1.2	-	-	-	13.3	-	-
BOD(5)-Soluble	<1	-	-	-	3.2	-	-
COD-Total	40	-	-	-	50	-	-
COD-Soluble	30	-	-	-	30	-	-
Oil & Grease	433	-	-	-	6.63	-	-
TDS	146	-	-	-	185	-	-
TDFS	100	-	-	-	113	-	-
TDVS	46	-	-	-	72	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	7.179	-	-	-	12.999	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012800

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FIXED FILM EFFLUENT DATA

	SAMPLING DATE	
	11-Dec-87	12-Dec-87
pH (units)	7	7.2
Phenols-Chemetrics	-	-
Total PO4-Hach	4	5.3
NH3-N Chemetrics	<1	<1
TSS	6	5
VSS	5	5
FSS	1	0
Phenols (4-AAP)	-	0.011
TOC	-	13.2
BOD(5)-Total	-	7.15
BOD(5)-Soluble	-	1.15
COD-Total	-	40
COD-Soluble	-	30
Oil & Grease	-	11.6
TDS	-	189
TDFS	-	119
TDVS	-	70
PCP (ug/L)	-	-
Total Cyanide	-	-
Total Det. PAH(ug/L)	-	4.115
Metals	-	-
Phenolics (EPA 604)	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012801

SPECTRIX QC # --- 3

ET ID 3:EF SAMPLE NUMBER FIXED FILM EFF

ORGANICS ANALYSIS DATA SHEET (PAGE 1)

LABORATORY NAME : SPECTRIX CASE NO. --
LAB SAMPLE ID NO 871200405 QC REPORT NO. --
SAMPLE MATRIX WATER CONTRACT NO. 12-01-87
DATA RELEASE AUTHORIZED BY MB DATE SAMPLE RECEIVED

VOLATILES

CONCENTRATION: LOW DATAFILE SU12C04V05
DATE ANALYZED 12/08/87 DILUTION FACTOR: 1.00

CAS #	COMPOUND	UG/L
C010	CHLOROMETHANE	10 U
C015	BROMOMETHANE	10 U
C020	VINYL CHLORIDE	10 U
C025	CHLOROETHANE	10 U
C030	METHYLENE CHLORIDE	5 7
C035	ACETONE	10 ..... 5 J
C040	CARBON DISULFIDE	5 U
C045	1,1-DICHLOROETHENE	5 U
C050	1,1-DICHLOROETHANE	5 U
C055	TRANS-1,2-DICHLOROETHENE	5 U
C060	CHLOROFORM	5 U
C065	1,2-DICHLOROETHANE	5 U
C110	2-BUTANONE	10 U
C115	1,1,1-TRICHLOROETHANE	5 U
C120	CARBON TETRACHLORIDE	5 U
C125	VINYL ACETATE	10 U
C130	BROMODICHLOROMETHANE	5 U
C140	1,2-DICHLOROPROPANE	5 U
C170	CIS-1,3-DICHLOROPROPENE(Z)	5 U
C150	TRICHLOROETHENE	5 U
C155	DIBROMOCHLOROMETHANE	5 U
C160	1,1,2-TRICHLOROETHANE	5 U
C165	BENZENE	5 U
C145	TRANS-1,3-DICHLOROPROPENE(E)	5 U
C175	2-CHLOROETHYLVINYLETHER	10 U
C180	BROMOFORM	5 U
C205	4-METHYL-2-PENTANONE	10 U
C210	2-HEXANONE	10 U
C220	TETRACHLOROETHENE	5 U
C225	1,1,2,2-TETRACHLOROETHANE	5 U
C230	TOLUENE	5 U
C235	CHLOROBENZENE	5 U
C240	ETHYLBENZENE	5 U
C245	STYRENE	5 U
C250	TOTAL XYLENES	5 U

U UNDETECTED AT THE LISTED DETECTION LIMIT
J COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

012802

012802

[illegible] 4910 [illegible] - 3

SAMPLE NUMBER FIXED FILM EFF

ORGANICS ANALYSIS DATA SHEET

LABORATORY NAME: SPECTRIX
LAB SAMPLE ID NO 8712004C3
SAMPLE MATRIX WATER
DATA RELEASE AUTHORIZED BY [illegible]

CASE NO. ---
QC REPORT NO ---
CONTRACT NO ---
DATE SAMPLE RECEIVED 12/1/87

SEMIVOLATILES

CONCENTRATION LOW
DATE EXTRACTED 12/2/87
DATE ANALYZED 12/14/87

DATAFILE 9U12004C03

DILUTION FACTOR 4.0

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND
C315	PHENOL	40 U	
C325	BIS(2-CHLOROETHYL)ETHER	40 U	
C330	2-CHLOROPHENOL	40 U	
C335	1,3-DICHLOROBENZENE	40 U	
C340	1,4-DICHLOROBENZENE	40 U	
C345	BENZYL ALCOHOL	40 U	
C350	1,2-DICHLOROBENZENE	40 U	
C355	2-METHYLPHENOL	40 U	
C360	BIS(2-CHLOROISOPROPYL)ETHER	40 U	
C365	4-METHYLPHENOL	40 U	
C370	N-NITROSODIPROPYLAMINE	40 U	
C375	HEXACHLOROETHANE	40 U	
C410	NITROBENZENE	40 U	
C415	ISOPHORONE	40 U	
C420	2-NITROPHENOL	40 U	
C425	2,4-DIMETHYLPHENOL	40 U	
C430	BENZOIC ACID	200 U	
C435	BIS(2-CHLOROETHOXY)METHANE	40 U	
C440	2,4-DICHLOROPHENOL	40 U	
C445	1,2,4-TRICHLOROBENZENE	40 U	
C450	NAPHTHALENE	40 U	
C455	4-CHLOROANILINE	40 U	
C460	HEXACHLOROBUTADIENE	40 U	
C465	P-CHLORO-M-CRESOL	40 U	
C470	2-METHYLNAPHTHALENE	40 U	
C510	HEXACHLOROCYCLOPENTADIENE	40 U	
C515	2,4,6-TRICHLOROPHENOL	40 U	
C520	2,4,5-TRICHLOROPHENOL	200 U	
C525	2-CHLORONAPHTHALENE	40 U	
C530	2-NITROANILINE	200 U	
C535	DIMETHYL PHTHALATE	40 U	
C540	ACENAPHTHYLENE	40 U	
C545	3-NITROANILINE	200 U	
C550	ACENAPHTHENE	40 U	
C555	2,4-DINITROPHENOL	200 U	
C560	4-NITROPHENOL	200 U	
C565	DIBENZOFURAN	40 U	
C570	2,4-DINITROTOLUENE	40 U	
C575	2,6-DINITROTOLUENE	40 U	

012803

012803

SAMPLE NUMBER FIXED FILM EFF

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET, CONTINUED

[illegible]FILE F:\2004C03

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND
C580	DIETHYL PHTHALATE	40	U
C585	4-CHLOROPHENYL PHENYL ETHER	40	U
C590	FLUORENE	40	U
C595	4-NITROANILINE	200	U
C610	4,6-DINITRO-2-METHYLPHENOL	200	U
C615	N-NITROSODIPHENYLAMINE	40	U
C625	4-BROMOPHENYL PHENYL ETHER	40	U
C630	HEXACHLOROBENZENE	40	U
C635	PENTACHLOROPHENOL	200	U
C640	PHENANTHRENE	40	U
C645	ANTHRACENE	40	U
C650	DI-N-BUTYL PHTHALATE	40	U
C655	FLUORANTHENE	40	U
C715	PYRENE	40	U
C720	BUTYL BENZYL PHTHALATE	40	U
C725	3,3'-DICHLOROBENZIDINE	80	U
C730	BENZO(A)ANTHRACENE	40	U
C735	BIS(2-ETHYLHEXYL)PHTHALATE	40	U
C740	CHRYSENE	40	U
C760	DI-N-OCTYL PHTHALATE	40	U
C765	BENZO(B)FLUORANTHENE	40	U
C770	BENZO(K)FLUORANTHENE	40	U
C775	BENZO(A)PYRENE	40	U
C780	INDENO(1,2,3-CD)PYRENE	40	U
C785	DIBENZO(A,H)ANTHRACENE	40	U
C790	BENZO(GHI)PERYLENE	40	U

012804

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

012804

SPECTRIX DC # --- 3

SAMPLE NUMBER: FIXED FILM EFF

ORGANICS ANALYSIS DATA SHEET - PAGE 4

LABORATORY NAME: SPECTRIX HOUSTON CASE NO. --

DC REPORT NO: -- ANALYST: RB DATAFILE: 5U12004V05

3 TENTATIVELY IDENTIFIED COMPOUNDS

CAS #	VOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT
				UG/

NO NON-HSL COMPOUNDS FOUND > 10% OF NEAREST INT. STD.

J = ESTIMATED VALUE - A 1.1 RESPONSE FACTOR IS ASSUMED

012805

SAMPLE FIXED FILM EFF.

ORGANICS ANALYSIS DATA SHEET - PAGE 5

LABORATORY NAME SPECTRIX CORPORATION CASE NO. ---

QC REPORT NO --- ANALYST CEJ DATAFILE PU:2004C05

3. TENTATIVELY IDENTIFIED COMPOUNDS

CAS #	SEMIVOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT
				UG/L

NO NCN--SL COMPOUNDS FOUND > 10% OF NEAREST INT STD.

ESTIMATED VALUE - A 1:1 RESPONSE FACTOR IS ASSUMED

012806

012806

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
FIXED FILM METALS DATA

Parameter (ug/l)	Fixed Film
Antimony	<60.0
Arsenic	<10.0
Beryllium	<5.00
Cadmium	<5.00
Chromium	<10.0
Copper	<25.0
Lead	<5.00
Mercury	1.15
Nickel	<40.0
Selenium	<5.00
Silver	<10.0
Thallium	<10.0
Zinc	1430

012807

012807

APPENDIX 2-F
ESTIMATION OF A HALF-LIFE FOR BENZO(a)PYRENE IN SURFACE SOILS

APPENDIX 2-F
ESTIMATION OF A HALF-LIFE FOR BENZO(a)PYRENE IN SURFACE SOILS

The USEPA has reported a half-life of 480 days for benzo-(a)pyrene B(a)P in soils (EPA 1986a). Because this value is not supported by a citation from the scientific literature, the literature was reviewed in order to develop a more reliable estimate of the degradation of B(a)P in surface soils. (All PAHs are assumed to degrade at a rate equal to B(a)P because the cancer potency of B(a)P is used herein to characterize all carcinogenic PAHs.)

Table F-1 lists the half-lives found in the literature that may be of relevance to the conditions found at Carver Terrace and Kennedy Sand and Gravel. The half-lives ranged from 10 days to 1957 days, with a mean of 375 days and standard deviation of 614 days. (The mean was calculated by using 15 days as the half life reported by Shilina et al. (1980).)

To be protective of the public health, a half-life of 1385 days was selected. This half-life represents a value below which 95% of half-lives are expected to fall, assuming that the values reported in the literature are representative of the real world. Ninety-five percent of all values in a normal distribution are expected to fall below the mean plus 1.645 standard deviations. Thus, the upper 95th percentile of half-lives was calculated by adding 1.645 standard deviations (614 days) to the mean (375 days).

The half-lives reported in the literature varied a great deal, probably because many site-specific factors can influence the rate at which B(a)P degrades. Thus, the value used in this risk assessment should not be interpreted as necessarily representative of soils in Texarkana or any other part of the United States. More detailed analysis of the factors influencing degradation is needed to derive site-specific values. Of special note is the apparent relatively rapid degradation of B(a)P in soils that have contained oil and PAHs for a long time compared to soils to which B(a)P has only recently been added. This indicates that acclimation of the

012809

TABLE F-1

SUMMARY IN THE LITERATURE

Half-Life (days)	References
1957	(a)
530	(b)
290	(b)
220	(b)
57	(c)
147	(d)
85.6	(d)
76.2	(d)
10-15	(e)

(a) Bossert, I.D. and R. Bartha. 1986. Structure-biodegradability relationship of polycyclic aromatic hydrocarbons in soil. Bull. Env. Contam. Tox., 37:490-495.

(b) Cooker, M.P. and R.C. Sims. 1987. The effect of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agrecultural soil. Haz. Waste Haz. Mat., 4:69-82.

(c) Groenewegen, D. and H. Stolp. 1976. Microbial breakdown of polyaromatic hydrocarbons. Zbl. Bakt. Hyg. I. Abt: Orig., B162: 225-232.

(d) Khesina, A. Ya., M.P. Shcherback, L.M. Shabad, and I.S. Vostrov. 2969. Benzpyrene breakdown by the soil microflora. Byulleten Ekxperimental' noi Biologii i Meditsiny., 68:70. As cited in Sims and Overcash 1983. Fate of polynuclear aromatic compounds (PNAs) in soil-plant systems. Residue Reviews, 88:1-68.

(e) Shilina, A.I., L.V. Vaneeva and A.V. Zhuravleva, 1980. Benzo(a)pyrene persisetnce in the soil when it is introduced with soil dust particles. Migr. Zagryaz. Vesh. Poch. Supred. Sredaleh, Tr. Vses. Soves., 2nd Bobvnikova, Malakhovs, eds. pp. 100-105 CA95:198765.

microbiological community in the soil to the presence of PAHs may be necessary for rapid degradation. If true, the PAHs in Carver Terrace and Kennedy Sand and Gravel surface soils, which have contained PAHs for many years, may degrade faster than the rates assumed in this risk assessment.

APPENDIX 2-G

ESTIMATION OF INHALATION RISKS OF UTILITY WORKERS FROM VOLATILIZATION OF POTENTIALLY CARCINOGENIC PAH FROM SUBSURFACE SOILS

APPENDIX G
(Fluidized Bed Treatment Results)

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
STATISTICAL SUMMARY
FLUIDIZED BED RECYCLE CHAMBER DATA

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
pH (units)	23	7.22	.34	7.07	7.37	7.21	1.05	6.80	8.00	7.65
Temperature (Deg C)	23	21.67	1.72	20.93	22.42	21.60	1.09	17.00	24.00	24.07
Flowrate (mls/min)	20	1.29	.20	1.19	1.38	1.27	1.16	.92	2.00	1.53
TSS	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
VSS	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
FSS	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Dissolved Oxygen	23	8.41	.92	8.01	8.80	8.36	1.11	7.10	11.00	9.52
Caustic Usage (mls)	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Acid Usage (mls)	18	.72	.65	.40	1.04	1.00	1.40	.00	2.00	1.53
D. O. Uptake	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Microscopic Observ.	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

All values are in mg/L unless otherwise noted.
Note: Flowrate indicates influent flow to unit

012814

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
STATISTICAL SUMMARY
FLUIDIZED BED EFFLUENT DATA

Parameters	# OF OBVS	MEAN	STD	95% CI LOWER	95% CI UPPER	GMEAN	GSTD	MIN	MAX	90% LT VALUE
pH (units)	23	7.20	.24	7.09	7.30	7.19	1.03	6.80	7.70	7.50
Phenols-Chemetrics	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Total PO4-Hach	23	3.52	.98	3.09	3.94	3.39	1.32	2.00	5.60	4.80
NH3-N Chemetrics	23	1.94	1.06	1.48	2.40	1.68	1.74	1.00	3.60	3.37
TSS	22	4.68	2.46	3.59	5.77	3.97	1.89	1.00	10.00	8.87
VSS	22	3.41	1.74	2.64	4.18	2.96	1.78	1.00	7.00	6.13
FSS	22	1.27	1.20	.74	1.81	1.47	1.49	.00	4.00	2.42
Phenols (4-AAP)	5	.00	.00	.00	.00	.01	1.00	.00	.00	.01
TOC	6	7.35	8.33	-1.40	16.09	5.17	2.27	2.19	24.20	14.52
BOD(5)-Total	5	3.31	3.39	-.90	7.52	2.26	2.58	1.00	9.00	7.47
BOD(5)-Soluble	5	1.72	1.61	-.28	3.72	1.36	1.98	1.00	4.60	3.21
COD-Total	5	13.20	6.61	4.99	21.41	12.24	1.49	10.00	25.00	20.30
COD-Soluble	5	10.40	.89	9.29	11.51	10.37	1.08	10.00	12.00	11.49
Oil & Grease	5	7.32	2.95	3.66	10.98	6.96	1.39	6.00	12.60	10.57
TDS	5	154.20	18.31	131.47	176.93	153.27	1.13	125.00	172.00	179.44
TDFS	5	129.40	10.92	115.84	142.96	129.05	1.08	119.00	148.00	142.97
TDVS	5	24.80	12.36	9.46	40.14	21.05	2.08	6.00	39.00	53.09
PCP (ug/L)	1	1.00	.00	1.00	1.00	1.00	.00	1.00	1.00	.00
Total Cyanide	1	.01	.00	.01	.01	.01	.00	.01	.01	.00
Total Det. PAH(ug/L)	5	.0000	.0000	.0000	.0000	1.00	1.0000	.0000	.0000	1.0000
Metals	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000
Phenolics (EPA 604)	0	.0000	.0000	.0000	.0000	.00	.0000	.0000	.0000	.0000

All values are in mg/L unless otherwise noted.

