HUMAN HEALTH RISK ASSESSMENT FOR THE FORMER GULF STATES CREOSOTING FACILITY, HATTIESBURG, MISSISSIPPI

May 2, 2001

Prepared for:

KERR-MCGEE CHEMICAL LLC 123 Robert S. Kerr Avenue P.O. Box 25861 Oklahoma City, OK 73125-0861

Prepared by:

ENVIRONMENTAL STANDARDS, INC. 1140 Valley Forge Road P.O. Box 810 Valley Forge, PA 19482-0810

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Table of Contents

			<u>Page</u>
Exe	cutiv	Summary	es-1
1.0	Intr	duction	1-1
2.0	Haz	ard Identification and Conceptual Site M	odel2-1
3.0	Data	Evaluation	3-1
,	3.1	Exposure Unit Delineation	3-1
		3.1.1 Exposure Unit 1	3-1
		3.1.2 Exposure Unit 2	3-2
		3.1.3 Exposure Unit 3	3-2
		3.1.4 Exposure Unit 4	3-3
		3.1.5 Exposure Unit 5	3-4
		3.1.6 Exposure Unit 6	3-5
	3.2	Statistical Evaluation	3-6
	3.3	Determination of Exposure-Point Concentr	rations
	3.4	COPC Selection	3-9
4.0	Exp	osure Assessment	4-1
	4.1	Receptor Identification	4-1
		4.1.1 Infrequent Site Visitor	4-2
		4.1.2 Maintenance Worker	4-3
		4.1.3 Construction Worker	4-3
		4.1.4 Future On-Site Residents	4-4
		4.1.5 Off-Site Residential Exposures	4-4
	4.2	General Intake Equation	4-4
		4.2.1 General Exposure Parameters	4-5
		4.2.1.1 Exposure Frequency	4-5
٠		4.2.1.2 Exposure Duration	4-8
		4.2.1.3 Averaging Time	4-8
-			4-9

Table of Contents (Cont.)

				Page
	4.2.2 Rou	te-Specific Exposure Parameters		4-9
	4.2.2.1	Dermal Exposure Parameters	•••••	4-10
	4.2.2.2	Ingestion Exposure Parameters		4-17
	4.2.2.3	Inhalation Exposure Parameters and Paradigms	***********	4-18
5.0	Toxicity Assessm	ent		5-1
6.0	Risk Characteriz	ation	••••••	6-1
7.0	Uncertainty Ana	lysis	****************	7-1
	7.1 Uncertainty	of Data Evaluation Factors	*****	7-1
	•	of Toxicity Values		
	7.3 Uncertaintie	s in Assessing Potential Exposure	***************************************	7-3
8.0	Summary of Fine	dings	*****************	8-1
Fig	ures			
Tat	oles			·

Executive Summary

A baseline human health risk assessment (HHRA) was conducted for the Former Gulf States Creosoting facility in Hattiesburg, Mississippi. The HHRA was performed in accordance with: Mississippi Commission on Environmental Quality's (MCEQ's) Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999); US EPA's Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (1989); US EPA Region 4 guidance entitled Technical Services Supplemental Guidance to RAGS, Region 4 Bulletins (1995); and other relevant US EPA guidance documents.

Creosoting constituents of potential health concern include polycyclic aromatic hydrocarbons (PAHs), of which benzo(a)pyrene is the predominant contributor to potential risks. Much of the former creosoting process area is currently covered with asphalt or large building structures. Potential future exposure scenarios included a construction worker, a maintenance worker, an infrequent Site visitor, and off-Site residents. Media of concern included soils, sediment, and surface water.

Hazards posed by chemical constituents in soils, sediment, and surface water for health effects other than an increased risk of cancer were well below a threshold of possible concern for each receptor evaluated in this risk assessment. Cancer risks for all exposure scenarios were within or below the US EPA's acceptable target risk range of 1×10^{-6} to 1×10^{-4} (i.e., one in one million to one in ten thousand) with the exception of maintenance worker exposure to soils in EU4 and off-site resident exposure to sediments in EU6. The added lifetime cancer risk conservatively estimated for a maintenance worker was 4×10^{-4} for the entire Site, while that for the off-site resident was 2×10^{-4} for the entire Site. The potential risk for a construction worker was estimated to be 5×10^{-5} for the entire Site. The estimated potential risk for an adolescent Site visitor was 9×10^{-5} for the entire Site. For the Site visitor, maintenance worker, and construction worker scenarios, oral contact with carcinogenic PAHs in sediment and soils drove the cancer risk level. For the off-Site resident scenario, oral contact with carcinogenic PAHs in sediment drove the cancer risk level.

Risk levels are mainly attributable to residual concentrations of carcinogenic polycyclic aromatic hydrocarbons (cPAH) in EUs 4, 5, and 6. Remedial actions currently planned for these areas, including deed restrictions, will result in incomplete exposure pathways thereby resulting in acceptable levels of risks to potential receptors. Proposed remediation activities to address impacted media in EUs 4, 5, and 6 include the following:

- Conduct in-situ biological treatment of impacted soils in the unpaved area between the former Process Area and the Southern railroad tracks (EU4);
- Attempt to recover free product from targeted areas within the former Process Area to address continuing sources (EU5);

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- Remove impacted sediments from the northeast drainage ditch and install a culvert to provide for surface drainage (EU6);
- Establish deed restrictions limiting the use of property to non-residential (i.e., "restricted") purposes (EU4 and EU5); and
- Include in the deed restrictions provisions for maintaining pavement to preclude contact with impacted media left in place (EU5).

Constituent concentrations in surface soils at two isolated locations within EU2 also resulted in maintenance worker risk levels slightly greater than 1×10^{-6} . Because these locations are within a densely wooded area where no maintenance activities currently occur and remediation would require significant clearing, no remediation activities are planned to address surface soils at these locations. Deed restrictions limiting the use of properties within EU2 to non-residential purposes will be established.

1.0 Introduction

Environmental Standards, Inc. (Environmental Standards) was retained by Kerr-McGee Chemical Corporation (Kerr-McGee) to perform a human health risk assessment (HHRA) to evaluate hazards and risks potentially posed by residual levels of chemicals present at the Former Gulf States Creosoting facility (Site). The Site, located near the intersection of US Highways 49 and 11 in Hattiesburg, Mississippi, was formerly a wood treating facility that operated between the early 1900s and 1960. In the early 1960s, the Site was redeveloped for commercial and light industrial uses (Michael Pisani & Assoc., 1997). The land on which the Site is located is a portion of the Sixteenth Section land owned by the Hattiesburg Public School District and leased to the current tenants under a 99-year lease, granted on July 7, 1947. At the time of this report, the Site, with the exception of the grassy and wooded areas in the south and southwest, respectively, was primarily used for automobile dealerships. There are no residential or institutional (i.e., schools) uses of the Site (Michael Pisani & Assoc., 1997).

Operations at the Site consisted of a small-scale wood preserving process using creosote. The creosoting process was primarily confined to a 2.5-acre area in the northeast corner of the Site; this is known as the former Process Area and is currently occupied by Courtesy Ford. During the redevelopment of the Site in the early 1960s, construction debris (e.g., broken concrete, asphalt, etc.) appears to have been relocated to the southwestern corner of the Site along Gordon's Creek. This area is known as the Fill Area and currently remains undeveloped.

This assessment has been conducted as a result of an agreement between Kerr-McGee, the Mississippi Department of Environmental Quality (MDEQ), and the Mississippi Commission on Environmental Quality (MCEQ) pursuant to the Uncontrolled Site Voluntary Evaluation Program. The MDEQ Office of Pollution Control, Uncontrolled Sites Section has been providing oversight and review of investigations and reports relating to the former Gulf States Creosoting facility.

This report will address the potential for on-Site exposures to human receptors and off-Site exposures to humans along the northeast drainage ditch.

The primary guidance used to develop this risk assessment was the MCEQ Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999). US EPA Region 4's Technical Services Supplemental Guidance to RAGS: Region 4 Bulletins (1995) were also referred to for guidance. Additional US EPA guidance documents cited herein include:

- Guidance for Remediation of Uncontrolled Hazardous Substance Sites in Mississippi (MDEQ, 1990);
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual/ Part A (RAGS/Part A) (US EPA, 1989);
- Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" (US EPA, 1991);
- Exposure Factors Handbook (US EPA, 1997);
- Guidelines for Exposure Assessment (US EPA 1992);
- Dermal Exposure Assessment: Principles and Applications (US EPA, 1992);

These documents are not listed in a hierarchical manner; other US EPA guidance documents and peer-reviewed technical papers may have also been referenced in this risk assessment report.

2.0 Hazard Identification and Conceptual Site Model

As a result of the historical wood preservation process, residual levels of creosote-related chemicals are present in soils in the former Process Area. Sediment and surface water in a drainage ditch along the southeast border of the former Process Area also contain chemical residuals. These Site-related chemicals, mostly polycyclic aromatic hydrocarbons (PAHs) are also present in the Fill Area. Residual levels of PAHs have been found in soil in the Fill Area and in Gordon's Creek surface water and sediment.

PAH residuals have also been detected in shallow groundwater underlying the Site. Currently, there are no private water wells located on-Site that access this shallow groundwater for potable purposes. The results of a door-to-door survey conducted by Michael Pisani and Associates on October 3, 2000 indicated no private uses of shallow groundwater downgradient of the Site. For these reasons, the groundwater exposure pathway, both on- and off-Site, was considered incomplete and not evaluated in this assessment.

A conceptual site model (CSM) was developed for the Site to aid in determining the potential receptors and exposure units to be evaluated under current and future potential land use (Figure 1). These receptors were identified as infrequent Site visitors, maintenance workers, construction workers, and off-Site residents.

Under current land use assumptions, Site visitors may potentially contact residual chemicals in Gordon's Creek surface water and sediment, and/or surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the drainage ditch along side of the former Process Area. Visitors may also potentially contact surface soil, surface water, and sediment along the former Process Area drainage ditch. The remaining affected areas of the Site are covered with either buildings or pavement precluding casual direct contact with surface soils. As a conservative measure, however, visitor exposure to soils from these paved areas was also assessed.

Under both current and future land use assumptions, a maintenance worker may contact surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the former Process Area and surrounding affected areas, including the drainage ditch located to the southeast of the former Process Area. Although most of the former Process Area and vicinity are paved, maintenance activities may involve some shallow digging; therefore, direct contact with shallow soils in this area was assessed. As a conservative measure, exposure to surface water and sediment in Gordon's Creek was assessed. The remainder of the Site was relatively unaffected by historical creosoting activities.

Although there are currently no major construction activities at the Site, these types of activities may occur at some time in the future. As with the maintenance worker scenario, construction activities could potentially occur in the Fill Area and vicinity, the grassy field southeast of the Fill Area, and the former Process Area and vicinity. Construction workers may be exposed to both surface and subsurface soils (down to the water table). Construction worker exposure to surface water and sediment in Gordon's Creek was assessed as a conservative measure. The remainder of the Site was relatively unaffected by historical creosoting activities.

Areas of the Site affected by historical creosoting activities will be deed restricted prohibiting future residential development. Off-Site areas along the northeast Drainage Ditch, currently a residential neighborhood, were assessed for residential exposures to soil, sediment, and surface water.

3.0 Data Evaluation

To characterize potential exposures to Site-related chemicals, the former Gulf States Creosoting facility was divided into six exposure units (EUs). Each exposure unit outlines potentially affected areas of the Site and adjacent on-Site locales that may be frequented by individuals accessing the Site for recreational or occupational purposes. The use of EUs is encouraged by the US EPA Region 4 (1995), which defines an EU as "an areal extent of a receptor's movements during a single day...." Each of these exposure units is depicted on Figure 2 and is discussed below.

A sixth EU was created for off-Site residential exposures to surface water and sediment along the northeast Drainage Ditch. This EU is delineated on Figure 3.

3.1 Exposure Unit Delineation

The following EUs were delineated based upon the presence of residual chemicals and the potential for receptors to contact those chemicals. Areas of the Site most affected were included in at least one of the five EUs while areas with relatively low or non-detectable concentrations of residuals were not included in an EU. By limiting Site-wide exposures to the EUs most affected by historical activities at the Site, worst-case scenarios were created.

3.1.1 Exposure Unit 1

EU1 outlines the on-Site areas in, adjacent to, and downstream of the Fill Area along Gordon's Creek (Figure 2). EU1 includes exposures to surface water and sediment by an infrequent Site visitor, future maintenance worker, and future construction worker. Although US EPA Region IV guidance indicates that "In most cases it is unnecessary to evaluate human exposures to sediments covered by surface water," (US EPA, 1995) dermal and oral surface water exposures were conservatively assessed herein at the request of the MDEQ (2000). Sediment samples included in EU 1 were SD07 and SD08. Surface water samples included in were SW-07 and SW-08.

Soil samples from this area were considered part of EU2 and exposures were assessed accordingly.

3.1.2 Exposure Unit 2

EU2 delineates the upland areas of the Fill Area and adjacent woody and grassy areas (Figure 2). Surface soils from zero to one foot and zero to six feet below ground surface [bgs] in this area were evaluated for potential visitor and future hypothetical maintenance worker scenarios, respectively. Surface and subsurface soils were also evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table (approximately 10 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU2 are presented in the table below:

Soils (0-1' bgs)	GEO-13/0-1'	SS-1	SS-2	SS-3	SS-4
	SS -5	SS-6	SS-7	SS-8	SS-9
·	SS-10	SS-11	SS-12	SS-13	
Soils (0-6' bgs)	GEO-03/2-3'	GEO-03/5-6"	GEO-10/2-3	GEO-10/5-6	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-44/5-6'	SS-1	SS-2
	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
·	SS-13				
Soils (0-10' bgs)	GEO-03/2-3'	GEO-03/5-6'	GEO-10/2-3	GEO-10/5-6'	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-43/7-8'	GEO-44/5-6'	GEO-45/7-8'
	SB-03/8-9.3	SB-05/4-9	SB-07/5-7	SS-1	SS-2
·	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
	SS-13				

3.1.3 Exposure Unit 3

In the southwest corner of the Site there exists a grassy field east of West Pine Street between Henson Auto Sales and Eagan Cars and Trucks. This grassy area has been defined as EU3 for purposes of this risk assessment (Figure 2). Similar to EU2, surface soil from zero to one foot and zero to six feet bgs were evaluated in EU2 for visitor and hypothetical future maintenance worker scenarios, respectively. Surface and subsurface soils in this EU were evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table(approximately 20 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU3 are presented in the table below:

Soils (0-1' bgs)	SS-15	SS-16	SS-17		
Soils (0-6' and 0-20' bgs)	GEO-16/2-3'	GEO-16/5-6'	GEO-17/2-3'	GEO-17/5-6'	SS-15
	SS-16	SS-17			

3.1.4 Exposure Unit 4

EU 4 encompasses the grassy drainage ditch area along the fenceline behind Courtesy Ford in the northeast corner of the Site and continues parallel to the railroad tracks, and west through EU 3 and EU 2 (Figure 2). EU 4, along the southeast side of the former Process Area, has been widened to include soil data from that area. Receptors associated with EU 4 included Site visitor exposures via casual contact with surface soil, sediment, and surface water. Maintenance worker and construction worker scenarios were also evaluated for exposures to surface water and sediment in EU 4 as well as soils in EU 4 near the former Process Area. Soils down to six feet bgs were evaluated for maintenance workers while soils down to the water table (approximately20 feet bgs) were evaluated for construction workers in this EU as requested by the MDEQ (2000). Sediment, surface water, and soil samples included in EU4 are presented in the following table:

Sediment	SD-02	SD-12	SD-18	SD-19	SD-20
	SD-21	SD-22	SD-23		
Surface Water	SW-02				:
Soils (0-1' bgs)	GEO-19/0-1'	GEO-20/0-1'	GEO-21/0-1'	GEO-46/0-1'	GEO-47/0-1'
	GEO-48/0-1'				
Soils (0-6' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6'	GEO-20/0-1'	GEO-20/2-3'
	GEO-20/5-6'	GEO-21/0-1	GEO-21/2-3'	GEO-21/5-6'	GEO-46/0-1'
	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1'	GEO-47/2-3'	GEO-47/5-6'
	GEO-48/0-1'	GEO-48/2-3'	GEO-48/5-6'		
Soils (0-20' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6'	GEO-20/0-1'	GEO-20/2-3'
	GEO-20/5-6'	GEO-20/9-10'	GEO-21/0-1'	GEO-21/2-3'	GEO-21/5-6'
	GEO-21/9-10'	GEO-46/0-1'	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1
	GEO-47/2-3	GEO-47/5-6'	GEO-47/7-8'	GEO-48/0-1'	GEO-48/2-3'
	GEO-48/5-6'			:	

3.1.5 Exposure Unit 5

EU5 outlines the former Process Area and the historical drip track and treated wood storage areas of the former Gulf States Creosoting facility (Figure 2). Surface soils from zero to six feet bgs were evaluated in EU5 for a hypothetical maintenance worker scenario. Available data for soils down to the water table (approximately 20 feet bgs) were evaluated in EU5 for a hypothetical future construction worker scenario. Soil samples included in EU5 are presented in the table below:

Soils (0-1' bgs)	GEO-28/0-1'	GEO-29/0-1'	GEO-30/0-1'	GEO-31/0-1'	GEO-32/0-1'
	GEO-33/0-1'	GEO-59/0-1'	GEO-60/0-1'		
Soils (0-6' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
	GEO-29/5-6'	GEO-30/0-1'	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	.GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
•	GEO-33/0-1'	GEO-33/2-3'	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1	GEO-60/2-3'	GEO-60/5-6'	
Soils (0-20' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
	GEO-29/5-6'	GEO-30/0-1'	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
	GEO-33/0-1	GEO-33/2-3'	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1'	GEO-60/2-3'	GEO-60/5-6'	GEO-60/7-8'
	SB-01/8-10	SB-02/9-11	SB-05/10.5-12.5	SB-06/6-10	SB-07/14-16

3.1.6 Exposure Unit 6

EU6 outlines a stretch (approximately 2700 feet in length) of the northeast drainage ditch that leads from the Site into the neighboring residential area. EU6 exposures include oral and dermal exposures by off-Site residents to sediment and surface water along the northeast drainage ditch. Soil exposures were not assessed in this area for lack of soil data. Also, it was anticipated that sediment exposures in this area represent a more conservative estimate of exposure in that chemical concentrations in the exposed sediment along the drainage ditch are likely to be greater than concentrations in the surrounding soils. Sediment and surface water samples included in EU6 are presented in the table below:

Sediment	SD -03	SD-04	SD-05	SD-13
	SD-14	SD-15	SD-16	SD-17
Surface Water	SW-03	SW-04		

3.2 Statistical Evaluation

Environmental samples undergo laboratory analyses that are designed to quantitate the concentrations of constituents in the various environmental media. As a result of the analytical procedures, a constituent may be detected and its concentration measured, detected but not able to be quantitated, or not detected at all in a sample. The data set for the Site contains a number of nondetections for some chemicals of potential concern (COPCs) in various samples. Assuming that the COPC is present in these samples at the achieved detection limit is biased because the chemical may be absent altogether. Assuming a concentration of zero is also flawed because the chemical could be present at a level below laboratory capabilities to detect and quantify the concentration. Consequently, in the event that an analyte identified at least once in a given medium was not detected in a given sample, it was conservatively assumed for the risk assessment purposes to be present at a concentration equivalent to one-half of the sample quantitation limit (SQL). In addition, samples labeled with an "R" (rejected) qualifier were not included in the data analysis because those data were deemed unreliable and, therefore, unusable. Constituents that were not detected in any sample from a particular medium were eliminated from further consideration in accordance with US EPA guidelines (1989).

Site analytical data used in this assessment were collected during the Phase I (1997) and Phase II (1998) remedial investigations as well as the additional investigation conducted in 2000 at the request of the MDEQ. These data were fully validated by qualified technical professionals using standard data validation protocols, as required by the MCEQ (1999).

Previous investigations at the Site have been conducted since 1990. These investigations included the following:

- 1990 soil gas and soil sampling by Roy F. Weston
- 1991 MDEQ Site inspections and Phase II report
- 1994 Phase II Site investigation by Environmental Protection Systems (EPS)
- 1994 Site investigation by Bonner Analytical Testing Company (BATCO)
- 1994 preliminary subsurface investigation by BATCO

- 1995 three-dimension resistivity surveys by American Remediation Technology
- 1996 investigation by McLaren/Hart
- 1996 investigation by Kerr McGee Chemical Corporation

Data acquired from these historical (pre-1997) investigatory activities were not used in this assessment as they were not validated by qualified chemists and sampling locations for some of the data could not be accurately established. These historical data were not considered valid and were, therefore, not appropriate to use in this assessment of risks. Only validated data that were considered to be representative of Site conditions with a reasonable level of confidence were used for this assessment.

The validated laboratory data from 1997, 1998, and 2000 investigations were compiled into data sets representing areas of potential exposure (EUs) for each potential receptor. Each data set was analyzed statistically using SiteStat[®], a commercially available software package, to calculate the minimum, maximum, arithmetic mean, logarithmic mean, standard error of the mean, and the 95% upper confidence limit of the mean concentration (95% UCL) for each constituent based on distributional analysis of the data (i.e., utilizing goodness-of-fit statistical tests to determine whether the data are distributed normally or lognormally). The data qualifier associated with the minimum and maximum detected concentrations as well as the location of the maximum detected concentration for each EU were also determined. Results of the quantitative and statistical analyses for each of the EUs discussed above are presented in Tables 1 through 18.

Standard sampling protocol requires the collection of duplicate field samples used to ensure the quality of a laboratory analysis (i.e., to ensure that analytical results can be replicated). As such, duplicate sample results were provided as part of the database for the Hattiesburg Site. In accordance with US EPA guidance (1989), duplicate sample results were averaged (for any sample containing duplicates) and the average concentration was used as a single concentration for that sample in the calculation of summary statistics as discussed below.

Soils down to one foot deep were assumed to be representative of surface soils at the Site for infrequent visitor exposures. A depth of 0 to 6 feet was used to define surface soils for maintenance worker exposures. These assumptions were recommended by the MDEQ (2000). The groundwater table was considered the extent of subsurface soils as recommended by MDEQ (2000). This value (depth-to-groundwater) varies significantly across the Site and, as such, the extent of subsurface soil was EU-specific as follows:

EU2 - soils down to 10 feet

EU3 - soils down to 20 feet

EU4 - soils down to 20 feet

EU5 – soils down to 20 feet

This risk assessment focuses mainly on environmental data collected from the former Process and Fill Areas and any other portions of the Site that were affected by former creosoting operations. Virtually unaffected areas (e.g., the developed area north of West Pine Street) as delineated using historical data were not considered to contribute significantly to risk levels and, therefore, were excluded from this risk assessment.

3.3 Determination of Exposure-Point Concentrations

Exposure-point concentrations were determined to be the 95% UCL or the maximum concentration of a COPC in an EU, whichever was lower. This methodology is in accordance with US EPA guidance (1989). If the distribution of the concentration data was determined to be lognormal, then the lognormal 95% UCL was compared to the maximum concentration to determine the exposure-point concentration. In the event that the distribution of a chemical in any given medium could not be confidently labeled as normal or lognormal, it is termed either "unknown" or "normal/lognormal." In these cases, the lognormal 95% UCL was compared to maximum concentration when determining the exposure-point concentration. It should be noted, however, that in cases where the distribution is "unknown," the normal and lognormal 95% UCLs could not be reliably predicted. Assuming a lognormal distribution of the data increases

the uncertainty associated with this step of the risk assessment process; however, hazard and risk estimates are likely to be less uncertain than if the maximum concentrations were used.

Exposure-point concentrations are provided on the statistical summary tables, Tables 1 through 18.

3.4 COPC Selection

Soils (both surface and subsurface) were screened according to MCEQ (1999) guidance. The first tier of the screening process compared maximum concentrations of a constituent in an EU with the Restricted Tier 1 target remediation goal (TRG) for maintenance worker and construction worker scenarios. Restricted TRGs were used because the Site is not currently used for residential purposes and the current commercial/industrial land-use is anticipated to remain into the future as a result of the implementation of deed restrictions on the impacted areas of the Site. If a maximum concentration of a constituent was less than the Restricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment.

Surface soil data (zero to one foot bgs) for the visitor scenario was screened using Unrestricted Tier 1 TRGs at the request of MDEQ (2000). If a maximum concentration of a constituent was less than the Unrestricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment. Conversely, if the maximum concentration of a constituent exceeded the Tier 1 TRG, that constituent was retained for quantitative analysis.

If the maximum concentration of a constituent in an EU exceeded the Tier 1 TRG, then the 95% UCL of the constituent was compared to the Tier 1 TRG (Restricted or Unrestricted, depending on the exposure scenarios as described above) as part of the Tier II screening process. In the event that the concentrations of a chemical were distributed lognormally, the lognormal 95% UCL of that constituent was compared to the Tier 1 TRG. If the distribution of data of a chemical could not be positively identified as either normal or lognormal, the lognormal 95% UCL was used in the screening process. In these cases, either the maximum concentration or the lognormal 95% UCL can be conservatively used. The US EPA, however, justifies the use of an

average concentration as the exposure-point concentration by explaining that toxicity criteria for both carcinogenic and non-carcinogenic effects are based on lifetime average exposures and that the "average concentration is most representative of the concentration that would be contacted at a site over time" (Supplemental Guidance to RAGS: Calculating the Concentration Term, 1992). Other US EPA guidance states that "...in most situations, assuming long-term contact with the maximum concentration is not reasonable" (Risk Assessment Guidance for Superfund, Part A, 1989). US EPA Region 4 also states that, generally, it is reasonable to assume that soil data are distributed lognormally (1995). In keeping with these guidances, the lognormal 95% UCL was considered in the screening process where the data distribution for a compound could not be defined as specifically normal or lognormal.

If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent was less than the Tier 1 TRG, then that constituent was eliminated from further quantitative analysis. If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent in soil exceeded the Tier 1 TRG, then that constituent was retained for quantitative analysis in the Site-specific risk assessment (Tier III).

MCEQ guidance (1999) does not specify screening levels for constituents in sediment or surface water; therefore, Region 4 was referred to for guidance (1995). Sediment is only found on the Site in drainage ditches that contain little to no water most of the time. US EPA Region 4 guidance states that sediments in an intermittent stream (or ditch) should be considered as surface soil for the portion of the year the stream is without water. Based on these factors and comments provided by the MDEQ (2000), the maximum detected constituent concentrations in sediment was compared to MCEQ unrestricted Tier 1 TRGs. The screening process then followed the same procedure as mentioned above for other soils.

For surface water, the maximum detected concentration of a constituent in an EU was compared to the US EPA Human Health Water Quality Standard (WQS) for consumption of water and organisms in accordance with US EPA Region 4 guidance (1995). If the maximum

concentration of a constituent in surface water was less than the WQS, then that constituent was eliminated from quantitative analysis. If the maximum concentration of a constituent in surface water exceeded the WQS, then that constituent was retained for quantitative analysis.

At the request of MDEQ (2000), if any single carcinogenic polycyclic aromatic hydrocarbon (cPAH) was retained as a COPC in a medium, then all cPAHs were also retained as COPCs in that medium. This guidance refers to the following chemicals: benzo(a)anthracene, benzo(b)fluoroanthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. To establish an exposure point concentration for undetected cPAHs retained as COPCs in an EU, one-half the maximum detection limit was used.

The results of the screening process are presented on the statistical summary tables, Tables 1 through 18. The screening process eliminated detected constituents from the subsurface soil dataset down to 20 feet bgs and surface soil dataset down to 6 feet bgs in EU3. For this reason, construction worker and maintenance worker exposures to soils in EU3 were not evaluated quantitatively in this assessment.

4.0 Exposure Assessment

Currently, a majority of the Site is used for commercial and light industrial purposes and is paved for roads and parking lots. Unpaved areas are limited to Gordon's Creek (EU 1), the wooded portion in and around the Fill Area (EU2) and the grassy field outlined by EU 3, and the drainage ditches and surrounding area delineated by EU 4 (Figure 2). Since the developed and undeveloped areas of the Site vary considerably with respect to both residual chemical concentrations and land use, the Site was divided into five EUs for the exposure assessment. A sixth EU was created to assess off-Site residential exposures. Chemical data from each EU were combined with EU-specific exposure parameter values and receptor scenarios to determine the chemical intake for each receptor potentially accessing an EU for occupational, recreational, or residential purposes.

4.1 Receptor Identification

The following exposures pathways (indicated with an "X") have been selected for this risk assessment as reasonable and realistic scenarios under current and future land-use assumptions:

EU/Media:		EU1	EU2	EU3		EU	J 4	EU5	1	EU6
Receptor/Route:	Sed.	Surf. Water	Soil	Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water
Visitor							-			
Dermal	Х	X	X	x	х	X	X	X		
Oral	X	X	×	x	Х	Х	X	x		.,,,
Inhalation										
Maint, Worker			•••••					······································	ļ	
Dermal	Х	X	Х	Х	х	Х	X	X		}iasses>esasess
Oral	X	X	X	X	X	X	X	X		
Inhalation		***************************************								\$
Const. Worker								·		
Dermal	Х	x	X	x	X	х	X	Х	**************	;,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Oral	X	X	×	×	X	X	X	X	1	4
Inhalation	•••••	•	x	×	X	••••••••••••••••••••••••••••••••••••••		X	†	

EU/Media:		EU1		EU2	EU3		EU	14	EU5		EU6
Receptor/Route:	Sed.	Surf.	Water	Soil	Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water
Off-Site Resident											
Dermai	***********		************	***************************************	*****************					X	Х
Oral				[1						х
Inhalation		å !			1						

Surface water present on-Site is either ephemeral or very shallow and is conducive only to wading-type activities. Ingestion of Site surface water was considered an insignificant exposure pathway since on-Site drainage ditches "contain little or no water most of the time" (MDEQ, 2000). In addition, US EPA IV guidance indicates that "In most cases, it is unnecessary to evaluate human exposures to sediments covered by surface water" (1995). At the request of MDEQ (2000), however, dermal and oral exposures to surface water were assessed for visitors, maintenance workers, and construction workers in EUs 1 and 4. Surface water exposures were also assessed for residents in off-Site EU 6.

Each of the potential receptors is discussed below.

4.1.1 Infrequent Site Visitor

Since the Site is not currently fenced or guarded, the general public has access to most areas of the Site at any given time. It is possible, though unlikely, that an individual may use some areas of the Site, such as EU1, EU2, or EU3, for recreational purposes. For this reason, sediment and surface water exposures to visitors in EU1, and surface soil exposures in EU2 and EU3 were assessed for the visitor scenario. The vast majority of the remainder of the Site (EU5) is covered with either buildings or pavement, precluding direct contact with surface soils; however, a small exposed area encompassing a drainage ditch exists along side of the former Process Area (EU4). Although this area is not attractive for recreational purposes, it is possible that an individual traversing the Site may contact surface soils, sediment, or surface water in this EU; therefore, these potential exposures were assessed. Sediment exposures in EU1 and EU4 were addressed in accordance with US EPA Region 4 guidance that recommends evaluating sediment exposures in intermittent streams. At the request of MDEQ (2000), soil exposures were assessed for visitors

in EU5 regardless of the existence of buildings and pavements precluding almost all potential direct contact with soils in this area.

4.1.2 Maintenance Worker

Currently, maintenance activities are most likely limited to the developed portions of the Site. Of these, the former Process Area and adjacent former drip track and treated wood storage areas (EU5) were most affected by historical wood preserving processes. Although these areas are mostly paved or built upon, it is possible that maintenance activities may require some shallow digging in unpaved areas; therefore, exposures to surface soils in EU5 were assessed. As a conservative measure, surface soil data from sample locations located in paved areas were evaluated in conjunction with surface soil data from exposed areas in EU5. If the currently undeveloped portions of the Site (EU2 and EU3) become developed in the future, similar maintenance activities may be required and, therefore, exposures to surface soils in EU2 and EU3 were also assessed. The drainage ditch encompassed by EU4 requires periodic maintenance; therefore, exposures to soil, sediment, and surface water in this area were assessed. At the request of MDEQ (2000), maintenance worker exposures to surface water and sediment in EU1 were also assessed.

4.1.3 Construction Worker

Although there are currently no major construction activities at the Site, such activities may hypothetically occur in the future. Thus, exposures to surface water and sediment in EUs 1 and 4, and exposures to soil in EUs 2 through 5 were assessed herein. Construction workers may be exposed to both surface and subsurface soils during activities such as excavating. Subsurface soils, for purposes of this assessment, were defined as those soils at the water table and shallower. Since the depth to the water varies significantly across the Site, so does the definition of "subsurface" soils. Accordingly, subsurface soils were evaluated down to 10 feet for EU2 and 20 feet for EUs 3, 4, and 5.

4.1.4 Future On-Site Residents

The affected areas of the Property (the Site) are currently zoned for industrial or light-commercial use, and, at the time of this report, there were no plans to develop the Site for residential housing. In fact, deed restrictions preventing residential development are in the process of being implemented for the impacted areas on Site. Because of these deed restrictions, it is reasonable and realistic to assume that the Site will remain commercial/industrial in the future, therefore, on-Site residential exposures were not addressed in this risk assessment.

4.1.5 Off-Site Residential Exposures

The northeast drainage ditch extends from the former Process Area to the northeast into a nearby residential community. Surface water and sediment data from areas along the northeast drainage ditch (EU6, Figure 3) were evaluated for off-Site residential exposures. For purposes of exposure assessment, a child resident between the ages of 1 and 6 years and an adolescent/adult resident between the ages of 7 and 30 years were evaluated. Hazards and risks for these two receptors were then combined (summed) to reflect the exposures incurred by a single individual living off-Site in the vicinity of the northeast drainage ditch for 30 years.

4.2 General Intake Equation

Chemical exposure/intake is expressed as the amount of the agent at the exchange boundaries of an organism (i.e., skin, lungs, gut) that is available for systemic absorption. An applied dose is defined as the amount of a chemical at the absorption barriers such as skin, lung, digestive tract, available for absorption and is (usually expressed in milligrams, or mg) absorbed per unit of body weight of the receptor (usually expressed in units of kilogram, or kg). Absorbed dose can be defined as the amount of chemical that penetrates the exchange boundaries. If the exposure occurs over time, the total exposure can be divided by the time period of interest to obtain an average exposure rate (e.g., mg/kg-day). The general equation, as defined by US EPA, for estimating a time-weighted average intake is:

Intake (mg/kg - day) =
$$\frac{C \times IR \times EF \times ED}{BW \times AT}$$

[Equation 1]

where:

C = chemical concentration at the exposure point (e.g., mg/m^3 air);

IR = intake rate $(e.g., m^3/hr)$;

EF = exposure frequency (days/year);

ED = exposure duration (years);

BW = body weight of exposed individual (kg); and

AT = averaging time (period over which exposure is averaged, usually

measured in days).

Additional parameters (e.g., skin surface area) were incorporated into the above general equation to evaluate the different potential exposure routes (dermal, oral, inhalation).

Table 19 presents the general and pathway-specific exposure parameters utilized for the intake equations in this assessment.

4.2.1 General Exposure Parameters

Although some of the parameters used to calculate potential exposure are pathway- or route-specific, exposure frequency (EF), exposure duration (ED), averaging time (AT; determined separately for carcinogenic and non-carcinogenic exposures), and body weight (BW) are present in each intake model. These general parameters remain consistent throughout the intake calculations for each specific receptor.

4.2.1.1 Exposure Frequency

The exposure frequency (EF) describes the number of times per year an event is likely to occur. It is most often expressed in units of days/year or events/year, depending on the scenario. Variables such as weather, vacations, sick days, and institutional controls often aid in determining reasonable and realistic exposure frequencies.

The EF for an adolescent visitor was extracted from US EPA Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) Interim Final (1989). This EF value of 12 days/year per EU is a reasonable estimate that assumes an adolescent would most likely be engaged in outdoor activity on the unpaved areas of the Site for one day a week during

the three warmest months of the year. This value was used for soil, sediment, and surface water exposures.

Typical construction projects, especially at industrial complexes, generally involve several phases of activity prior to completion. The EF parameter used for oral exposure in construction workers, therefore, was subdivided into two exposure events. The first event hypothetically lasts for 10 days (used in relevant exposure model calculations under "Exposure Level A") and would involve earth-moving activities such as foundation. The second exposure event to the same individual hypothetically lasts for 70 days (for a total of 80 days at the Site for an individual; this value was used in relevant exposure model calculations under "Exposure Level B") and included remaining construction activities such as building framing, plumbing installation, electrical installation, and roofing. Generally, to complete each of these phases, a different team of specialized contractors is employed to perform the tasks for which they are most qualified. As a result, an individual may only remain at the construction site for a few days or weeks until his/her task has been completed and the next phase has begun. This is especially true for those activities involving direct contact with soil such as excavating and foundation pouring. Individuals performing these tasks are not usually qualified or employed to continue with the actual building processes. For dermal and inhalation exposures, however, an 80-day EF was used and accounted for an individual to be involved in construction activities for four entire months of the year (assuming five-day work weeks).

For surface water and sediment exposures to construction workers, an EF value of 8 days/year was used. This value represents 1/10th of the time a worker may be on-Site for construction-type activities and is conservative in that it is unlikely that construction workers would be exposed at all to Site surface water or sediment.

The EF value used for the maintenance worker scenario was 150 days/year for surface soil exposures in EUs 2, 3, and 5. This is also a conservative assumption in that the currently developed areas of the Site are covered with buildings or pavement. Maintenance activities in

these areas would require little contact with the obscured surface soils. The undeveloped areas of the Site currently require little or no maintenance as they are only occasionally mowed or allowed to grow naturally. Should these areas become developed, they will most likely take on the appearance of the remainder of the Site, including industrial/commercial buildings and paved roads or parking lots. Once again, extensive direct contact with surface soils would be minimal for a maintenance worker.

For maintenance worker sediment and surface water exposures in EUs 1 and 4 and surface soil exposures in EU 4, an EF value of 30 days/year was used. Historically, the northeast drainage ditch has been maintained on an as-needed basis (less than annually). Maintenance worker exposures to sediment and surface water in these areas were assessed at the request of the MDEQ (2000). An EF value of 30 days/year is amply conservative in that both Gordon's Creek (EU 1) and the northeast drainage ditch (EU 4) are currently maintained less than annually.

For residential soil exposures, an exposure frequency of 350 days/year was used in accordance with Region IV guidance. This value assumes that 15 days/year are spent away from home (US EPA, 1991).

Sediments along the bank of the northeast drainage ditch are not comparable to surface soils comprising a yard with respect to exposure. Typically, yard soils include relatively large areas where children frequently play and where surface soils are tracked into the home to become part of the household dust that can be ingested, particularly by crawling infants, on a daily basis. These are the assumptions that underlie the standard residential soil exposure algorithm and parameter values. However, it is not realistic to assume that infants, children, or adults will directly contact a relatively small area of sediments on the banks of a drainage ditch on a daily basis. A more realistic exposure scenario for this unique area under an assumption of residential land use is for a resident child to play on occasion in the drainage ditch that traverses the residential property. An exposure frequency of 40 days/year, two hours per exploring event, is conservatively plausible.

4.2.1.2 Exposure Duration

The ED parameter represents the number of years during which an event is likely to occur. Factors affecting this parameter include variables such as age of receptor, population mobility, and occupational mobility. Exposure durations of less than seven years typically correspond to subchronic exposures while those greater than seven years are typically considered chronic exposures (US EPA, 1989). Toxicity indices are selected based on subchronic or chronic exposure durations.

The future construction worker scenario used an ED of one year because it is highly unlikely that a future construction worker would remain on one site for more than a year. Often, two months is considered the maximum amount of time a construction worker may reasonably remain at the same site.

The future maintenance worker ED, on the other hand, is based on occupational mobility studies. The ED of 25 years was obtained from US EPA (1991) which recommends a 95th percentile value of 25 years based on a study by the Bureau of Labor Statistics as of 1987. US EPA Region 4 also recommends a default value of 25 years for worker scenarios (1995).

The adolescent visitor scenario used an ED of 10 years. An adolescent was defined in this assessment as an individual aged seven to 16 years in accordance with US EPA Region 4 (1995); therefore, an exposure duration of 10 years was most appropriate.

An ED of 30 years (US EPA Region 4, 1995) was used for off-Site residents. This value assumes an individual spends 6 years as a child and 24 years as an adolescent/adult in the same location.

4.2.1.3 Averaging Time

The averaging time (AT) parameter is the time period over which exposure is averaged. For human health cancer risk calculations, the AT_c value prorates a total cumulative dose over a

lifetime. As a conservative approach, the AT_c value for each receptor is the product of a 365-day year and a 70-year life span, equaling 25,550 days.

The AT_n used for non-carcinogenic effects is the product of a 365-day year and the exposure duration (i.e., $AT_n = 365$ days \times ED). Because the ED parameter changes for each receptor, the AT_n changes as well. The AT_n values used for each receptor are summarized below:

Future Construction Worker - 365 days

Maintenance Worker - 9125 days

Adolescent Visitor - 3650 days

Off-Site Child Resident - 2,190 days

Off-Site Adult Resident - 8,760 days

4.2.1.4 Body Weight

The body weight used for the adult exposures (future construction worker and maintenance worker) analyzed in this assessment was the current US EPA default value of 70 kg (US EPA, 1989; US EPA Region 4, 1995). This value was also used for the adolescent/adult off-Site resident scenario. The adolescent body weight used for the visitor scenarios was 45 kg. This value was extracted from US EPA Region 4 guidance (1995). For the child resident scenario, a body weight of 15 kg was used as recommended by US EPA (1991).

4.2.2 Route-Specific Exposure Parameters

The general intake equation discussed above (Equation 1) was modified by including route-specific exposure parameters in order to calculate route-specific intake values. For dermal exposures, skin surface area, adherence factor, exposure time (surface water exposures only), and absorption factor parameters were included in the intake equation. For ingestion exposures, an ingestion rate and a matrix effect were included in the intake calculation. For inhalation exposures, an inhalation rate and a retention factor for fugitive dusts were included in the intake equation. Also, for inhalation exposures, an additional paradigm was necessary to convert soil concentrations to concentrations in air available for intake.

4.2.2.1 Dermal Exposure Parameters

Skin Surface Area

The total skin surface area used for adult receptors in this assessment was 20,000 cm². This is a US EPA default value extracted from the *Exposure Factors Handbook* (1997). For adolescent exposures, a value of 12,768.3 cm² was used for total skin surface area. This was a mean value calculated based on the distributions of total skin surface areas for males and females between the ages of 7 and 16 as presented in *Exposure Factors Handbook* (1997). For the off-Site child resident scenario, a skin surface area of 7,213 cm² was used. This value was based on skin surface area data for male and female children provided in *Exposure Factors Handbook* (1997).

For purposes of exposure, it was assumed that only portions of the body would be exposed to the affected media on the Site. For the construction worker scenario, it was assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. These body parts comprise 27.8% of the total skin surface area, or 5560 cm².

For maintenance worker exposures to Site soils, it was assumed that the hands, forearms, and face would be exposed. These body parts comprise 15 percent of the total skin surface area, or 3000 cm².

For surface water and sediment exposures, exposed body parts for construction and maintenance workers included hands, forearms, and face or 3000 cm² (15% of the total skin surface area).

The visitor and off-Site resident scenarios assumed that the hands, forearms, and lower legs would be exposed for contact with Site soils. These body parts comprise 23.9% of the total skin surface area, or 3052 cm² for adolescent visitors, 1724 cm² for child residents, and 4780 cm² for adult residents. For exposures to surface water and sediment, hands, forearms, lower legs, and feet were assumed exposed for adolescent visitor and off-Site resident scenarios. These body parts comprise 30.9 % of the total skin surface area or 3945 cm² for adolescent visitors, 2229 cm² for child residents, and 6180 cm² for adult residents.

Soil Adherence Factor

Until recently, the US EPA-recommended default for soil adherence on skin ranged from 0.2 to 1.0 mg/cm² for the entire exposed surface area, without consideration of the type of activity (US EPA, 1992). However, the data from which that range was derived were primarily the result of indirect measurements, artificial activities, and sampling of hands only. A more recent study has presented the results of direct measurement of soil loading on skin surfaces before and after normal occupational and recreational activities that might result in soil contact (Kissel et al., 1996). A fiveorder of magnitude range (roughly 10⁻³ to 10⁺² mg/cm²) was reported for observed activity-related hand loadings. That report indicated that hand loadings within the range of 0.2 to 1.0 mg/cm² were produced by activities in which there was vigorous soil contact (e.g., rugby, farming); but for activities in which there was less soil contact (e.g., soccer, professional grounds maintenance), loadings substantially less than 0.2 mg/cm² were found on hands and other body parts. Kissel et al. (1996) concluded that, because non-hand loadings attributable to higher contact activities exceeded hand loadings resulting from lower contact activities, hand data from limited activities cannot be used as a conservative predictor of loadings that might occur on other body surfaces without regard to activity. Furthermore, because exposures are activity-dependent, dermal exposure to soil should be quantified using data describing human behavior (e.g., type of activity, frequency, duration, including interval before bathing, clothing worn, etc.).

The most recent version of the Exposure Factors Handbook (1997) states:

In consideration, of these general observations and the recent data from Kissel et al. (1996, 1997), this document recommends a new approach for estimating soil adherence to skin. First use Table 6-12 [Summary of Field Studies, Kissel et al., 1996a] to select the activity which best approximates the exposure scenario of concern. Next, use Table 6-13 [Mean Soil Adherence by Activity and Body Region, Kissel et al., 1996a] to select soil loadings on exposed skin surfaces which correspond to the activity of interest. This table contains soil loading estimates for various body parts. The estimates were derived from soil adherence measurements of body parts of individuals engaged in specific activities described in Table 6-12. These results provide the best estimate of central loadings, but are

based on limited data. Therefore, they have a high degree of uncertainty such that considerable judgment must be used when selecting them for an assessment.

In another study that assessed the percentage of skin coverage in several soil contact trials in a greenhouse and an irrigation pipe laying trial, Kissel et al. (1996) concluded that adjusted loadings may be two to three orders of magnitude larger than average loadings if average loadings are small.

The activity-specific soil adherence factor for exposures to a maintenance worker was calculated based on data presented by Kissel et al. (1996) for grounds keepers, as presented below:

		Soil	Adherence Factor	r by Body Part (mg	/cm²)
Receptor	Representative Activity	Hands	Arms	Lower Legs	Face
Maintenance Worker	Grounds Keepers	0,030 - 0.15	0.0021 - 0.023	0.0008 - 0.0012	0.0021 - 0.01

Data for the grounds keepers were used for the maintenance worker estimates because the activities of a grounds keeper best mimic those of a maintenance worker.

Soil adherence factors were calculated by normalizing each body part-specific soil adherence value (using the mid-points of the ranges tabulated above) with regard to the percentage of total body surface area represented by the respective body part (extracted from the US EPA Dermal Exposure Assessment: Principles and Applications [US EPA, 1992]). The maintenance worker adherence factor for soil was calculated based upon exposure to the hands, forearms and face. Surface area percentages for the hands, forearms, and face are 5.2, 5.9, and 3.9 percent, respectively (US EPA, 1997). Those body parts comprise 15 percent of the total body surface area. The normalized values for all body parts of interest were added, and the sum was divided by the total percentage of body surface area occupied by the parts. For example, the soil and sediment adherence factors for maintenance worker soil exposures (0.038 mg/cm²) were calculated as follows:

AF (mg/cm²) =
$$\frac{(0.09 \times 0.052) + (0.0126 \times 0.059) + (0.006 \times 0.039)}{0.15} = 0.038$$

The construction worker adherence factor was also calculated in this fashion. This exposure scenario assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. Soil loadings for the upper torso (chest and back) were not measured by Kissel et al. (1996) for construction workers because this body area is generally covered. However, to account for exposure to the upper torso during the very hot months of the year, the total area of the forearms, legs, hands, and face were assumed to be completely exposed. The hands, forearms, legs, and face comprise 5.2%, 5.9%, 12.8%, and 3.9% of the total skin surface area, respectively (with the face comprising one-third the surface area of the head), for a total of 27.8% exposed surface area. The construction worker soil adherence factor was based on data from Kissel et al. (1996) for construction workers as follows:

		Soil Adh	erence Fact	or by Body Part (mg/cm²)
Receptor	Representative Activity	Hands	Arms	Lower Legs	Face
Construction Worker	Construction Worker	0.24	0.098	0.066	0.029

The soil adherence factor for the construction worker scenario was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.066 \times 0.128) + (0.029 \times 0.039)}{0.278} = 0.1$$

For sediment exposures, the soil adherence factor was calculated for the construction worker scenario using adherence data from Kissel et al. (1996) for construction workers (as tabulated above) for the hands, forearms, and face. The hands, forearms, and face comprise 5.2, 5.9, and

3.9 percent of the total skin surface area, respectively (totaling 15 percent). Thus, the adherence factor for construction workers exposed to sediment (0.13 mg/cm²) was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.029 \times 0.039)}{0.15}$$
 = 0.13

The adherence factor for visitor and off-Site resident exposures to soil assumed that the forearms, hands, and lower legs would be exposed to soil or sediment. The data used in these calculation were based on data by Kissel et al. (1996) for soccer players (exposed to a playing field of roughly one-half grass and one-half bare earth in a light mist) as presented below:

		Soil Adherence	Factor by Body	Part (mg/cm ²)
Receptor	Representative Activity	Arms	Hands	Lower Legs
Visitor and Off- Site Resident	Soccer Players	0.0029 - 0.011	0.019 - 0.11	0.0081 - 0.031

The forearms, hands, and lower legs comprise 5.9%, 5.2%, and 12.8% of the total skin surface area, respectively, for a total of 23.9% (US EPA Exposure Factors Handbook, 1997). The adherence factor was then calculated for visitor and off-Site resident dermal exposures to soil as follows:

AF (mg/cm²) =
$$\frac{(0.00695 \times 0.059) + (0.0645 \times 0.052) + (0.0196 \times 0.128)}{0.239} = 0.026$$

A value of 0.026 mg/cm² was used as the soil adherence factor for visitors to the Site and off-Site residents.

Soil adherence factors for sediment exposures to Site visitors and off-Site residents were calculated using adherence data for the hands, forearms, lower legs, and feet. Adherence data for

reed gatherers were used for these exposures to best mimic activities that may incur sediment exposures. The reed gatherers studied by Kissel et al. (1996) periodically visited tidal flats to collect raw materials for basket weaving. The data from Kissel et al. (1996) presented in Exposure Factors Handbook (US EPA, 1997) were as follows:

Receptor	Representative Activity	Soil Adherence Factor by Body Part (mg/cm²)			
		Hands	Arms	Lower Legs	Feet
Visitors and Off-Site Residents	Reed Gatherers	0.66	0.036	0.128	0.63

The hands, forearms, lower legs, and feet comprises 5.2, 5.9, 12.8 and 7.0 percent of the total skin surface area, respectively (totaling 30.9 percent). Thus, the adherence factor for visitors and off-Site residents exposed to sediment (0.33 mg/cm²) was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.66 \times 0.052) + (0.036 \times 0.059) + (0.16 \times 0.128) + (0.63 \times 0.07)}{0.309} = 0.33$$

Exposure Time

To estimate intakes as a result of dermal exposure to surface water, an exposure time (ET) parameter was included in the intake formula for Site visitors and off-Site residents. The parameter value of 1.0 hour/day was estimated using best professional judgement. This value represents the amount of time a Site visitor or off-Site resident may spend exposed to surface water in any one EU.

Dermal Permeability Constant

The permeability constant, Kp, accounts for the movement of a constituent dissolved in water through the skin, across the stratum corneum, and into the blood stream. Kp values for the constituents examined in this assessment for surface water exposures were obtained from US EPA Dermal Exposure Assessment: Principles and Applications (1992). For values not available in

US EPA Dermal Exposure Assessment (1992), the Kp value were calculated using the equations provided by the US EPA in the same document.

Dermal Absorption Factor

The final parameter included in the dermal intake paradigm was a dermal absorption factor. In general, the skin provides an effective barrier to environmental toxins. For example, certain hair-coloring formulations which are vigorously rubbed onto the scalp on a daily basis contain lead acetate at concentrations up to 200,000 ppm, yet lead toxicity does not appear to result. Moore et al. (1980) determined that the rate of lead absorption from 203^{Pb} labeled lead acetate in cosmetic preparations containing six mmol Pb acetate/L in male volunteers over 12 hours was 0.06% during normal use of such preparations. For most inorganic salts, percutaneous (skin) absorption is considered insignificant relative to incidental ingestion (for example, US EPA, 1986). On the other hand, some drugs (e.g., nicotine) are effectively administered and absorbed into the blood stream from dermal "patches."