012815

[redacted] COMPANY, INC.
[redacted], [redacted]
GROUNDWATER BIOLOGICAL TREATABILITY
FLUIDIZED BED

PARAMETER

PAH COMPOUND (ug/l)	# of Rings	Aqueous Solubility at 25° C	11/23/87	11/30/87	12/04/87	12/08/87	12/12/87
Acenaphthylene	3	-	<2.00	<2.00	<2.00	<2.00	<2.00
Acenaphthene	3	3930	<2.00	<2.00	<2.00	<2.00	<2.00
Fluorene	3	1980	<0.200	<0.200	<0.200	<0.200	<0.200
Phenanthrene	3	1290	<0.500	<0.500	0.500	<0.500	<0.500
Anthracene	3	73	0.500	0.500	<0.500	<0.500	0.500
Fluoranthene	4	260	<0.200	<0.200	<0.200	0.200	0.200
Pyrene	4	135	<0.300	<0.300	<0.300	0.300	0.300
Benzo(a)anthracene	4	14	0.020	0.020	0.020	<0.020	0.020
Chrysene	4	-	<0.150	<0.150	<0.150	0.150	0.150
Benzo(a)pyrene	5	3.8	0.020	<0.020	<0.020	<0.020	<0.020
Benzo(b)fluoranthene	5	-	<0.020	<0.020	<0.020	<0.020	<0.020
Benzo(k)fluoranthene	5	-	0.020	<0.020	<0.020	<0.020	<0.020
Dibenz(a,h)anthracene	5	2.49	0.030	<0.030	<0.030	<0.030	<0.030
Benzo(g,h,i)perylene	6	-	<0.050	<0.050	0.050	<0.050	<0.050
Indeno(1,2,3-cd)pyrene	6	-	0.050	<0.050	0.050	0.050	0.050
TOTAL DETECTABLE PAH			0.00	0.00	0.00	0.00	0.00
Carbazole	-	-	<2.00	<2.00	<2.00	<2.00	<2.00
Naphthalene	2	1700	<2.00	<2.00	<2.00	<2.00	<2.00

012816

012816

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED RECYCLE CHAMBER DATA

	SAMPLING DATE						
	20-Nov-87	21-Nov-87	22-Nov-87	23-Nov-87	24-Nov-87	25-Nov-87	26-Nov-
pH (units)	7.6	7.8	7.7	7.9	8	7	7.25
Temperature (Deg C)	22	17	17	19	22	23	24
Flowrate (mls/min)	1.29	1.3	1.3	1.28	1.29	1.29	1.24
TSS	-	-	-	-	-	-	-
VSS	-	-	-	-	-	-	-
FSS	-	-	-	-	-	-	-
Dissolved Oxygen	8.4	11	10.6	9.4	8.9	8.9	7.1
Caustic Usage (mls)	-	-	-	-	-	-	-
Acid Usage (mls)	-	-	-	-	-	2	1
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	-	*	-	-	-	*	-

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012817

012817

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED RECYCLE CHAMBER DATA

	SAMPLING DATE						
	27-Nov-87	28-Nov-87	29-Nov-87	30-Nov-87	01-Dec-87	02-Dec-87	03-Dec-8
pH (units)	7.3	7.05	7.15	7	6.95	6.8	6.8
Temperature (Deg C)	22	22	22	22	23	22	22
Flowrate (mls/min)	1.35	0.98	1.29	2	1.3	1.14	1.18
TSS	-	-	-	-	-	-	-
VSS	-	-	-	-	-	-	-
FSS	-	-	-	-	-	-	-
Dissolved Oxygen	8.2	8.35	8.5	7.9	7.8	8.15	8.3
Caustic Usage (mls)	-	-	-	-	-	-	-
Acid Usage (mls)	2	1	1	1	0	1	1
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	-	*	-	*	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012819

012818

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED RECYCLE CHAMBER DATA

	SAMPLING DATE						
	04-Dec-87	05-Dec-87	06-Dec-87	07-Dec-87	08-Dec-87	09-Dec-87	10-Dec-8
pH (units)	6.9	6.9	6.95	7.2	7.1	7.2	7.1
Temperature (Deg C)	22	22	22	22	22	23	23
Flowrate (mls/min)	-	1.29	-	1.29	1.32	1.35	-
TSS	-	-	-	-	-	-	-
VSS	-	-	-	-	-	-	-
FSS	-	-	-	-	-	-	-
Dissolved Oxygen	8.25	8.05	8.1	8.25	8.1	7.2	7.7
Caustic Usage (mls)	-	-	-	-	-	-	-
Acid Usage (mls)	1	0	1	0	0	0	0
D. O. Uptake	-	-	-	-	-	-	-
Microscopic Observ.	*	*	*	*	*	*	-

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012819

012819

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED RECYCLE CHAMBER DATA

	SAMPLING DATE	
	11-Dec-87	12-Dec-87
pH (units)	7.15	7.2
Temperature (Deg C)	22	21.5
Flowrate (mls/min)	0.92	1.32
TSS	-	-
VSS	-	-
FSS	-	-
Dissolved Oxygen	7.9	7.8
Caustic Usage (mls)	-	-
Acid Usage (mls)	0.5	0.5
D. O. Uptake	-	-
Microscopic Observ.	*	*

All values are in mg/L unless otherwise noted.
* Indicates that the test was performed.
Note: Flowrate indicates influent flow to unit.

012820

012820

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED EFFLUENT DATA

	SAMPLING DATE						
	10-Nov-87	11-Nov-87	12-Nov-87	13-Nov-87	14-Nov-87	15-Nov-87	16-Nov-8
pH (units)	-	-	-	-	-	-	-
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	-	-	-	-	-	-	-
NH3-N Chemetrics	-	-	-	-	-	-	-
TSS	-	-	-	-	-	-	-
VSS	-	-	-	-	-	-	-
FSS	-	-	-	-	-	-	-
Phenols (4-AAP)	-	-	-	-	-	-	-
TOC	24.2	-	-	-	-	-	-
BOD(5)-Total	-	-	-	-	-	-	-
BOD(5)-Soluble	-	-	-	-	-	-	-
COD-Total	-	-	-	-	-	-	-
COD-Soluble	-	-	-	-	-	-	-
Oil & Grease	-	-	-	-	-	-	-
TDS	-	-	-	-	-	-	-
TDFS	-	-	-	-	-	-	-
TDVS	-	-	-	-	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012821

012821

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED EFFLUENT DATA

	SAMPLING DATE						
	17-Nov-87	18-Nov-87	19-Nov-87	20-Nov-87	21-Nov-87	22-Nov-87	23-Nov-87
pH (units)	-	-	-	7.4	7.4	7.4	7.6
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	-	-	-	2.8	2	2.5	2.5
NH3-N Chemetrics	-	-	-	3.2	3.2	3.2	3.2
TSS	-	-	-	6	5	5	4
VSS	-	-	-	4	1	3	3
FSS	-	-	-	2	4	2	1
Phenols (4-AAP)	-	-	-	-	-	-	<0.005
TOC	-	-	-	-	-	-	2.19
BOD(5)-Total	-	-	-	-	-	-	<1
BOD(5)-Soluble	-	-	-	-	-	-	<1
COD-Total	-	-	-	-	-	-	11
COD-Soluble	-	-	-	-	-	-	<10
Oil & Grease	-	-	-	-	-	-	<6
TDS	-	-	-	-	-	-	125
TDFS	-	-	-	-	-	-	119
TDVS	-	-	-	-	-	-	6
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	-	-	-	0
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012822

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED EFFLUENT DATA

	SAMPLING DATE						
	24-Nov-87	25-Nov-87	26-Nov-87	27-Nov-87	28-Nov-87	29-Nov-87	30-Nov-
pH (units)	7.7	7.1	7.25	7.1	6.85	7.1	6.9
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	2.7	2.7	2.7	4	4.3	3.8	4.3
NH3-N Chemetrics	3.2	3.2	2.4	3.6	2.4	3.2	1.6
TSS	6	6	4	7	-	6	9
VSS	4	5	3	6	-	4	6
FSS	2	1	1	1	-	2	3
Phenols (4-AAP)	-	-	-	-	-	-	<0.005
TOC	-	-	-	-	-	-	4.58
BOD(5)-Total	-	-	-	-	-	-	9
BOD(5)-Soluble	-	-	-	-	-	-	1
COD-Total	-	-	-	-	-	-	25
COD-Soluble	-	-	-	-	-	-	12
Oil & Grease	-	-	-	-	-	-	<6
TDS	-	-	-	-	-	-	172
TDFS	-	-	-	-	-	-	148
TDVS	-	-	-	-	-	-	24
PCP (ug/L)	-	-	-	-	-	-	<1
Total Cyanide	-	-	-	-	-	-	<0.01
Total Det. PAH(ug/L)	-	-	-	-	-	-	0
Metals	-	-	-	-	-	-	*
Phenolics (EPA 604)	-	-	-	-	-	-	*

All values are in mg/L unless otherwise noted.
* See data in appendix.

012823

012823

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED EFFLUENT DATA

	SAMPLING DATE						
	01-Dec-87	02-Dec-87	03-Dec-87	04-Dec-87	05-Dec-87	06-Dec-87	07-Dec-
pH (units)	7.2	7	6.8	7	7	6.9	7.4
Phenols-Chemetrics	-	-	-	-	-	-	-
Total PO4-Hach	2.8	3.3	2.8	3	3	3	5.6
NH3-N Chemetrics	1.25	<1	<1	<1	<1	<1	<1
TSS	10	2	3	4	4	5	1
VSS	7	2	3	2	4	3	1
FSS	3	0	0	2	0	2	0
Phenols (4-AAP)	-	-	-	0.005	-	-	-
TOC	-	-	-	5.32	-	-	-
BOD(5)-Total	-	-	-	<1	-	-	-
BOD(5)-Soluble	-	-	-	<1	-	-	-
COD-Total	-	-	-	<10	-	-	-
COD-Soluble	-	-	-	<10	-	-	-
Oil & Grease	-	-	-	<6	-	-	-
TDS	-	-	-	150	-	-	-
TDFS	-	-	-	127	-	-	-
TDVS	-	-	-	23	-	-	-
PCP (ug/L)	-	-	-	-	-	-	-
Total Cyanide	-	-	-	-	-	-	-
Total Det. PAH(ug/L)	-	-	-	0	-	-	-
Metals	-	-	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012824

012824

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
WEEKLY DATA SHEETS
FLUIDIZED BED EFFLUENT DATA

	SAMPLING DATE				
	08-Dec-87	09-Dec-87	10-Dec-87	11-Dec-87	12-Dec-87
pH (units)	7.35	7.4	7.3	7.2	7.2
Phenols-Chemetrics	-	-	-	-	-
Total PO4-Hach	4.3	5	4.5	4.3	5
NH3-N Chemetrics	<1	<1	<1	<1	<1
TSS	2	2	1	8	3
VSS	2	2	1	6	3
FSS	0	0	0	2	0
Phenols (4-AAP)	<0.005	-	-	-	0.005
TOC	3.31	-	-	-	4.47
BOD(5)-Total	3.85	-	-	-	1.7
BOD(5)-Soluble	4.6	-	-	-	<1
COD-Total	<10	-	-	-	<10
COD-Soluble	<10	-	-	-	<10
Oil & Grease	<6	-	-	-	12.6
TDS	166	-	-	-	158
TDFS	127	-	-	-	126
TDVS	39	-	-	-	32
PCP (ug/L)	-	-	-	-	-
Total Cyanide	-	-	-	-	-
Total Det. PAH(ug/L)	0	-	-	-	0
Metals	-	-	-	-	-
Phenolics (EPA 604)	-	-	-	-	-

All values are in mg/L unless otherwise noted.
* See data in appendix.

012825

SPECTRIX DC # --- 8

NST ID 51EF SAMPLE NUMBER: FLUIDIZED BED EFF.

ORGANICS ANALYSIS DATA SHEET (PAGE 1)

ABORATORY NAME: SPECTRIX
LAB SAMPLE ID NO.: 871200403
AMPLE MATRIX: WATER
ATA RELEASE AUTHORIZED BY: MB

CASE NO.: --
QC REPORT NO.: --
CONTRACT NO.: 12-01-87
DATE SAMPLE RECEIVED: 12-01-87

VOLATILES

CONCENTRATION: LOW
DATE ANALYZED: 12/08/87

DATAFILE: 5U12004V03
DILUTION FACTOR: 1.00

	CAS #	COMPOUND	UG/L	
C010		CHLOROMETHANE	10 U	
C015		BROMOMETHANE	10 U	
C020		VINYL CHLORIDE	10 U	
C025		CHLOROETHANE	10 U	
C030		METHYLENE CHLORIDE	5	8
C035		ACETONE	10 U	
C040		CARBON DISULFIDE	5 U	
C045		1,1-DICHLOROETHENE	5 U	
C050		1,1-DICHLOROETHANE	5 U	
C055		TRANS-1,2-DICHLOROETHENE	5 U	
C060		CHLOROFORM	5 U	
C065		1,2-DICHLOROETHANE	5 U	
C110		2-BUTANONE	10 U	
C115		1,1,1-TRICHLOROETHANE	5 U	
C120		CARBON TETRACHLORIDE	5 U	
C125		VINYL ACETATE	10 U	
C130		BROMODICHLOROMETHANE	5 U	
C140		1,2-DICHLOROPROPANE	5 U	
C170		CIS-1,3-DICHLOROPROPENE(Z)	5 U	
C150		TRICHLOROETHENE	5 U	
C155		DIBROMOCHLOROMETHANE	5 U	
C160		1,1,2-TRICHLOROETHANE	5 U	
C165		BENZENE	5 U	
C145		TRANS-1,3-DICHLOROPROPENE(E)	5 U	
C175		2-CHLOROETHYLVINYLETHER	10 U	
C180		BROMOFORM	5 U	
C205		4-METHYL-2-PENTANONE	10 U	
C210		2-HEXANONE	10 U	
C220		TETRACHLOROETHENE	5 U	
C225		1,1,2,2-TETRACHLOROETHANE	5 U	
C230		TOLUENE	5 U	
C235		CHLOROBENZENE	5 U	
C240		ETHYLBENZENE	5 U	
C245		STYRENE	5 U	
C250		TOTAL XYLENES	5 U	

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

012826

012826

NST ID: 4510

SPECTRIX DC # --- . - 8
SAMPLE NUMBER: FLUIDIZED BED EFF

ORGANICS ANALYSIS DATA SHEET

LABORATORY NAME SPECTRIX
LAB SAMPLE ID NO 871200403
MATRIX: WATER
DATA RELEASE AUTHORIZED BY: ...

CASE NO.: ---
QC REPORT NO. ---
CONTRACT NO : ---
DATE SAMPLE RECEIVED: 12/1/87

SEMIVOLATILES

CONCENTRATION: LOW
DATE EXTRACTED: 12/2/87
DATE ANALYZED: 12/14/87

DATAFILE: 9U12004C03
DILUTION FACTOR: 2.0

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND
C315	PHENOL	20 U	
C325	BIS(2-CHLOROETHYL)ETHER	20 U	
C330	2-CHLOROPHENOL	20 U	
C335	1,3-DICHLOROBENZENE	20 U	
C340	1,4-DICHLOROBENZENE	20 U	
C345	BENZYL ALCOHOL	20 U	
C350	1,2-DICHLOROBENZENE	20 U	
C355	2-METHYLPHENOL	20 U	
C360	BIS(2-CHLOROISOPROPYL)ETHER	20 U	
C365	4-METHYLPHENOL	20 U	
C370	N-NITROSODIPROPYLAMINE	20 U	
C375	HEXACHLOROETHANE	20 U	
C410	NITROBENZENE	20 U	
C415	ISOPHORONE	20 U	
C420	2-NITROPHENOL	20 U	
C425	2,4-DIMETHYLPHENOL	20 U	
C430	BENZOIC ACID	100 U	
C435	BIS(2-CHLOROETHOXY)METHANE	20 U	
C440	2,4-DICHLOROPHENOL	20 U	
C445	1,2,4-TRICHLOROBENZENE	20 U	
C450	NAPHTHALENE	20 U	
C455	4-CHLOROANILINE	20 U	
C460	HEXACHLOROBUTADIENE	20 U	
C465	P-CHLORO-M-CRESOL	20 U	
C470	2-METHYLNAPHTHALENE	20 U	
C510	HEXACHLOROCYCLOPENTADIENE	20 U	
C515	2,4,6-TRICHLOROPHENOL	20 U	
C520	2,4,5-TRICHLOROPHENOL	100 U	
C525	2-CHLORONAPHTHALENE	20 U	
C530	2-NITROANILINE	100 U	
C535	DIMETHYL PHTHALATE	20 U	
C540	ACENAPHTHYLENE	20 U	
C545	3-NITROANILINE	100 U	
C550	ACENAPHTHENE	20 U	
C555	2,4-DINITROPHENOL	100 U	
C560	4-NITROPHENOL	100 U	
C565	DIBENZOFURAN	20 U	
C570	2,4-DINITROTOLUENE	20 U	
C575	2,6-DINITROTOLUENE	20 U	

012827

012827

SPECTRIX DC # ---- 8

SAMPLE NUMBER: FLUIDIZED BED

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET, CONTINUED

DATAFILE: 9U12004C03

	COMPOUND	DETECTION LIMIT (MICROGRAMS / LITER)	AMOUNT FOUND
C580	DIETHYL PHTHALATE	20 U	
C585	4-CHLOROPHENYL PHENYL ETHER	20 U	
C590	FLUORENE	20 U	
C595	4-NITROANILINE	100 U	
C610	4,6-DINITRO-2-METHYLPHENOL	100 U	
C615	N-NITROSODIPHENYLAMINE	20 U	
C625	4-BROMOPHENYL PHENYL ETHER	20 U	
C630	HEXACHLOROBENZENE	20 U	
C635	PENTACHLOROPHENOL	100 U	
C640	PHENANTHRENE	20 U	
C645	ANTHRACENE	20 U	
C650	DI-N-BUTYL PHTHALATE	20 U	
C655	FLUORANTHENE	20 U	
C715	PYRENE	20 U	
C720	BUTYL BENZYL PHTHALATE	20 U	
C725	3,3'-DICHLOROBENZIDINE	40 U	
C730	BENZO(A)ANTHRACENE	20 U	
C735	BIS(2-ETHYLHEXYL)PHTHALATE	20 U	
C740	CHRYSENE	20 U	
C760	DI-N-OCTYL PHTHALATE	20 U	
C765	BENZO(B)FLUORANTHENE	20 U	
C770	BENZO(K)FLUORANTHENE	20 U	
C775	BENZO(A)PYRENE	20 U	
C780	INDENO(1,2,3-CD)PYRENE	20 U	
C785	DIBENZO(A,H)ANTHRACENE	20 U	
C790	BENZO(GHI)PERYLENE	20 U	

012828

U = UNDETECTED AT THE LISTED DETECTION LIMIT
J = COMPOUND IS PRESENT, BUT BELOW THE LISTED DETECTION LIMIT

NST ID: 51EF

SPECTRIX DC # --- 8

SAMPLE NUMBER: FLUIDIZED BED EFF.

ORGANICS ANALYSIS DATA SHEET - PAGE 4

ABORATORY NAME: SPECTRIX HOUSTON

CASE NO.: --

QC REPORT NO.: --

ANALYST: RCJ

DATAFILE: SU12004V03

B. TENTATIVELY IDENTIFIED COMPOUNDS

CAS #	VOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT

UG/L

NO NON-HSL COMPOUNDS FOUND > 10% OF NEAREST INT. STD.

J = ESTIMATED VALUE - A 1:1 RESPONSE FACTOR IS ASSUMED

SAMPLE: FLUIDIZED BED EFF

ORGANICS ANALYSIS DATA SHEET - PAGE 5

LABORATORY NAME: SPECTRIX CORPORATION CASE NO.: ---

DC REPORT NO.: --- ANALYST: CEB DATAFILE: 9U12004C03

B. TENTATIVELY IDENTIFIED COMPOUNDS

CAS #	SEMIVOLATILE COMPOUND NAMES	SCAN#	PURITY	AMOUNT

UG/L

NO NON-HSL COMPOUNDS FOUND > 10% OF NEAREST INT. STD.

ESTIMATED VALUE - A 1:1 RESPONSE FACTOR IS ASSUMED

012830

KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
FLUIDIZED BED METALS DATA

Parameter (ug/l)	Fluidized Bed
Antimony	<60.0
Arsenic	<10.0
Beryllium	<5.00
Cadmium	9.10
Chromium	<10.0
Copper	<25.0
Lead	<5.00
Mercury	<0.200
Nickel	<40.0
Selenium	<5.00
Silver	<10.0
Thallium	<10.0
Zinc	125

APPENDIX 2-G

ESTIMATION OF INHALATION RISKS OF UTILITY WORKERS FROM VOLATILIZATION OF POTENTIALLY CARCINOGENIC PAH FROM SUBSURFACE SOILS

Risks associated with air concentrations of potentially carcinogenic PAH are derived in this appendix. The air concentrations are based upon the maximum measured concentration of detected carcinogenic PAH in Carver Terrace subsurface soils. The calculated air concentrations only consider volatilization and do not account for dispersion. Utlitity worker exposures were estimated based on the assumptions detailed in Table 2-4.

Computation of Potentially Carcinogenic PAH Concentrations in Air Above Soil and Risks Associated with Those. A compound in soil may be partitioned between the soil water, soil air and the soil constituents. The three main transport processes for a compound in soil to enter the atmosphere are:

- compound in soil to compound in solution
- compound in solution to compound in vapor phase in soil air
- compound in vapor phase in soil air to compound in atmosphere (Lyman et al. 1982).

A compound may adhere strongly to dry soil, reducing its volatilization rate, but when soil is wetted the stronger affinity of the water displaces the compound allowing volatilization to occur at a faster rate. However, if the concentration of a compound in soil becomes high enough so that its chemical activity approaches that of a pure compound, the presence or absence of water will not affect its volatilization (Lyman et al. 1982). A pure compound can volatilize directly into a vapor. This calculation assumes that no pure compound exists.

The partitioning of the compound between soil and water is determined by the partition coefficient, K_{oc}, and fraction of organic carbon, f_{oc}, as shown by the following equation (Mills et al. 1985):

(1) $\frac{\text{concentration in soil}}{\text{concentration in soil water}} = K_{oc} f_{oc}$.

The partitioning of the compound between soil water and soil air is determined by Henry's Constant, K_H, as shown by the following equation (Mills et al. 1985):

(2) $\frac{\text{concentration in soil air}}{\text{concentration in soil water}} = 41.6\ K_H$ (atm-m^3/mole), at 20°C

The concentration of a compound in soil air can thus be calculated for a given concentration of the compound in soil by combining equations 1 and 2.

(3) $\frac{\text{concentration in soil air}}{\text{concentration in soil}} = \frac{41.6\ K_H}{K_{oc}\ f_{oc}}$

Table G-1 shows the concentration in the soil air calculated from the maximum concentrations of detected potentially carcinogenic PAHs in Carver Terrace subsurface soils. The concentrations of potentially carcinogenic PAH in the soil air surrounding the soil containing the PAH are very low (Table G-1). Summing the concentration of each individual PAH results in a total potentially carcinogenic PAH concentration of 1.39×10^{-6} (mg/m^3). The concentration of potentially carcinogenic PAH in the atmoshpere above the soil cannot exceed this concentration. Assuming that a utility worker breathes 16 cubic meters of soil air per day, that he or she is on site for 10 days per year and one year per lifetime,

that the utility worker weighs 70 kilograms, and that all potentially carcinogenic PAH are as potent as benzo(a)pyrene, his or her excess lifetime cancer risk is 1.43×10^{-9}.

True risks will likely be orders of magnitude lower because true air concentrations will be orders of magnitude lower. Some of the mechanisms that have not been accounted for in this analysis and that would result in lower atmospheric concentrations are listed below.

1. The soil containing the PAHs may be dry part of the time, causing a decrease in the rate of volatilization. If there is no soil water, the PAHs cannot dissolve and then volatilize into the air.
2. A cycling rate of the air above the soil will dilute the atmospheric concentration because fresh air, air not containing PAHs from the site, will continually be introduced into the area above the site.

012834

Table G-1

CALCULATION OF POTENTIALLY CARCINOGENIC PAH IN AIR DUE TO VOLATILIZATION

Shown are the conentrations of PCOCs in soil vapor. Concentrations were calculated only for potentially carcinogenic PAH detected in Carver Terrace subsurface soils. The air concentrations are based on the maximum concentrations detected.

PCOC	MAXIMUM SOIL CONCENTRATION (ppb)	$K_{oc} FG_{oc}$ (a)	$K_H \times 41.6$ (a)	AIR CONCENTRATION (ppb)	AIR CONCENTRATION (mg/m^3)(b)
Benzo(a)anthracene	9.50E+02	2.00E+03	4.16E-05	2.00E-05	1.90E-07
Benzo(a)pyrene	4.70E+02	5.50E+04	2.94E-05	1.70E-07	1.70E-09
Benzo(a)fluoranthene	8.30E+02	5.50E+03	5.62E-04	8.50E-05	8.50E-07
Chrysene	1.00E+03	2.00E+03	4.37E-05	2.20E-05	3.50E-07
Total Potentially Carc. PAH					1.39E-06

(a) Taken from: Mabey, W.R, J.H. Smith, R.T. Podoll, H.L. Johnson, T. Mill, T.W. Chow, J. Gates, I.W. Partridge, H. Juber, and D. Vandenberg. 1982. Aquatic Fate Process Data for Organic Priority Pollutants. EPA Rept. No. 44/4-81-014.

(b) Conversion factors were taken from: Verschueren, K. 1983. Handbook of Environmental Data on Organic Chemicals (second edition). Van Norstrand Reinhold Co., New York.

012835

APPENDIX 4-A

TREATABILITY STUDY REPORT

012836

SOIL WASHING RESULTS
ADDENDUM
TREATABILITY STUDY REPORT
KOPPERS COMPANY, INC.

Prepared for:

KOPPERS COMPANY, INC
PREVIOUSLY OPERATED PROPERTY
TEXARKANA, TEXAS

Prepared by:

KEYSTONE ENVIRONMENTAL RESOURCES, INC.
440 COLLEGE PARK DRIVE
MONROEVILLE, PENNSYLVANIA 15146

PROJECT 157673-08

MARCH 1988

012837

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1.0 INTRODUCTION

The following report presents the results from the treatability evaluation for soil washing for samples collected at the Koppers Company, Inc. Previously Operated Properties in Texarkana, Texas. This report is an addendum to the "TREATABILITY STUDY REPORT", issued in February, 1988.

Included in this report is a background section describing the basics of soil washing, followed by the procedures and the results from the laboratory testing performed. Keystone's standard operating procedures for soil washing were followed throughout the testing.

2.0 BACKGROUND

2.1 Ex Situ Soil Washing

Ex situ soil washing refers to the excavation of contaminated soils and the subsequent mechanical washing of the soils in a slurry type reactor. The soil contaminants are transferred into the liquid phase. The soil reduced in contaminants is placed back on-site with the washwater containing the contaminants treated.

Ex situ soil washing involves the removal of contaminants from the soil substrate, using a mechanical washing technique. It is a physical separation procedure for contaminant removal from soil that involves the washing of the soil into a liquid medium. The process is carried out in equipment that is designed for contacting excavated soils with the liquid. Removal of contaminants from the soil matrix involves both physical displacement of loosely held contaminants and desorption of the contaminants that are more tightly bound to the soil particles.

The separation of contaminants from soil particles depends on the relative wetability of the particle surfaces. The surface free energy of a particle is lowered by the addition of surface active agents, i. e. surfactants. This creates a hydrophobic surface on the soil particles and therefore separates the soil from the contaminant particles. The surfactant/water solution is then physically separated from the washing solution. The cleaned soil particles are dewatered and returned to the site.

The soil washing evaluation results can be used for more than one purpose. Soil washing can be used at the site for ex situ washing , following excavation of the contaminated soil, or the surfactants can be applied to in situ treatment of the contaminated soils.

3.0 PROCEDURES

3.1 Soil Sampling

Both shallow and deep samples were collected for use in the treatability work. Shallow samples were collected with the use of a shovel. Deep soil samples (7-8 feet) were collected with the use of a backhoe. A 55 gallon drum and 5 gallon pails were used for sample collection and transport.

A local contractor was hired to dig the deep sample with a backhoe. The deep sample was obtain at the 7-8 feet level, within the saturated soil zone.

Shallow soil samples were collected by Keystone field services personnel. A cleaned shovel was used. These samples was placed in 5 gallon pails for transport. The shallow samples were used in the ex situ (soil washing) treatability work. Deep samples were used for the in situ (bioreclamation) treatability work.

Upon arrival at the research center in Monroeville, the sample codes were specified for each of the sample containers. The codes and corresponding descriptions are listed below.

Sample Description	Sample Code
Deep sample adjacent to church (55 gallon drum)	T-TX-8
Surface soil near DW-01 (5 gallon pail)	T-TX-9
Surface soil under creosote contaminated area (5 gallon pail)	T-TX-10
Surface soil from creosote contaminated area (5 gallon pail)	T-TX-11
Surface soil, from heavy naphthalene contamination area (5 gallon pail)	T-TX-12

3.2 Laboratory Procedures

The procedure for determining the applicability of soil washing treatment was conducted in 3 phases.

Phase I involved the washing of several soil samples with different surfactants and visually evaluating the soils and wash solutions. Following each wash, the soil was emersed in methylene chloride solution. The addition of creosote compounds darken the methylene chloride solution in relation to the concentration. From this observation the choice of surfactants is narrowed down.

Phase II work involved washing the soil with the best visually observed surfactant or combination of surfactants. Generally, oil & grease (freon extractables) and methylene chloride extractables analysis were performed on these samples.

These two methods of analysis have been chosen because they indicate gross removal of contaminants. Oil & grease analysis was performed because it is an EPA accepted method. Methylene chloride analysis was performed due to its greater affinity for creosote compounds making it a better choice.

Phase III work involved the evaluation of the results obtained in Phase II and choosing the best surfactant(s). A final washing is then conducted and the sample is submitted for more extensive chemical analysis.

A total of five soils were washed to determine the most effective surfactant or combination of surfactants for each different soil type collected. A two wash cycle was selected for soils from this site. A greater number of wash cycles can be performed on a particular soil depending on the cleanup criteria.

The soil samples were screened with a $^1/_4$ inch mesh prior to soil washing to remove large pieces of foreign matter, i.e. pieces of wood, large cinders,and rocks.

The following procedure was followed for all five runs:

1. All raw samples are premixed.

2. Impeller speed is set at 900 rpm.

3. 1000 grams of hot tap water within the temperature range of 45-50^{0}C is added to the soil wash unit.

4. pH of solution adjusted to 10 with 20% (by weight) NaOH.

5. Surfactant added.

6. 500 gm raw soil in the soil wash unit.

7. Air is applied at a very low flow rate.

8. Soil is washed for 15 minutes while maintaining pH=10.

9. Wash procedure is repeated using 50% of initial surfactant dosage. Water is added, the pH adjusted and surfactant added and washed another 15 minutes.

10. In the final step, the washed soil is rinsed one or more times with warm water, the impeller speed maintained at 900 rpm and the air flow rate set on high.

4.0 RESULTS

4.1 Phase I and Phase II

Two separate screening runs were performed on each of the soils, using different surfactant combinations that were visually chosen in Phase I (described above). Two surfactant combinations (#1 and #2) were evaluated based on Phase I results. Oil & grease (freon extractables) and methylene chloride extractables analysis were used to evaluate surfactants from the screening run and are presented in Table 4-1. The % removals are also included. These results were used in choosing the surfactant combination for the final Phase II runs.

4.2 Phase III

The screening run for T-TX-8 indicated better removals using the surfactant combination #2, which was chosen for the final run. As evidenced by the results in Table 4-2, for the final run, both methylene chloride extractables and oil & grease showed similar reductions as in the screening run. The results indicate good removals for other compounds. Pentachlorophenol (PCP) was reduced 87%. Toluene was reduced 97% and xylene 99%. PAH removal showed very good results with a total PAH removal of 85%.

For soil T-TX-9, surfactant combination #2 showed better removals and was chosen for the final run. Soil washing results from the final run for soil T-TX-9 are presented in Table 4-3. Results from the final run show good overall removals. Oil & grease and methylene chloride extractables were reduced 97 and 91%, respectively. Both toluene and xylene were reduced >99.9%. Total PAH compounds were reduced 60%.

The results from the final treatment run for soil T-TX-10 can be found in Table 4-4. Surfactant #1 was chosen for the final treatment run. The results showed greater than 90% removals for both oil & grease and methylene chloride extractables. PCP was reduced 86%. Petroleum hydrocarbons, benzene, and xylene were all reduced >99.9%. PAH concentration were relatively low in the soil and thus a total PAH reduction of 35% was achieved.