Most dermal bioavailability data for impacted soil have been obtained in laboratory animals or in vitro test systems. This introduces a significant source of uncertainty for predicting the human response. Safety factors have sometimes been applied to dermal absorption data obtained in animals to conservatively estimate the upper-bound of likely human percutaneous uptake of a certain constituent from skin exposure. This is usually unnecessary because human skin has generally been shown, for a diverse group of constituents, to be about 10-fold less permeable than the skin of typical animal species, such as rabbits and rats (Bartek and LaBudde, 1975; Shu et al., 1988).

US EPA Region III evaluated available data concerning the dermal absorption of specific constituents and classes of constituents and provided several recommendations (US EPA Region 3, 1995). For semivolatile compounds, such as bis(2-ethylhexyl)phthalate, the US EPA recommends a range of 1% to 10% (US EPA, 1995). Kao et al. (1985) reported 2.7 percent for absorption of topically applied pure benzo(a)pyrene by human skin in vitro. The US EPA

Region 3 recommends using 10% as a conservative assumption based on the Ryan et al. study (1987). In addition, US EPA Region 4 guidance (1995) states that a soil dermal absorption factor "of 1.0% for organics and 0.1% for inorganics should be used as defaults in determining the uptake associated with dermal exposure" (see the Dermal Contact subsection of Exposure Assessment section of the 1995 guidance). For the purpose of this risk assessment, an ABS of 3% for cPAHs and of 10% for other SVOCs were conservatively assumed for dermal absorption, in keeping with US EPA Region 3's and MDEQ's recommendations.

4.2.2.2 Ingestion Exposure Parameters

Ingestion Rate

US EPA's Exposure Factors Handbook (1997) discusses three adult soil ingestion studies with results ranging from 10 mg/day to 480 mg/day. Hawley's (1985) value of 480 mg/day (as recommended by the MDEQ) was "derived from assumptions about soil/dust levels on hands and mouthing behavior" (US EPA, 1997). Since no supporting measurements were made for Hawley's study, the US EPA states that Hawley's estimate "must be considered conjectural" (1997). As such, the US EPA goes on to suggest adult soil ingestion rates of 50 mg/day for industrial settings and 100 mg/day for residential and agricultural settings, although "50 mg/day still represents a reasonable central estimate of adult soil ingestion and is the recommended value..." (1997). Accordingly, a value of 100 mg/day for the maintenance worker and adult off-Site resident is amply conservative and was used in this assessment. In conjunction with the use of a two-tiered EF to reflect the different stages of potential future construction activities (see Section 4.2.1.1), the soil ingestion s for the construction worker scenario was also divided into two exposure levels for a single individual. A highly conservative ingestion rate of 480 mg/day (used in relevant exposure model calculations under "Exposure Level A") was used for construction workers for the first 10 days of exposure to address direct contact with soil during earth-moving activities such as foundation excavating. A soil ingestion rate of 100 mg/day (used in relevant exposure model calculations under "Exposure Level B") was used for the remainder of the construction worker exposure (70 days). Risks were then summed for both exposure levels to estimate the total potential risk posed to an individual construction worker

The ingestion rate used for the adolescent visitor scenario was 100 mg/day. The US EPA Region IV (1995) recommends a value of 200 mg/day as a mean ingestion rate for children under six years of age. This value was conservatively used in this assessment to estimate soil and sediment ingestion exposures for an off-Site resident child aged one to six years.

Gastrointestinal Matrix Effects of Soil

Incidental ingestion incorporates the matrix effect (ME; sometimes called the absorption adjustment factor [AAF]) into the general intake equation. When constituents are administered in solid vehicles such as food and soil, only a fraction of the ingested dose is extracted from the vehicle and subsequently absorbed through the gastrointestinal tract (US EPA Estimated Exposure to Dioxin-like Compounds, 1992). Gastrointestinal absorption of constituents sorbed onto such a medium is inhibited by physical-constituent bonding to the matrix (Hawley, 1985). This phenomenon is referred to as the gastrointestinal matrix effect of soil. Several studies referenced in the US EPA's Estimated Exposure to Dioxin-like Compounds (1992) have been performed to estimate the oral absorption factors of constituents from soil. At the request of MDEQ (2001), however, a gastrointestinal matrix effect of 1.0 was used in accordance with US EPA Region IV guidance (1995), although this approach is highly conservative and does not account for scientific studies that indicate the absorption of chemical constituents through the gastrointestinal tract is less than 100%.

4.2.2.3 Inhalation Exposure Parameters and Paradigms

Inhalation Rate

The inhalation rate used for the construction worker scenario was 20 m³/day. This is a common US EPA default value and was recommended by US EPA Region 4 (1995).

Retention Factor

According to the International Commission on Radiological Protection (ICRP), 75 percent of respirable dust particles (PM₁₀, or particles less than 10 microns in aerodynamic diameter) are retained when inhaled, the vast majority of which is potentially subsequently swallowed (ICRP,

1968). This 75% was included in the inhalation intake equation as the retention factor parameter (RF). This parameter applies only to non-VOC constituents entrained onto dust particles.

Concentration in Air

To estimate airborne dust levels during hypothetical construction activities, an emission rate of suspendible particles of less than 15 microns in aerodynamic diameter (PM₁₅) was calculated (grams/second); particles less than 10 microns were considered to be respirable. Considering particles of 15 microns or less in diameter in the emission rate calculation is a conservative assumption, inasmuch as only particles with an aerodynamic diameter of less than five to seven microns are inhaled into the lung.

The two types of construction activities at the Site that have the potential to emit fugitive dusts are vehicular movement over bare (unpaved or unvegetated) surfaces and the excavation of soil. Estimation of fugitive dust emissions caused by each activity were examined separately, as follows, and were derived from existing estimates of general construction exposure. The sum of the emissions from these two activities was multiplied by the concentration of constituent in the soil (Cs) in order to derive the total emission rate (Ei) for non-VOCs as follows:

$$Ei = C_x \times (PERv + PERe)$$
 [Equation 2]

where:

Ei = Emission rate (mg/sec);

 $C_s = Concentration in soil (mg/kg);$

PERv = Particulate emission rate for vehicular movement (lb/vehicle mile);

and

PERe = Particulate emission rate for excavation (lb/vehicle mile).

The following empirical expression (US EPA, 1988) was used to estimate the fugitive dust generated by vehicles during construction activities:

PERv (lbs/vehicle mile) = $k \times 5.9 \times (s/12)(S/30) \times (mvw/3)^{0.7} \times (ww/4)^{0.5} \times ((365 - p)/365)$ [Equation 3]

where:

PERv = Vehicle particle emission rate (lb/vehicle mile traveled);

s = Percent silt content (unitless);

k = Particle size multiplier (unitless);

S = Mean vehicle speed (mph); myw = Mean vehicle weight (ton);

ww = Mean number of wheels per vehicle (unitless); and

p = Mean number of days with ≥ 0.01 inches of precipitation per year

(unitless).

It was assumed that the vehicle travels during 40% of the 80-day exposure duration and 0.5 miles per day. The result is a value of 16 miles per construction event. Percent silt content was estimated to have a mean value of 50%, based on geotechnical data provided in the *Remedial Investigation Report* (Pisani & Assoc., 1997). US EPA default values were utilized and referenced for all other parameters. The particle size multiplier was assumed to be 0.50, corresponding to particles less than 15 microns (US EPA, 1996). Vehicle characteristics consist of the following: mean vehicle speed was assumed to be 15 mph, with mean vehicle weight assumed to be approximately 12.5 tons, for 8-wheeled vehicles (US EPA, 1988). The estimated mean number of days with precipitation equal to or greater than 0.01 inches per year is 110 (US EPA, 1988). Total resultant dust emissions for constituents during vehicular movement activities were estimated to be approximately 16.5 lbs/vehicle mile traveled, or 0.0001 kg/sec. Calculations are summarized in Table 20.

Future excavation may be performed by bulldozers, a backhoe, or other heavy construction equipment. The following estimate of particulate emissions, less than 15 μm in diameter resulting from bulldozing activity, was based on the approach described in the US EPA Compilation of Air Pollution Emission Factors (1996), as developed from studies of emissions from uncontrolled open dust sources resulting from bulldozing at western surface coal mines.

PERe (lb/hour) =
$$\frac{1.0 \times s^{1.5}}{M^{1.4}}$$
 [Equation 4]

where:

PERe = Excavation particle emission rate (lb/hr);

s = Percent silt content (unitless); and

M = Soil moisture content (unitless).

Percent soil moisture content was assumed to be 15.1%, an average of Site-specific soil moisture data and percent silt content 50%, as described above.

The resultant fugitive dust emission rate during excavation activities was 7.9 lbs/hr or 0.001 kg/sec. Table 20 summarizes these calculations.

Once the emission rate (Ei in Equation 2) was calculated, it was converted to a concentration in ambient air. Gaussian models are conventionally used to determine downwind ambient air concentrations, Ca, from the emission rate, Ei, estimated. However, in this scenario, such models have limited applicability when the receptor(s) is at or very near the source of emission. In this case, a bulldozer operator, for example, is situated directly within the area of ground emissions of vapors and dusts. Average ambient air concentrations in this circumstance are best estimated by use of a near-field box model (US EPA, 1988).

The near-field box model assumes uniform wind speed and uniform mixing throughout the box. The release and mixing of VOCs or respirable dusts in ambient air is estimated as follows:

Ca (mg/m³) =
$$\frac{Ei}{W_b \times H_b \times V}$$
 [Equation 5]

where:

Ca = Concentration of constituent in ambient air (mg/m³);

Ei = Emission rate of constituent (mg/sec);

W_b = Width of box in crosswind dimension within the area of residual

constituent in soil (m);

H_b = Downwind height of box (m); and

V = Average wind speed through the box (m/sec).

The value of H_b in this calculation is determined by the downwind distance and the atmospheric turbulence at ground level, which determines the trajectory of a release from the upwind edge of the source of vapor or dust emissions. For neutral atmospheric conditions, the height at the downwind boundary (H_b) may be expressed by the following function (Pasquill 1975, Horst 1979):

$$z = 6.25 \text{ r} [H_b/r \times \ln (H_b/r) - 1.58 H_b/r + 1.58]$$
 [Equation 6]

where:

 $H_b = Downwind height of box (m);$

z = Downwind distance to boundary (m); and

r = A terrain-dependent roughness height (m)

H_b (defined in Equation 5) is adjusted until the z parameter is equal to W_b (defined in Equation 5). The resulting H_b value is the height of the box. On any given workday, it is estimated that grading or excavation activities occur over the entire "workable" Site area (exposure unit) from which dusts are generated. This area is estimated to be 2,500 m², with length of the box estimated to be 50 meters (downwind distance) and the width of the box (W) estimated to be 50 meters. The greater the roughness height, the greater the wind turbulence and constituent dilution (i.e., the height of the box increases). For the purposes of this risk assessment, it is conservatively assumed that the roughness height is 0.20 meters, which corresponds to a terrain with grass, some small bushes, and occasional trees (US EPA Rapid Assessment of Exposure to Particulate Emission from Surface Contamination Sites, 1985). This

assumption is appropriate for the actual Site conditions. An annual average wind speed (4.69 m/sec) is obtained from the STAR data set, accessed through the Personal Computer Graphical Exposure Modeling System (PCGEMS), for STAR station 03940, Jackson/Thompson, MS for the period 1974-1978 (Table 21).

5.0 Toxicity Assessment

The toxicity assessment involves the evaluation of available toxicity information to be utilized in the risk assessment process. Toxicity values derived from a dose-response relationship can be used to estimate the potential for the occurrence of adverse effects in individuals exposed to various constituent levels.

Exposure to a constituent does not necessarily result in adverse effects. The relationship between dose and response defines the quantitative indices of toxicity required to evaluate the potential health risks associated with a given level of exposure. If the nature of the dose-response relationship is such that no effects can be demonstrated below a certain level of exposure, a threshold can be defined and an acceptable exposure level derived. Humans are routinely exposed to naturally-occurring constituents and man-made constituents through the typical diet, air, and water, with no apparent adverse effects. However, the potential for adverse effects may occur if the exposure level exceeds the threshold in a variably sensitive population. This threshold applies primarily to constituents which produce non-carcinogenic (systemic) effects, although there is a growing body of scientific evidence which suggests that exposure thresholds may exist for certain carcinogenic constituents as well.

Adverse effects can be caused by acute exposure, which is a single or short-term exposure to a toxic substance, or by chronic exposure on a continuous or repeated basis over an extended period of time. "Acceptable" acute or chronic levels of exposure are considered to be without any anticipated adverse effects. Such exposure levels are commonly expressed as reference doses (RfDs), health advisories, etc. An acceptable exposure level is calculated to provide an "adequate margin of safety."

Chronic RfDs, which have been derived by the US EPA for a large number of constituents, were utilized to evaluate exposures lasting seven to 70 years (US EPA, 1989). Activities involving exposures of shorter duration to COPCs at the Site are anticipated to result in hazard and risk estimates that are lower than those associated with the long-term exposures. Identification of

subchronic toxicity values corresponding to shorter-term exposure scenarios (i.e., less than seven years) are included in the risk assessment to ensure that both short-term and long-term risks can be addressed.

Currently, the US EPA has not developed toxicity values to be utilized in dermal exposure scenarios; however, the US EPA does provide the following guidance for dermal exposure:

No RfDs or slope factors are available for the dermal route of exposure. In some cases, however, non-carcinogenic or carcinogenic risks associated with dermal exposure can be evaluated using an oral RfD or oral slope factor, respectively. (US EPA, 1989).

Provisional dermal toxicity values were developed and utilized in the dermal exposure pathways considered in the human health risk assessment to provide a more accurate Site-specific risk assessment. These dermal RfD values were developed by multiplying the published oral RfD for a given constituent by the fraction of that constituent that can be absorbed through the gastrointestinal tract (stomach/intestine lining). The absorption fraction utilized was 50% for semivolatiles as extracted from US EPA Region 4 guidance (1995).

A number of sources of toxicity information exists, and these sources vary with regard to the availability and strength of supporting evidence. The following protocol has been established for the determination of toxicity indices; it defines a hierarchy of sources to be consulted and the methodology for the determination of toxicity values. This protocol has been developed in accordance with current US EPA methodology. Toxicity values for the COPCs at the Site were obtained with reference to the following hierarchy of sources developed in accordance with MCEQ guidance (1999):

Toxicity values were obtained from the Integrated Risk Information System (IRIS, 1999) database. This database contains the RfDs and Cancer Slope Factors (CSFs), which have been verified by the US EPA's RfD and Carcinogen Risk Assessment Verification Endeavor (CRAVE) workgroups, and is, thus, the

agency's preferred source for toxicity values. IRIS supersedes all other information sources.

- For toxicity values which are unavailable on IRIS, the most current source of information is the Health Effects Assessment Summary Tables (HEAST, US EPA, 1997), published by the US EPA. HEAST contains interim, as well as verified RfDs and CSFs. Supporting toxicity information for verified values is provided in an extensive reference section of HEAST.
- Region III's Risk-Based Concentration (RBC) Tables were visited. These tables often provide toxicity values generated by reliable sources other than IRIS or HEAST. For example, in response to specific requests from risk assessors, the US EPA National Center for Environmental Assessment (NCEA) develops provisional RfDs or CSFs for chemicals not listed in IRIS or HEAST. Region III's RBC tables will list such provisional values. Also, RfDs or CSFs that have since been withdrawn from IRIS or HEAST may still be listed on the Region III RBC tables, although they are flagged with a "W." These toxicity values were no longer agreed upon by US EPA scientists; however, the Region III RBC tables continue to publish such values because risk assessors still need to quantify exposures to these chemicals. Lastly, the Region III RBC tables will list toxicity indices found in "other" US EPA documents. These values are flagged with an "O" on the tables.

The US EPA has derived carcinogenic slope factors for both oral and inhalation pathways, and these are utilized to quantitatively estimate risks. In the first step of the US EPA's evaluation, the available data are analyzed to determine the likelihood that the agent is a human carcinogen. The evidence is characterized separately for human studies and animal studies as sufficient, limited, inadequate, no data, or evidence of no effect. The characterizations of these two types of data are combined, and based on the extent to which the agent has been shown to be a carcinogen in experimental animals or humans, or both, the agent is given a provisional weight-of-evidence classification. The US EPA scientists then adjust the provisional classification upward or downward, based on other supporting evidence of carcinogenicity (see Section 7.1.3, US EPA, 1989). For a further description of the role of supporting evidence, see the US EPA guidelines (US EPA, 1986).

The US EPA classification system for weight of evidence is shown in the table below. This system is adapted from the approach taken by the International Agency for Research on Cancer.

	US EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY
Group	Description
A	Human carcinogen
B1 or B2	Probable human carcinogen
	B1 indicates that limited human data are available
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
C .	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of non-carcinogenicity for humans

(US EPA, 1989)

Table 22 summarizes the available toxicity values for the identified COPCs. COPCs lacking published toxicity values were not able to be quantitatively evaluated in this assessment in accordance with MCEQ guidance (1999). The MCEQ limits the use of toxicity values to those that have been published in IRIS, HEAST, ATSDR toxicity profiles, or other peer-reviewed reference sources or literature approved by the MCEQ (1999). The MDEQ (2001), however, requested that risks from dermal exposure to cPAHs be estimated using the oral cancer slope factor for benzo(a)pyrene, applying benzo(a)pyrene relative potency factors, and accounting for an absorption efficiency of 50%. This methodology was used accordingly.

6.0 Risk Characterization

The objective of the risk characterization is to determine potential risk to receptors by combining the results of the exposure and toxicity assessments. Non-carcinogenic effects and carcinogenic risks are summarized in Table 23. Tables 24 through 78 provide algorithms and parameters for each pathway.

The estimated intakes calculated for each exposure pathway considered and each COPC were compared to RfDs for non-carcinogenic effects. The following formula was used to estimate the potential for non-carcinogenic health effects for each COPC.

HQ = ADI/RfD

[Equation 7]

where:

HQ = Hazard quotient - potential for noncancer health effects (unitless);

ADI = Average daily intake of COPC (mg/kg-day); and

RfD = Reference dose (mg/kg-day).

RfDs have been developed by the US EPA for chronic (e.g., lifetime) and/or subchronic exposure to constituents based on the most sensitive non-carcinogenic effects. The chronic RfD for a constituent is an estimate of a lifetime daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. The potential for noncancer health effects was evaluated by comparing the Site-specific exposure level with the RfD derived by the US EPA for a similar exposure period. This ratio of exposure to toxicity is called the hazard quotient (HQ). If the Site-specific exposure level exceeds the threshold (i.e., the HQ exceeds a value greater than 1.0), there may be concern for potential noncancer effects.

To assess the overall potential for noncancer effects posed by multiple constituents, a hazard index (HI) is derived by summing the individual HQs. This approach assumes additivity of critical effects of multiple constituents. This is appropriate only for compounds that induce the

same effect by the same mechanism of action. This conservative approach significantly overestimates the actual potential for adverse health impacts.

In cancer risk assessment, the US EPA has required the use of the upper limit which produces an estimate of potential risk that has a 95% probability of exceeding the actual risk, which may, in fact, be zero. The following formula was utilized to estimate the upper bound excess cancer risk for each carcinogen (note that not all COPCs are carcinogens):

 $TR = CLDI \times SF$

[Equation 8]

where:

SF

TR = Target risk - excess probability of an individual developing cancer (unitless);

CLDI = Calculated lifetime average daily intake of carcinogenic COPC

(mg/kg-day); and Cancer slope factor (mg/kg-day)⁻¹.

For exposures to multiple carcinogens, the upper limits of cancer risks are summed to derive a total cancer risk. The US EPA recognizes that it is not technically appropriate to sum upper confidence limits of the risk to produce a realistic total probability, but requires this approach be used.

Carcinogenic risk refers to the probability of developing cancer as a result of exposure to known or suspected carcinogens. The National Contingency Plan (NCP) endorses an acceptable risk range of 10^{-4} to 10^{-6} for exposure to multiple carcinogens. This range represents an incremental increase of 1 in 10,000 to 1 in 1,000,000 in the chance of developing cancer over a lifetime. The MCEQ (1999) indicates that the target risk level is 1×10^{-6} per individual carcinogen and an acceptable cumulative risk level is 1×10^{-4} . As such, risk levels totaled across oral, dermal, and inhalation pathways may exceed 1×10^{-6} and still be in compliance with MCEQ requirements (1999) as long as no single carcinogen exceeds 1×10^{-6} and the cumulative risk for a single receptor does not exceed 1×10^{-4} .

Table 23 provides a summary of the non-carcinogenic effects and carcinogenic risks associated with each of the pathways evaluated in this assessment.

The overall hazard index across the assessed pathways and EUs was 0.1 for the Site visitor scenario. This value is below the acceptable benchmark of 1.0. The highest hazard index associated with the Site visitor scenario was 0.07 corresponding to dermal exposure to sediment in EU4. The overall cancer risk for exposures to Site visitors was estimated to be 9 × 10⁻⁵ and is primarily attributable to oral and dermal exposure to benzo(a)pyrene and associated cPAHs in EU4 soil and sediments. Oral exposure to the same constituents in EU4 and EU5 surface soils also contributed to the cancer risk estimate for the site visitor. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the maintenance worker scenarios was 0.08 and is below the acceptable benchmark of 1.0. The highest hazard index associated with the maintenance worker scenario was 0.05 corresponding to oral exposure to sediment in EU4. The overall cancer risk for the maintenance worker scenario was 4×10^{-4} and was primarily attributable to dermal and oral exposure to benzo(a)pyrene and other cPAHs in surface soils in EUs 2, 4, and 5. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the hypothetical future construction worker was 0.000001 and is well below the acceptable benchmark of 1.0. The highest hazard index associated with the construction worker scenario was 9×10^{-7} corresponding to dermal exposure to surface water in EU 4. The overall cancer risk for the hypothetical future construction worker scenario was 5×10^{-5} and is attributable to benzo(a)pyrene and associated cPAH oral exposure in EU4 sediment and oral and dermal exposure to EU4 and EU5 soils. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The off-Site resident scenario revealed a hazard index of 6×10^{-4} . This value is considerably below the acceptable benchmark of 1.0. The overall cancer risk for the resident exposure

scenario was estimated to be 2×10^{-4} and is attributable to oral and dermal exposure to benzo(a)pyrene and associated cPAHs in EU6.

7.0 Uncertainty Analysis

Risk assessment uses a wide array of information sources and techniques. Even in those rare circumstances where constituent intake for an exposed individual may be measured relatively precisely, assumptions will still be required to evaluate the associated risk. Generally, data are not available for critical aspects of the risk assessment, and the use of professional judgment, inferences based on analogy, the use of default values, model estimation techniques, etc., result in uncertainty of varying degrees.

The expressions of risk in this assessment are not probabilistic; the expressions of risk are conditional, based on the conditions represented by the single-point values selected for the analysis. This section is intended to identify and qualitatively evaluate the more salient Site-specific uncertainties and their potential influence on the credibility of the estimated Site risks.

7.1 Uncertainty of Data Evaluation Factors

Uncertainties in data analysis include analytical error, selection of COPCs, adequacy of sampling design, etc. Generally, there is far less uncertainty in this phase of the risk assessment process than other aspects contribute.

Laboratory analysis is extremely accurate relative to the potential error of "professional judgment" in exposure assessments. The uncertainty of analytical data is likely to be less than 25 percent, most of the time.

The adequacy of the sampling strategies to characterize Site conditions is a potentially large source of uncertainty. Because of the limited availability of resources, sample collection is generally limited. However, sampling (especially in multiple surveys) is not random, but is designed to locate the areas with the highest levels of constituents. Thus, test data are biased toward overestimation of average constituent levels. In addition, in most instances, the upper 95-percent confidence limit of the average concentration is utilized as an exposure-point

concentration in the risk assessment. The use of this value likely will result in an overestimation of risk, as the 95% UCL represents a value that will be greater than the true average 95% of the time.

Oftentimes, only a portion of detected constituents are carried through the risk assessment process because constituents are eliminated through COPC screening procedures (US EPA, 1989). This could result in an underestimation of risk, although the COPC selection process is intended to identify those constituents that account for the vast majority of potential risk. COPCs lacking published RfD values were not quantitatively evaluated and this may result in an underestimation of potential hazards (non-carcinogenic effects).

7.2 Uncertainty of Toxicity Values

The US EPA's IRIS states that the uncertainty associated with RfD values for non-carcinogenic endpoints of toxicity "span perhaps an order of magnitude." In fact, the uncertainty of extrapolating dose-response data from animals to humans with the application of multiple safety factors (100 to 10,000 or more) is likely to be several orders of magnitude. Current policies for deriving RfD values will often result in an overestimation of risk.

The uncertainty associated with the estimation of cancer risk contributes, by far, the major source of potential error and uncertainty. It is beyond the scope of this analysis to explore this toxicity assessment factor in any detail. However, a few salient points are noted below.

Some constituents classified as carcinogens have been shown to produce an increased incidence of cancer in mice but not rats, for example. If the mouse is not an adequate model for the rat, it may be wondered how reliable a model it is for human beings. The assumption of linearity and a non-threshold phenomenon in the dose versus risk relationship may not be valid and could result in a very large overestimation of actual cancer risk, if any even exist at low doses in humans.

The US EPA evaluated the uncertainty of cancer risk estimates from exposures to trichloroethene and several other related VOCs in public drinking water supplies (Cothern et al., 1984). These US EPA scientists concluded the following:

- The largest uncertainty in the calculations is due to the choice of the model [Multistage, Weiball, Logit, Probit, etc.] used in extrapolating risk to low doses in humans, and is 5 to 6 orders of magnitude;
- If a single model were chosen [assumed to be valid], the overall uncertainty in risk estimates would be 2 to 3 orders of magnitude;
- The exposure estimates contribute, at most, an order of magnitude to the uncertainty;
 and
- It would appear that until a particular compound's mechanisms of cancer are better known, it is likely that the uncertainty in the toxicity will not be improved.

7.3 Uncertainties in Assessing Potential Exposure

Ideally, Site-specific exposure values should be used when assessing potential intakes of chemicals at a Site. Oftentimes, however, Site-specific data are not available; therefore, the risk assessor must estimate values that most accurately reflect Site conditions. In doing so, US EPA or other regulatory default values were utilized in place of Site-specific data. These values may over- or under-estimate risks, depending on Site conditions and the percentile range in which the default values fall (e.g., 50th, 95th).

Although a considerable amount of published data is available on the most common exposure parameters (e.g., body weight, skin surface area), even these data contain uncertainties. Studies conducted by different scientists often provide differing levels of detail, statistics, and accuracy based on sample size, study design, geographic area, etc. Such discrepancies can increase uncertainty when the data are combined to derive a single-point default value. These data may be the best available; however, the reflection of reality may still be imprecise.

Where published exposure parameters were not available, best professional judgment had to be used, thereby increasing uncertainty. The default or estimated exposure parameters used in this assessment likely resulted in a moderate over-estimation of risk.

The intakes estimated for dermal absorption of PAHs adsorbed into soils adhering to skin may overestimate risks for a host of reasons. Early studies conducted by Falk and coworkers indicated that the carcinogenic effect of B(a)P on subcutaneous injection in mice could be markedly inhibited by the simultaneous administration of various non-carcinogenic PAHs (Falk et al., 1964, as cited in ATSDR, 1988. In other subcutaneous injection and skin-painting studies with mice, it was shown that a combination of several non-carcinogenic PAH compounds, mixed according to the proportion occurring in auto exhaust, did not enhance or inhibit the action of two potent PAH carcinogens, B(a)P and dibenz(a,h)anthracene- (ATSDR, 1988).

The carcinogenic potency of B(a)P and other carcinogenic PAHs is generally determined by injecting solutions under the skin, painting the skin with the carcinogenic PAH dissolved in a solvent, or dissolved in corn oil in feeding studies. This vehicle or matrix affords a high level of bioavailability of the carcinogenic PAH compound. Recently, Krueger et al. (1999) conducted in vitro percutaneous absorption studies with contaminated soils and organic solvent extracts of contaminated soils collected at former manufactured gas plant (MGP) sites. The MGP tarcontaminated soils contained PAHs at levels ranging from 10 to 2400 mg/kg. The dermal penetration rates of PAH from the MGP tar-contaminated soils and soil solvent extracts were determined experimentally through human skin using tritrum-labelled B(a)P as a surrogate. Results showed reductions of two to three orders of magnitude in PAH absorption through human skin from the most contaminated soils in comparison to the soil extracts. Reduction in PAH penetration was attributed to soil matrix properties. That is, PAH compounds adsorbed to organic carbon in a soil matrix are far less bioavailable for dermal flux than PAH compounds dissolved in a solvent. [No correction for such a profound soil matrix effect was applied in quantitatively estimating cancer risks due to dermal absorption of B(a)P and other carcinogenic PAHs in this assessment.]

8.0 Summary of Findings

The results of the baseline human health risk assessment indicate potentially unacceptable risk levels for the following exposure scenarios:

Potentially Exposed Population	Media	EU
Site Visitor	Sediment	4
	Surface Soil	4, 5
Maintenance Worker	Sediment	4
	Surface Soil	2, 4, 5
Construction Worker	Sediment	4
	Subsurface Soil	4, 5
Off-Site Resident	Sediment	6

The risk levels associated with the above scenarios were driven by cPAHs, particularly benzo(a)pyrene. To determine the extent of remediation necessary to reduce these risks to acceptable levels, sediment and soil data for cPAHs in EUs 2, 4, 5, and 6 were closely examined.

The benzo(a)pyrene exposure-point concentration used to evaluate maintenance worker exposures to surface soil in EU2 was 5.2 mg/kg (sample location GEO-13/0-1'). This was the maximum benzo(a)pyrene concentration found in surface soil in EU2. The next highest concentration of benzo(a)pyrene in surface soil was found at SS-10 (2.4 mg/kg). However, as previously noted, these samples were collected at locations within a densely wooded area. No remediation is planned to address surface soils at these locations for the following reasons:

- No maintenance activities are currently conducted in this area;
- · Any remediation would require significant clearing; and
- Cancer risks associated with surface soils at these locations only slightly exceed 1 × 10⁻⁶ for two individual constituents, and the total cancer risk level is still less than 1 × 10⁻⁵.

In EU4, the maximum concentration of benzo(a)pyrene was used as the exposure-point concentration for site visitor, maintenance worker, and construction worker exposure to sediment. The benzo(a)pyrene exposure-point concentration used to evaluate these in EU4 was 130 mg/kg (sample location SD-02, see Figure 2). The next two highest concentrations of benzo(a)pyrene in sediment were found at SD-12 (71 mg/kg) and SD-23 (5.57 mg/kg), respectively. Implementing a remedy to remove, treat, or preclude contact with sediment at sample locations SD-02, SD-12, and SD-23 would leave a concentration of 3.1 mg/kg (sample location SD-18) as the maximum concentration in sediment that could be potentially contacted by site visitors, maintenance workers, and/or construction workers in EU 4. Excluding samples SD-02, SD-12, and SD-23 and using 3.1 mg/kg as the exposure-point concentration drops the risk level for dermal and oral contact with sediment by a visitor and oral contact with sediment by a maintenance worker or construction worker to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 79 - 83).

In EU4, the maximum concentration of benzo(a)pyrene was also used as the exposure-point concentration for site visitor, maintenance worker, and construction worker soil exposures. Each of these receptors could potentially be exposed to soils at different depth ranges: visitor 0-1' bgs, maintenance worker 0-6' bgs, and construction worker 0-20' bgs. The sample locations and corresponding concentrations of benzo(a)pyrene that contributed to elevated risk estimates in the three exposure scenarios are presented in the table below:

Sample Location	Benzo(a)pyrene Concentration
	(mg/kg)
GEO-48/0-1'	500
GEO-21/0-1'	230
GEO-21/2-3'	190
GEO-19/0-1'	56
GEO-46/0-1'	16

Sample Location	Benzo(a)pyrene Concentration
•	(mg/kg)
GEO-20/5-6'	11
GEO-47/5-6'	9.6
GEO-48/2-3'	6.1
GEO-20/0-1'	3.2
GEO-47/0-1'	3
GEO-19/2-3'	2.4

Implementing a remedy to remove, treat, or preclude contact with the surface (0-1' bgs) soil sample locations tabulated above would result in eliminating exposures for the site visitor scenario (i.e., the 0-1' bgs samples listed above comprise the entire data set for visitor exposures to surface soils in EU4). In addition, implementation of a remedy addressing the sample locations tabulated above would leave a maximum benzo(a)pyrene soil concentration in the 0-6' horizon of 0.29 mg/kg (sample location GEO-19/5-6'). Using the concentration of 0.29 mg/kg as the exposure-point concentration for estimating risk to maintenance workers drops the risk levels to within acceptable levels (Tables 84 - 85). Implementation of this remedy would also reduce the benzo(a)pyrene exposure-point concentration in soils in the 0-20' horizon for construction workers to 5.2 mg/kg resulting in estimated risk values well below acceptable levels (Tables 86-88). In situ biological treatment is proposed to address impacted soils within EU4. This will include clearing, tilling, application of inorganic nutrients, and, once soils are remediated to the extent practicable, placement of concrete cover. The area to be remediated will extend at least from Courtesy Ford to the edge of the railroad right-of-way, and may extend onto the railroad right-of-way with the permission of the Southern railway.

In EU5, the surface soil sample locations contributing most to elevated risk levels for the maintenance worker, construction worker, and site visitor scenarios were GEO-33/0-1', GEO-33/2-3', GEO-30/0-1', GEO-59/0-1, GEO-29/0-1', and GEO-28/0-1' (see Figure 2). All sample locations, with the exception of GEO-59/0-1', are located underneath paved areas in a

parcel of land extending from Courtesy Ford to the southeast (Figure 2). Pavement in this area precludes direct contact with surface and subsurface soils; therefore, it is not anticipated that current or future maintenance workers or site visitors will have access to soils in or around these sample locations. In addition, a deed restriction will be implemented requiring the maintenance of the paved areas to ensure protection of human health in the future. Sample location GEO-59/0-1', with a benzo(a)pyrene exposure point concentration is 6.1 mg/kg, however, is adjacent to West Pine Street in an unpaved area. Implementing a remedy to remove, treat, or preclude contact with surface soil at this location would leave a concentration of 0.37 mg/kg (GEO-60/0-1') as the maximum concentration in surface soil not covered by pavement that could potentially be contacted by any of the three receptors in this EU. Excluding sample GEO-59/0-1' and using 0.37 mg/kg as the exposure-point concentration drops the estimated exposures in EU5 to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 89 - 92).

The benzo(a)pyrene exposure-point concentration used to evaluate adult and child resident exposures to sediment in EU6 was 49 mg/kg (sample location SD-03, see Figure 3). This was the maximum benzo(a)pyrene concentration found in sediments in EU6. Sample locations SD-04, SD-14, SD-13, SD-16, SD-15, and SD-17 (33, 12.2, 3.27, 2.8, 2.42, and 2.26 mg/kg, respectively) also contributed to elevated cancer risk estimates for both receptors. Implementing a remedy to remove, treat, or preclude contact with sediment at these sample locations would leave a concentration of 0.97 mg/kg (sample location SD-05). Using the benzo(a)pyrene concentration of 0.97 mg/kg as the exposure-point concentration for sediment exposure to adult and child residents reduces the risk estimate to within acceptable limits (i.e., no risk level associated with a single carcinogen exceeds 1×10^{-6} ; Tables 93 - 96). Remediation activities are proposed to remove impacted sediment and preclude contact with residuals in the northeast drainage ditch. These activities include removal and off-Site treatment and/or disposal of impacted sediments, installation of a storm water collection and conveyance pipe, backfilling around the culvert, and planting with native grass.

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Figure 1 Site Conceptual Model and Selection of Exposure Pathways Kerr McGee, Hattiesburg, MS

Receptor Receptor E Population Age Visitor Adolescent In Visitor Adolescent In Worker Adult				
Soil (0-1) Soil (0-1) Exposure Unit 1 Visitor Adolescent In Exposure Unit 2 Visitor Adolescent In Exposure Unit 3 Visitor Adolescent In Exposure Unit 4 Visitor Adolescent In Exposure Unit 5 Visitor Adolescent In Exposure Unit 5 Visitor Adolescent In Exposure Unit 5 Visitor Adolescent In Exposure Unit 6 Worker Adult Worker Adult Exposure Unit 7 Worker Adult Worker Adult Exposure Unit 8 Maintenance Adult Worker Adult Exposure Unit 6 Maintenance Adult Worker Adult Worker Adult Worker Adult Worker Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 6 Resident Child/Adult Adolescent Adult Adolescent Adult In Visitor Adolescent		On-Site/	Type of	Rationale for Selection or Exclusion
Soil (0-1) Soil (0-1) Exposure Unit 2 Visitor Adolescent Exposure Unit 3 Visitor Adolescent Exposure Unit 4 Visitor Adolescent Exposure Unit 1 Maintenance Adult Exposure Unit 3 Maintenance Adult Exposure Unit 3 Maintenance Adult Exposure Unit 3 Maintenance Adult Exposure Unit 4 Worker Worker Exposure Unit 3 Maintenance Adult Exposure Unit 4 Worker Worker Adult Exposure Unit 5 Maintenance Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 6 Resident Child/Adult Adolescent Sediment Sediment Exposure Unit 1 Visitor Adolescent		Off-Site A	Analysis	of Exposure Pathway
Soil (0-17) Exposure Unit 2 Visitor Adolescent Exposure Unit 3 Visitor Adolescent Exposure Unit 4 Visitor Adolescent Exposure Unit 1 Worker Soil (0-67) Exposure Unit 2 Maintenance Adult Exposure Unit 3 Worker Maintenance Adult Exposure Unit 3 Worker Worker Adult Exposure Unit 4 Maintenance Adult Exposure Unit 5 Maintenance Adult Exposure Unit 5 Maintenance Adult Exposure Unit 5 Maintenance Adult Exposure Unit 6 Maintenance Adult Adolescent Exposure Unit 1 Visitor Adolescent Exposure Unit 1 Visitor Adolescent	4	On Cite	None	EU1 includes only surface water and sediment. Soils in this area are included in EU2
Soil (0-1) Exposure Unit 2 Visitor Adolescent In Exposure Unit 4 Visitor Adolescent In Exposure Unit 4 Visitor Adolescent In Exposure Unit 5 Visitor Adolescent Morker Adult Exposure Unit 3 Maintenance Adult Worker Adult Exposure Unit 3 Maintenance Adult Worker Adult Exposure Unit 4 Maintenance Adult Worker Adult Exposure Unit 5 Maintenance Adult Sediment Exposure Unit 5 Maintenance Adult Adult In Worker Adult In Worker Adult Exposure Unit 5 Maintenance Adult In Worker Adult In Wistor Adolescent Indianal In Wistor Adolescent Indianal Ind	_			
Exposure Unit 2 Visitor Adolescent In Exposure Unit 4 Visitor Adolescent In Exposure Unit 5 Visitor Adolescent In Exposure Unit 2 Worker Adult Exposure Unit 3 Maintenance Adult Worker Exposure Unit 3 Maintenance Adult Worker Adult Exposure Unit 4 Maintenance Adult Worker Adult Exposure Unit 5 Maintenance Adult Worker Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 1 Visitor Adolescent Adolescent Adolescent Exposure Unit 1 Visitor Adolescent Adolescent Exposure Unit 1 Visitor Adolescent	Oral			EU1 includes only surface water and sediment. Soils in this area are included in EU2
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Exposure Unit 3 Visitor Adolescent In Exposure Unit 4 Visitor Adolescent In Exposure Unit 5 Visitor Adolescent Worker Adult Exposure Unit 2 Maintenance Adult Worker Exposure Unit 3 Maintenance Adult Worker Exposure Unit 4 Maintenance Adult Worker Adult Exposure Unit 5 Maintenance Adult Worker Adult Exposure Unit 6 Maintenance Adult Adult In Visitor Adolescent A	_			Area potentially attractive for occasional recreational use
Exposure Unit 3 Visitor Adolescent Surface Exposure Unit 3 Visitor Adolescent Exposure Unit 3 Maintenance Adult Exposure Unit 3 Maintenance Adult Exposure Unit 4 Maintenance Adult Exposure Unit 5 Maintenance Adult Worker Adult Worker Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 1 Visitor Adolescent Sediment Exposure Unit 1 Visitor Adolescent	Inhalation			VOCs not present at levels of concern
Exposure Unit 4 Visitor Adolescent Surface Exposure Unit 3 Visitor Adolescent Exposure Unit 3 Maintenance Adult Exposure Unit 4 Maintenance Adult Worker Adult Worker Adult Exposure Unit 5 Maintenance Adult Worker Adult Worker Adult	╀	On-Site Ou	Ougnitiative Arr	Area potentially attractive for occasional recreational use
Exposure Unit 4 Visitor Adolescent Surface Exposure Unit 2 Waintenance Adult Exposure Unit 3 Maintenance Adult Exposure Unit 4 Maintenance Adult Worker Adult Exposure Unit 5 Maintenance Adult Worker Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent				Area potentially attractive for occasional recreational use
Exposure Unit 4 Visitor Adolescent Surface Exposure Unit 2 Maintenance Adult Exposure Unit 3 Maintenance Adult Exposure Unit 4 Maintenance Adult Worker Adult Worker Adult Exposure Unit 5 Maintenance Adult Worker Adult Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent	Inholotion	,		VOCs not present at levels of concern
Exposure Unit 5 Visitor Adolescent Surface Exposure Unit 2 Waintenance Adult Exposure Unit 3 Maintenance Adult Worker Adult Exposure Unit 5 Maintenance Adult Worker Adult Exposure Unit 5 Maintenance Adult Worker Adult Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 6 Nisitor Adolescent	+	On Site Ou	š	Exposed ground around drainage ditch potentially contacted by a visitor
Surface Exposure Unit 3 Visitor Adolescent Exposure Unit 3 Maintenance Adult Worker Exposure Unit 3 Maintenance Adult Worker Exposure Unit 4 Maintenance Adult Worker Exposure Unit 5 Maintenance Adult Exposure Unit 5 Maintenance Adult Exposure Unit 6 Resident Child/Adult Exposure Unit 6 Resident Child/Adult Adolescent Adolescent Adolescent Adolescent				Exposed ground around drainage ditch potentially contacted by a visitor
Surface Exposure Unit 5 Visitor Adolescent Soil (0-6') Exposure Unit 2 Maintenance Adult Exposure Unit 3 Maintenance Adult Worker Exposure Unit 5 Maintenance Adult Worker Exposure Unit 5 Maintenance Adult Worker Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent	Inhalation		_	VOCs not present at levels of concern
Soil (0-6') Soil (0-6') Soil (0-6') Exposure Unit 2 Worker Exposure Unit 3 Worker Exposure Unit 4 Worker Worker Worker Exposure Unit 5 Worker Worker Worker Adult Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 6 Resident Adolescent Adolescent Adolescent	+	On-Site Ou	Š	Visitors may traverse the area
Soil (0-67) Soil (0-67) Soil (0-67) Exposure Unit 2 Worker Exposure Unit 3 Waintenance Adult Worker Worker Exposure Unit 5 Worker Worker Adult Exposure Unit 5 Worker Worker Adult Adult Adult Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent			_	Visitors may traverse the area
Soil (0-67) Soil (0-67) Worker Exposure Unit 2 Worker Exposure Unit 3 Worker Exposure Unit 4 Worker Exposure Unit 5 Worker Worker Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent Adolescent Adolescent	Inhalation	, 		concern
Soil (0-67) Soil (0-67) Worker Exposure Unit 2 Worker Worker Exposure Unit 3 Worker Worker Exposure Unit 5 Worker Worker Worker Exposure Unit 5 Worker Worker Worker Worker Worker Adult Adult Adult Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent	+	On-Site	Γ	ediment.
Soil (0-67) Exposure Unit 2 Worker Exposure Unit 3 Worker Exposure Unit 4 Worker Worker Worker Exposure Unit 5 Maintenance Adult Worker W		;	-	EU! includes only surface water and sediment. Soils in this area are included in EU2
Exposure Unit 2 Maintenance Adult Worker Exposure Unit 4 Maintenance Adult Worker Exposure Unit 5 Maintenance Adult Worker Worker Worker Taposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent	Inhalation			EUI includes only surface water and sediment. Soils in this area are included in EUZ
Exposure Unit 3 Maintenance Adult Exposure Unit 4 Maintenance Adult Exposure Unit 5 Maintenance Adult Worker Worke	+	On-Site	Γ	Surface Soil exposures addressed in EU2 under a future scenario
Exposure Unit 3 Maintenance Adult Exposure Unit 4 Maintenance Adult Worker Adult Adult				Surface Soil exposures addressed in EU2 under a future scenario
Exposure Unit 3 Maintenance Adult Exposure Unit 4 Maintenance Adult Worker Worker Exposure Unit 5 Maintenance Adult Worker Worker Voitor Adolescent Sediment Exposure Unit 1 Visitor Adolescent	Inhalation	<u>.</u>		Surface Soil exposures addressed in EU2 under a future scenario
Exposure Unit 4 Worker Exposure Unit 5 Maintenance Adult Worker Wor	+	On-Site		Surface Soil exposures addressed in EU3 under a future scenario
Exposure Unit 4 Maintenance Adult Worker Exposure Unit 5 Maintenance Adult Worker Adult Adult Adult Adul				Surface Soil exposures addressed in EU3 under a future scenario
Exposure Unit 4 Maintenance Adult Worker Exposure Unit 5 Maintenance Adult Worker Worker Child/Adult Sediment Exposure Unit 6 Resident Child/Adult	Olai Chalairta			Surface Soil exposures addressed in EU3 under a future scenario
Exposure Unit 4 Maintenance Adult Worker Exposure Unit 5 Maintenance Adult Worker Worker Child/Adult Sediment Exposure Unit 6 Resident Child/Adult	$\frac{1}{1}$	Sile O	2	Infrequent maintenance of drainage ditch
Worker Exposure Unit 5 Maintenance Adult Worker Worker Worke				Infrequent maintenance of drainage ditch
Exposure Unit 5 Maintenance Adult Worker Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent	Of all	у 		VOCs not present at levels of concern
Exposure Unit 5 Mantenance Adult Exposure Unit 6 Resident Child/Adult Sediment Exposure Unit 1 Visitor Adolescent	\dagger	On-Site		Surface Soil exposures addressed in EUS under a future scenario
Sediment Exposure Unit 1 Visitor Adolescent		<u>!</u>		Surface Soil exposures addressed in EUS under a future acenario
Sediment Exposure Unit I Visitor Adolescent	Inhalation			Surface Soil exposures addressed in EUS under a future scenario
Sediment Exposure Unit I Visitor Adolescent	+	Off-Site	Γ	Sediment exposures represent worst-case; no soil data
Sediment Exposure Unit 1 Visitor Adolescent				Sediment exposures represent worst-case; no soil data
Sediment Exposure Unit 1 Visitor Adolescent	la halation			Sediment exposures represent worst-case, no soil data
Sediment Exposure Unit i Visitor Adolescent	╀	On-Site O	Quantitative V	Visitor may potentially wade in Gordon's Creek
Vicing				Visitor may potentially wade in Gordon's Creek
Visitor	Inhalation			VOCs not present at levels of concern
	╀	On-Site Q	Quantitative V	Visitor may potentially walk through drainage ditten
				Visitor may potentially walk through drainage ditch
stanti	Inhafation		None	VOCs not present at levels of concern