TABLE 4-1
KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
SOIL WASHING PHASE II RESULTS
SCREENING RUN

Sample	Wet Weight		Dry Weight		% Removals	
	Oil & Grease	Me Chl Ext	Oil & Grease	Me Chl Ext	Oil & Grease	Me Chl Ext
T-TX-8 RAW	738	1480	891	1770	---	---
T-TX-8 #1	660	727	818	858	8	52
T-TX-8 #2	520	393	624	453	30	74
T-TX-9 RAW	16200	42700	16981	44759	---	---
T-TX-9 #1	820	7610	981	9103	94	80
T-TX-9 #2	967	8120	1146	9621	93	79
T-TX-10 RAW	2040	12700	2321	14448	---	---
T-TX-10 #1	240	833	298	1035	87	93
T-TX-10 #2	253	653	314	810	86	94
T-TX-11 RAW	18800	52700	20705	58040	---	---
T-TX-11 #1	1650	9740	2102	12408	90	79
T-TX-11 #2	1390	8120	1762	10292	91	82
T-TX-12 RAW	34200	65500	43456	83227	---	---
T-TX-12 #1	1570	5000	1990	6337	95	92
T-TX-12 #2	3320	8700	4240	11111	90	87

Note: Me Chl Ext indicates Methylene Chloride Extractables
All values in units of mg/L

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TABLE 4-2
KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
SOIL WASHING PHASE III RESULTS
SOIL SAMPLE T-TX-8
(Surfactant Combination #2)

Sample Parameter (mg/Kg)			Wet Weight Initial	Wet Weight Final	Dry Weight Initial	Dry Weight Final	% Remov
Oil & Grease	---	---	738	473	891	552	38
Methylene Chloride Ext.	---	---	1480	733	1770	855	52
Pentachlorophenol	---	---	33.5	4.60	40.1	5.37	87
Petroleum Hydrocarbons	---	---	300	130	359	152	58
Benzene	---	---	<0.040	0.032	<0.048	0.038	NA
Toluene	---	---	1.530	0.040	1.848	0.046	97
Xylene	---	---	9.950	0.097	12.017	0.113	99
PAH Compounds (mg/Kg)	# Of Rings	Aqueous Solubility at 25 C, ug/L					
Naphthalene	2	31,700	341	21	412	24.5	94
Acenaphthylene	3	-	38.8	11.1	46.9	13.0	72
Acenaphthene	3	3,930	200	45.8	242	53.4	78
Fluorene	3	1,980	166	20.4	200	23.8	88
Phenanthrene	3	1,290	481	60.5	581	70.6	88
Anthracene	3	73	116	15.5	140	18.1	87
Fluoranthene	4	260	216	41.1	261	48.0	82
Pyrene	4	135	188	29.4	227	34.3	85
Benzo(a)anthracene	4	14	47.1	16.2	56.9	18.9	67
Chrysene	4	2	50.2	16.[illegible]	60.6	19.3	68
Benzo(a)pyrene	5	3.8	23.0	3.75	27.8	4.4	84
Benzo(b)fluoranthene	5	-	38.4	6.95	46.4	8.1	83
Benzo(k)fluoranthene	5	-	14.8	2.63	17.9	3.1	83
Dibenzo(a,h)anthracene	5	2.49	11.8	7.32	14.3	8.5	40
Benzo(g,h,i)perylene	6	-	23.1	5.43	27.9	6.3	77
Indeno(1,2,3-cd)pyrene	6	-	12.5	4.11	15.1	4.8	68
Total PAH			1968	308	2376	359	85

NA - Not Applicable

012847

TABLE 4-3
KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
SOIL WASHING PHASE III RESULTS
SOIL SAMPLE T-TX-9
(Surfactant Combination #2)

Sample Parameter (mg/Kg)			Wet Weight Initial	Wet Weight Final	Dry Weight Initial	Dry Weight Final	% Remc
Oil & Grease	---	---	14100	407	14811	493	97
Methylene Chloride Ext.	---	---	42900	3390	45063	4104	91
Pentachlorophenol	---	---	0.265	0.030	0.278	0.037	87
Petroleum Hydrocarbons	---	---	2180	120	2290	145	94
Benzene	---	---	0.107	0.025	0.112	0.030	73
Toluene	---	---	0.032	<0.020	0.033	<0.024	>99.9
Xylene	---	---	0.132	<0.030	0.139	<0.036	>99.9
PAH Compounds (mg/Kg)	# Of Rings	Aqueous Solubility at 25 C, ug/L					
Naphthalene	2	31,700	<1.00	18.20	<1.00	22.00	NA
Acenaphthylene	3	-	<1.00	<1.00	<1.05	<1.21	NA
Acenaphthene	3	3,930	58.10	30.00	61.03	36.32	40
Fluorene	3	1,980	4.15	4.97	4.36	6.02	NA
Phenanthrene	3	1,290	19.50	19.50	20.48	23.61	NA
Anthracene	3	73	6.02	6.13	6.32	7.42	NA
Fluoranthene	4	260	122.00	92.10	128.15	111.50	13
Pyrene	4	135	139.00	75.40	146.01	91.28	37
Benzo(a)anthracene	4	14	711.00	60.40	746.85	73.12	90
Chrysene	4	2	105.00	78.10	110.29	94.55	14
Benzo(a)pyrene	5	3.8	90.60	28.70	95.17	34.75	63
Benzo(b)fluoranthene	5	-	218.00	65.70	228.99	79.54	65
Benzo(k)fluoranthene	5	-	67.70	24.60	71.11	29.78	58
Dibenzo(a,h)anthracene	5	2.49	227.00	90.20	238.45	109.20	54
Benzo(g,h,i)perylene	6	-	152.00	70.70	159.66	85.59	46
Indeno(1,2,3-cd)pyrene	6	-	145.00	51.10	152.31	61.86	59
Total PAH			2065.07	715.80	2171.29	867.80	60

NA - Not Applicable

012848

TABLE 4-4
KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
SOIL WASHING PHASE III RESULTS
SOIL SAMPLE T-TX-10
(Surfactant Combination #2)

Sample Parameter (mg/Kg)			Wet Weight Initial	Wet Weight Final	Dry Weight Initial	Dry Weight Final	% Remo
Oil & Grease	---	---	2200	113	2469	138	94
Methylene Chloride Ext.	---	---	11500	920	12907	1121	91
Pentachlorophenol	---	---	1.440	0.186	1.616	0.227	86
Petroleum Hydrocarbons	---	---	830	<100	932	<122	>99.9
Benzene	---	---	0.027	<0.020	0.030	<0.024	>99.9
Toluene	---	---	0.058	0.020	0.065	0.024	62
Xylene	---	---	0.125	<0.030	0.140	<0.037	>99.9
PAH Compounds (mg/Kg)	# Of Rings	Aqueous Solubility at 25 C, ug/L					
Naphthalene	2	31,700	3.81	2.80	4	3.41	20
Acenaphthylene	3	-	INT	<1.00	---	<1.22	---
Acenaphthene	3	3,930	48.4	<1.00	54	<1.22	98
Fluorene	3	1,980	INT	<0.200	---	<0.244	---
Phenanthrene	3	1,290	1.69	2.34	2	2.85	NA
Anthracene	3	73	0.620	0.650	1	0.792	NA
Fluoranthene	4	260	6.58	15.8	7	19.2	NA
Pyrene	4	135	12.7	13.1	14	16.0	NA
Benzo(a)anthracene	4	14	5.00	7.34	6	8.94	NA
Chrysene	4	2	7.50	8.26	8.42	10.06	NA
Benzo(a)pyrene	5	3.8	7.39	5.82	8.29	7.09	15
Benzo(b)fluoranthene	5	-	22.8	15.6	25.6	19.0	26
Benzo(k)fluoranthene	5	-	4.71	4.44	5.29	5.41	NA
Dibenzo(a,h)anthracene	5	2.49	25.4	11.5	28.5	14.0	51
Benzo(g,h,i)perylene	6	-	14.1	7.72	15.82	9.40	41
Indeno(1,2,3-cd)pyrene	6	-	16.7	8.09	18.74	9.85	47
Total PAH			177.4	105.66	199	129	35

Note: INT indicates interference encountered during analysis
NA = Not Applicable

012849

The results for soil T-TX-11 are in Table 4-5. Surfactant combination #2 was chosen from the screening run to be used in the final run. Oil & grease and methylene chloride extractables were reduced 94 and 89%, respectively. PCP was reduced 82% and petroleum hydrocarbons 93%. Benzene was reduced 60% and both toluene and xylene were reduced >99.9%. Total PAH compounds were reduced 42%.

Surfactant combination #1 was chosen from the screening run for soil T-TX-12, to be used in the final treatment run. Results from the final treatment run for soil T-TX-12 can be found in Table 4-6. Results indicate that oil & grease, pentachlorophenol, petroleum hydrocarbons and xylene were all reduced >99.9%. Methylene chloride extractables were reduced 99.9%. Reduction of PAH compounds showed excellent results with 99% reduction of total PAH compounds.

TABLE 4-5
KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
SOIL WASHING PHASE III RESULTS
SOIL SAMPLE T-TX-11
(Surfactant Combination #2)

Sample Parameter (mg/Kg)			Wet Weight Initial	Wet Weight Final	Dry Weight Initial	Dry Weight Final	% Remov
Oil & Grease	---	---	18300	920	20288	1147	94
Methylene Chloride Ext.	---	---	54500	5250	60421	6546	89
Pentachlorophenol	---	---	30.70	4.80	34.04	5.99	82
Petroleum Hydrocarbons	---	---	4730	300	5240	374	93
Benzene	---	---	0.069	0.025	0.077	0.031	60
Toluene	---	---	0.202	<0.020	0.224	<0.025	>99.9
Xylene	---	---	0.416	<0.030	0.461	<0.037	>99.9
PAH Compounds (mg/Kg)	# Of Rings	Aqueous Solubility at 25 C, ug/L					
Naphthalene	2	31700	18.0	34.1	20.0	42.5	NA
Acenaphthylene	3	-	<1.00	<1.00	<1.11	<1.25	NA
Acenaphthene	3	3930	26.4	<1.00	29.0	<1.25	96
Fluorene	3	1980	7.3	0.985	8.09	1.23	85
Phenanthrene	3	1290	28.9	30.6	32.0	38.2	NA
Anthracene	3	73	10	7.35	11.1	9.2	17
Fluoranthene	4	260	286	209	317	261	18
Pyrene	4	135	325	198	360	247	31
Benzo(a)anthracene	4	14	196	90.3	217	113	48
Chrysene	4	2	243	105	269	131	51
Benzo(a)pyrene	5	3.8	67.5	30.1	74.8	37.5	50
Benzo(b)fluoranthene	5	-	169	70.0	187	87.3	53
Benzo(k)fluoranthene	5	-	65.9	27.6	73.1	34.4	53
Dibenzo(a,h)anthracene	5	2.49	171	46.3	190	57.7	70
Benzo(g,h,i)perylene	6	-	112	44.1	124	55.0	56
Indeno(1,2,3-cd)pyrene	6	-	85.1	43.3	94.3	54.0	43
Total PAH			1812	939	2009	1170	42

NA = Not Applicable

4-2a

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TABLE 4-6
KOPPERS COMPANY, INC.
TEXARKANA, TX TREATABILITY STUDY
SOIL WASHING PHASE III RESULTS
SOIL SAMPLE T-TX-12
(Surfactant Combination #1)

Sample Parameter (mg/Kg)			Wet Weight Initial	Wet Weight Final	Dry Weight Initial	Dry Weight Final	% Remo
Oil & Grease	---	---	101000	<50.0	135570	<63.0	>99.9
Methylene Chloride Ext.	---	---	112000	173	150336	218	99.9
Pentachlorophenol	---	---	0.094	<0.010	0.127	<0.013	>99.9
Petroleum Hydrocarbons	---	---	4300	<100	5772	<126	>99.9
Benzene	---	---	<0.200	<0.020	<0.268	<0.025	NA
Toluene	---	---	<0.200	<0.020	<0.268	<0.025	NA
Xylene	---	---	5.26	<0.030	7.060	<0.038	>99.9
PAH Compounds (mg/Kg)	# Of Rings	Aqueous Solubility at 25 C, ug/L					
Naphthalene	2	31,700	19700	189	26443	238	99
Acenaphthylene	3	-	1120	4.98	1503	6.27	99.6
Acenaphthene	3	3,930	317	8.80	426	11.1	97
Fluorene	3	1,980	244	8.62	328	10.9	97
Phenanthrene	3	1,290	1330	57.40	1785	72.3	96
Anthracene	3	73	69.7	2.81	93.6	3.54	96
Fluoranthene	4	260	512	18.8	687	23.7	97
Pyrene	4	135	230	10.5	309	13.2	96
Benzo(a)anthracene	4	14	163	4.74	219	5.97	97
Chrysene	4	2	165	4.83	221	6.08	97
Benzo(a)pyrene	5	3.8	230	0.717	309	0.903	99.7
Benzo(b)fluoranthene	5	-	70.8	2.23	95.0	2.81	97
Benzo(k)fluoranthene	5	-	31.5	1.01	42.3	1.27	97
Dibenzo(a,h)anthracene	5	2.49	63.4	3.56	85.1	4.48	95
Benzo(g,h,i)perylene	6	-	52.2	2.66	70.1	3.35	95
Indeno(1,2,3-cd)pyrene	6	-	45.4	1.81	60.9	2.28	96
Total PAH			24344	322	32677	406	99

NA - Not Applicable

4-2b

012852

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5.0 SUMMARY AND CONCLUSIONS

The laboratory treatability results presented show that ex situ soil washing is effective in reducing soil contaminant concentrations measured.

Based on a two wash cycle, soil washing of five different soils achieved the following reductions in soil contaminant concentrations with results reported on a dry weight basis: (i) oil & grease was reduced from an initial range of 900 - 136,000 mg/Kg to 140 - 1,150 mg/Kg, (ii) methylene chloride extractables, from an initial concentration range of 1,770 - 150,336 mg/Kg to 218 - 6,546, (iii) pentachlorophenol, from an initial concentration range of 0.127 - 40.1 to <0.013 - 5.99 mg/Kg, (iv) petroleum hydrocarbons, from an initial concentration range of 359 - 5,772 mg/Kg to <122 - 374 mg/Kg, (v) benzene, from an initial concentration range of 0.030 - 1.848 mg/Kg to <0.025 - 0.046 mg/Kg, (vi) toluene, from an initial concentration range of 0.033 - 1.848 to <0.024 - 0.046 mg/Kg, (vii) xylene, from an initial concentration range of 0.139 - 12.017 to <0.037 - 0.113 mg/Kg, and (viii) total PAH's, from an initial concentration range of 199 - 32,677 mg/Kg to 129 - 1,170 mg/Kg.

The variations in the treated soil concentrations among the different soils tested is mainly attributable to the different physical/chemical interactions between a specific chemical and a specific soil type. These interactions account for the fact that chemical compounds such as pentachlorophenol measured between <0.013 to 5.99 mg/Kg in treated soil while individual PAH's measured between <0.244 - 111 mg/Kg; total PAH's in the treated soil ranged between 129 - 1,170 mg/Kg. The level of PAH's in the treated soil is due to the fact that the particular soil type tested is such that PAH's are tightly bound to the treated soil and will not solubilize into solution. Pentachlorophenol on the other hand, is not as tightly bound to the soil as PAH's are.

The absorptive capacity of a soil for PAH's has been investigated and shown to be highly correlated with the organic carbon content of the soil.[1] The ability of the soil to tightly bind hydrophobic contaminants can hinder the complete removal of these compounds. The relationship between organic matter in soils and the organic carbon content of the soil can be estimated. Likewise, an estimation of the amount of these compounds that will not readily be released from the soil matrix, can be determined. It is recommended that prior to further treatment, the organic carbon content and

clay content of the soil should be investigated and an estimation of the absorbed carbon be determined.

The fact that PAH's are so tightly bound to the treated soil infers that incineration, some type of solvent washing, or thermal desorption may be needed if further reductions in soil PAH's are needed. In lieu of incineration, it may also be possible to support higher levels through a risk based approach which draws upon the fact that PAH,s are very tightly bound to the soil. It is also possible that lower soil PAH concentrations could be achieved with more wash cycles.

REFERENCES

1. Fu, J. K. "Aromatic Compound Solubility and Sorption Onto Soils in Solvent/Water Mixtures," PhD Dissertation, Carnegie Mellon University, 1985.

APPENDIX 6-A

COSTING TABLES ASSOCIATED WITH THE UNSATURATED SOIL RESPONSE MEDIA UNIT ALTERNATIVES

APPENDIX 6-A

UNSATURATED SOIL ALTERNATIVE COSTING TABLES

This appendix presents pertinent information associated with the detailed evaluation of the unsaturated soil alternatives (Section 6.0). For the purposes of the detailed cost estimate for Alternatives SL-1, SL-2, SL-3, and SL-4, it has been assumed that the areas to be sampled and/or possibly remediated are those that had been previously sodded as shown on Figure 1. This assumption was used solely for cost estimating purposes. Actual areas to be sampled and/or remediated will be determined in the Record of Decision.

Included in this appendix are the present worth tables for the baseline cost evaluation; the capital and present worth costs for the low cost evaluation; and the capital and present worth costs for the high cost evaluation. Also included in this appendix is a listing of the major baseline unit costs and their corresponding sources.

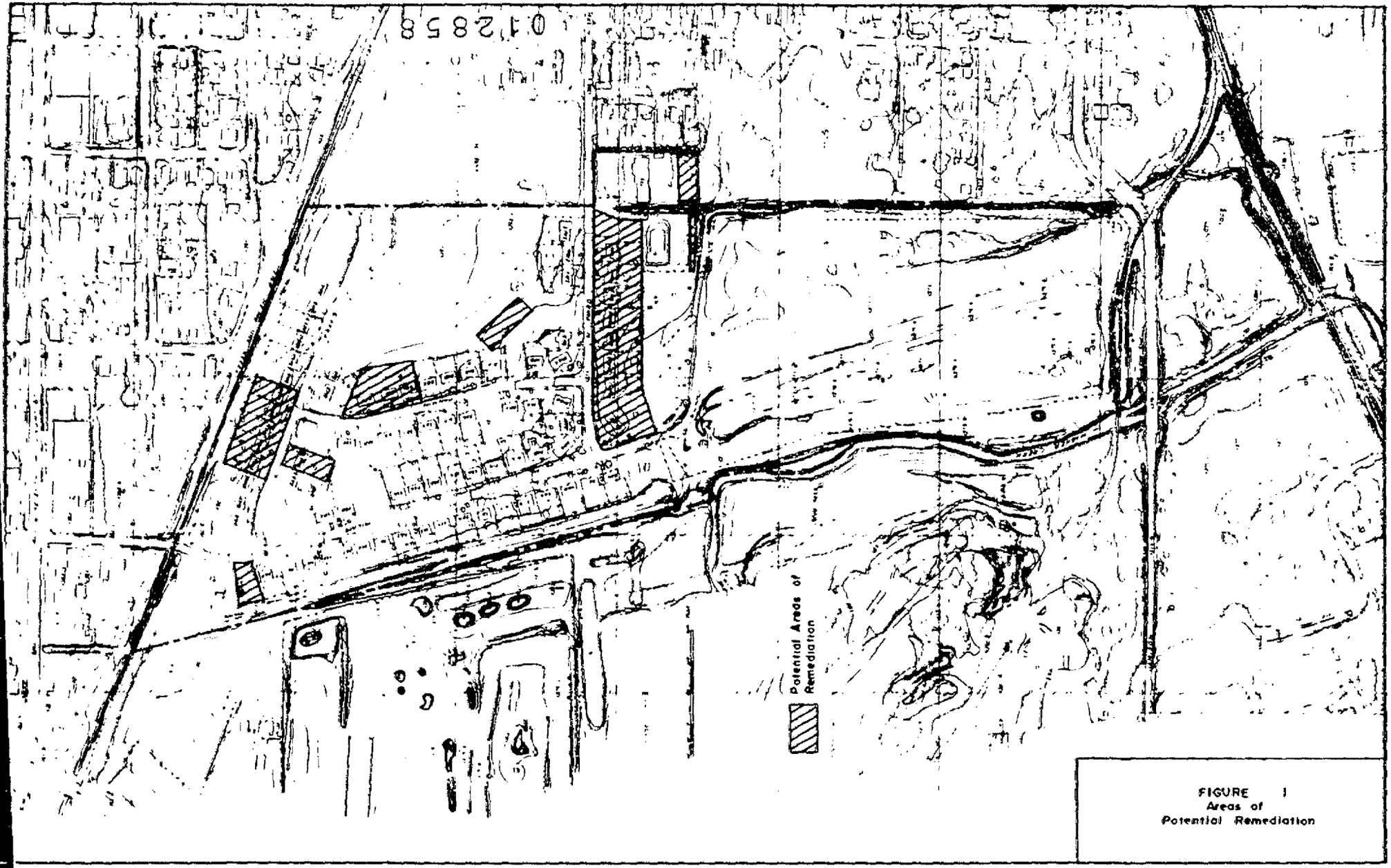

FIGURE 1
Areas of
Potential Remediation

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ALTERNATIVE SL-1: PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	27.0												
O&M COSTS		14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
TOTAL ANNUAL COST	27.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	27.0	12.7	11.6	10.5	9.6	8.7	7.9	7.2	6.5	5.9	5.4	4.9	4.5

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
TOTAL ANNUAL COST	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	4.1	3.7	3.3	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.6	1.4	1.3

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	14.0	14.0	14.0	14.0	14.0	
TOTAL ANNUAL COST	14.0	14.0	14.0	14.0	14.0	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	1.2	1.1	1.0	0.9	0.8	159.0

(PW-SL1)

ALTERNATIVE SL-1: LOW CAPITAL COSTS

NO ACTION/MONITORING

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
CARVER TERRACE SOILS:	NO CAPITAL EXPENDITURES						
BULK SOLIDS TO BE TREATED WITH GROUND WATER:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS CONTAINING SOIL CUTTINGS FROM THE RI	0.95	$15,200
ON-SITE HAULING	160	CY	$3	$480	HAULED TO THE GRAVEL PITS TO BE TREATED BY GROUND WATER	1.0	$480
HEALTH & SAFETY	1	WEEK	$4,000	$4,000	INCLUDES A H&S OFFICER DURING REMEDIATION; HNU, RESPIRATOR, CLOTHING	0.95	$3,800
DIRECT CAPITAL COST							$19,480
ENGINEERING & DESIGN (11%)							$2,143
CONTINGENCY (20%)							$3,896
TOTAL CAPITAL COST							$25,519
							**********
APPROXIMATE TOTAL CAPITAL COST							$26,000

(LOW-SL1)

012860

012860

ALTERNATIVE SL-1: LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	26.0												
O&M COSTS		14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
TOTAL ANNUAL COST	26.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PPESENT WORTH	26.0	12.7	11.6	10.5	9.6	8.7	7.9	7.2	6.5	5.9	5.4	4.9	4.5

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
TOTAL ANNUAL COST	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	4.1	3.7	3.3	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.6	1.4	1.3

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	14.0	14.0	14.0	14.0	14.0	
TOTAL ANNUAL COST	14.0	14.0	14.0	14.0	14.0	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	1.2	1.1	1.0	0.9	0.8	158.0

(LPWSL1)

ALTERNATIVE SL-1: HIGH CAPITAL COSTS

NO ACTION/MONITORING

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
CARVER TERRACE SOILS:	NO CAPITAL EXPENDITURES						
BULK SOLIDS TO BE TREATED WITH GROUND WATER:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS CONTAINING SOIL CUTTINGS FROM THE RI	1.1	$17,600
ON-SITE HAULING	160	CY	$3	$480	HAULED TO THE GRAVEL PITS TO BE TREATED BY GROUND WATER	1.0	$480
HEALTH & SAFETY	1	WEEK	$4,000	$4,000	INCLUDES A H&S OFFICER DURING REMEDIATION; HNU, RESPIRATOR, CLOTHING	1.1	$4,400
DIRECT CAPITAL COST							$22,480
ENGINEERING & DESIGN (11%)							$2,473
CONTINGENCY (20%)							$4,496
TOTAL CAPITAL COST							$29,449
APPROXIMATE TOTAL CAPITAL COST							$29,000

(HI-SL1)

012862

012862

ALTERNATIVE SL-1: HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	29.0												
O&M COSTS		14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
TOTAL ANNUAL COST	29.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	29.0	12.7	11.6	10.5	9.6	8.7	7.9	7.2	6.5	5.9	5.4	4.9	4.5

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
TOTAL ANNUAL COST	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	4.1	3.7	3.3	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.6	1.4	1.3

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	14.0	14.0	14.0	14.0	14.0	
TOTAL ANNUAL COST	14.0	14.0	14.0	14.0	14.0	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	1.2	1.1	1.0	0.9	0.8	161.0

(HPWSL1)

012863

012863

ALTERNATIVE SL-2: PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	759.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	759.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	759.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	808.0

(PW-SL2)

012864

012864

TABLE 6-3: ALTERNATIVE SL-2: LOW CAPITAL COSTS

CAPPING/MONITORING/INSTITUTIONAL CONTROLS

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.40	ACRES	$1,450	$6,380		0.95	$6,061
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES/DAY COLLECTED	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	0.95	$52,668
CAPPING:							
PREVIOUSLY SODDED AREAS:							
EXCAVATION-(12")	7900	CY	$15.00	$118,500	178,000 SF; 20% BULKING	0.95	$112,575
ON-SITE HAULING	7900	CY	$3	$23,700	HAUL TO PITS, TREAT VIA GW	1.0	$23,700
TOPSOIL-(10")	5500	CY	$7.50	$41,250	178,000 SF; 20% BULKING	0.95	$39,188
TOPSOIL-SPREADING	5500	CY	$2.00	$11,000		0.95	$10,450
SOD-(2")	19800	SY	$3.55	$70,290	INCLUDES MATERIAL AND LABOR	0.95	$66,776
NEWLY SODDED AREAS:							
TOPSOIL-(10")	450	CY	$7.50	$3,375	12,000 SF; 20% BULKING	0.95	$3,206
TOPSOIL-SPREADING	450	CY	$2.00	$900		0.95	$855
SOD (2")	1300	SY	$3.55	$4,615	INCLUDES MATERIAL AND LABOR	0.95	$4,384
ESTABLISHMENT OF SOIL\SOD BARRIER:							
PERIODIC INSPECTIONS	4	INSPECT	$1,200	$4,800	$400 LABOR + TRAVEL/INSPECT	1.0	$4,800
FERTILIZING	22	LOTS	$180	$3,960	$30/MONTH/LOT	0.95	$3,762
MOWING	22	LOTS	$720	$15,840	$120/MONTH/LOT	0.95	$15,048
WATER	22	LOTS	$90	$1,980	$15/MONTH/LOT	0.95	$1,881
BULK SOLIDS TO BE TREATED BY GROUND WATER:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS CONTAINING SOIL CUTTINGS FROM THE RI	0.95	$15,200
ON-SITE HAULING	160	CY	$3	$480	HAULED TO THE GRAVEL PITS, TO BE TREATED BY GROUND WATER	1.0	$480
HEALTH & SAFETY	48	WEEKS	$4,000	$192,000	H&S OFFICER DURING INITIAL MONITORING AND EXCAVATION (2 WEEKS/LOT); HNu, RESPIRATOR, CLOTHING	0.95	$182,400
DIRECT CAPITAL COST							$551,794
ENGINEERING & DESIGN (11%)							$60,697
CONTINGENCY (20%)							$110,359
TOTAL CAPITAL COST							$722,849 **********
APPROXIMATE TOTAL CAPITAL COST							$723,000

(LOW-SL2)

012865

012865

ALTERNATIVE SL-2: LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	723.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	723.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	723.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	772.0

(LPWSL2)

012866

012866

ALTERNATIVE SL-2: HIGH CAPITAL COSTS

CAPPING/MONITORING/INSTITUTIONAL CONTROLS

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.40	ACRES	$1,450	$6,380		1.1	$7,018
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES/DAY COLLECTED	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	1.1	$60,984
CAPPING:							
PREVIOUSLY SODDED AREAS:							
EXCAVATION-(12")	7900	CY	$15.00	$118,500	1' OVER 178,000 SF; 20%	1.1	$130,350
ON-SITE HAULING	7900	CY	$3	$23,700	BULKING HAULED TO THE GRAVEL PITS, TO BE TREATED BY GROUND WATER	1.0	$23,700
TOPSOIL-(10")	5500	CY	$7.50	$41,250	10" OVER 178,000 SF; 20% BULKING	1.1	$45,375
TOPSOIL-SPREADING	5500	CY	$2.00	$11,000		1.1	$12,100
SOD-(2")	19800	SY	$3.55	$70,290	INCLUDES MATERIAL AND LABOR	1.1	$77,319
NEWLY SODDED AREAS:							
TOPSOIL-(10")	450	CY	$7.50	$3,375	10" OVER 12,000 SF; 20% BULKING	1.1	$3,713
TOPSOIL-SPREADING	450	CY	$2.00	$900		1.1	$990
SOD (2")	1300	SY	$3.55	$4,615	INCLUDES MATERIAL AND LABOR	1.1	$5,077
ESTABLISHMENT OF SOIL\SOD BARRIER:							
PERIODIC INSPECTIONS	4	INSPECT	$1,200	$4,800	$400 LABOR + TRAVEL/INSPECT	1.0	$4,800
FERTILIZING	22	LOTS	$180	$3,960	$30/MONTH/LOT	1.1	$4,356
MOWING	22	LOTS	$720	$15,840	$120/MONTH/LOT	1.1	$17,424
WATER	22	LOTS	$90	$1,980	$15/MONTH/LOT	1.1	$2,178
BULK SOLIDS TO BE TREATED BY GROUND WATER:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS CONTAINING SOIL CUTTINGS FROM THE RI	1.1	$17,600
ON-SITE HAULING	160	CY	$3	$480	HAULED TO THE GRAVEL PITS, TO BE TREATED BY GROUND WATER	1.0	$480
HEALTH & SAFETY	48	WEEKS	$4,000	$192,000	H&S OFFICER DURING INITIAL MONITORING AND EXCAVATION (2 WEEKS/LOT); HNu, RESPIRATOR, CLOTHING	1.1	$211,200
DIRECT CAPITAL COST							$634,343
ENGINEERING & DESIGN (11%)							$69,778
CONTINGENCY (20%)							$126,869
TOTAL CAPITAL COST							$830,989
APPROXIMATE TOTAL CAPITAL COST							$831,000

(HI-SL2)

012867

012867

ALTERNATIVE SL-2: HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	831.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	831.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	831.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	880.0

(HPWSL2)

012868

012868

ALTERNATIVE SL-3: PRESENT WORTH ANALYSIS: 10 YEAR TREATMENT

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1494.0												
O&M COSTS		72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	5.2	5.2
TOTAL ANNUAL COST	1494.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1494.0	65.4	59.5	54.1	49.2	44.7	40.6	36.9	33.6	30.5	27.8	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	1953.4

(PW-SL3)

012869

012869

ALTERNATIVE SL-3: LOW CAPITAL COSTS

IN-SITU BIODEGRADATION

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.40	ACRES	$1,450	$6,380		0.95	$6,061
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	0.95	$52,668
INSTALL SPRINKLER SYSTEM	22	LOTS	$2,000	$44,000	INCL. BOX AND METER	0.95	$41,800
IN-SITU BIORECLAMATION	7000	CY	$135	$945,000	190,000 SF TREATED TO A DEPTH OF 1 FT; NO BULKING	0.95	$897,750
BULK SOLIDS TO BE TREATED WITH GROUND WATER:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS CONTAINING SOIL CUTTINGS	0.95	$15,200
ON-SITE HAULING	160	CY	$3	$480	FROM THE RI HAULED TO THE GRAVEL PITS TO BE TREATED BY GROUND WATER	1.0	$480
HEALTH & SAFETY	16	WEEKS	$4,000	$64,000	H&S OFFICER DURING MONITORING & REMEDIATION; HNu, RESPIRATOR	0.95	$60,800
DIRECT CAPITAL COST							$1,083,119
ENGINEERING & DESIGN (11%)							$119,143
CONTINGENCY (20%)							$216,624
TOTAL CAPITAL COST							$1,418,886
APPROXIMATE TOTAL CAPITAL COST							$1,419,000

(LOW-SL3)

012870

012870

ALTERNATIVE SL-3: LOW PRESENT WORTH ANALYSIS: 10 YEAR TREATMENT

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1419.0												
O&M COSTS		72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	5.2	5.2
TOTAL ANNUAL COST	1419.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1419.0	65.4	59.5	54.1	49.2	44.7	40.6	36.9	33.6	30.5	27.8	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	1878.4

(LPWSL3)

012871

012871

ALTERNATIVE SL-3: HIGH CAPITAL COSTS

IN-SITU BIODEGRADATION

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.40	ACRES	$1,450	$6,380		1.1	$7,018
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	1.1	$60,984
INSTALL SPRINKLER SYSTEM	22	LOTS	$2,000	$44,000	INCL. BOX AND METER	1.1	$48,400
IN-SITU BIORECLAMATION	7000	CY	$135	$945,000	190,000 SF TREATED TO A DEPTH OF 1 FT; NO BULKING	1.1	$1,039,500
BULK SOLIDS TO BE TREATED WITH GROUND WATER:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS CONTAINING SOIL CUTTINGS	1.1	$17,600
ON-SITE HAULING	160	CY	$3	$480	FROM THE RI HAULED TO THE GRAVEL PITS TO BE TREATED BY GROUND WATER	1.0	$480
HEALTH & SAFETY	16	WEEKS	$4,000	$64,000	H&S OFFICER DURING MONITORING & REMEDIATION; HNU, RESPIRATOR	1.1	$70,400
DIRECT CAPITAL COST							$1,254,062
ENGINEERING & DESIGN (11%)							$137,947
CONTINGENCY (20%)							$250,812
TOTAL CAPITAL COST							$1,642,821
APPROXIMATE TOTAL CAPITAL COST							$1,643,000

(HI-SL3)

012872

012872

ALTERNATIVE SL-3: HIGH PRESENT WORTH ANALYSIS: 10 YEAR TREATMENT

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1643.0												
O&M COSTS		72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	5.2	5.2
TOTAL ANNUAL COST	1643.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1643.0	65.4	59.5	54.1	49.2	44.7	40.6	36.9	33.6	30.5	27.8	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3

TOTAL NET PRESENT WORTH (THOUSAND $'s)

2102.4

(HPWSL3)

012873

012873

ALTERNATIVE SL-4(A): PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	2021.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2		5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	2021.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2		5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	2021.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	2070.0

(PW-SL4A)