Pathways -Figure 1 Site Conce

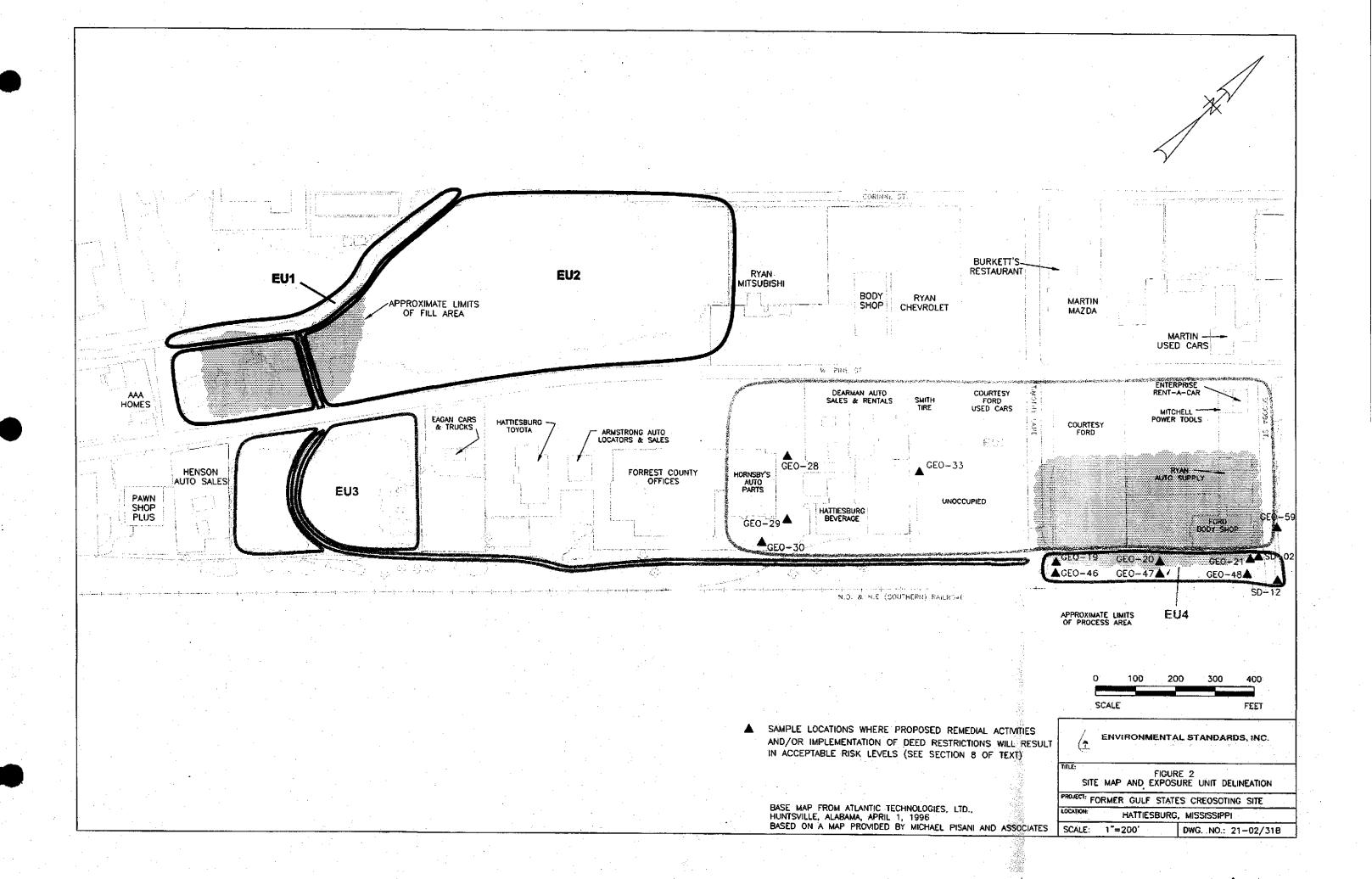
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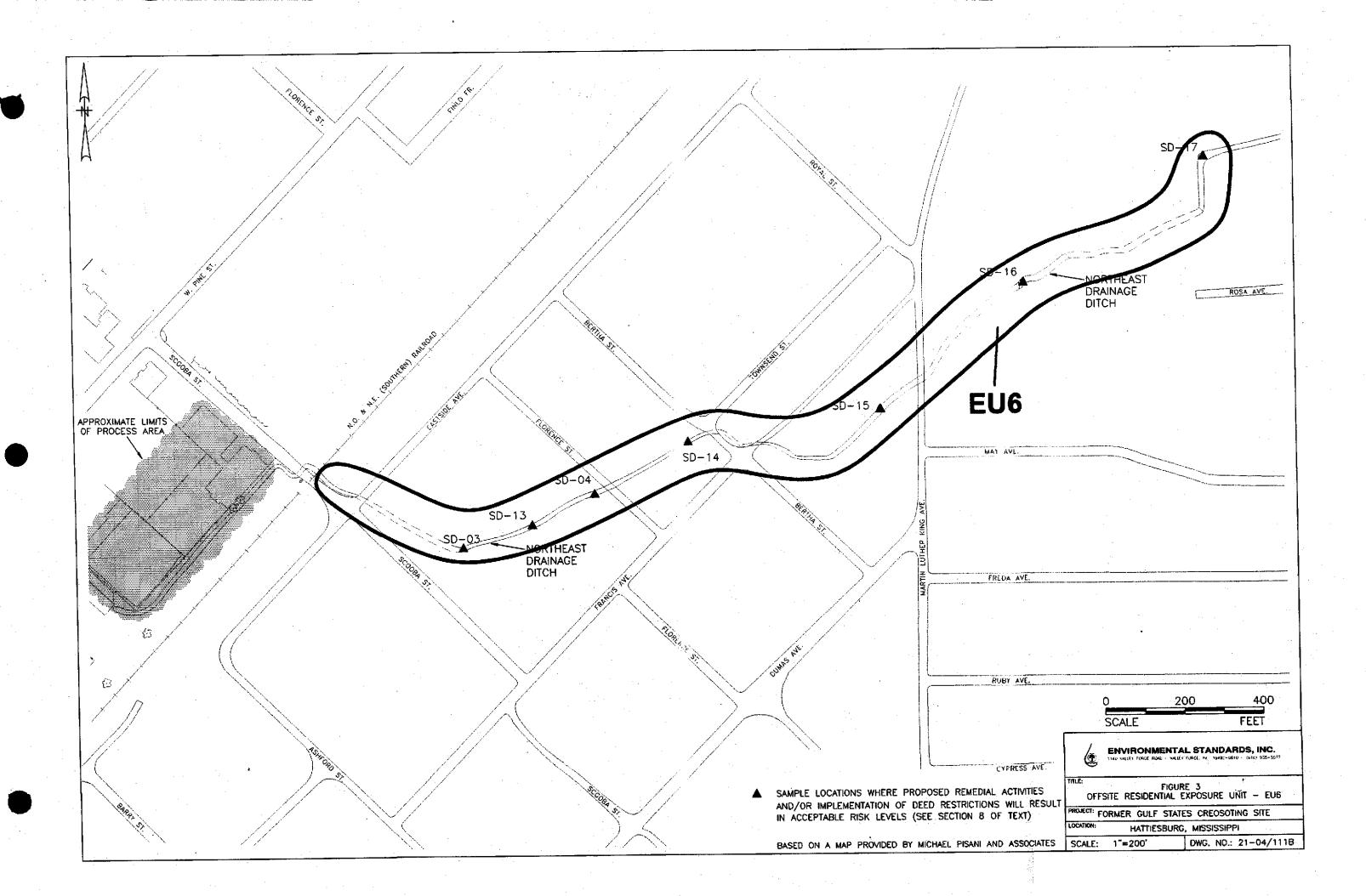
rr McGe	e. Hattle	Your McGee, Hattlesburg, MS							
							1-13-0	Transof	Rationale for Selection or Exclusion
Scenario	Medium	Exposure	Exposite	Receptor	Receptor	Exposure	OF SHE	Anabieie	of Exposure Pathway
-		Medium	Point	Population	Age	Route	Off-Site	Analysis	
1				Malatonomica	Adult	Demial	On-Site	None S	Sediment exposures addressed in EU1 under a future scenario
			Exposure Our 1	W. L. Jan		Č		None	Sediment exposures addressed in EUI under a future scenario
				WORKE		Inhalation		None	Sediment exposures addressed in EU1 under a future scenario
			1 1 1 1	Laintenemen	Adult	Dermai	On-Site	Quantitative I	Infrequent maintenance of drainage ditch
			Exposure Out 4	IV-diameter 114-diameter 114-di		e C			Infrequent maintenance of drainage ditch
· .				WOIKE		Inhalation	•		VOCs not present at levels of concern
			T I last 6	Decident	Child/Adult	Demal	Off-Site	Quantitative P	Playing/working in drainage ditch
•			Exposure Cint o	Nesidelli)	[E]O			Playing/working in drainage ditch
					***************************************	Inhalation			VOCs not present at levels of concern
					Adolonooni	- Leaner	S-Sile	2	Visitor may potentially wade in Gordon's Creek
	Surface	Surface	Exposure Unit i	VISION	Addressem	1	·		Visitor may potentially wade in Gordon's Creek
	Water	Water				Inhalation			VOCs not present at levels of concern
				1000	Adolescent	- Land	On-Site	Ouantitative	Visitor may potentially walk through drainage ditch
			Exposure Onn 4	VISIG	WATER TO LEAVE	3		-	Visitor may potentially walk through drainage ditch
						Inhalation		-	VOCs not present at levels of concern
	:						on Cite		Surface Water exposures addressed in EU1 under a future scenario
			Exposure Unit 1	Maintenance	Adult		2 .		Surface Water exposures addressed in EUI under a future scenario
				Worker		Ē			Confere Nater evenesings addressed in EUI under a future scenario
	_					Inhalation		-1-	THE ACT WAYS CAPOSING CO.
			Exposure Unit 4	Maintenance	Adult	Dermal	On-Site		Infrequent maintenance of dramage discr
				Worker		Oral		Quantitative	Infrequent maintenance of drainage discin
						Inhalation		None	VOCs not present at levels of concern
•			A Init &	Decident	Child/Adult	Dermai	Off-Sile	Quantitative	Playing/working in drainage ditch
			Exposure Out o	Kesiden		Oral			Playing/working in drainage ditch
					,	Inhalation		_	em
					44.4	Jems J	On-Site	Γ	ediment.
Future	Surface	Surface	Exposure Unit I.	Maintenance	nanc.) Indiana		None	
	So.	Soil		Worker		Inhalation		None	EUI includes only surface water and sediment. Soils in this area are included in EU2
		(0-6)	1	Maintenance	Arbeite	Dermal	On-Site	Quantitative	May potentially become a maintained area
			Exposure Office	Worker		C		Quantitative	May potentially become a maintained area
			•			Inhalation		None	VOCs not present at levels of concern
. ,				Maintenance	Adrilt	Dermal	On-Site	None	COPCs eliminated during screening process
			Exposure Oim 5	TV1		Cra		None	COPCs eliminated during screening process
				TO MORE		tuhatation		None	COPCs eliminated during screening process
				17.	Achille	Dermai	On-Site	None	Surface Soil exposures addressed in EU4 under a current scenario
			Exposure Unit 4	Majnienance	1800	ie C		None	Surface Soil exposures addressed in EU4 under a current scenario
	3.	•		MO KG		Inhalation		None	Surface Soil exposures addressed in EU4 under a current scenario
					4 4.48		2000	Ouantitative	May potentially become a maintained area
	÷		Exposure Unit 5	Maintenance	JIMPY	2		Ouantitative	May potentially become a maintained area
				Worker				None	VOCs not present at levels of concern

Figure 1 Site Conceptual Model and Selection of Exposure Pathways

	100	Additional Designation	Fxposiire	Receptor	Receptor	Exposure	On-Site/	Type of	Rationale for Selection or Exclusion
Scenario Timefranie	Monum	Medium	Point	Population	Age	Route	Off-Site	Analysis	OI Expusure rantway
	Cubeurface	Subcurface	Exposure Unit 1	Construction	Adult	Dermal	On-Site	None	EUI includes only surface water and sediment. Soils in this area are included in EU2
	Snil		-	Worker		Oral		None	EUI includes only surface water and sediment. Soils in this area are included in EU2
	}	(0' to water				Inhalation		None	
		table)	Exposure Unit 2	Construction	Adult	Dermal	- Ca-Site	Quantitative	Determinally constructship area in the future
				Worker		<u>E</u>		Quantitative	Aca. 3.0C entrained funitive dust generation during potential construction activities
						Inhalation		Cuamitative	CODE - diminated during errepting process
			Exposure Unit 3	Construction	Adult	Dermal	On-Site	None	
	J			Worker		Oral		None	
						Inhalation		None	COPCs eliminated during scienting process
			Exposure Unit 4	Construction	Adult	Dermal	On-Site	Quantitative	Infrequent construction activities may occur in the future
				Worker		Oral		Quanlitative	infrequent construction activities may occur, in the construction activities
						Inhalation		Quantitative	Non-VOC entrained jugitive dust generation of this promise
			Exposure 1 hit 5	Construction	Adult	Dermal	On-Site	Quantilative	Potentially constructable area in the future
			a mendya	Worker		Oral		Quantitative	Potentially constructable area in the future
						Inhalation		Quantitative	Non-VOC entrained fugitive dust generation during potential construction activities
•				Maintenance	Adult	Dermai	On-Site	Quantitative	Infrequent maintenance of Gordon's Creek
	Sediment	Sediment	Exposure Out	Marricolarice		1		Ouantitative	Infrequent maintenance of Gordon's Creck
				Worker		fuhalation		None	VOCs not present at levels of concern
						IIIII	0.0	Mone	Sediment exposures addressed in EU4 under a current scenario
			Exposure Unit 4	Maintenance	Adult	Certai		None	Sediment exposures addressed in EU4 under a current scenario
				Worker		5		Mond	Codinent expositives addressed in EU4 under a current scenario
	_		-		·	Inhalation		allow o	e. G construction activities may occur in the future
			Exposure Unit 1	Construction	Adult	Dermal	On-Site	Cuantitative	interpretations are accounted to the fitting
				Worker		Oral		Quantitative	Infrequent construction activities they were in the same
						Inhalation		None	VOCs not present at levels of concern
			True I bait	Construction	Adult	Dermal	On-Site	Quantitative	Infrequent construction activities may occur in the luture
			Exposure contra	Worker		Oral		Quantilative	Infrequent construction activities may occur in the future
						Inhalation		None	VOCs not present at levels of concern
		_		Maintenance	Adult	Derma	On-Site	Quantitative	Infrequent maintenance of Gordon's Creek
	Surface		Exposure Out 1	Maintenance		Ter C		Ouantitative	Infrequent maintenance of Gordon's Creek
	Water	Water		W CITACL		Inholation		None None	VOCs not present at levels of concern
	-					HIIIBIALINII		ago _N	Surface Water exposures addressed in EU4 under a current scenario
			Exposure Unit 4	Maintenance	Yoult	Derma	210-15	None and	Surface Water exposures addressed in EU4 under a current scenario
	<u> </u>			Worker					Surface Water exposures addressed in EU4 under a current scenario
	-					Inhalation		None	Jufface nack construction activities may occur in the future
			Exposure Unit 1	Construction	Adult	Derma	2 5 5	Quantities	Infragram constitution activities may occur in the future
				Worker		<u>a</u>		Cuantilative	William of messen at levels of concern
						Inhalation		4	7
			Exposure Unit 4	Construction	Adult	Dermai	On-site		
	· .			Worker		Oral		Quantitative	Infrequent construction activities may occur in the receipt
	_	_			_		•		







Statistical Summary and Selection of COPCs in EU1 Sediment Kerr McGee, Hattiesburg, MS

-		Total		Ē	Minimum Detection	Maximum Detection	Minimum	Minimum	•	Logarithmic	~	Maximum	Location of	Standard
,	CAS	Number of		Frequency 6/	Limit	Limit mg/kg	Detected ma/kg	Detected	Mean me/kg	Mean me/kg	Detected mg/kg	Detected Qualifier	Maximum Concentration	mg/kg
Constituent	Zemper.	Samples	SIICS		A WANTED	W.W.								
Semivolatiles		•	•	6	000000	0.005100	7 408-02	-	2.92E-01	1.94E-01	5.10E-01		SD-07	3.08E-01
2-methylnaphthalene	91-21-0	7	~	3	30.0	0.00.0	200			1000	A COE OI		2D-02	1.91E-03
Acensulthene	83-32-9	7	7	<u>8</u>	0.00E+00	0.00E+00	1.80E-01	-,	3.135-01	10-208.7	4.305-01	•		.0.00.7
Acensehibulene	208-96-R	2		50	4.00E-02	4.00E-02	7.80E-02	-	4.90E-02	3.95E-02	7.80E-02	~	20-05	4.105-02
Accilapiumyicus	170 174		٠,٠	5	0.00F+00	0.005+00	2.60E-01	-	3.60E-01	3.46E-01	4.60E-01		SD-07	1.41E-01
Anthracene	7-71-071	4 (۹ ج	3 2	0.005+00	0.005+00	1 SOE-01	•	3.85E-01	3.26E-01	5.90E-01		SD-07	2.90E-01
Benzo(a)anthracene	20-00-	7 (4 (3 9	0.000	0.005	1 205.01	, -	2 \$5E-01	2.16E-01	3.90E-01	-	SD-07	1.91E-01
Benzo(a)pyrene	50-32-8	~	7	3 :	0.000	0.005100	10-202.	, -	3.75E.01	3.14E-01	₹ 80F-01		SD-07	2.90E-01
Benzo(b)fluoranthene	205-99-2	7	~	3	0.00E+00	0.00=	1,705-01			1 60 1 5	1 908 01	-	SD-07	8,13E-02
Benzo(ghi)perylene	191-24-2	7	7	8	0.00E+00	0.005+00	6.50E-02	-	1.23E-01	1.080-01	1.000-01	, -		00100
Benzo/k)@noranthene	207-08-9	2	7	<u>8</u>	0.00E+00	0.005+00	6.40E-02	-	1.27E-01	1.10E-01	1.508-01	•	30-07	0.715-02
Control Agriculture	0 77 90	,		2	0.00E+00	0.00E+00	1.60E-01	-	3.65E-01	3.02E-01	5.70E-01		SD-07	2.90E-01
Carbazoic	210016			2	0.005+00	0.005+00	1 80E-01	7	3.55E-01	3.09E-01	5.30E-01		SD-07	2.47E-01
Chrysene	K-10-017	۷ ۲	٠ -	3 8	4 00E 01	4 OOF 02	6 20 1-02	-	4.10E-02	3.52E-02	6.20E-02	-,	SD-07	2.97E-02
Dibenz(a,h)anthracene	5-07-65	7 (3 5	4.00E-02	10-700-0	1 505-01	· -	2 ROF-01	2.48E-01	4.10E-01		SD-07	1.84E-01
Dibenzofuran	132-64-9	7	7	001	0.005+00	0,005,00	4 80E 01	•	105+00	086+00	1.70E+00		SD-07	7.21E-01
Fluoranthene	206-44-0	7	7	3	0.00E+00	0.005+00	0.605-01	•	70.000	3 705 01	6 205-01		SD-07	2.76E-01
Fluorene	86-73-7	2	7	<u>6</u>	0.00E+00	0.00E+00	2.30E-01	,	4.23E-01	3.185-01	0.205-01	•	6 6	103601
anomica(by C (1) control	101,10.5	,		001	0.00E+00	0.00E+00	6.90E-02	-	1.45E-01	1.23E-01	2.20E-01	-	SD-07	10.076-01
macinal test cappy and	. 00.10	יי	, ,	2	0.0F+00	0.005+00	1.80E-01	•	6.40E-01	4.45E-01	1.106+00		SD-07	6.51E-01
Naprimaiche	6-03-14	4 (٠,	2 5	000000	000000	7.20E-01		1.21E+00	1.11E+00	1.70E+00		SD-07	6.93E-01
Phenanthrene	8-in-s	7	7	200	0.005100	0.005.00	10 000 7		10.905.0	8 20F-01	1.40F+00		SD-07	6.51E-01
Pyrene	129-00-0	2	7	3	0.00=+00	0.WE+00	4.000-01							

Table 1
Statistical Summary and Selection of COPCs in EU1 Sediment
Kerr McGee, Hattiesburg, MS

tes phihalene ine Acne	mg/kg 1.67E+00 1.17E+00 2.32E-01 0 0 1 F-01	mg/kg 1.60E+22 3.23E+04 8.34E+09 2.23E+01 1.25E+08 6.25E+07	Confidence Unknown Unknown Unknown Unknown	5.10E-01 4.50E-01	mg/kg	TRG?	TRG?
thalene 1.	7E+00 7E+00 2E-01	1.60E+22 3.23E+04 8.34E+09 2.23E+01 1.25E+08 6.25E+07	Unknown Unknown Unknown Unknown	5.10E-01 4.50E-01			
6	7E+00 7E+00 2E-01	1.60E+22 3.23E+04 8.34E+09 2.23E+01 1.25E+08 6.25E+07	Unknown Unknown Unknown Unknown	5.10E-01 4.50E-01	3 115+03	ç	
- 700	7E+00 2E-01	3.23E+04 8.34E+09 2.23E+01 1.25E+08 6.25E+07	Unknown Unknown Unknown Unknown	4.50E-01	3.13E103	•	
. 61 0	2E-01	8.34E+09 2.23E+01 1.25E+08 6.25E+07	Unknown Unknown Unknown	2000	4.69E+03	2	
	E-01	2.23E+01 1.25E+08 6.25E+07	Unknown Unknown	70-20g-/	4.69E+03	9	
		1.25E+08 6.25E+07	Unknown	4.60E-01	2.35E+04	일	
` -	10-716	6.25E+07		5.90E-01	8.75E-01	00	YES*
	200	0.73670	Inknown	3.90E-01	8.75E-02	YES	YES - COPC
	20-12	007306 F	Introduct	\$ 80E-01	8.75E-01	2	YES*
Benzo(b)fluoranthene 1.67	0/2+00	4.79E+06	Cuality	1.000.01	2 15E+01	2	
Benzo(ghi)perylene 4.86	86E-01	2.08E+05	Christown	10-200-1		É	VEC
5	:.25E-01	1.71E+06	Unknown	1.90E-01	8.752+00	2	3
_	66E+00	2.15E+09	Unknown	5.70E-01	3.19E+01	2	4 5
	46E+00	3.73E+06	Unknown	5.305-01	8.75E+01	or	YES
· -	74E.03	2.15E+06	Unknown	6.20E-02	8.75E-02	011	YES
I macene	105+00	3.27E+05	Unknown	4.10E-01	3.13E+02	110	,
7	418+00	1.22E+05	Unknown	1.70E+00	3.13E+03	011	.*
202	645.00	3.35E+05	Unknown	6.20E-01	3.13E+03	90	
. v	5.21E-01	1 88F+07	Unknown	2.20E-01	8.75E-01	.00	YES*
-cappyrene	546+00	6 10E+19	Unknown	1.105+00	6.45E+02	10	
reapplications 2.3	30E+00	2.92E+04	Unknown	1.70E+00	2.35E+03	9	
	OPETO	7 405+06	Inknown	1.40E+00	2.35E+03	uo	

* Retained as a COPC, as per MDEQ Comments (8/2/2000):

Table 2
Statistical Summary and Selection of COPCs in EU1 Surface Water
Kerr McGee, Hattlesburg, MS

		Total		Ě	Minimum Detection	Maximum Detection	~	Minimum		Logarithmic	_	Maximum	Location of	Standard
	CAS	Number of	Hits	Frequency %	Limit mg/L	L.hmit mg/L	Detected mg/L	Detected Qualifier	Mean mg/L	Mean mg/L	mg/L	Oualifier	-1	mg/L
Constituent		1					•				1	,	00 000	2 545 04
Seni volutines	62 55 3	ŗ	-	۶	1.00E-03	1.00E-03	1.00E-03	- -,	7.50E-04	7.07E-04	1.00E-03	-	2W-00	0.040.04
Benzo(a)anthracene	C-CC-DC	1 :	- 4	۲	1000	1000	004500	Ž	\$ 00E-04	5.00E-04	0.00E+00	٧Z	SW-08	0.00E+0
Benzo(a)pyrene	50-32-8	7	>	5	CO-200.	1,000	20.000	: ;	1001	F 000 04	OUTTOO	2	SW-DR	0.00E+0
1	204-00-2	7	0	0	1.00E-03	.00E-03	0.00E+00	₹ Z	3,00E-04	3.00E-04	0.00	<u> </u>		21000
Benzologianicie	1 66 106			c	1 00E-03	1.00F-03	0.00E+00	٧Z	5.00E-04	5.00E-04	0.00E+00	× Z	2W-08	0.00540
Benzo(k)fluoranthene	6-80-/07	7	>	> '	100	20 200.1	000000	YIV	S OUT DA	5 OOE-04	0.00E+00	Ϋ́Z	SW-08	0.00E+0
Chryene	218-01-9	7	-	0	1.00E-03	1.00E-03	U.USETUD	۲ <u>:</u>	3,001-04	2000	00.000.0	. YIX	80'703	0.005+0
Difference hypertheseeme	53-70-3	7	•	0	1.00E-03	1.00E-03	0.00E+00	₹ Z	5.00E-04	S.00E-04	U.UGETUO	Į.	90-110	000000
Uluciiz(a,ii/aliniiaciic	102 30.5		•	¢	1.00E-03	1.00E-03	0.00E+00	۷ Z	5.00E-04	5.00E-04	0.00E+00	Ϋ́	80- M	0.005
Indeno(1,4,3-cd)pyrene	0.40.061	4 6		· \$	1 00E-03	1 00F-03	7.50E-03	,	4.00E-03	1.94E-03	7.50E-03		SW-08	4.95E-U3
Fluoranthene	0-44-007	7	-	3 ;	200.	40 100	.00	-	7 505 04	7.07E.04	1 00E-03	-	SW-08	3.545-04
Distance	129-00-0	. 7	_	δ.	1:00E-03	1.00E-03	1.00E-03	•	1,3015-04			y.		

NA - Not applicable: constituent not detected in media.

Statistical Summary and Selection of COPCs in EUI Surface Water Kerr McGee, Hattiesburg, MS Table 2

					Human Health	
	15Ñ %\$6	Logarithmic Logarithmic 95% UCL	Distribution 99%	Exposure Point Concentration	Consumption of Water & Organisms AWQC m9/L	Is Maximum Detected > AWOC?
Constituent	mg/L	mg/L	Consucer	2 /2		
Semivalatiles					1	
	2 115.01	4 17F-01	l Inknown	1.00E-03	4.40E-06	YES - COP
Denzola janimacene	CD-1105-4				70 201 1	****
Benzolelmurene	\$.00E-04	5.00E-04	Unknown	5.00E-04	4.40E-00	3
	\$ 00E 04	6 NO E 04	Imboundari	\$ 00E-04	4.40E-06	YES**
Benzo(b)Huoranthene	3.005-04	7.000			20 1104 1	****
Den 2017 Mucronthene	5.00E-04	5.00E-04	Chknown	S.00E-04	4.40E-00	3
Denizora Jugorania men	40 60	100	Labourn	5 00 E.O.	4.40E-06	YES**
Chrysene	5.00E-04	3.00E-04	CIIKIOWII	7.000	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	**300
City to the property	5.00F-04	5.00E-04	Unknown	S.00E-04	4.405-50	3
	5 OOE OF	5 00E-04	i inknown	5.00E-04	4.40E-06	YES**
Indeno(1,2,3-ca)pyrene	בתיתותים	10.000		5000 5	1.005-01	0
Fluoranthene	2.61E-02	Z.90E+42	UNKNOWE	CO-GOC'		
0.00	2.33E-03	4.37E-01	Unknown	1.00E-03	9.60E-01	9

NA - Not Available

*Retained as a COPC, as per MDEQ Comments (8/2/2000): constituent is a member of carcinogenic PAH family, one of which has been retained as a COPC.