012874

012874

ALTERNATIVE SL-4(A): LOW CAPITAL COSTS

EXCAVATION/SOIL WASHING

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		0.95	$6,061
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED	0.95	$52,668
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT DEPTH OVER 190,000 SF; 20% BULKING	0.95	$119,700
ON-SITE HAULING	8400	CY	$3	$25,200		0.95	$23,940
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	0.95	$15,200
ON-SITE HAULING	160	CY	$3	$480		1.0	$480
SOIL WASHING TREATMENT SYSTEM:							
TREATMENT SYSTEM MOB/DEMOB	1	LP SUM	$14,000	$14,000		1.0	$14,000
TREATMENT EQUIP. RENTAL (TREATED AT A RATE OF 2.5 TONS PER HOUR @ 10 HOURS PER DAY)	12	MONTHS	$58,000	$696,000	INCLUDES REACTORS, TANKS, MIXERS, HOPPERS	0.95	$661,200
CHEMICALS	1	LP SUM	$18,000	$18,000		0.95	$17,100
UTILITIES	1	LP SUM	$11,000	$11,000		0.95	$10,450
UV/OZONE	1	LP SUM	$6,750	$6,750		0.95	$6,413
OPERATION & SUPERVISION	1	LP SUM	$165,000	$165,000		0.95	$156,750
AIR MONITORING	12	MONTHS	$3,000	$36,000		0.95	$34,200
BACKFILLING OF TREATED SOILS	8560	CY	$3.00	$25,680	CARVER TERRACE SOILS AND BULK SOLIDS; PLACED WITHIN THE KS&G PROPERTY	0.95	$24,396
SITE RESTORATION:							
CLEAN BACKFILL-(10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	0.95	$33,250
SPREADING	7000	CY	$2.00	$14,000		0.95	$13,300
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	0.95	$71,160
HEALTH & SAFETY	52	WEEKS	$4,000	$208,000	H&S DURING INITIAL MONITORING AND EXCAVATION/TREATMENT	0.95	$197,600
DIRECT CAPITAL COST							$1,466,227
ENGINEERING & DESIGN (11%)							$161,285
CONTINGENCY (20%)							$293,245
TOTAL CAPITAL COST							$1,920,753 **********
APPROXIMATE TOTAL CAPITAL COST							$1,921,000

012875

012875

ALTERNATIVE SL-4(A): LOW NET PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1921.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	1921.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1921.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	1970.0

(LPWSL4A)

012876

012876

ALTERNATIVE SL-4(A): HIGH CAPITAL COSTS

EXCAVATION/SOIL WASHING

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		1.1	$7,018
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED	1.1	$60,984
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT DEPTH OVER 190,000 SF; 20% BULKING	1.1	$138,600
ON-SITE HAULING	8400	CY	$3	$25,200		1.1	$27,720
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	1.1	$17,600
ON-SITE HAULING	160	CY	$3	$480		1.0	$480
SOIL WASHING TREATMENT SYSTEM:							
TREATMENT SYSTEM MOB/DEMOB	1	LP SUM	$14,000	$14,000		1.0	$14,000
TREATMENT EQUIP. RENTAL (TREATED AT A RATE OF 2.5 TONS PER HOUR @ 10 HOURS PER DAY)	12	MONTHS	$58,000	$696,000	INCLUDES REACTORS, TANKS, MIXERS, HOPPERS	1.1	$765,600
CHEMICALS	1	LP SUM	$18,000	$18,000		1.1	$19,800
UTILITIES	1	LP SUM	$11,000	$11,000		1.1	$12,100
UV/OZONE	1	LP SUM	$6,750	$6,750		1.1	$7,425
OPERATION & SUPERVISION	1	LP SUM	$165,000	$165,000		1.1	$181,500
AIR MONITORING	12	MONTHS	$3,000	$36,000		1.1	$39,600
BACKFILLING OF TREATED SOILS	8560	CY	$3.00	$25,680	CARVER TERRACE SOILS AND BULK SOLIDS; PLACED WITHIN THE KS&G PROPERTY	1.1	$28,248
SITE RESTORATION:							
CLEAN BACKFILL-(10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	1.1	$38,500
SPREADING	7000	CY	$2.00	$14,000		1.1	$15,400
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	1.1	$82,396
HEALTH & SAFETY	52	WEEKS	$4,000	$208,000	H&S DURING INITIAL MONITORING AND EXCAVATION/TREATMENT	1.1	$228,800
DIRECT CAPITAL COST							$1,695,451
ENGINEERING & DESIGN (11%)							$186,500
CONTINGENCY (20%)							$339,090
TOTAL CAPITAL COST							$2,221,040
APPROXIMATE TOTAL CAPITAL COST							$2,221,000

(HI-SL4A)

012877

012877

ALTERNATIVE SL-4(A): HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	2221.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	2221.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	2221.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	2270.0

(HPWSL4A)

012878

012878

ALTERNATIVE SL-4(B): PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	3959.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	3959.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	3959.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3

TOTAL NET PRESENT WORTH (THOUSAND $'s)
4008.0

(PW-SL4B)

012879

012879

ALTERNATIVE SL-4(B): LOW CAPITAL COSTS

EXCAVATION/ON-SITE INCINERATION/BACKFILL ASH

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		0.95	$6,061
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	0.95	$52,668
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT DEPTH OVER 190,000 SF; 20% BULKING; EXCAVATE 1/2 OF A LOT AT A TIME	0.95	$119,700
ON-SITE HAULING	8400	CY	$3.00	$25,200		0.95	$23,940
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	0.95	$15,200
ON-SITE HAULING	160	CY	$3.00	$480		1.0	$480
ON-SITE INCINERATOR SYSTEM:							
MOB/DEMOB	1	LP SUM	$100,000	$100,000		1.0	$100,000
TEST BURN	1	LP SUM	$80,000	$80,000		1.0	$80,000
INCINERATION	8560	CY	$250	$2,140,000	50 CY PER DAY	0.95	$2,033,000
ELECTR & INSTRUM	1	LP SUM	$95,000	$95,000		0.95	$90,250
AIR MONITORING	6	MONTHS	$3,000	$18,000		0.95	$17,100
ASH TESTING (DELISTING)	1	LP SUM	$100,000	$100,000		1.0	$100,000
ASH SPREADING	4280	CY	$3.50	$14,980	ASSUME 50% VOLUME LOSS; PLACED WITHIN KS&G PROPERTY	0.95	$14,231
SITE RESTORATION:							
CLEAN BACKFILL-(10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	0.95	$33,250
SPREADING	7000	CY	$2.00	$14,000		0.95	$13,300
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	0.95	$71,160
HEALTH & SAFETY	28	WEEKS	$4,000	$112,000	INCLUDES A H&S OFFICER DURING REMEDIATION	0.95	$106,400
DIRECT CAPITAL COST							$2,885,100
ENGINEERING & DESIGN (11%)							$317,361
CONTINGENCY (20%)							$577,020
TOTAL CAPITAL COST							$3,779,481
							**********
APPROXIMATE TOTAL CAPITAL COST							$3,779,000

(LOW-SL4B)

012880

012880

ALTERNATIVE SL-4(B): LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	3779.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	3779.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	3779.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'S)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	3828.0

(LPWSL4B)

012881

012881

ALTERNATIVE SL-4(B): HIGH CAPITAL COSTS

EXCAVATION/ON-SITE INCINERATION/BACKFILL ASH

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		1.1	$7,018
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	1.1	$60,984
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT DEPTH OVER 190,000 SF; 20% BULKING; EXCAVATE 1/2 OF A LOT AT A TIME	1.1	$138,600
ON-SITE HAULING	8400	CY	$3.00	$25,200		1.1	$27,720
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	1.1	$17,600
ON-SITE HAULING	160	CY	$3.00	$480		1.0	$480
ON-SITE INCINERATOR SYSTEM:							
MOB/DEMOB	1	LP SUM	$100,000	$100,000		1.0	$100,000
TEST BURN	1	LP SUM	$80,000	$80,000		1.0	$80,000
INCINERATION	8560	CY	$250	$2,140,000	50 CY PER DAY	1.1	$2,354,000
ELECTR & INSTRUM	1	LP SUM	$95,000	$95,000		1.1	$104,500
AIR MONITORING	6	MONTHS	$3,000	$18,000		1.1	$19,800
ASH TESTING (DELISTING)	1	LP SUM	$100,000	$100,000		1.0	$100,000
ASH SPREADING	4280	CY	$3.50	$14,980	ASSUME 50% VOLUME LOSS; PLACED WITHIN KS&G PROPERTY	1.1	$16,478
SITE RESTORATION:							
CLEAN BACKFILL-(10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	1.1	$38,500
SPREADING	7000	CY	$2.00	$14,000		1.1	$15,400
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	1.1	$82,396
HEALTH & SAFETY	28	WEEKS	$4,000	$112,000	INCLUDES A H&S OFFICER DURING REMEDIATION	1.1	$123,200
DIRECT CAPITAL COST							$3,296,356
ENGINEERING & DESIGN (11%)							$362,599
CONTINGENCY (20%)							$659,271
TOTAL CAPITAL COST							$4,318,226
APPROXIMATE TOTAL CAPITAL COST							$4,318,000

(HI-SL4B)

012882

012882

ALTERNATIVE SL-4(B): HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	4318.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	4318.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	4318.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	4367.0

(HPWSL4B)

012883

012883

ALTERNATIVE SL-4(B2): PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	5599.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5599.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.39	0.319
NET PRESENT WORTH	5599.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3

TOTAL NET PRESENT WORTH (THOUSAND $'s)
5648.0

(PW-SL4B2)

012884

012884

ALTERNATIVE SL-4(82): LOW CAPITAL COSTS

EXCAVATION/ON-SITE INCINERATION/OFF-SITE DISPOSAL OF ASH

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		0.95	$6,061
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	0.95	$52,668
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT OVER 190,000 SF; 20% BULKING; EXCAV 1/2 OF A LOT AT A TIME-1 WEEK	0.95	$119,700
ON-SITE HAULING	8400	CY	$3.00	$25,200		0.95	$23,940
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	0.95	$15,200
ON-SITE HAULING	160	CY	$3.00	$480		1.0	$480
ON-SITE INCINERATOR SYSTEM:							
MOB/DEMOB	1	LP SUM	$100,000	$100,000		1.0	$100,000
TEST BURN	1	LP SUM	$80,000	$80,000		1.0	$80,000
INCINERATION	8560	CY	$250	$2,140,000	50 CY PER DAY	0.95	$2,033,000
ELECTR & INSTRUM	1	LP SUM	$95,000	$95,000		0.95	$90,250
AIR MONITORING	6	MONTHS	$3,000	$18,000		0.95	$17,100
ASH TESTING (DELISTING)	1	LP SUM	$100,000	$100,000		1.0	$100,000
ASH DISPOSAL:							
LOADING ASH	4280	CY	$3.50	$14,980	ASSUME 50% VOLUME LOSS;	0.95	$14,231
TRANSPORTATION	99000	LH	$4.00	$396,000	300 MILES ONE-WAY; 13 CY/20 TON TRUCK=330 LOADS	0.95	$376,200
DISPOSAL	4280	CY	$200	$856,000	DISPOSED AT AN OFF-SITE	0.95	$813,200
SITE RESTORATION:							
CLEAN BACKFILL-(10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	0.95	$33,250
SPREADING	7000	CY	$2.00	$14,000		0.95	$13,300
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	0.95	$71,1[illegible]
HEALTH & SAFETY	28	WEEKS	$4,000	$112,000	INCLUDES A H&S OFFICER DURING REMEDIATION	0.95	$106,400
DIRECT CAPITAL COST							$4,074,500
ENGINEERING & DESIGN (11%)							$448,195
CONTINGENCY (20%)							$814,900
TOTAL CAPITAL COST							$5,337,595 **********
APPROXIMATE TOTAL CAPITAL COST							$5,338,000

(LOWSL4B2)

012885

012885

ALTERNATIVE SL-4(82): LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	5338.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5338.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	5338.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3

TOTAL NET PRESENT WORTH (THOUSAND $'s)

5387.0

(LPWSL4B2)

012886

012886

ALTERNATIVE SL-4(82): HIGH CAPITAL COSTS

EXCAVATION/ON-SITE INCINERATION/OFF-SITE DISPOSAL OF ASH

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		1.1	$7,018
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	1.1	$60,984
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT OVER 190,000 SF; 20% BULKING; EXCAV 1/2 OF A LOT AT A TIME-1 WEEK	1.1	$138,600
ON-SITE HAULING	8400	CY	$3.00	$25,200		1.1	$27,720
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	1.1	$17,600
ON-SITE HAULING	160	CY	$3.00	$480		1.0	$480
ON-SITE INCINERATOR SYSTEM:							
MOB/DEMOB	1	LP SUM	$100,000	$100,000		1.0	$100,000
TEST BURN	1	LP SUM	$80,000	$80,000		1.0	$80,000
INCINERATION	8560	CY	$250	$2,140,000	50 CY PER DAY	1.1	$2,354,000
ELECTR & INSTRUM	1	LP SUM	$95,000	$95,000		1.1	$104,500
AIR MONITORING	6	MONTHS	$3,000	$18,000		1.1	$19,800
ASH TESTING (DELISTING)	1	LP SUM	$100,000	$100,000		1.0	$100,000
ASH DISPOSAL:							
LOADING ASH	4280	CY	$3.50	$14,980	ASSUME 50% VOLUME LOSS;	1.1	$16,478
TRANSPORTATION	99000	LM	$4.00	$396,000	300 MILES ONE-WAY; 13 CY/20 TON TRUCK=330 LOADS	1.1	$435,600
DISPOSAL	4280	CY	$200	$856,000	DISPOSED AT AN OFF-SITE	1.1	$941,600
SITE RESTORATION:							
CLEAN BACKFILL-(10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	1.1	$38,500
SPREADING	7000	CY	$2.00	$14,000		1.1	$15,400
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	1.1	$82,396
HEALTH & SAFETY	28	WEEKS	$4,000	$112,000	INCLUDES A H&S OFFICER DURING REMEDIATION	1.1	$123,200
DIRECT CAPITAL COST							$4,673,556
ENGINEERING & DESIGN (11%)							$514,091
CONTINGENCY (20%)							$934,711
TOTAL CAPITAL COST							$6,122,358 **********
APPROXIMATE TOTAL CAPITAL COST							$6,122,000

(HI-SL482)

012887

012887

ALTERNATIVE SL-4(B2): HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	6122.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	6122.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	6122.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3

TOTAL NET PRESENT WORTH (THOUSAND $'s)
6171.0

(HPWSL4B2)

012888

012888

ALTERNATIVE SL-4(C): PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	21806.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	21806.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	21806.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	21855.0

(PW-SL4C)

012889

012889

ALTERNATIVE SL-4(C): LOW CAPITAL COSTS

EXCAVATION\OFF-SITE INCINERATION

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		0.95	$6,061
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	0.95	$52,668
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATE	8400	CY	$15	$126,000	1 FT DEPTH OVER 190,000 SF; 20% BULKING; 35 CY/WEEK EXCAVATED; PLACED IN 20-GALLON CONTAINERS	0.95	$119,700
TRANSPORTATION	194100	LM	$4	$776,400	300 MI ONE-WAY; 13CY/20 TON TRUCK	0.95	$737,580
INCINERATE	8400	CY	$1,700	$14,280,000		0.95	$13,566,000
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOADING BULK SOLIDS	160	CY	$100	$16,000		0.95	$15,200
TRANSPORTATION	1200	LM	$4	$4,800		1.0	$4,800
INCINERATE	160	CY	$1,700	$272,000		0.95	$258,400
SITE RESTORATION:							
BACKFILL (10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	0.95	$33,250
SPREADING	7000	CY	$2.00	$14,000		0.95	$13,300
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	0.95	$71,160
HEALTH & SAFETY	244	WEEKS	$4,000	$976,000	H&S OFFICER DURING MONITORING & EXCAVATION; HNu AND RESPIRATORS	0.95	$927,200
DIRECT CAPITAL COST							$15,813,679
ENGINEERING & DESIGN (11%)							$1,739,505
CONTINGENCY (20%)							$3,162,736
TOTAL CAPITAL COST							$20,715,919 **********
APPROXIMATE TOTAL CAPITAL COST							$20,716,000

(LOW-SL4C)

012890

012890

ALTERNATIVE SL-4(C): LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	20716.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	20716.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	20716.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3

TOTAL NET PRESENT WORTH (THOUSAND $'s)

20765.0

(LPWSL4C)

012891

012891

ALTERNATIVE SL-4(C): HIGH CAPITAL COSTS

EXCAVATION\OFF-SITE INCINERATION

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		1.1	$7,018
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	1.1	$60,984
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATE	8400	CY	$15	$126,000	1 FT DEPTH OVER 190,000 SF; 20% BULKING; 35 CY/WEEK EXCAVATED; PLACED IN 20-GALLON CONTAINERS	1.1	$138,600
TRANSPORTATION	194100	LM	$4	$776,400	300 MI ONE-WAY; 13CY/20 TON TRUCK	1.1	$854,040
INCINERATE	8400	CY	$1,700	$14,280,000		1.1	$15,708,000
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOADING BULK SOLIDS	160	CY	$100	$16,000		1.1	$17,600
TRANSPORTATION	1200	LM	$4	$4,800		1.0	$4,800
INCINERATE	160	CY	$1,700	$272,000		1.1	$299,200
SITE RESTORATION:							
BACKFILL (10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	1.1	$38,500
SPREADING	7000	CY	$2.00	$14,000		1.1	$15,400
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	1.1	$82,396
HEALTH & SAFETY	244	WEEKS	$4,000	$976,000	H&S OFFICER DURING MONITORING & EXCAVATION; HNu AND RESPIRATORS	1.1	$1,073,600
DIRECT CAPITAL COST							$18,309,818
ENGINEERING & DESIGN (11%)							$2,014,080
CONTINGENCY (20%)							$3,661,964
TOTAL CAPITAL COST							$23,985,861
							**********
APPROXIMATE TOTAL CAPITAL COST							$23,986,000