Table 3
Statistical Summary and Selection of COPCs in EU2 Soil (0-1' bgs)
Kerr McGee, Hattiesburg, MS

		1		i	Minimum	Maximum Detection	Minimum	Minimum	ı.	Logarithmic	Maximum	Maximum	Location of	Standard
· · · · · · · · · · · · · · · · · · ·	CAS	Number of	H	Frequency	Limit me/kg	Limit mg/kg	Detected mg/kg	Detected Qualifier	Mean mg/kg	Mean mg/kg	Detected mg/kg	Detected Qualifier	Maximum Concentration	Deviation mg/kg
Constituent) In minor	1						-	1,045,00	2 155 03	1 60E-01	ſ	8S-10	3.99E-02
2.methylnaphthalene	91-57-6	*	7	14.29	3.30E-02	3.30E-02	7.00E-02	-, ·	3.005-02	20-35-02	4 00 5 00		GEO-13	8.69E-03
Acenanhthene	83-32-9	14	مــو٠	7.14	3.30E-02	3.30E-02	4.90E-02		1.88E-02	1.78E-02	4.30E-02	•	GEO-13	3.52E-01
Acenaphthylene	208-96-8	*	9	42.86	3.30E-02	3.30E-02	3.70E-02	_	1.59E-01	4.29E-02	0013051		GEO-13	4.28E-01
Anthracene	120-12-7	4	7	20	3.30E-02	3.30E-02	4.10E-02	-	1.896-01	5.00E-02	001301		GEO-13	1.78E+00
Renzo/alanthracene	56-55-3	4	12	85.71	3.30E-02	3.30E-02	4.10E-02	- , ·	8.98E-01	2.28E-01	6.70E+00		GEO-13	1.42E+00
Denzo(a)nvrenz	50-32-8	4	=	78.57	6.70E-02	6.70E-02	8.40E-02	- ,	8.31E-01	2.82E-01	5.205100		GEO-13	2 62E+00
Denso(h)flucenothene	705-00-7	. <u>*</u>	17	85.71	6.70E-02	6.70E-02	1.10E-01	barg .	1.84E+00	5.958-01	9.205700		GEO 13	6 05E-01
Senzo(o)autoranuncire	101.34.3	- 4	=	71.43	6.70E-02	6.70E-02	1.70E-01	_	5.17E-01	2.20E-01	2.30E+00		5-0-13	0.3550
Benzo(gni)peryiche	7-67-161	<u> </u>	2 0	2, 7,0	1.30E-01	1.30E-01	1.90E-01	-	7.01E-01	2.88E-01	3.60E+00	,	560-13	0.045-001
Benzo(k)Huoranmene	6-00-107	1 2	٠ ٦	28 57	3.30E-02	3.30E-02	4.30E-02	_	6.28E-02	2.94E-02	3.50E-01	-	GEO-13	10-360.1
Carbazoie	0-1-00	<u>: 1</u>	. :	1 20	1 305 07	3 10E-02	6.20E-02	-	1.19E+00	3.11E-01	8.00E+00		CEO-13	2.10E+00
Chrysene	218-01-9	4	7.	93.7	3,30E-02	20000	7 305 03		1.85E-01	8.87E-02	9.10E-01	. •	GEO-13	2.66E-01
Dibenz(a,h)anthracene	53-70-3	7	7	20	0.70E-02	0.705-02	10-105-1	, -	3.63E-07	2.08E-02	9.80E-02	7	SS-10	2.54E-02
Dibenzofuran	132-64-9	14	7	14.29	3.30E-02	3.305-02	20-307.7	, -	4 305 03	1 68E-02	1.10E-03	-	SS-10	2.50E-02
Di-n-butylphthalate	84-74-2	4	6	64.29	3.30E-02	7.20E-02	3.0015-02	-, -	1 406+00	3.00E-01	1.20E+0!		GEO-13	3.16E+00
Fluoranthene	206-44-0	<u>+</u>	7	85.71	3.30E-02	3.30E-02	6.60E-02	, -	00.304.4	10.000	3 70F-01		GEO-13	9.42E-02
Fluorene	86-73-7	4	~	14.29	3.30E-02	3.30E-02	4.50E-02	- n. '	4.385-04	20-312-02 23-316-02	3 200100		GEO.13	1.03E+00
Indeno(1.2.3-cd)nvrene	193-39-5	14	9	71.43	6.70E-02	6.70E-02	9.60E-02	_	6.59E-01	2.3/E-01	3.70E100	-	01.22	4 39F-02
Nanhthalene	91-20-3	4	~	14.29	3.30E-02	3.30E-02	8.80E-02	-	3.26E-02	2.20E-02	1.705-01	•	11-035	2 08E-01
Dhononthreno	8-10-58	4	20	57.14	3.30E-02	3.30E-02	3.70E-02		1.28E-01	5.30E-02	7.40E-01		65030	3 66E±00
Perene	129-00-0	14	2	85.71	6.70E-02	6.70E-02	9.80E-02	-	1.70E+00	4.60E-01	1.40E+01		Circia	2000

Table 3
Statistical Summary and Selection of COPCs in EU2 Soil (0-1' bgs)
Kerr McGee, Hattiesburg, MS

					Tier	Is the	
		Logarithmic	Distribution	Exposure Point	Unrestricted	Maximum	
	95% UCL	95% UCL	%66	Concentration	Soil TRG	Detected >	Is the 95%
Constituent	me/kg	mg/kg	Confidence	mg/kg	mg/kg	TRG?	UCL > IRG
Semivolatiles			i				
2-methylnaphthalene	4.95E-02	4.29E-02	Unknown	4.29E-02	3.13E+63	2	
A conorbithene	2 79F-02	2.17É-02	Unknown	2.17E-02	4.69E+03	OL	
Accilapitualia	3 265.01	4 99E-01	Unknown	4.99E-01	4.69E+03	110	
Acenaphoryicae	10.202.0	6 205-01	Unknown	6.29E-01	2.35E+04	Q	
Anthracene	3.715-01	0012100	[comounal	6.70E+00	8.75E-01	YES	YES - COPC
Benzo(a)anthracene	1./4E+00	0011001	Loginormal Loginormal	\$ 08E+00	8 75E-02	YES	YES - COPC
Benzo(a)pyrene	1.50E+00	3.08E+00	LOSSINGI INSI	0 205-00	8 75E-01	YES	YES - COPC
Benzo(b)fluoranthene	3.08E+00	2.33E+01	Cognorman	7.20E.00	con a se c	ŝ	
Benzo(ghi)berviene	8.46E-01	2.74E+00	Lognormal	Z.30E+00	2.358703	2	****
Benzo/k)@toranthene	195+00	2.93E+00	Lognormal	2.93E+00	8.75E+00	<u>0</u>	3
Dellacon (a)	10.321	1.24E-01	Unknown	1,24E-01	3.19E+01	00	
Carbazore	1115100	1 685±01	foonomal	8.00E+00	8.75E+01	u0	YES*
Chrysene	2.225.00	103601	Linkmonton	4 93F-01	8.75E-02	YES	YES - COPC
Dibenz(a,h)anthracene	3.115-01	4.955-01		3 576.07	1 13E+02	2	
Dibenzofuran	3.83E-02	3.57E-02	UNKHOWN	۰ ·	1000000		
Di-n-butylohthalate	5.48E-02	6.30E-02	Normal/Lognorma	_	7.28ETU3	≧.	
Fluoranthene	2.89E+00	1.66E+01	Lognormal	1.20E+01	3.13E+03	00	
Elionene	8 84F-07	5.84E-02	Unknown	5.84E-02	3.13E+03	110	- 1
Figurence 1.2 ed betrene	1 1 SE+00	4 296+00	Lognormal	3.70E+00	8.75E-01	YES	YES - COPC
indeno(1,4,5-culpy) circ	6 24E 03	4 715-02	Linknown	4.71E-02	6.45E+02	20	
Naphthatene	20-24C-C	1 06F-01	Lognormal	3.96E-01	2.35E+03	ш	
Phenanthrene	2.20E-01	1072501	l concerns	1.25E+01	2.35E+03	110	
Pyrene	3.43E+00	10-3C7.1	Annual Longitudes	5.43E+U0 1.23E+U1 Loginalism is member of carcinogenic PAH family.	nogenic PAH fami	<u> </u>	

*Retained as a COPC, as per MDEQ Comments (8/2/2000): constitued one of which has been retained as a COPC.

of COPCs in EU2 Soil (0-6' bgs)	
tical Summary and Selection of COPC	burg, MS
Statistical Summary	Kerr McGee, Hatties

		1 1		Ē	Minimum Detection	Maximum Detection	Missimum	Minimem	_	Logarithmic Maximum	Maximum	Maximum	Location of	Standard
-	CAS	Number of		Frequency	C mic	Limit	Detected	Detected	Mean	Mean	Detected mo/kg	Detected Oualifier	Maximum Concentration	Deviation mg/kg
Constituent	Number	Samples	Hits	%	mg/kg	mg/kg	mg/kg	Cupillier	E V	2 A A	4			
Semivolatiles	:					1	E 0 1	_	3 315 6	2.075-02	1.60E-01	-	SS-10	3.34E-02
7-nv-thvinaphthalene	91-57-6	20	7	<u>e</u>	3.30E-02	3.90E-02	7.00E-02	-	20-211-02	10.000	A GOE-DO		650-13	2.95E-02
According	83-32-9	21	-	4.76	3.30E-02	3.00E-01	4.90E-02	-	70-916.7	20-210-2	40.706.	•	GEO-13	2 91 E.D.
Acenaphinene	8-96-806	21	9	28.57	3.30E-02	3.00E-01	3.70E-02	Pag.	1.19E-01	3.60E-02	1.30E+00			1 545 01
Acenaphunyiene	130-12-7	: 5	oc.	38.	3.30E-02	3.90E-02	4.10E-02	-	1.37E-01	3.94E-02	1.60E+00		2000	10-340-0
Anthracene	56.66.3		7	66.67	3.30E-02	3.80E-02	4.10E-02	_	6.10E-01	1.12E-01	6.70E+00		CEO-13	00.000
Benzo(a)anthracene	0-00-00	.	: :	20.00	2 305.0	6 70E-02	8.40E-02	•	5.65E-01	1.25E-01	5.20E+00		GEO-13	1.215+00
Benzo(a)pyrene	20-32-8	17	7 :	77.14	3,700-04	1000	0 505-02	-	1.295+00	3.16E-01	9.20E+00		GEO-13	2.26E+00
Benzo(b)fluoranthene	202-99-2	7.1	9	76.19	3.70E-02	0.70E-02	9.300-02		2 54E-01	1 04F-01	2.30E+00		GEO-13	6.08E-01
Benzofehilbervlene	191-24-2	21	=	\$2.38	3.70E-02	6.70E-02	8.50E-02	•	100000	10 110	1 60F+00		GEO-13	8.79E-01
Benzo(k)fluoranthene	207-08-9	21	13	61.9	3.70E-02	1.30E-01	5.10E-02	٠. ٠	3.415-01	1.045.0	3 705.01	-	GEO-13	7,50E-02
Bist2-cibythexy)bobthalate	117-81-7	20	_	5	6.70E-02	7.80E-02	3.70E-01	-, -	20-20-07 4 0/17 03	3.916-02	1 SOF-01	. –	GEO-13	8.92E-02
Carbazole	86-74-8	70	4	20	3.30E-02	3.90E-02	4.30E-02	- , -	4.900-02	70-3/6.7	00E+00	•	GEO-13	1.83E+00
Chrysene	218-01-9	21	-13	61.9	3.30E-02	7.40E-02	5.10E-02		8.035-01	1.325.1 1.305.3	9.005.00 9.10E-01		GEO-13	2.29E-01
Oitenz(a h)anthracene	53-70-3	21	∞	38.1	3.70E-02	6.70E-02	1.88E-02	-, '	10-2671	3.305-02	0.80E-02	-	SS-10	2.13E-02
Dibenzofuran	132-64-9	20	~	2	3.30E-02	3.90E-02	7.20E-02	- , .	2.41E-02	20-020.2	1.050	. –	SS-10	2.08E-02
Die hutvinhthalate	84-74-2	07	٥	45	3.30E-02	7.80E-02	3.60E-02	- , ·	4:135-02	30-31/10	100000	•	GEO-13	2.63E+00
Fluoranthene	206-44-0	21	4	66.67	3.30E-02	3.80E-02	5.00E-02		9.54E-U1	10-27-1	2.70E-01		GEO-13	9.99E-02
The section of the se	86-73-7	21	4	19.05	3,30E-02	3.80E-02	2.90E-02	- :	208E-02	70-3647	3.705-01		GEO-13	8.86E-01
Indeposit 2 3-red margane	193-39-5	21	=	52.38	3.70E-02	6.70E-02	9.60E-02	-, ·	4.50E-01	1.115-01	3.705.01	-	88-10	4.47E-02
Michigan 1,455 vojejivite	91-20-3	- 73	7	9.52	3.30E-02	3.00E-01	8.80E-02	-	3.43E-02	70-31E-07	1.70E-01		GFO-13	1.77E-01
Dhananhrene	85-01-8	17	6	42.86	3.30E-02	3.90E-02	3.70E-02	_	1.01E-01	20-377-6	10-204-7	-	GEO-13	4.24E-02
Dhend	108-95-2	20	7	<u>e</u>	3.30E-02	7.80E-02	1.10E-01	- , ·	3.51E-02	2.52E-02	1.305-01	•	GEO-13	3.05E+00
Directo	129-00-0	21	14	66.67	3.70E-02	6.70E-02	6.80E-02	-	1.16E+00	1.926-01	1,405,41		270	

Table 4
Statistical Summary and Selection of COPCs in EU2 Soll (0-6' bgs)
Kerr McGee, Hattiesburg, MS

					I Ier I	SER	
		Logarithmic	Distribution	Logarithmic Distribution Exposure Point	Restricted Soil	Maximum	•
	95% UCL		%66	Concentration	TRG	Detected >	Is the 95%
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	ING	
Comivolatiles							
2 mathydronahthalene	4 00F-02	1.22E-02	Unknown	3.22E-02	8.18E+04	2	é
Z-meinymapinnarene Z-merktene	3.67F-02	2 90F-02	Unknown	2.90E-02	1.23E+05	OU.	
Acenaphurene	2 385.01	1 83E-01	Inknown	1.83E-01	1.23E+05	ᅋ	
Acenapathylene	2.40C-01	3 00E-01	linknown	2.09E-01	6.13E+05	91	
Anthracene	7.705-01	10-740-7 1 00E-100	Lognormal	2 ROE+00	7.84E+00	0t	YES*
Benzo(a)anthracene	1.178700	2.005100	Weight .	1645400	7 84F-01	YES	YES - COPC
Benzo(a)pyrene	1.02E+00	2.64E+00	Lognormal	7.04E+00	7 045400	3±2	YES - COPC
Benzoth)finoranthene	2.14E+00	1.096+01	Lognormal	9.20E+00	7.645-100	3	
Omno (ahi merulene	5.83E-01	1.41E+00	Lognormal	1.41E+00	6.13E+04	2	Ç
Oction (Sm) per years	8 57F-01	1.84E+00	Lognormal	1.84E+00	7.84E+01	0	YES.
Benzo(k)mooramment Bi-73 - Ahallom Dabibabia		\$ 77F-02	Unknown	5.77E-02	4.09E+02	잍	
Bis(2-einymexyr), gammaraec		6 51 15.00	Unknown	6.51E-02	2.86E+02	9	
Carbazole	4011-02	00.110.0	Lomorma	5.13E+00	7.84E+02	2	YES*
Chrysene	.49E+00	0.335E-00		2.200.01	7 84F.01	YES	YES**
Dibenz(a,h)anthracene	2.16E-01	2.39E-01	Unknows	4.375.01	5011010		٠
Dibenzofuran	3.23E-02	2.86E-02	Unknown	2.86E-02	8.18E+03	2	
Di-n-butviphthalate	4.95E-02	5.24E-02	Lognormal	5.24E-02	2.28E+03	Q.	
Elucranthene	1.94E+00	5.34E+00	Lognormal	5.34E+00	8.17E+04	9	
	8 R4E-02	6.16E-02	Unknown	6.16E-02	8.17E+04	2	
	7 835-01	1 975+00	Lognormal	1.97E+00	7.84E+00	OF O	YES*
anarydina-c.z, i yonabni	10 2 CO 2 C	A 37E-02	Ilaknown	4,37E-02	8.24E+02	ou	
Naphthalene	3.11E-04	10-11-11	The beautiful	1 88E-01	6.13E+04	2	
Phenanthrene	1.67E-01	1.88E-01	Onkilowii	(C) 1107 T	1 215+05	Ē	
Phenol	5.15E-02		Unknown	4.00E-02	0.257		
Durante	2.31E+00	7.47E+00	Lognormal	7.47E+00	0.138+04	2	

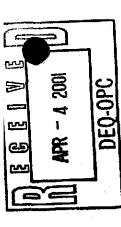


Table 5
Statistical Summary and Selection of COPCs in EU2 Soil (0-10' bgs)
Kerr McGee, Hattiesburg, MS

	1				Minimum	Maximum		Minimum		Locarithmic Maximum		Maximum	Location of	Standard
	CAS	Total Number of		HII Frequency	Detection Limit	Detection Limit	Detected	Detected	Mean	Mean			Maximum	Deviation
Constituent	Nomber	Samples	Hits	*	mg/kg	mg/kg	mg/kg	Qualifter	≡g/kg	mg/kg	mg/kg	Cualifier	Concentration	EW NG
Pesticides	-							•		100 r	100	-	50 do	
Endosuifan I	8-86-656	_	_	9	0.00E+00	0.00E+00	4.00E-03	-	4.00E-03	4.00E-03	4.00E-03	•	900	1
Heptachlor	76-44-8	-		901	0.00E+00	0.00E+00	1.00E-02		1.00E-02	1.00E-02	1.00E-02		SB-03	:
Semivolatiles									!			•	90	100000
2.4-dimethylphenol	105-67-9	23	-	4.35	6.70E-02	3.30E-01	1.10E+00	٦	8.68E-02	4.33E-02	1.10E+00	-	CO-92	10-3077
2-methylnaphthalene	91-57-6	23	4	17.39	3.30E-02	3.90E-02	7.00E-02	-	1.87E+01	4.58E-02	2.30E+02		SB-07	6.21E+UI
Acenanhthene	83-32-9	50	~	11.54	2.80E-02	3.10E-01	4.90E-02	-	1.14E+01	4.20E-02	2.00E+02		SB-07	4.29E+01
Acenanhthulene	208-96-8	26	00	30.77	2.80E-02	3.10E-01	3.70E-02	-	6.65E-01	5.37E-02	7.70E+00		SB-07	1.97E+00
Acculaption	120-12-7	3,5	2	38.46	7.90E-04	3.90E-02	4.10E-02	-	8.11E+00	5.28E-02	1.20E+02		SB-07	2.86E+01
Denzo(e)anthracens	56-55-1	36	2 12	61.54	8.60E-04	3.80E-02	4.10E-02	-	4.69E+00	1.16E-01	6.10E+01		SB-07	1.48E+01
Desired a January 1	50.72.8	3 6	2 2	61 54	3.70E-02	6.70E-02	1.69E-03	 -	2.09E+00	1.33E-01	2.20E+01		SB-07	5.75E+00
Denizo(a)pyrene	204-00-2	2 %	2 5	76.92	3.70E-02	6.70E-02	7.60E-04	-	3.49E+00	2.74E-01	3.30E+01	7	SB-07	8.58E+00
Desizo(chiberdan)	101-24-2	2 %	3 4	53.85	1.70E-02	6.70E-02	1.80E-03	•	7.49E-01	1.06E-01	6.40E+00		SB-07	1.65E+00
Denizo(Bin)perytene	207.00	3 6	2	65.38	3 70E-02	1.30E-01	5.10E-04	~	1.18E+00	1.62E-01	1.10E+01		SB-07	2.70E+00
Desize(n)stantantantantantantantantantantantantant	117-81-7	, K	: -	4.35	6.70E-02	5.00E-01	3.70E-01	۰,	6.43E-02	4,48E-02	3.70E-01	pary.	GEO-13	8.41E-02
Distantiance of Cartesian	86-74-8) K	. v	26.09	3.30E-02	3.90E-02	4.30E-02	-	3.39E+00	4.75E-02	5.00E+01		SB-05	1.16E+01
Carona	218-01-9	8	. 5	57.69	2.50E-03	7.40E-02	5.10E-02	-	4.36E+00	1.44E-01	5.20E+01		SB-07	1.316+01
City Selection Descriptions	51.70.1	36	9	38.46	5.30E-04	6.70E-02	1.88E-02	-	3.23E-01	5.14E-02	3.40E+00		SB-07	7.82E-01
Diberio 4, riyanini accile	132,64.0	3 5	4	17.39	3.30E-02	3.90E-02	7.20E-02	-	1.33E+01	4.35E-02	1.80E+02		SB-07	4.47E+01
Dischargentalists	84-74-2	2	•	39.13	3.30E-02	2.50E-01	3.60E-02	 3	4.59E-02	3.91E-02	1.105-01	٦.	SS-10	2.80E-02
Fluoranthene	206-44-0	26	. 9	61.54	2.00E-03	3.80E-02	5.00E-02	-	1.73E+01	1.63E-01	2.50E+02		SB-07	5.91E+01
Fliorene	86-73-7	79	9	23.08	2.60E-03	3.80E-02	2.90E-02	-	1.48E+01	4.19E-02	2.50E+02		SB-07	5.48E+01
Indeno(12.3-cd)myrene	193-39-5	36	4	53.85	1.10E-02	6.70E-02	1.40E-03		1,01E+00	1.11E-01	8.70E+00		SB-07	2.30E+00
Nanhthalene	91-20-3	56	ď	19.23	2.80E-02	3.10E-01	8.80E-02	_	2.31E+01	5.46E-02	3.90E+02		SB-05	8.54E+01
Phenanthrene	85-01-8	26		42.31	2.10E-03	3.90E-02	3.70E-02	-	3.34E+01	6.64E-02	5.10E+02		SB-07	1.20E+02
Dhenol	108.05.2	23	~	6.7	3.30E-02	2.50E-01	1.10E-01	7	4.04E-02	2.79E-02	1.90E-01	_	GEO-03	4.49E-02
Dymana	120-00-0	ş 2	<u>, </u>	61.54	4.50E-03	6.70E-02	6.80E-02	-	1.59E+01	2.33E-01	2.30E+02		SB-07	5.37E+01
Valatiles											-			1
Action	67-64-1	(e)	-	33,33	7.00E-03	3.50E-02	6.30E-02	ſ	2.80E-02		6.30E-02	- -3	SB-03	3.118-02
Ethylbenzene	10041-4	, en	~	29.99	1.00E-03	1.00E-03	6.80E-02		9.62E-02		2,20E-01		SB-05	1.12E-01
Tohiene	108-88-3	m	~	29.99	1.00E-03	1.00E-03	1.40E-02	-	2.07E-02	_	4.75E-02	-	SB-05	2.42E-02
Xulene (total)	1330-20-7	. M		66.67	1,00E-03	1,00E-03	4.90E-01		5.64E-01	6.65E-02	1.20E+00		SB-05	6.03E-01
Aylone (wound		_	1									-		



Statistical Summary and Selection of COPCs in EU2 Soil (0-10' bgs) Kerr McGee, Hattiesburg, MS Table 5

mg/kg Confidence mg/kg Unknown 4.00E-03 1 Unknown 4.00E-02 1 3.97E+01 Unknown 3.97E+01 8 8.98E+00 Unknown 3.97E+01 8 9.96E+01 Unknown 3.27E+01 1 9.96E+01 Unknown 3.27E+01 1 9.96E+01 Lognormal 2.17E+01 1 1.42E+02 Lognormal 2.17E+01 1 1.71E+01 Lognormal 2.17E+01 1 1.71E+01 Lognormal 2.17E+01 1 7.81E-02 Unknown 3.4E+00 1 7.90E+01 Lognormal 1.69E+00 2 1.59E+00 Unknown 2.24E+01 2 2.95E-02 Lognormal 2.50E+02 2 2.15E+01 Unknown 2.15E+01 2 2.55E+02 Lognormal 2.30E+02 2 2.55E+02 Lognormal 2.30E+02 2	Ÿ	05% IICL	Logarithmic 95% [JCL	Distribution 99%	Exposure Point Concentration	Soil TRG	is the Maximum Is the 95% UCL >	the 95% UCL >
henol 1.66E-01 8.51E-02 Unknown 1.00E-03 1 halene 4.10E+01 3.97E+01 Unknown 3.97E+01 1.37E+01 Unknown 3.97E+01 1.37E+01 Unknown 3.97E+01 1.37E+01 Unknown 3.97E+01 1.37E+01 Unknown 3.27E+01 1.37E+01 Unknown 3.27E+01 1.37E+01 1.37E+01 Unknown 3.27E+01 1.37E+01 Unknown 3.27E+01 1.30E+00 2.17E+01 Lognormal 2.08E+00 1.17E+01 Lognormal 2.08E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.75E+00 1.71E+01 Lognormal 3.30E+01 1.35E+00 1.75E+00 1.75E+00 1.75E+01 1.69E+00 1.75E+01 1.00E+01 1		mg/kg	mg/kg	Confidence	mg/kg	mg/kg	Detected > TRG?	TRG?
Linknown 4,00E-03 Linknown 1,00E-03 Linknown 1,00E-03 Linknown 1,00E-02 Linknown 1,00E-02 Linknown 1,00E-02 Linknown 1,00E-02 Linknown 1,00E-03 Linknown 1,00E-04 Linknown 1,20E+00 Linknown 1,21E-01 Lognormal 1,10E+01 Linknown 1,10E+02 Lognormal 1,20E+01 Linknown 1,10E+02 Lognormal 2,30E+02 Lognormal 3,30E+02 Lognormal 3,30E+02 Lognorm	sticides							
Likebool 1.66E-01 8.51E-02 Unknown 1.00E-02	dosnifan I	ł	ı	Unknown	4.00E-03	1.23E+03	2	
henol 1.66E-01 8.51E-02 Unknown 3.9TE-01 8.51E-02	eptachlor	ŀ	:	Unknown	1.00E-02	1.95E-01	2	
henol 1.66E-01 8.51E-02 Unknown 8.51E-02 halene 4.10E+01 3.97E+01 Unknown 3.97E+01 8.98E+00 Unknown 1.26E+00 1.26E+00 Unknown 3.27E+01 9.66E+00 9.96E+01 Lognormal 6.10E+01 7/10E+01 3.27E+01 Lognormal 3.27E+01 7/10E+01 1.20E+00 1.71E+01 Lognormal 3.30E+01 7/10E+01 1.30E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.71E+01 Lognormal 1.10E+01 1.30E+00 1.71E+01 Lognormal 1.50E+00 1.71E+01 1.69E+00 Unknown 2.24E+01 1.69E+00 Lognormal 1.50E+01 1.69E+00 Lognormal 1.50E+01 1.33E+01	smivolatiles					;		
e 4.10E+01 3.97E+01 Unknown 3.97E+01 8 2.58E+01 8.98E+00 Unknown 8.98E+00 1.35E+01 1.35E+00 Unknown 1.26E+00 1.35E+01 3.27E+01 Unknown 3.27E+01 1.35E+00 2.17E+01 Lognormal 6.10E+01 1.30E+00 2.17E+01 Lognormal 3.30E+01 1.30E+00 1.31E+00 Lognormal 3.30E+01 1.30E+01 Lognormal 3.30E+01 1.30E+01 1.30E+01 Lognormal 3.30E+01 1.30E+01 1.30E+0	henol 1	.66E-01	8.51E-02	Unknown	8.51E-02	4.08E+04	00	
2.58E+01 8.98E+00 Unknown 8.98E+00 1.36E+00 1.26E+00 Unknown 1.26E+00 1.77E+01 3.27E+01 Unknown 3.27E+01 9.66E+00 2.17E+01 Lognormal 2.17E+01 4.02E+00 2.17E+01 Lognormal 2.17E+01 1.30E+00 1.42E+02 Lognormal 3.30E+01 1.30E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.71E+00 1.70E+00 Unknown 3.44E+00 1.70E+01 1.69E+00 Unknown 3.44E+00 1.50E+01 1.69E+01 1.16E+02 1.30E+02 1.33E+01 1.11E+02 1.36E+02 1.17E+01 1.11E+02 1.30E+02 1.17E+01 1.56E+01 1.11E+02 1.56E-01 1.66E+02 1.17E+01 1.56E+01 1.66E-01 1.66E+02 1.17E+02 1.66E-01 1.66E+02 1.17E+02 1.66E-01 1.66E+02 1.66E-01 1.	4	105-01	3.97E+01	Unknown	3.97E+01	8.18E+04	2	
1.33E+00 1.26E+00 Unknown 1.26E+00 1.77E+01 3.27E+01 Unknown 3.27E+01 1.77E+01 3.27E+01 Unknown 3.27E+01 4.02E+00 2.17E+01 Lognormal 6.10E+01 4.02E+00 2.17E+01 Lognormal 2.17E+01 5.3E+00 3.31E+00 Lognormal 3.30E+01 1.30E+00 3.31E+00 Lognormal 3.31E+00 7.55E+00 3.31E+01 Lognormal 3.31E+00 7.55E+00 3.4E+00 Unknown 3.4E+00 8.74E+00 7.90E+01 Lognormal 5.20E+01 8.74E+01 2.24E+01 Unknown 2.24E+01 3.32E+01 2.3E+01 Unknown 2.3E+01 3.32E+01 2.3E+01 Unknown 2.3E+01 5.55E-02 5.50E-02 Unknown 2.39E+02 5.55E-02 5.50E-02 Unknown 2.39E+02 5.55E-02 5.50E-02 Unknown 2.30E+02 5.55E-02 5.50E-02 Unknown 2.30E+02 5.55E-03 2.55E+02 Lognormal 2.30E+02 5.55E-04 2.55E+04 Unknown 2.30E+02 5.55E-05 2.56E+05 Unknown 2.30E+02 5.55E-05 2.56E+05 Normal/Lognormal 4.75E-02 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02 6.16E-03 2.26E+21 Normal/Lognormal 4.75E-02 1.17E+04 2.26E+21 Normal/Lognormal 4.75E-02 1.17E+05 2.26E+21 Normal/Lognormal 4.75E-02 1.15E+05 2.26E+05 2.26E+05 2.26E+05 1.15E+05 2.26E+05 2.26E+05 2.26E+05 1.15E+05 2		\$8E+01	8.98E+00	Unknown	8.98E+00	1,23E+05	OL	
1.77E+01 3.27E+01 Unknown 3.27E+01 4.02E+00 9.96E+01 Lognormal 6.10E+01 4.02E+00 2.17E+01 Lognormal 2.17E+01 4.02E+00 2.17E+01 Lognormal 3.30E+01 5.3E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.71E+01 Lognormal 5.31E+00 7.5SE+00 7.90E+01 Lognormal 7.81E-02 7.5SE+00 7.90E+01 Lognormal 5.20E+01 8.74E+00 7.90E+01 Lognormal 5.20E+01 8.74E+00 2.24E+01 Unknown 2.24E+01 8.32E+01 2.24E+01 Unknown 2.35E+02 8.32E+01 2.15E+01 Unknown 2.35E+02 8.32E+01 2.5SE+02 Lognormal 8.70E+02 8.32E+01 2.5SE+02 Unknown 2.39E+02 8.32E+01 2.5SE+02 Unknown 2.39E+02 8.32E+01 2.5SE+02 Unknown 2.30E+02 8.32E+01 2.5SE+02 Lognormal 2.30E+02 8.32E+01 2.5SE+02 Lognormal 2.30E-02 8.32E-01 2.5SE+02 Normal/Lognormal 4.75E-02 8.32E-01 2.6SE+22 Normal/Lognormal 4.75E-02 8.32E-01 2.26E+21 Normal/Lognormal 4.75E-02 8.32E-01 2.26E+21 Normal/Lognormal 4.75E-02 9.66E+00 9.66E+01 Normal/Lognormal 4.75E-02 9.66E+00 9.66E+01 Normal/Lognormal 4.75E-02 9.66E+00 0.66E+01 Normal/Lognormal 4.75E-02 9.66E+00 0.66E+01 Normal/Lognormal 4.75E-02 9.66E+00 0.66E+01 Normal/Lognormal 4.75E-02 9.66E+01 0.66E+01 0.66E+01 0.66E+01 9.66E+01 0.66E+01 0.66E+01 0.66E+01 9.66E+01 0.66E+01 0.66E+01 0.66E+01 9.66E+01 0.66E+01 0.66E+01 0.66E+01 9.66E+01 0.66E+01 0.66E+01 0.66E+01 0.66E+01 9.66E+01 0.66E+01		33E+00	1.26E+00	Unknown	1.26E+00	1.23E+05	92	
9.66E+00 9.96E+01 Lognormal 6.10E+01 4.02E+00 2.17E+01 Lognormal 2.17E+01 2.36E+00 1.42E+02 Lognormal 3.30E+01 1.30E+00 1.30E+00 1.30E+00 1.71E+01 Lognormal 3.30E+01 1.30E+00 1.71E+01 Lognormal 1.10E+01 1.30E+00 1.71E+01 Lognormal 1.10E+01 1.55E+00 1.75E+00 1.69E+00 Unknown 5.46E+00 1.69E+00 1.69E+00 1.69E+00 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.59E+01 1.59E+01 1.59E+01 1.59E+01 1.31E+01 1.11E+01 Unknown 2.15E+01 1.11E+02 1.35E+01 Unknown 2.33E+01 1.11E+02 1.55E+01 Unknown 1.11E+02 1.55E+01 1.11E+02 1.55E+01 1.11E+02 1.55E+02 1.17E+01 1.11E+02 1.55E+02 1.17E+01 1.11E+02 1.55E+02 1.17E+01 1.55E+02 1.17E+01 1.55E+02 1.17E+01 1.55E+02 1.17E+02 1.55E+02 1.17E+02 1.55E+03 1.17E+03 1	-	77F+01	3.27E+01	Unknown	3.27E+01	6.13E+05	10	
4.02E+00 2.17E+01 Lognormal 2.17E+01 1.30E+00 1.42E+02 Lognormal 3.30E+01 1.30E+00 1.42E+02 Lognormal 3.30E+01 1.30E+00 1.31E+00 Lognormal 5.31E+00 1.30E+00 1.71E+01 Lognormal 1.10E+01 1.30E+00 1.71E+01 Lognormal 1.10E+01 1.55E+00 1.40E+00 Unknown 5.44E+00 1.69E+00 Lognormal 1.69E+00 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.59E+01 1.59E+01 1.59E+01 1.59E+01 1.31E+01 1.31E+01 Unknown 2.35E+01 1.31E+01 Unknown 2.35E+01 1.31E+01 Unknown 1.11E+02 1.35E+01 1.11E+02 1.35E+01 Unknown 1.35E+01 1.11E+02 1.35E+01 Unknown 1.35E+01 1.35E+01 Unknown 1.35E+01 1.35E+01 Unknown 1.35E+02 1.35E+02 1.35E+02 1.35E+03 1.35		66E+00	9.96E+01	Lognorma	6.10E+01	7.84E+00	YES	YES-COPC
6.36E+00 1.42E+02 Lognormal 3.30E+01 1.30E+00 1.30E+00 1.31E+00 1.31E+00 1.30E+01 1.30E+00 1.31E+00 1.31E+01 1.31E+02 1.33E+01 1.31E+02 1.33E+01 1.	. 4	02E+00	2 17E+01	Lognormal	2.17E+01	7.84E-01	YES	YES-COPC
1.30E+00	v	365+00	1 42E+02	Lognormal	3.30E+01	7.84E+00	YES	YES-COPC
2.08E+00 1.71E+01 Lognormal 1.10E+01 7.55E+00 5.44E+00 Unknown 7.44E+00 7.50E+00 1.69E+00 Unknown 7.45E+00 7.50E+01 Lognormal 7.81E-02 7.55E+00 7.50E+01 Lognormal 7.80E+01 7.53E+01 1.69E+00 Lognormal 7.55E+01 7.59E+01 1.69E+01 1		30E+00	\$ 31E+00	Lognormal	5.31E+00	6.13E+04	잂	
alate 9.44E-02 7.81E-02 Unknown 7.81E-02 7.55E+00 5.44E+00 Unknown 5.44E+00 8.74E+00 7.90E+01 Lognormal 5.20E+01 2.93E+01 2.93E+01 2.93E+01 2.93E+01 2.95E+02 1.09normal 5.59E-02 3.71E+01 4.36E+02 Lognormal 5.95E-02 3.71E+01 4.36E+02 Lognormal 5.95E-02 3.71E+01 2.15E+01 Unknown 2.15E+01 5.15E+01 2.15E+01 0.09normal 8.70E+00 5.50E-02 1.78E+01 1.11E+02 1.34E+01 1.11E+02 1.35E+01 1.35E+01 1.35E+01 1.35E+01 1.35E+02 1.		001430	1.71E+01	Lognormal	1.10E+01	7.84E+01	6	COPC*
7.55E+00 7.96E+01 7.55E+00 7.90E+01 7.95E+00 7.90E+01 7.9	alate	44F-02	7.81E-02	Unknown	7.81E-02	4.09E+02	то	
8.74E+00 7.90E+01 Lognormal 5.20E+01 and 5.30E+01 1.69E+00 1.69E+00 1.69E+00 1.69E+00 1.69E+00 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+01 1.69E+02 1.78E+02 1.78E+02 1.78E+02 1.78E+01 1.78E+02 1.78E+02 1.78E+03 1.78E+0	, 1	55E+00	5.44E+00	Unknown	5.44E+00	2.86E+02	00	
hyanthracene 5.85E-01 1.69E+00 Logmormal 1.69E+00 2.93E+01 2.24E+01 Unknown 2.24E+01 2.95E-02 5.95E-02 Logmormal 2.24E+01 3.71E+01 4.36E+02 Logmormal 2.59E-02 3.32E+01 2.15E+01 Unknown 2.15E+01 2.3-cd)pyrene 1.78E+00 9.60E+00 Logmormal 8.70E+00 5.17E+01 2.83E+01 Unknown 1.11E+02 7.34E+01 1.11E+02 Unknown 5.50E-02 5.65E-02 5.50E-02 Unknown 5.50E-02 3.39E+01 2.55E+02 Logmormal 2.30E+02 8.04E-02 1.17E+07 Normal/Logmormal 2.20E-01 6.15E-02 2.26E+21 Normal/Logmormal 4.75E-02	- ox	74F+00	7.90E+01	Lognormal	5.20E+01	7.84E+02	01	* COPC*
2.93E+01 2.93E+01 2.93E+01 2.95E-02 2.95E-02 3.71E+01 3.32E+01 2.15E+01 2.15E+01 3.32E+01 2.15E+01 2.16E+02 2.1E+02 2.1E+03 2	heatheacen	8.E.01	1.69E+00	Lognormal	1.69E+00	7.84E-01	YES	YES-COPC
halate 5.95E-02 Lognormal 5.95E-02 3.71E+01 4.36E+02 Lognormal 2.50E+02 3.32E+01 2.15E+01 Unknown 2.15E+01 5.17E+01 2.83E+01 Unknown 2.83E+01 7.34E+01 1.11E+02 Unknown 1.11E+02 5.65E-02 5.50E-02 Unknown 5.50E-02 3.39E+01 2.55E+02 Lognormal 2.30E+02 2.86E-01 2.55E+04 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02	•	936-01	2.24E+01	Unknown	2.24E+01	8.18E+03	OU	٠
thene 3.71E+01 4.36E+02 Lognormal 2.50E+02 1.213-cd)pyrene 3.32E+01 2.15E+01 Unknown 2.15E+01 2.32E+01 2.32E+01 Unknown 2.33E+01 2.33E+01 Unknown 2.33E+01 2.36E+02 2.35E+02 Unknown 1.11E+02 2.56E+02 2.55E+02 Lognormal 2.30E+02 3.39E+01 2.55E+02 Lognormal 2.30E+02 2.86E-01 2.86E+02 Normal/Lognormal 2.20E-01 2.26E+12 Normal/Lognormal 4.75E-02	halote ,	50E-07	\$ 95E-02	Lognormal	5.95E-02	2.28E+03	00	
12,3-cd)pyrene 1.78E+01 Unknown 2.15E+01 1.73E+01 Unknown 2.15E+01 1.73E+00 9.60E+00 Lognormal 8.70E+00 1.73E+01 1.11E+02 Unknown 2.13E+01 1.11E+02 Unknown 1.11E+02 5.50E-02 5.50E-02 Unknown 5.50E-02 3.39E+01 2.55E+02 Lognormal 2.30E+02 2.86E-01 2.86E-01 2.86E+42 Normal/Lognormal 2.20E-01 2.86E-02 2.26E+21 Normal/Lognormal 4.75E-02	•	71E+01	4.36E+02	Lognormal	2.50E+02	8.17E+04	OL	-
1,2,3-cd)pyrene 1.78E+00 9.60E+00 Lognormal 8.70E+00 1.2,3-cd)pyrene 1.78E+00 9.60E+00 Lognormal 8.70E+00 2.83E+01 Unknown 2.83E+01 5.65E-02 5.50E-02 Unknown 5.50E-02 3.39E+01 2.55E+02 Lognormal 2.30E+02 2.86E-01 2.86E-01 2.86E-01 2.86E-01 2.86E-01 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02	,	32E+01	2.15E+01	Unknown	2.15E+01	8.17E+04	011	1
threne 5.17E+01 2.83E+01 Unknown 2.83E+01 5.65E-02 Unknown 1.11E+02	2 3-cdbwrene	78E+00	9.60E+00	Lognormal	8.70E+00	7.84E+00	YES	YES-COPC
threne 7.34E+01 1.11E+02 Unknown 1.11E+02 5.65E-02 5.50E-02 Unknown 5.50E-02 3.39E+01 2.55E+02 Lognormal 2.30E+02 2.86E-02 1.17E+07 Normal/Lognormal 6.30E-02 2.86E-01 2.68E+42 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02		17E+01	2.83E+01	Unknown	2.83E+01	8.24E+02	ou 0	
5.65E-02 5.50E-02 Unknown 5.50E-02 3.39E+01 2.55E+02 Lognormal 2.30E+02 2.30E+02 1.17E+07 Normal/Lognormal 6.30E-02 2.86E-01 2.68E+42 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02	, 1,	34E+01	1.11E+02	Unknown	1.11E+02	6.13E+04	ou	
3.39E+01 2.55E+02 Lognormal 2.30E+02 88.04E-02 1.17E+07 Normal/Lognormal 6.30E-02 2.86E-01 2.68E+42 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02		65E-02	5.50E-02	Unknown	5.50E-02	1.23E+05	9	
es 8.04E-02 1.17E+07 Normal/Lognormal 6.30E-02 nrzene 2.86E-01 2.68E+42 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02		39E+01	2.55E+02	Lognormal	2.30E+02	6.13E+04	9	
8.04E-02 1.17E+07 Normal/Lognormal 6.30E-02 cene 2.86E-01 2.68E+42 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02	Alotifee					-		
zene 2.86E-01 2.68E+42 Normal/Lognormal 2.20E-01 6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02		3.04E-02	1.17E+07	Normal/Lognormal	6.30E-02	1.04E+05	잂	
6.15E-02 2.26E+21 Normal/Lognormal 4.75E-02	zene	2.86E-01	2.68E+42	Normal/Lognormal	2.20E-01	3.95E+02	90	
		5.15E-02	2.26E+21	Normal/Lognormal	4.75E-02	3.80E+01	2	
otal) 1.58E+00 3.97E+75 Normal/Lognormal 1.20E+00	Colone (total)	.58E+00	3.97E+75	Normal/Lognormal	1.20E+00	3.18E+02	2	

*Retained as a COPC, as per MDEQ Comments (8/2/2000) one of which has been retained as a COPC.

Table 6
Statistical Summary and Selection of COPCs in EU3 Soll (0-1' bgs)
Kerr McGee, Hattiesburg, MS

					Minimum	Maximum								
-		Total		Ħ	Detection	Detection	Minimum	Minimam		Logarithmic	Maximum	Maximum	Location of	Standard
	CAS	Number of		Frequency	Limit	Limit	Detected	Detected	Mean	Mean	Detected	Detected	Maximum	Deviation
Constituent	Number	Samples	Hits	%	mg/kg	mg/kg	mg/kg	Qualifier	mg/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Semivolatiles														
2-methylnaphthalene	91-57-6	m	_	33,33	3.30E-02	3.30E-02	2.30E-01		8.77E-02	3.97E-02	2.30E-01	7	SS-16	1.23E-01
Acenaphthylene	208-96-8	m	7	. 29.99	3.30E-02	3.30E-02	1,20E-01	¬	1.02E-01	6.96E-02	1.70E-01	•	SS-16	7.83E-02
Anthracene	120-12-7	3	~	19.99	3.30E-02	3.30E-02	1.20E-01	-	1.02E-01	6.96E-02	1.70E-01	ſ	SS-16	7.83E-02
Benzo(a)anthracene	56-55-3	8	~	100	0.00E+00	0.00E+00	5.60E-02	-	3.62E-01	2.46E-01	5.40E-01		SS-15	2.66E-01
Benzo(a)pyrene	50-32-8	m	7	19.99	6.70E-02	6.70E-02	5.60E-01		4.35E-01	2.37E-01	7.10E-01		SS-16	3.55E-01
Benzo(b)fluoranthene	205-99-2	ю	٣	100	0.00E+00	0.00E+00	1.906-01	_	9.30E-01	6.83E-01	1.40E+00		SS-16	6.49E-01
Benzo(ghi)perylene	191-24-2	٣	m	100	0.00E+00	0.00E+00	8.00E-02	-	6.53E-01	4.03E-01	1.20E+00		SS-16	5.60E-01
Benzo(k)fluoranthene	207-08-9	ĸ	7	66.67	1.30E-01	1.30E-01	4.70E-01		3.42E-01	2.46E-01	4.90E-01		SS-16	2.40E-01
Carbazole	86-74-8	m	7	66.67	3.30E-02	3.30E-02	4.60E-02	_	5.75E-02	4.37E-02	1.10E-01	•	SS-15	4.78E-02
Chrysene	218-01-9	m	٣	100	0.00E+00	0.00E+00	1.10E-01	_	5.93E-01	4.25E-01	8.70E-01		SS-16	4.20E-01
Dibenz(a,h)anthracene	53-70-3	۳	7	66.67	6.70E-02	6.70E-02	1.40E-01	_	1.115-01	9.09E-02	1.60E-01	•	SS-16	6.80E-02
Dibenzofuran	132-64-9	6	7	19.99	3.30E-02	3.30E-02	3,60E-02	_	4.85E-02	3.81E-02	9.30E-02	 3	SS-16	3.98E-02
Di-n-butyl phthalate	84-74-2	m	~	100	0.00E+00	0.00E+00	4.00E-02	-	8.30E-02	7.58E-02	1.10E-01	ſ	SS-16	3.76E-02
Fluoranthene	206-44-0	m	æ	001	0.00E+00	0.00E+00	1.20E-01	-	5.27E-01	3.99E-01	7.80E-01		SS-16	3.56E-01
Indeno(1,2,3-cd)pyrene	193-39-5	*^	m	001	0.00E+00	0.00E+00	8.60E-02	-,	3.85E-01	2.89E-01	6.00E-01	٠.	SS-16	2.67E-01
Naphthalene	91-20-3	e	_	33.33	3.30E-02	3.30E-02	1.60E-01	_	6.43E-02	3.52E-02	1.60E-01	-	SS-16	8.28E-02
Phenanthrene	82-01-8	m	7	29.99	3.30E-02	3.30E-02	1.30E-01	•	1.32E-01	8.12E-02	2.50E-01	-	SS-16	1.17E-01
Рутепе	129-00-0	EF)	e	<u>80</u>	0.00E+00	0.00E+00	1.20E-01		6.90E-01	4.85E-01	1.00E+00		SS-17	4.94E-01

Table 6
Statistical Summary and Selection of COPCs in EU3 Soil (0-1' bgs)
Kerr McGee, Hattiesburg, MS

		•					
		Logarithmic	Distribution	Exposure Point	Unrestricted	Maximum	Logarithmic
Constituent	95% UCL	95% UCL	99% Confidence	Concentration mg/kg	mg/kg	TRG?	TRG>
Semivolatiles	4.	4					
2-methylnaphthalene	2.95E-01	2.43E+08	Unknown	2.30E-01	3.13E+03	no	
Arenanhthvlene	2.34E-01	3.45E+05	Normal/Lognormal	1.70E-01	4.69E+03	9	
Anthracene	2.34E-01	3.45E+05	Normal/Lognormal	1.70E-01	2.35E+04	04	
The second secon	9 11 E-01	2 155+06	Normal/Lognormal	5.40E-01	8.75E-01	10	YES*
Benzo(a)animacone Deno(a)anima	1 015+06	1.82E+11	Normal/Lognormal	7,105-01	8.75E-02	YES	YES - COPC
Benzo(a)pyrene Benzo(b)Onomorhene	2.02E-00	1.136+05	Normal/Lognormal	1.40E+00	8.75E-01	YES	YES - COPC
Delizo(o)ituoraiturene Delizo(obi)berrdene	00:379:7	1 70E+08	Normal/Lognormal	1.20E+00	2.35E+03	90	
Bellzo(giii)peryiche Denzo(b)Buoranthene	7.46F-01	1.06E+05	Normal/Lognormal	4.90E-01	8.75E+00	110	YES*
Caffernia	1 18E-01	2 R1E+02	Normal/Lognormal	1,10E-01	3.19E+01	92	
Chamana	1 30F+00	2 63E+05	Normal/Lognormal	8.70E-01	8.75E+01	92	YES*
Oilteansta hisanthracene	2.26E-01	1.35E+02	Normal/Lognormal	1.60E-01	8.75E-02	YES	YES - COPC
Dibenzofiran	1.16E-01	5.59E+01	Normal/Lognormal	9.30E-02	3.13E+02	Q	
Di-n-hutyl ohthalate	1.46E-01	1.52E+00	Normal/Lognormal	1.10E-01	2.28E+03	30	
Elvoranthene	1.13E+00	1.59E+04	Normal/Lognormal	7.80E-01	3.13E+03	ОĽ	
Indeport 2 3-rd)morene	8.36E-01	1.56E+04	Normal/Lognormal	6.00E-01	8.75E-01	10	YES*
Monththalene	2.04E-01	6.64E+05	Unknown	10-3091	6.45E+02	2	
Phenanthrene	3.29E-01	2.65E+07	Normal/Lognormal	2.50E-01	2.35E+03	no	
Desame	1 57E+00	7.45E+05	Normal/Lognormal	1.00E+00	2.35E+03	OU OU	

*Retained as a COPC, as per MDEQ Comments (8/2/2000): cons one of which has been retained as a COPC.

Statistical Summary and Selection of COPCs in EU3 Soil (0-6' bgs) Kerr McGee, Hattiesburg, MS

		Total		Ē	Minimum Detection	Maximum Detection	Minimum	Minimum		Logarithmic Maximum	Maximom	Maximum	Location of	Standard
Concilinent	CAS	Number of Samples	Hits	Frequency %	Limit mg/kg	Limit mg/kg	Detected mg/kg	Detected Qualifier	Mean mg/kg	Mean mg/kg	Detected mg/kg	Derected	Concentration	mg/kg
Semivolatiles									120	10 302 0	105-01	,	SS-16	8.00E-02
7 methylnenlithatene	91-57-6	7	-	14.29	3.30E-02	4.00E-02	2.30E-01	-	4.835-02	20-220.2	1 100 01		97-55	6.34E-02
A concentified and	8-96-800		7	28.57	3.30E-02	4.00E-02	1.20E-01	-	5.47E-02	3.338-02	10-101	ų -	91-88	6.34E-02
Actuapinory	120-12-7		7	28.57	3.30E-02	4.00E-02	1.20E-01	-	5.47E-02	3.33E-02	1.705-01	•	51-55	7 39E-01
Anumercine	56.56.3		m	42.86	3.70E-02	4.00E-02	5.60E-02	-	1.66E-01	5.71E-02	5.40E-01		91 99	3 02E-01
Denzo(a)antinacene	50.12.8			28.57	3.70E-02	6.70E-02	5.60E-01	,	1.97E-01	5.62E-02	7.10E-01		91.99	6 145-01
Benzo(a)pyrene	2000		1 "	47.86	3.70E-02	4.00E-02	1.90E-01	7	4.10E-01	8.85E-02	1.40E+00		01-00	0.11.0
Benzo(b)fluoranthene	7-66-507	~ 1		70 04	בת שטב נ	4.00E-02	8 00E-02	-	2.91E-01	7.06E-02	1.20E+00		. SS-16	4.09E-UI
Benzo(ghi)perylene	191-24-2		-73 ·	42.80	3.705-02	10000	A 70E-01		1.57E-01	5.72E-02	4.90E-01		SS-16	2.21E-01
Benzo(k)fluoranthene	207:08-9	٠.7	7	78.57	3.70E-02	10-200.	4 605 03	-	3.565-02	2.72F-02	1.10E-01	_	SS-15	3.44E-02
Carbazole	86-74-8	7	7	28.57	3.30E-02	4.00E-02	1.000	,	265E-01	7.22E-02	8.70E-01		SS-16	3.91E-01
Chrysene	218-01-9	7	m	42.86	3.70E-02	4.005-02	10-201		\$ 86E-02	1.73E-02	1.60E-01	_	. 91-SS	6.29E-02
Dibenz(a,h)anthracene	53-70-3	 	~1	28.57	3.70E-02	6.705-02	1,400-01		3 17E-03	2 57E-02	9.30E-02	<u>-</u>	SS-16	2.78E-02
Dibenzofuran	132-64-9	!~	7	28.57	3.30E-02	4.00E-02	3.005-02	· -	\$ 74E-02	5.13E-02	1.10E-01	-	91-SS	3.23E-02
Di-n-butylphthalate	84-74-2	7	~	42.86	7.50E-02	7.906-02	4.005-02	, -	2,7E-01	7.03E-02	7.80E-01		91-SS	3.40E-01
Fluoranthene	206-44-0	7	m	42.86	3.70E-02	4.00E-02	1.205-01	· -	1 76E-01	6 13F-07	6.00E-01		SS-16	2.49E-01
Indeno(1,2,3-cd)pyrene	193-39-5	7	3	42.86	3.70E-02	4.00E-02	8.005-02	-, -	1 25E 03	2.48E-02	1.60E-01	-	SS-16	5.36E-02
Naphthalene	91-20-3	7	-	14.29	3.30E-02	4.00E-02	100201	, -	2,00E-02	1 SSE-02	2 50E-01	ſ	SS-16	.9.05E-02
Phenanthrene	85-01-8	7	7	28.57	3.30E-02	4.00E-02	1.305-01		6.70E-02	3 95E.02	2.30E-01	-	GEO-17	7.81E-02
Phenol	108-95-2	7	~	28.57	3.30E-02	7.905-02	9.605-02		2071506	1 KAE-03	1 00E+00		SS-17	4.58E-01
Pyrene	129-00-0	7	~	42.86	3.70E-02	4.00E-02	1.20E-01	_	3.07.5-01	1.012-02	25.77			

Table 7
Statistical Summary and Selection of COPCs in EU3 Soil (0-6' bgs)
Kerr McGee, Hattiesburg, MS

					Tier !	Is the
		Legarithmic	Distribution	Exposure Point Concentration	Restricted Soil TRG	Maximum Detected >
Constituent	y5% UCL mg/kg		Confidence	mg/kg	mg/kg	TRG
Semivolatiles				;		;
7-methylnanhthalene	1.07E-01	1.70E-01	Unknown	1.70E-01	8.18E+04	2
A canambibulene	1.016-01	2.50E-01	Unknown	1.70E-01	1.23E+05	2
Accimpant years	1015-01	2.50E-01	Unknown	1.70E-01	6.13E+05	01
Antinaccinc	3.42E-01	\$ 64E+00	Unknown	5.40E-01	7.84E+00	8
Benzo(a)anunacene	A 10E-01	1.086+01	Unknown	7.10E-01	7.84E-01	9
Benzo(a)pyrene	2.61E.01	1 83E+02	Lognormal	1.40E+00	7.84E+00	ᅋ
Benzalohimendene Benzalohimendene	6.35F-01	3.79E+01	Lognormal	1,20E+00	6.13E+04	2
Benzo(k)fluomothene	1.20F.01	4.72E+00	Lognormal	4.90E-01	7.84E+01	01
Certain Arabian and Certain Arabian Ar	6.08F-02	8.08E-02	Unknown	8.08E-02	2.86E+02	ou U
יוסמטוגי.	\$ \$2E-01	3.06E+01	Cognormal	8.70E-01	7.84E+02	OU
Citysene Nitema(a h)anthracene	1.05E-01	2 52E-01	Unknown	1.60E-01	7.84E-01	п
Jiucilia (dali jamini accuma	5 215 03	6.21E-02	Unknown	6.21E-02	8, I8E+03	<u>о</u> ц
Dioenzoidian Di ttalabébatata	9.17E-02	0.18F-02	Unknown	9.38E-02	2.28E+03	110
DI-n-outy (proteste	4 87E-01	2.068+01	Lognormal	7.80E-01	8.17E+04	or O
rigoraliticals	10-10-1	6 02 17+00	Гототта	6.00E-01	7.84E+00	04
Indenot 1,2,3-coppyrene	10.375.01	0.725.0	Linknown	1.03E-01	8.24E+02	90
Naphthalene	1.19E-02	10 2767	Linkmowan	2 50F-01	6.13E+04	2
Phenanthrene	10-21 - 01.	4.345-01	Lomografia	2 30E-01	1.23E+05	ou
Phenol	1.22E-01	3.112-01	Lognorma	1 00E+00	6.13F+04	2
Pyrene	6.43E-01	5.32E+01	LOGINAL	- COL. CO.		