(HI-SL4C)

012892

012892

ALTERNATIVE SL-4(C): HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	23986.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	23986.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	23986.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3

TOTAL NET PRESENT WORTH (THOUSAND $'s)

24035.0

(HPWSL4C)

012893

012893

ALTERNATIVE SL-4(D): PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	3854.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	3854.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	3854.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	3903.0

(PW-SL4D)

012894

012894

ALTERNATIVE SL-4(D): LOW CAPITAL COSTS

EXCAVATION/OFF-SITE LANDFILL

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		0.95	$6,061
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	0.95	$52,668
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT OVER 190,000 SF; 20% BULKING; EXCAV 1/2 OF A LOT AT A TIME-1 WEEK	0.95	$119,700
TRANSPORT	194100	LM	$4.00	$776,400	300 MILES ONE-WAY, 13 CYS PER 20 TON TRUCK = 647 TRUCK LOADS	0.95	$737,580
DISPOSAL	8400	CY	$200	$1,680,000		0.95	$1,596,000
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	0.95	$15,200
TRANSPORT	1200	LM	$4.00	$4,800		1.0	$4,800
DISPOSAL	160	CY	$200	$32,000		0.95	$30,400
SITE RESTORATION:							
CLEAN BACKFILL (10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	0.95	$33,250
SPREADING	7000	CY	$2.00	$14,000		0.95	$13,300
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	0.95	$71,160
HEALTH & SAFETY	28	WEEKS	4000	$112,000	H&S OFFICER DURING MONITORING & EXCAVATION; HNu, RESPIRATORS	0.95	$106,400
DIRECT CAPITAL COST							$2,794,879
ENGINEERING & DESIGN (11%)							$307,437
CONTINGENCY (20%)							$558,976
TOTAL CAPITAL COST							$3,661,291
							**********
APPROXIMATE TOTAL CAPITAL COST							$3,661,000

(LOW-SL4D)

012895

012895

ALTERNATIVE SL-4(D): LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	3661.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	3661.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	3661.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	3710.0

(LPWSL4D)

012896

012896

ALTERNATIVE SL-4(D): HIGH CAPITAL COSTS

EXCAVATION/OFF-SITE LANDFILL

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	4.4	ACRES	$1,450	$6,380		1.1	$7,018
INITIAL MONITORING							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	1.1	$60,984
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATION	8400	CY	$15	$126,000	1 FT OVER 190,000 SF; 20% BULKING; EXCAV 1/2 OF A LOT AT A TIME-1 WEEK	1.1	$138,600
TRANSPORT	194100	LM	$4.00	$776,400	300 MILES ONE-WAY, 13 CYS PER 20 TON TRUCK = 647 TRUCK LOADS	1.1	$854,040
DISPOSAL	8400	CY	$200	$1,680,000		1.1	$1,848,000
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	1.1	$17,600
TRANSPORT	1200	LM	$4.00	$4,800		1.0	$4,800
DISPOSAL	160	CY	$200	$32,000		1.1	$35,200
SITE RESTORATION:							
CLEAN BACKFILL (10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	1.1	$38,500
SPREADING	7000	CY	$2.00	$14,000		1.1	$15,400
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	1.1	$82,396
HEALTH & SAFETY	28	WEEKS	4000	$112,000	H&S OFFICER DURING MONITORING & EXCAVATION; HNu, RESPIRATORS	1.1	$123,200
DIRECT CAPITAL COST							$3,235,418
ENGINEERING & DESIGN (11%)							$355,896
CONTINGENCY (20%)							$647,084
TOTAL CAPITAL COST							$4,238,397
							**********
APPROXIMATE TOTAL CAPITAL COST							$4,238,000

(HI-SL4D)

012897

012897

ALTERNATIVE SL-4(D): HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	4238.0												
O&M COSTS		5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	4238.0	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	4238.0	4.7	4.3	3.9	3.6	3.2	2.9	2.7	2.4	2.2	2.0	1.8	1.7

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
ANNUAL DISCOUNT RATE@10%	0.29	0.26	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7	0.6	0.6	0.5	0.5

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	5.2	5.2	5.2	5.2	5.2	
TOTAL ANNUAL COST	5.2	5.2	5.2	5.2	5.2	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.4	0.4	0.4	0.3	0.3	4287.0

(HPWSL4D)

012898

012898

ALTERNATIVE SL-4(E): PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	615.0												
O&M COSTS		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TOTAL ANNUAL COST	615.0	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	615.0	6.9	6.3	5.7	5.2	4.7	4.3	3.9	3.5	3.2	2.9	2.7	2.4

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TOTAL ANNUAL COST	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	2.2	2.0	1.8	1.7	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	7.6	7.6	7.6	7.6	7.6	
TOTAL ANNUAL COST	7.6	7.6	7.6	7.6	7.6	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.6	0.6	0.5	0.5	0.4	686.6

(PW-SL4E)

012899

012899

ALTERNATIVE SL-4(E): LOW CAPITAL COSTS

EXCAVATION/PASSIVE SOIL WASHING

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	1	LP SUM	$2,000	$2,000		0.95	$1,900
INITIAL MONITORING:							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	0.95	$8,360
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	0.95	$52,668
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATE	8400	CY	$15	$126,000	1 FT OVER 190,000 SF; 20% BULKING; EXCAVATE 1/2 OF A LOT AT A TIME-1 WEEK	0.95	$119,700
ON-SITE HAULING	8400	CY	$3	$25,200	HAULED TO THE GRAVEL PITS; TO BE TREATED WITH GROUND WATER	0.95	$23,940
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	0.95	$15,200
ON-SITE HAULING	160	CY	$3.00	$480	HAULED TO THE GRAVEL PITS TO BE TREATED WITH GROUND WATER	1.0	$480
SITE RESTORATION:							
CLEAN BACKFILL (10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	0.95	$33,250
SPREADING	7000	CY	$2.00	$14,000		0.95	$13,300
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	0.95	$71,160
HEALTH & SAFETY	28	WEEKS	$4,000	$112,000	H&S OFFICER DURING MONITORING & EXCAVATION; HNu, RESPIRATOR	0.95	$106,400
DIRECT CAPITAL COST							$446,358
ENGINEERING & DESIGN (11%)							$49,099
CONTINGENCY (20%)							$89,272
TOTAL CAPITAL COST							$584,729
							**********
APPROXIMATE TOTAL CAPITAL COST							$585,000

(LOW-SL4E)

012900

012900

ALTERNATIVE SL-4(E): LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	585.0												
O&M COSTS		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TOTAL ANNUAL COST	585.0	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	585.0	6.9	6.3	5.7	5.2	4.7	4.3	3.9	3.5	3.2	2.9	2.7	2.4

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TOTAL ANNUAL COST	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	2.2	2.0	1.8	1.7	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	7.6	7.6	7.6	7.6	7.6	
TOTAL ANNUAL COST	7.6	7.6	7.6	7.6	7.6	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.6	0.6	0.5	0.5	0.4	656.6

(LPWSL4E)

012901

012901

ALTERNATIVE SL-4(E): HIGH CAPITAL COSTS

EXCAVATION/PASSIVE SOIL WASHING

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	1	LP SUM	$2,000	$2,000		1.1	$2,200
INITIAL MONITORING:							
SAMPLING	22	DAYS	$400	$8,800	8 SAMPLES COLLECTED/DAY	1.1	$9,680
ANALYSIS	176	SAMPLES	$315	$55,440	8 SAMPLES/LOT ANALYZED FOR PAHs AND ARSENIC	1.1	$60,984
SOILS FROM THE CARVER TERRACE SUBDIVISION:							
EXCAVATE	8400	CY	$15	$126,000	1 FT OVER 190,000 SF; 20% BULKING; EXCAVATE 1/2 OF A LOT AT A TIME-1 WEEK	1.1	$138,600
ON-SITE HAULING	8400	CY	$3	$25,200	HAULED TO THE GRAVEL PITS; TO BE TREATED WITH GROUND WATER	1.1	$27,720
BULK SOLIDS FROM THE KENNEDY SAND AND GRAVEL PROPERTY:							
LOAD BULK SOLIDS	160	CY	$100	$16,000	FOUR 40-CY ROLL-OFFS	1.1	$17,600
ON-SITE HAULING	160	CY	$3.00	$480	HAULED TO THE GRAVEL PITS TO BE TREATED WITH GROUND WATER	1.0	$480
SITE RESTORATION:							
CLEAN BACKFILL (10")	7000	CY	$5.00	$35,000	ONLY FOR CARVER TERRACE AREA	1.1	$38,500
SPREADING	7000	CY	$2.00	$14,000		1.1	$15,400
SOD (2")	21100	SY	$3.55	$74,905	ONLY FOR CARVER TERRACE AREA	1.1	$82,396
HEALTH & SAFETY	28	WEEKS	$4,000	$112,000	H&S OFFICER DURING MONITORING & EXCAVATION; HNu, RESPIRATOR	1.1	$123,200
DIRECT CAPITAL COST							$516,760
ENGINEERING & DESIGN (11%)							$56,844
CONTINGENCY (20%)							$103,352
TOTAL CAPITAL COST							$676,955
APPROXIMATE TOTAL CAPITAL COST							$677,000

(HI-SL4E)

012902

012902

ALTERNATIVE SL-4(E): HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	677.0												
O&M COSTS		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TOTAL ANNUAL COST	677.0	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	677.0	6.9	6.3	5.7	5.2	4.7	4.3	3.9	3.5	3.2	2.9	2.7	2.4

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TOTAL ANNUAL COST	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	2.2	2.0	1.8	1.7	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.7

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	7.6	7.6	7.6	7.6	7.6	
TOTAL ANNUAL COST	7.6	7.6	7.6	7.6	7.6	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.6	0.6	0.5	0.5	0.4	748.6

(HPWSL4E)

012903

012903

SOURCE INFORMATION FOR MAJOR COST ITEMS

SITE PREPARATION	$1,450/ACRE; MEANS, 021 108.0500, 1988
SAMPLING	$400/DAY; ASSUMES $40/HOUR LABOR + EXPENSES
ANALYSIS	$315/SAMPLE, NUS 1988 PRICE GUIDE
HEALTH & SAFETY	$4000/WEEK; ASSUMES LABOR COST OF $50.00/HOUR; $800 ROUND TRIP; $200/WEEK FOR RESPIRATOR; $150/WEEK FOR A HNU; AND APPROX $850/WEEK EXPENSES
PERIODIC INSPECTION	$1,200/INSPECTION; ASSUMES $50/HR LABOR + $800 ROUND TRIP TRAVEL EXPENSE
FENCE MAINTENANCE	MEANS, 015 304.0010, 1988
LOAD BULK SOLIDS	$100/CY; MEANS, 020 717.1120, 1988
EXCAVATION	$15/CY; MEANS, 022 254.0050,1988 + HEALTH&SAFETY
ON-SITE HAULING	$3/CY; MEANS, 022 266.1150, 1988 + HEALTH&SAFETY
TOPSOIL	$7.50/CY; VENDOR QUOTE
SPREADING TOPSOIL	$2/CY; VENDOR QUOTE
SOD	$3.55/SY; VENDOR QUOTE
FERTILIZING	$180/LOT; $30/MONTH/LOT-VENDOR QUOTE; USED 6 MONTHS
MOWING	$720/LOT; $120/MONTH/LOT-VENDOR QUOTE; USED 6 MONTHS
WATER	$90/LOT; $15/MONTH/LOT-VENDOR QUOTE; USED 6 MONTHS
SPRINKLER SYSTEM	$2,000/LOT; VENDOR QUOTE; INCLUDES BOX AND METER
IN-SITU BIORECLAMATION	$135/CY; KEYSTONE ENVIRONMENTAL RESOURCES (KER) ESTIMATE
MECHANICAL SOIL WASHING TREATMENT UNIT	ALL ASSOCIATED COSTS ARE KER ESTIMATES
ON-SITE INCINERATION	
MOB/DEMOB	$100,000; COST FROM ERT PREVIOUS REPORTS
TEST BURN	$80,000; COST FROM ERT PREVIOUS REPORTS
INCINERATION	$250/CY; COST FROM EPA PREVIOUS REPORT
AIR MONITORING	$3,000/MONTH; COST FROM ERT PREVIOUS REPORTS
ASH TESTING	$100,000; COST FROM ERT PREVIOUS REPORTS
OFF-SITE TRANSPORTATION	$4/LOADED MILE; COST FROM ERT PREVIOUS REPORTS
OFF-SITE DISPOSAL	$200/CY; MEANS 020 717.6021, 1988
OFF-SITE INCINERATION	$1,700/CY; VENDOR QUOTE

(SL-SOURC)

012904

012904

APPENDIX 6-B

COSTING TABLES ASSOCIATED WITH THE GROUND WATER RESPONSE MEDIA UNIT ALTERNATIVES

APPENDIX 6-B

GROUND WATER ALTERNATIVE COSTING TABLE

This appendix presents the costing table used for the detailed evaluation of the ground water alternatives (Section 6.0). Included are the tables for the baseline present worth evaluation; the capital and present work tables for the low cost evaluation; and the capital and present worth costs for the high cost evaluation. Also included in this appendix is a listing of the major baseline unit costs and their corresponding sources.

ALTERNATIVE GW-1: PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	45.0												
O&M COSTS		9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
TOTAL ANNUAL COST	45.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	45.0	8.2	7.4	6.8	6.1	5.6	5.1	4.6	4.2	3.8	3.5	3.2	2.9

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
TOTAL ANNUAL COST	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	2.6	2.4	2.2	2.0	1.8	1.6	1.5	1.3	1.2	1.1	1.0	0.9	0.8

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	9.0	9.0	9.0	9.0	9.0	
TOTAL ANNUAL COST	9.0	9.0	9.0	9.0	9.0	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	0.8	0.7	0.6	0.6	0.5	129.8

(PW GW1)

012907

012907

ALTERNATIVE GW-2A: PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1248.0												
O&M COSTS		311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
TOTAL ANNUAL COST	1248.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1248.0	282.7	256.9	233.6	212.4	193.1	175.4	159.5	145.2	131.9	120.0	108.9	99.2

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
TOTAL ANNUAL COST	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	90.2	81.8	74.3	67.8	61.6	56.0	51.0	46.3	42.0	38.3	34.8	31.4	28.6

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	311.0	311.0	311.0	311.0	311.0	
TOTAL ANNUAL COST	311.0	311.0	311.0	311.0	311.0	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	26.1	23.6	21.5	19.6	17.7	4179.5

(PW-GW2A)

012908

012908

ALTERNATIVE GW-2(A): LOW CAPITAL COSTS

ACTIVATED CARBON

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	1	LP SUM	$5,000	$5,000		0.95	$4,750
WELL REPLACEMENT	9	WELLS	$5,000	$45,000		0.95	$42,750
SUBSURFACE DRAIN SYSTEM:							
DRAINS INSTALL	2100	LF	$50	$105,000		0.95	$99,750
PUMPS	20	PUMPS	$3,000	$60,000		0.95	$57,000
SUMP INSTALL	20	SUMPS	$3,000	$60,000		0.95	$57,000
PIPING	1	LP SUM	$8,000	$8,000		0.95	$7,600
RECHARGE TRENCHING (IN-SITU SOIL FLUSHING):					BASED UPON A 10,000		
SHALLOW TRENCH INSTAL	1500	LF	$25	$37,500	GAL/DAY INJECTION RATE	0.95	$35,625
INJECTION PUMPS	2	PUMPS	$3,500	$7,000		0.95	$6,650
PIPING	1	LP SUM	$35,000	$35,000		0.95	$33,250
ELECT & INSTRUM	1	LP SUM	$20,000	$20,000		0.95	$19,000
INJECTION TANK	1	LP SUM	$10,000	$10,000		1.0	$10,000
CHEMICAL FEED SYSTEM	1	LP SUM	$5,000	$5,000		1.0	$5,000
HANDLING OF EXCAVATED SOILS FROM TRENCH EXCAVATION:							
EXCAVATE	2000	CY	$15	$30,000		0.95	$28,500
ON-SITE HAULING	2000	CY	$3.00	$6,000	HAULED ON SITE TO THE GRAVEL PITS; TREATED VIA GROUND WATER	0.95	$5,700
GROUNDWATER TREATMENT PLANT - PRELIMINARY EARTHWORK:							
SOIL FILL	4000	CY	$16	$64,000		0.95	$60,800
SURVEYING	1	LP SUM	$5,000	$5,000		0.95	$4,750
TREATMENT SYSTEM:							
OFFICE/LAB	1	LP SUM	$35,000	$35,000		1.0	$35,000
OIL/WATER SEP	1	LP SUM	$16,000	$16,000		1.0	$16,000
CARB ADSORP UNIT	1	LP SUM	$40,000	$40,000		1.0	$40,000
INIT CARB FILL	5000	LBS	$1.00	$5,000		0.95	$4,750
PIPING/PUMPS	1	LP SUM	$47,000	$47,000		0.95	$44,650
ELECTR & INSTRUM	1	LP SUM	$85,000	$85,000		0.95	$80,750
ANCIL EQUIPMT	1	LP SUM	$81,000	$81,000		0.95	$76,950
OTHER PROC TANKS	1	LP SUM	$45,000	$45,000		0.95	$42,750
HEALTH & SAFETY	24	WEEKS	$4,000	$96,000	H&S OFFICER DURING EXCAV; HNu AND RESPIRATORS	0.95	$91,200
DIRECT CAPITAL COST							$910,175
ENGINEERING & DESIGN (11%)							$100,119
CONTINGENCY (20%)							$182,035
TOTAL CAPITAL COST							$1,192,329
APPROXIMATE TOTAL CAPITAL COST							$1,192,000

012909

012909

ALTERNATIVE GW 2A: LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1192.0												
O&M COSTS		311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
TOTAL ANNUAL COST	1192.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1192.0	282.7	256.9	233.6	212.4	193.1	175.4	159.5	145.2	131.9	120.0	108.9	99.2

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
TOTAL ANNUAL COST	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	90.2	81.8	74.3	67.8	61.6	56.0	51.0	46.3	42.0	38.3	34.8	31.4	28.6

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	311.0	311.0	311.0	311.0	311.0	
TOTAL ANNUAL COST	311.0	311.0	311.0	311.0	311.0	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	26.1	23.6	21.5	19.6	17.7	4123.5

(LPWGW2A)

012910

ALTERNATIVE GW-2(A): HIGH CAPITAL COSTS

ACTIVATED CARBON

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	1	LP SUM	$5,000	$5,000		1.1	$5,500
WELL REPLACEMENT	9	WELLS	$5,000	$45,000		1.1	$49,500
SUBSURFACE DRAIN SYSTEM:							
DRAINS INSTALL	2100	LF	$50	$105,000		1.1	$115,500
PUMPS	20	PUMPS	$3,000	$60,000		1.1	$66,000
SUMP INSTALL	20	SUMPS	$3,000	$60,000		1.1	$66,000
PIPING	1	LP SUM	$8,000	$8,000		1.1	$8,800
RECHARGE TRENCHING (IN-SITU SOIL FLUSHING):					BASED UPON A 10,000 GAL/DAY INJECTION RATE		
SHALLOW TRENCH INSTAL	1500	LF	$25	$37,500		1.1	$41,250
INJECTION PUMPS	2	PUMPS	$3,500	$7,000		1.1	$7,700
PIPING	1	LP SUM	$35,000	$35,000		1.1	$38,500
ELECT & INSTRUM	1	LP SUM	$20,000	$20,000		1.1	$22,000
INJECTION TANK	1	LP SUM	$10,000	$10,000		1.0	$10,000
CHEMICAL FEED SYSTEM	1	LP SUM	$5,000	$5,000		1.0	$5,000
HANDLING OF EXCAVATED SOILS FROM TRENCH EXCAVATION:							
EXCAVATE	2000	CY	$15	$30,000		1.1	$33,000
ON-SITE HAULING	2000	CY	$3.00	$6,000	HAULED ON SITE TO THE GRAVEL PITS; TREATED VIA GROUND WATER	1.1	$6,600
GROUNDWATER TREATMENT PLANT - PRELIMINARY EARTHWORK:							
SOIL FILL	4000	CY	$16	$64,000		1.1	$70,400
SURVEYING	1	LP SUM	$5,000	$5,000		1.1	$5,500
TREATMENT SYSTEM:							
OFFICE/LAB	1	LP SUM	$35,000	$35,000		1.0	$35,000
OIL/WATER SEP	1	LP SUM	$16,000	$16,000		1.0	$16,000
CARB ADSORP UNIT	1	LP SUM	$40,000	$40,000		1.0	$40,000
INIT CARB FILL	5000	LBS	$1	$5,000		1.1	$5,500
PIPING/PUMPS	1	LP SUM	$47,000	$47,000		1.1	$51,700
ELECTR & INSTRUM	1	LP SUM	$85,000	$85,000		1.1	$93,500
ANCIL EQUIPMT	1	LP SUM	$81,000	$81,000		1.1	$89,100
OTHER PROC TANKS	1	LP SUM	$45,000	$45,000		1.1	$49,500
HEALTH & SAFETY	24	WEEKS	$4,000	$96,000	H&S OFFICER DURING EXCAV; HNU AND RESPIRATORS	1.1	$105,600
DIRECT CAPITAL COST							$1,037,150
ENGINEERING & DESIGN (11%)							$114,087
CONTINGENCY (20%)							$207,430
TOTAL CAPITAL COST							$1,358,667
							**********
APPROXIMATE TOTAL CAPITAL COST							$1,359,000

(HI-GW2A)

012911

012911

ALTERNATIVE GW-2A: HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1359.0												
O&M COSTS		311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
TOTAL ANNUAL COST	1359.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1359.0	282.7	256.9	233.6	212.4	193.1	175.4	159.5	145.2	131.9	120.0	108.9	99.2

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
TOTAL ANNUAL COST	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0	311.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	90.2	81.8	74.3	67.8	61.6	56.0	51.0	46.3	42.0	38.3	34.8	31.4	28.6

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	311.0	311.0	311.0	311.0	311.0
TOTAL ANNUAL COST	311.0	311.0	311.0	311.0	311.0
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	26.1	23.6	21.5	19.6	17.7

TOTAL NET PRESENT WORTH (THOUSAND $'s)

4290.5

(HPWGW2A)

012912

012912

ALTERNATIVE GW-2B: PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1311.0												
O&M COSTS		324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	1311.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1311.0	294.5	267.6	243.3	221.3	201.2	182.7	166.2	151.3	137.4	125.1	113.4	103.4

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	94.0	85.2	77.4	70.6	64.2	58.3	53.1	48.3	43.7	39.9	36.3	32.7	29.8

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	27.2	24.6	22.4	20.4	18.5

TOTAL NET PRESENT WORTH (THOUSAND $'s)
4365.0

(PW-GW2B)

012913

012913

ALTERNATIVE GW-2B: LOW PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1252.0												
O&M COSTS		324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	1252.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1252.0	294.5	267.6	243.3	221.3	201.2	182.7	166.2	151.3	137.4	125.1	113.4	103.4

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	94.0	85.2	77.4	70.6	64.2	58.3	53.1	48.3	43.7	39.9	36.3	32.7	29.8

	26	27	28	29	30	TOTAL NET PRESENT WORTH (THOUSAND $'s)
CAPITAL COST						
O&M COSTS	324.0	324.0	324.0	324.0	324.0	
TOTAL ANNUAL COST	324.0	324.0	324.0	324.0	324.0	
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057	
NET PRESENT WORTH	27.2	24.6	22.4	20.4	18.5	4306.0

(LPWGW2B)

012914

012914

ALTERNATIVE GW-2(B): LOW CAPITAL COSTS

FLUIDIZED CARBON BED

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	1	LP SUM	$5,000	$5,000		0.95	$4,750
WELL REPLACEMENT	9	WELLS	$5,000	$45,000		0.95	$42,750
SUBSURFACE DRAIN SYSTEM:							
DRAINS INSTALL	2100	LF	$50	$105,000		0.95	$99,750
FLOATING PUMPS	20	PUMPS	$3,000	$60,000		0.95	$57,000
SUMP INSTALL	20	SUMPS	$3,000	$60,000		0.95	$57,000
PIPING	1	LP SUM	$8,000	$8,000		0.95	$7,600
RECHARGE TRENCHING (IN-SITU SOIL FLUSHING):					BASED UPON A 10,000 GPD		
SHALLOW TRENCH INSTALL	1500	LF	$25.00	$37,500	INJECTION RATE	0.95	$35,625
INJECTION PUMPS	2	PUMPS	$3,500	$7,000		0.95	$6,650
PIPING	1	LP SUM	$35,000	$35,000		0.95	$33,250
ELECT & INSTRUM	1	LP SUM	$20,000	$20,000		0.95	$19,000
INJECTION TANK	1	LP SUM	$10,000	$10,000		1.0	$10,000
CHEMICAL FEED SYSTEM	1	LP SUM	$5,000	$5,000		1.0	$5,000
HANDLING OF EXCAVATED SOILS FROM TRENCH EXCAVATION:							
EXCAVATE	2000	CY	$15	$30,000		0.95	$28,500
ON-SITE HAULING	2000	CY	$3.00	$6,000	HAULED ON SITE TO GRAVEL PITS; TREATED VIA GROUND WATER	0.95	$5,700
GROUNDWATER TREATMENT PLANT - PRELIMINARY EARTHWORK:							
SOIL FILL	4000	CY	$16	$64,000		0.95	$60,800
SURVEYING	1	LP SUM	$5,000	$5,000		0.95	$4,750
TREATMENT SYSTEM:							
OFFICE/LAB	1	LP SUM	$35,000	$35,000		1.0	$35,000
OIL/WATER SEP	1	LP SUM	$16,000	$16,000		1.0	$16,000
FLUID BED REACT	1	LP SUM	$35,000	$35,000		1.0	$35,000
PIPING/PUMPS	1	LP SUM	$65,000	$65,000		0.95	$61,750
ELECTR & INSTRUM	1	LP SUM	$85,000	$85,000		0.95	$80,750
ANCIL EQUIPMT	1	LP SUM	$101,000	$101,000		0.95	$95,950
OTHER PROC TANKS	1	LP SUM	$69,000	$65,000		0.95	$61,750
HEALTH & SAFETY	24	WEEKS	$4,000	$96,000	H&S OFFICER DURING EXCAVATION; RMs AND RESPIRATORS	0.95	$91,200
DIRECT CAPITAL COST							$955,525
ENGINEERING & DESIGN (11%)							$105,108
CONTINGENCY (20%)							$191,105
TOTAL CAPITAL COST							$1,251,738
APPROXIMATE TOTAL CAPITAL COST							$1,252,000

(LOW-GW2B)

012915

ALTERNATIVE GW-2(B): HIGH CAPITAL COSTS

FLUIDIZED CARBON BED

COST COMPONENT	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS	SENSITIVITY FACTOR	TOTAL COST
SITE PREPARATION	1	LP SUM	$5,000	$5,000			
WELL REPLACEMENT	9	WELLS	$5,000	$45,000		1.1	$5,500
SUBSURFACE DRAIN SYSTEM:						1.1	$49,500
DRAINS INSTALL	2100	LF	$50	$105,000			
FLOATING PUMPS	20	PUMPS	$3,000	$60,000		1.1	$115,500
SUMP INSTALL	20	SUMPS	$3,000	$60,000		1.1	$66,000
PIPING	1	LP SUM	$8,000	$8,000		1.1	$66,000
						1.1	$8,800
RECHARGE TRENCHING (IN-SITU SOIL FLUSHING):							
SHALLOW TRENCH INSTALL	1500	LF	$25.00	$37,500	BASED UPON A 10,000 GPD INJECTION RATE		
INJECTION PUMPS	2	PUMPS	$3,500	$7,000		1.1	$41,250
PIPING	1	LP SUM	$35,000	$35,000		1.1	$7,700
ELECT & INSTRUM	1	LP SUM	$20,000	$20,000		1.1	$38,500
INJECTION TANK	1	LP SUM	$10,000	$10,000		1.1	$22,000
CHEMICAL FEED SYSTEM	1	LP SUM	$5,000	$5,000		1.0	$10,000
						1.0	$5,000
HANDLING OF EXCAVATED SOILS FROM TRENCH EXCAVATION:							
EXCAVATE	2000	CY	$15	$30,000			
ON-SITE HAULING	2000	CY	$3.00	$6,000	HAULED ON SITE TO GRAVEL PITS; TREATED VIA GROUND WATER	1.1	$33,000
						1.1	$6,600
GROUNDWATER TREATMENT PLANT - PRELIMINARY EARTHWORK:							
SOIL FILL	4000	CY	$16	$64,000			
SURVEYING	1	LP SUM	$5,000	$5,000		1.1	$70,400
						1.1	$5,500
TREATMENT SYSTEM:							
OFFICE/LAB	1	LP SUM	$35,000	$35,000			
OIL/WATER SEP	1	LP SUM	$16,000	$16,000		1.0	$35,000
FLUID BED REACT	1	LP SUM	$35,000	$35,000		1.0	$16,000
PIPING/PUMPS	1	LP SUM	$65,000	$65,000		1.0	$35,000
ELECTR & INSTRUM	1	LP SUM	$85,000	$85,000		1.1	$71,500
ANCIL EQUIPMT	1	LP SUM	$101,000	$101,000		1.1	$93,500
OTHER PROC TANKS	1	LP SUM	$65,000	$65,000		1.1	$111,100
						1.1	$71,500
HEALTH & SAFETY	24	WEEKS	$4,000	$96,000	H&S OFFICER DURING EXCAVATION; RNU AND RESPIRATORS	1.1	$105,600
DIRECT CAPITAL COST							$1,090,450
ENGINEERING & DESIGN (11%)							$119,950
CONTINGENCY (20%)							$218,090
TOTAL CAPITAL COST							$1,428,490
APPROXIMATE TOTAL CAPITAL COST							$1,428,000

(RI-GW2B)

0129 16

0129 16

ALTERNATIVE GW-2B: HIGH PRESENT WORTH ANALYSIS

COST PER YEAR PER $1000

	0	1	2	3	4	5	6	7	8	9	10	11	12
CAPITAL COST	1428.0												
O&M COSTS		324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	1428.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	1	0.909	0.826	0.751	0.683	0.621	0.564	0.513	0.467	0.424	0.386	0.35	0.319
NET PRESENT WORTH	1428.0	294.5	267.6	243.3	221.3	201.2	182.7	166.2	151.3	137.4	125.1	113.4	103.4

	13	14	15	16	17	18	19	20	21	21	23	24	25
CAPITAL COST													
O&M COSTS	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	0.29	0.263	0.239	0.218	0.198	0.18	0.164	0.149	0.135	0.123	0.112	0.101	0.092
NET PRESENT WORTH	94.0	85.2	77.4	70.6	64.2	58.3	53.1	48.3	43.7	39.9	36.3	32.7	29.8

	26	27	28	29	30
CAPITAL COST					
O&M COSTS	324.0	324.0	324.0	324.0	324.0
TOTAL ANNUAL COST	324.0	324.0	324.0	324.0	324.0
ANNUAL DISCOUNT RATE@10%	0.084	0.076	0.069	0.063	0.057
NET PRESENT WORTH	27.2	24.6	22.4	20.4	18.5

TOTAL NET PRESENT WORTH (THOUSAND $'s)

4482.0

(HPWGW2B)

012917

012917

SOURCE INFORMATION FOR MAJOR COST ITEMS

HEALTH & SAFETY	$4000/WEEK; ASSUMES LABOR COST OF $50.00/HOUR; $800 ROUND TRIP; $200/WEEK FOR RESPIRATOR; $150/WEEK FOR A HNU; AND APPROX $850/WEEK EXPENSES
WELL MONITORING	$1000/WELL; LABOR AND 1988 NUS ANALYTICAL COSTS
EXCAVATION	$15/CY; MEANS, 022 254.0050,1988 + HEALTH&SAFETY
ON-SITE HAULING	$3/CY; MEANS, 022 266.1150, 1988 + HEALTH&SAFETY
SOIL FILL	$16/CY; KEYSTONE ENVIRONMENTAL RESOURCES (KER) ESTIMATE
SURVEYING	KER ESTIMATE
SUBSURFACE DRAIN SYSTEM	
DRAINS	$50/LF; COST FROM ERT PREVIOUS REPORTS
PUMPS	$3,000/PUMP; COST FROM ERT PREVIOUS REPORTS
SUMP	$3,000/SUMP; COST FROM ERT PREVIOUS REPORTS
PIPING	$8,000; COST FROM ERT PREVIOUS REPORTS
RECHARGE TRENCHING	
TRENCH INSTALLATION	KER ESTIMATE
INJECTION PUMPS	KER ESTIMATE
PIPING	KER ESTIMATE
ELECT & INSTRUM	KER ESTIMATE
INJECTION TANK	KER ESTIMATE
CHEMICAL FEED SYSTEM	KER ESTIMATE
OFFICE/LAB	KER ESTIMATE
OIL/WATER SEPARATOR	KER ESTIMATE
ACTIVATED CARBON TREATMENT SYSTEM	ALL ASSOCIATED COSTS ARE KER ESTIMATES
FLUIDIZED CARBON BED REACTOR	ALL ASSOCIATED COSTS ARE KER ESTIMATES

(GW-SOURC)

012918

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