Table Summary and Selection of COPCs in EU3 Soil (0-20' bgs) Kerr McGee, Hattiesburg, MS

					Minimum	Meximum								
		Total		Ĭ	Detection	Detection	Minimum	Mlaimum	-	Logarithmic Maximum	Maximum	Maximum	Location of	Standard
	CAS	Number of		Frequency	Limit	Llmit	Detected	Detected	Mean	Mean	Detected	Detected	Maximum	Deviation
Constituent	Number	Samples	Hits	%	mg/kg	mg/kg	mg/kg	Qualifier	mg/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Semivolatiles														
2-methylnaphthalene	91-57-6	7	_	14.29	3.30E-02	4.00E-02	2.30E-01	_	4.85E-02	2.62E-02	2.30E-01		SS-16	8.00E-02
Acenaphthylene	208-96-8	. 1	7	28.57	3.30E-02	4.00E-02	1.20E-01	- .	5.47E-02	3.33E-02	1.70E-01	-	SS-16	6.34E-02
Anthracene	120-12-7	7	7	28.57	3.30E-02	4.00E-02	1.20E-01	-,	5.47E-02	3.33E-02	1.70E-01	-	91-SS	6.34E-02
Renzo(a)anthracene	56-55-3	_	m	42.86	3.70E-02	4.00E-02	S.60E-02	-4	1.66E-01	5.71E-02	5.40E-01		SS-15	2.39E-01
Benzo(a)nvrene	50-32-8	-	. 7	28.57	3.70E-02	6.70E-02	5.60E-01		1.97E-01	5.62E-02	7.10E-01		91-SS	3.02E-01
Benzo(b) fluoranthene	205-99-2		ı m	42.86	3.70E-02	4.00E-02	1.90E-01	٠-,	4.10E-01	8.85E-02	1.40E+00		SS-16	6.14E-01
Benzo(ahi)merylene	191-24-2	. ~	i eri	42.86	3.70E-02	4,00E-02	8.00E-02	-	2.91E-01	7.06E-02	1.20E+00		SS-16	4.69E-01
Renzo(k Muoranthene	207-08-9		- 12	28.57	3.70E-02	1.30E-01	4.70E-01		1.57E-01	5.72E-02	4.90E-01	-	91-SS	2.21E-01
Carbazole	86-74-8		~	28.57	3.30E-02	4.00E-02	4.60E-02	-	3.56E-02	2.72E-02	1.10E-01	-	SS-15	3.44E-02
Chrysene	218-01-9	7	m	42.86	3.70E-02	4.00E-02	1.10E-01	÷	2.65E-01	7.22E-02	8.70E-01		91-SS	3.91E-01
Pibenzía, h)anthracene	53.70-3	~	~	28.57	3.70E-02	6.70E-02	1.40E-01	, lead	5.86E-02	3.73E-02	1.60E-01	_	SS-16	6.29E-02
Dibenzofiran	132-64-9	7	7	28.57	3.30E-02	4.00E-02	3.60E-02	-,	3.17E-02	2.57E-02	9.30E-02	7	SS-16	2.78E-02
Di-n-butvinhthalate	84-74-2		ı m	42.86	7.50E-02	7.90E-02	4.00E-02	,	5.74E-02	5.13E-02	1.10E-01	_	SS-16	3.23E-02
Fhoranthene	206-44-6	7	. 643	42.86	3.70E-02	4.00E-02	1.20E-01	•••	2.37E-01	7.03E-02	7.80E-01		SS-16	3.40E-01
Indeno(1.2.3-cd)ovrene	193-39-5	-	m	42.86	3.70E-02	4.00E-02	8.60E-02		1.76E-01	6.13E-02	6.00E-01		SS-16	2.49E-01
Nanhthalene	91-20-3	_	_	14.29	3.30E-02	4.00E-02	1.60E-01	~	3.85E-02	2.48E-02	1.60E-01	¬	SS-16	S.36E-02
Phenanthrene	85-01-8	7	7	28.57	3.30E-02	4.00E-02	1.30E-01		6.76E-02	3.55E-02	2.50E-01	-	SS-16	9.05E-02
Phenol	108-95-2	7	7	28.57	3.30E-02	7.90E-02	9.60E-02		6.47E-02	3.95E-02	2.30E-01	-	GEO-17	7.81E-02
Pyrene	129-00-0	7	m	42.86	3.70E-02	4.00E-02	1.20E-01	- -,	3.07E-01	7.64E-02	1.00E+00		SS-17	4.58E-01

Table 8
Statistical Summary and Selection of COPCs in EU3 Soil (0-20' bgs)
Kerr McGee, Hattiesburg, MS

					Tier I	Is the
		Logarithmic	Distribution	Exposure Point - Restricted Soil	Restricted Soil	Maximum
	95% UCL	95% UCL	%66	Concentration	TRG	Detected >
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	TRG?
Semivolatiles						
2-methylnaphthalene	1.07E-01	1.70E-01	Unknown	1.70E-01	8.18E+04	Q
Acenaphthylene	1.01E-01	2.50E-01	Unknown	I 70E-01	1.23E+05	0H
Anthracene	1.01E-01	2.50E-01	Unknown	1.70E-01	6.13E+05	011
Benzotalanthracene	3.42E-01	5.64E+00	Unknown	5.40E-01	7.84E+00	110
Benzo(a)ovrene	4.19E-01	1.08E+01	Unknown	7.10E-01	7.84E-01	ŌE
Benzo(b)(Juoranthene	8.61E-01	1.83E+02	Lognormal	1.40E+00	7.84E+00	011
Benzo(ghi)perylene	6.35E-01	3.79E+01	Lognormal	1.20E+00	6.13E+04	011
Benzo(k)fluoranthene	3.20E-01	4.72E+00	Lognormal	4.90E-01	7.84E+01	он 0
Carbazole	6.08E-02	8.08E-02	Unknown	8.08E-02	2.86E+02	011
Chrysene	5.52E-01	3.06E+01	Lognormal	8.70E-01	7.84E+02	9
Dibenz(a.h)anthracene	1.05E-01	2.52E-01	Unknown	I 60E-01	7.84E-01	9
Dibenzofiiran	5.21E-02	6.21E-02	Unknown	6.21E-02	8.18E+03	υO
Di-n-butylohthalate	8.12E-02	9.38E-02	Unknown	9.38E-02	2.28E+03	2
Fluoranthene	4.87E-01	2.06E+01	Lognormal	7.80E-01	8.17E+04	Ou.
Indeno(1.2.3-cd)pyrene	3.59E-01	6.92E+00	Lognorma	6.00E-01	7.84E+00	Ş
Nanhthalene	7.79E-02	1.03E-01	Unknown	1.03E-01	8.24E+02	ou 0
Phenanthrene	1.34E-01	4.34E-01	Unknown	2.50E-01	6.13E+04	9
Phenol	1.22E-01	3.11E-01	Lognormal	2.30E-01	1.23E+05	92
Pyrene	6.43E-01	5,32E+01	Lognormal	1.00E+00	6.13E+04	no

Tabic) Statistical Summary and Selection of COPCs in EU4 Sediment Kerr McGee, Hattiesburg, MS

		1		35	Minimum	Maximum	Minimem	Minimum	_	Logarithmic Maximum	Maximum	Maximum	Location of	Standard
	CAS	Number of		Frequency	Limit	Limit	Detected	Detected	Mean	Mean	Detected	Detected	Maximum	Deviation mo/ko
Constituent	Number	Samples	Hits	%	mg/kg	mg/kg	mg/kg	Qualifier	mg/kg	⊞g/Kg	mg/Kg	Z n		4
Semivolatiles							;				001200	-	cD.03	V.Z
2 4 dimethylahahan	0.75-67.0	_	_	8	0.00E+00	0.00E+00	1.50E+00	-	1.50±+00	1.502+00	1.505700	•	20-00	
Charling in the control of the contr	2000		. <u>-</u>	9	0.00F+00	0.00E+00	1.50E+03		1.50E+03	1.50E+03	1.50E+03		SD-02	٧ 2
2-methyinaphthalene	0-75-16	- (- ,	3	\$ 20E OI	1 00E±03	6 505+00	_	1.08E+02	6.96E+00	3.45E+02	7	SD-12	1.99E+02
Acenaphthene	83-32-9	x 0	7	3 ;	3.705-01	50.100.	3 605.0		1 775+01	3 \$7F+00	3.50E+01		SD-02	3.26E+01
Acenaphthylene	208-96-8	6 0		12.5	5.70E-01	1.63ETU4	3.305.01	٢	4 01 5 +03	1 785+00	1 90E+03		SD-02	7.57E+02
Anthracene	120-12-7	00	4	20	3.80E-02	5.56E-U1	1.80€+00	3 1	4.01E:02	0017007	3 20E±02		SD-02	1.23E+02
Renzofalanthracene	56-55-3	œ	0 0	901	0.00E+00	0.00E+00	2.29E-01	7	0.52E+01	4.965+00	3.300.02	-	SD 03	4 81F+01
Benzo(a)nymene	50-12-8	œ	∞	901	0.00E+00	0.00E+00	2.80E-01	Z,	2.69E+01	4.43E+00	1.30E+02	-, ·	20-02	7.015.01
Deriza (a) pyrene	208.00.7	• •	• •	9	0.00E+00	0.00E+00	4.25E-01	2	3.29E+0I	6.00E+00	1.80E+02		SD-02	0.315401
Benzolo Jilluoramunere	4-66-604		•	9	0.00E+00	0.00E+00	1,73E-01	•	7.24E+00	2.05E+00	3.60E+01		SD-02	1.25E+01
Benzo(ghi)peryiene	7-67-161	•	9 0	8 2	0.005	0.005+00	2.13E-01	7	1.38E+01	2.88E+00	6.40E+01		SD-02	2.38E+01
Benzo(k) Ruoranthene	6-80-702	so ·	ю.	3 2	0.000.00	00.000	5 OUE 103		5 90E+03	5 90F+02	5.90E+02		SD-02	ΥZ
Carbazole	86-74-8	-	ب	<u> </u>	0.00E+00	0.00=+00	3.500.02	ŀ	5 445.01	4 85E+00	2 905-102		SD-02	1.05E+02
Chrysene	218-01-9	0 0	0 0	<u>8</u>	0.00E+00	0.005+00	2.508-01	7 -	3.445.00	6 00 E 01	1 205+01		SD-02	4.76E+00
Dibenz(a,h)anthracene	53-70-3	00	7	87.5	6.00E-02	6.00E-02	3./0E-02	•	2.935.00	0.300.00	0.406407		SD-02	Ϋ́
Dibenzofuran	132-64-9	-	-	100	0.00E+00	0.00E+00	9.40E+02	ı	9.40E+02	9.40E+02	1.400.402		SD-03	6 16E+02
Characthons	206-44-0	00	00	901	0.00E+00	0.00E+00	2.60E-01	7	3.2/E+02	1.425+01	1.001			4 516103
ringlativical	2 2 2 2 3 3	• •	, ,,	27.5	5 30E-02	4.50E-01	7.40E+00	2	2.32E+02	1.93E+00	1.20E+03		SD-02	4.315.42
Fluorene	/-07-09	0 (٠,		000000	0.005400	2 23E_01	-	1.08E+01	2.98E+00	4.70E+01		SD-02	1.75E+01
Indeno(1,2,3-cd)pyrene 193-39-5	193-39-5	×	ю	3	0.005100	0.000	00.500		3 805103	7 605+00	3.00E+03		SD-02	1.06E+03
Naphthalene	91-20-3	00	N	52.	5.705-01	1.836+02	0.202.0	, t	20.776.07	00+30%	3.20F+03		SD-02	1.24E+03
Phenanthrene	82-01-8	00	~	37.5	3.10E-02	1.05E+00	7.305+01	1 •	20.75.0	1 (2001)	1 005403		SD-02	4.44E+02
Pyrene	129-00-0	8	∞	100	0.00E+00	0.00E+00	4.59E-01	_	7.48E+02	1.0/5401	20.700.1			

Table 9
Statistical Summary and Selection of COPCs in EU4 Sediment
Kerr McGee, Huttiesburg, MS

					Tier I	Is the	
	•	Logarithmic Distribution	Distribution	Exposure Point	Unrestricted	Maximum	Is the 95%
	04% 11CT	05% HCL	%66	Concentration	Soil TRG	Detected >	NCL >
Canadifuent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	TRG	TRG?
Compacition	D D	0					
Schnyolatines 2.4.4:	7	Ž	Unknown	1.50E+00	1.56E+03	10	
2,4-dimemyiphenoi	5 5	477	I introduce	1 50E+03	3.13E+03	2	
2-methylnaphthalene	Z.	Y			A COELOS	Ş	
Acenaphthene	2.41E+02	8.24E+05	Cognormal	3.45E±02	4.09/2103	2	
Acceptibility	3.90E+01	1.12E+03	Lognormal	3.50E+01	4.69E+03	2	
and the same	0.085+07	1 74F+15	Lognormal	1.90E+03	2.35E+04	DI	
Anthracene	1 405.00	3 016405	Lognorma	3.30E+02	8,75E-01	YES	YES - COPC
Henzo(a)anthracene	1.405702	2.910.0	Comound	1 105+07	8.75E-02	YES	YES - COPC
Benzo(a)pyrene	5.916+01	6.94E+03	Logue	100.100.1	0 165 01	VEC	VEC. COPC
Benzo(b)fluoranthene	7.52E+01	4.80E+03	Lognormal	1.80E+02	8.735-01	3	3
Benzo(shi)nerylene	1.56E+01	2.97E+02	Lognormal	3.60E+01	2.35E+03	2	1
Derivation of the property of	3 08F+01	1 74F+03	Lognormal	6,40E+01	8.75E+00	YES	VES - COPC
Denzo(K)ttuutattuette	- N	NA N	Linknown	5.90E+02	3.19E+01	YES	YES - COPC
Carbazole	100	1 195105	Lognormal	2.90E+02	8.75E+01	YES	YES COPC
Chrysene	1.235702	100.00	Locuscus	1 205+01	8.75E-02	YES	YES - COPC
Dibenz(a,h)anthracene	6.12E+00	9.17Em2	- Interesting	0 406+02	3.13E+02	YES	YES - COPC
Dibenzofuran	Ϋ́	ζ.	CHRIDMI	70.701.7	113610	ţ	
Fluoranthene	7,40E+02	6.03E+07	Lognorma	1.605+03	3.136703	€	-
	5 34E+02	1.26E+12	Lognormal	1.20E+03	3.13E+03	2	
Transfer C C C		₹ 07E±03	I nenormal	4,70E+01	8.75E-01	YES	YES - COPC
Indeno(1,2,3-cu)pyrene	٠,	30.000	learnonno l	1 005+03	6.45E+02	YES	YES - COPC
Naphthalene	1,105+03	8.936+00		00.000.0	7 155+01	YES	YES - COPC
Phenanthrene	1.48E+03	1.30E+15	Lognormal	3.20E+03	20.00.0	}	
Pyrene	5.46E+02	5.33E+06	Lognormal	1.00E+03	2.35E+03	no	,

Statistical Summary and Selection of COPCs in EU4 Surface Water Kerr McGee, Hattiesburg, MS

	CAS	_	Frec	Z P	Maximum Detection Limit	Minimum Detected	Minimum Detected Ovalifier	Mean mg/L	Logarithmic Maximum Mean Detected mg/L mg/L	Maximum Detected mg/L	Maximum Detected Qualifier	Location of Maximum Concentration	Standard Deviation mg/L
Constituent Semivolatiles Acenaphthene Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(c)fluoranthene Benzo(k)fluoranthene Bis(2-ethylhexyl)phthalate Carbazole Cirysene Dibenz(a,h)anthracenc Fluoranthene Fluoranthene Fluoranthene Fluoranthene Fluoranthene	81-32-9 120-12-7 56-55-3 50-32-8 205-99-2 207-08-9 117-81-7 86-74-8 86-74-8 218-01-9 53-70-3 132-64-9 206-44-0 86-73-7 193-39-5 85-73-7	Samples	Hits %	0.00E+00 0.00E+00 0.00E+00 1.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00	0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00	1.40E-02 1.30E-02 5.00E-03 0.00E+00 1.20E-03 2.00E-03 3.00E-03 1.00E-02 0.00E+00 1.10E-02 3.90E-02 1.20E-02 2.10E-02	- ^V V Z	1.40E-02 5.00E-03 5.00E-03 1.20E-02 2.00E-03 3.00E-03 1.00E-03 1.00E-03 5.00E-04 1.10E-02 3.90E-02 5.00E-04 1.70E-02 2.10E-02	1 - 0 0 - 0 m - 0 0 - m - 0 - 0	1.40E-02 5.00E-03 0.00E+00 1.20E-02 2.00E-03 3.00E-03 1.00E-02 6.00E-03 0.00E+00 1.10E-02 1.20E-02 1.20E-02 2.10E-02	n V n n n n V V V V V V V V V V V V V V	SW-02	0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00 0.00E+00

NA - Not applicable: constituent not detected in media.

Statistical Summary and Selection of COPCs in EU4 Surface Water Kerr McGee, Hattiesburg, MS Table 10

					Human Health	
	%56	Logarithmic	Distribution	_	Consumption of Water	Is Maximum Detected >
•	UCI.	95% UCL	99% Confidence	Concentration mg/L	es Organisms A C	AWQC?
Constituent		111/11				
Semivolatiles				(V 300 ·	1 30E±00	011
Aconomhthene	ž	×	Unknown	1.40E-02	20.707.1	1
and the second second	1	V.V.	1 Inknown	1,30E-02	9.60E+00	<u>و</u>
Anthracene	ď Z	ž.		6 000 03	4 405-06	YES - COPC
Benzo(a)anthracene	ž	Y Z	Unknown	3.005.03	70 101	**54A
Denzolalmane	Ž	ΥN	Unknown	5.00E-04	4.4UE-U0	3
Delização producto	: 2	, V	Thenown	1.20E-02	4.40E-06	YES-COPC
Benzo(b)fluoranthene	ž	5		10000	4.405-06	YES - COPC
Benzo(k)fluoranthene	ž	Y Z	Chknown	2.002	00 HOG -	VEC. COPC
Diecz-ethytherythuhilbalate	Ϋ́	ž	Unknown	3.00E-03	1.805-05	50
212(2-cit), mond/, (cit)	1	MA	Inknown	1 00E-02	٧Z	0
Carbazole*	<u> </u>	2 :	11.1	5 00 5 03	4 40E-06	YES - COPC
Chrysene	ž	¥ Z	Unknown	0.000	20 1107	*****
Dihenzía handracene	ž	Ϋ́Z	Unknown	5.00E-04	4,40E-00	3
	V	YZ.	Unknown	1.10E-02	₹ Z	2
Cloenzoluran		¥ Z	Finknown	3.90E-02	3.00E-01	90
Fluoranthene	ž :	5 3	r Independ	1 208-02	1.30E+00	01
Fluorene	< Z	C	CHARLOWER	10 100 1	4 405 06	VES*
Indeport 2 3-cd bytene	×z	۲Z	Unknown	5.005-04	4.405-00	}
The state of the s	Y	Y	Unknown	1.70E-02	V Z	9
Phenantinene		¥ N	I Inventura	2.10E-02	9.60E-01	ᅃ
Pyrene	X Z	NA	UNKNOWII	70.701.7		1

NA - Not Available

* Constituent will be retained as a COPC due to lack of published screening criteria.

**Retained as a COPC, as per MDEQ Comments (8/2/2000): constituent is a member of carcinogenic PAH family, one of which has been retained as a COPC.

Table 11 Statistical Summary and Selection of COPCs in EU4 Soil (0-1' bgs) Kerr McGee, Hattiesburg, MS

	,													
		Total		Ĭ	Minimum Detection	Maximum Detection	Minimum	Minimum Detected	Mean	Logarithmic Maximum Mean Detected		_	Location of Maximum	Standard Deviation
	CAS	Number of Samples	Hits	Frequency %	mg/kg	mg/kg	mg/kg	Qualifier	mg/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Constituent								•	007500	6 315 01	2 SOF-01		GEO-19	2.73E+00
Sellity Oracles	105-67-9	.	_	33.33	4.10E-01	9.90E+00	2.50E-01	, '	1.805.100	3.426.400	2 SOE+07		GEO-21	1.61E+02
2,4-dimensingipismo	9-23-10	· ~	m	<u>80</u>	0.00E+00	0.00E+00	2.70E-01	 , 1	9.305+01	3.425.00	70-306-7	. –	GEO-19	1.39E+00
2-methyliapinot	95-48-7	·m	· -	33.33	2.00E-01	5.00E+00	7.30E-02	<u> </u>	8.916-01	2.03E-01	3.10E-01	. –	GEO-19	2.74E+00
2 and 4-methylphenol	106-44-5	m	-	33.33	4.10E-01	9.90E+00	2.10E-01	-	1./96+00	3.97E-01	1 90F+02		GEO-21	3.00E+02
Acenanhthene	83-32-9	9	7	33.33	2.00E-01	1.50E+03	1.00E+00		276403	1 345-01	4.70E+01	-	GEO-21	3.01E+02
Acenaphthylene	8-96-80	9	ю	જ	2.80E+00	1.50E+03	1.40E+05	-	7017171	2.06E+03	3.00E+03	2	GEO-48	1.20E+03
Anthracene	120-12-7	9	'n	83.33	5.30E-02	5.30E-02	2.10E+00	t	30.325.02	1615401	9.30E+02	2	GEO-48	3.65E+02
Renzo(a)anthracette	56-55-3	9	9	100	0.00E+00	0.005+00	2.10E+00	7	7011017	3.166+01	\$ 00F+02	7	GEO-48	1.99E+02
Renzo(a)nyrene	50-32-8	9	9	<u>8</u>	0.00E+00	0.00E+00	3.00E+00		1.355102	4 59F±01	5.30E+02	Z	GEO-48	2.43E+02
Benzu(h)fluoranthene	205-99-2	9	9	001	0.00E+00	0.00E+00	3.50E+00	-	40755404	1.455+01	1.30E+02	-	GEO-48	5.43E+01
Benzo(ghi)perylene	191-24-2	9	9	901	0.005+00	0.00E+00	1.60E+00	- r	4.2/E-01	1 94E+01	2.90E+02	7	GEO-48	1.18E+02
Benzo(k)fluoranthene	207-08-9	, v o	9	<u>9</u>	0.00E+00	0.00E+00	1.80E+00	7 -	7 995.0	9 145+00	2.30E+02		GEO-21	1.31E+02
Carbazole	86-74-8	€1	£.	<u>9</u>	0.00E+00	0.005+00	6.00E-01	۰, ۱	70E+07	3 775+01	6.90E+02	Z	GEO-48	2.73E+02
Chrysene	218-01-9	9	9	8	0.00E+00	0.00E+00	2.70E+00	,	1.072.02	4 98F+00	6.40E+01	-	GEO-48	2.57E+01
Dibenz(a,h)anthracene	53-70-3	9	9	<u>001</u>	0.00E+00	0.00E+00	4.80E-01	~ -	4 175+01	3.65E+00	1 90E+02		GEO-21	1.09E+02
Dibenzofuran	132-64-9	~	m.	00	0,00E+00	0.00E+00	3.405-01	- h	0.075.01	7.65E±01	4.60E+03	7	GEO-48	1 83E+03
Fluoranthene	206-44-0	9	9	<u>9</u>	0.005+00	0.005+00	2.80E+00	1	3.04E+02	4 84F+00	1.80E+03	2	GEO-48	7.21E+02
Flancene	86-73-7	9	₩	29.99	2.00E-01	2.60E-01	1.40E+00	t	20.24.5	1 946+01	2 SOE+02	-	GEO-48	9.91E+01
Indenty(1.2.3-cd)pyrene	193-39-5	9	9	001	0.00E+00	0.00E+00	2.006+00	7 -	4 SOE+03	1 30F+01	2.20E+03	-	GEO-48	8.79E+02
Nanhthalene	91-20-3	9	4	66.67	2.80E+00	1.20E+01	6.80E-01	•	4.705.4	2 105-01	2 00E-01	,	GEO-20	1.38E+00
N-nitrosodiphenylamine	9-06-98	E D-	_	33.33	3.70E-02	5.00E+00		-	7.00E-01	2 335+01	6.40E+03	2	GEO-48	2.57E+03
Phenanthrene	85-01-8	· •	9	<u>8</u>	0.00E+00	0.00E+00		- 1	8 76E402	9.14F+01	4.40E+03		GEO-20	1.74E+03
Pyrene	129-00-0	9	9	8	0.00E+00	0.00E+00	3.10E+00	7	0.700.02	10.7				

Table II Statistical Summary and Selection of COPCs in EU4 Soil (0-1' bgs) Kerr McGee, Hattiesburg, MS

in a state of the		. •	1	Francure Point	Unrestricted Soil	Maximum	
		Logarithmic	Distribution	EA mount of com-	Car	Detected >	Is the 95%
anetituent	95% UCL	95% UCL	99% Confidence	Concentration mg/kg	mg/kg	TRG?	UCL > TRG?
Onsur-	mg/kg	швукв	Commerce				
Semivolatifes			learner Til.	2 50E-01	1.56E+03	Q1	
2,4-dimethylphenol	6.40E+00		Normali Logicoma	2 80E+02	3.13E+03	0 <u>1</u>	
2-methylnaphthalene	3.66E+02	4.00E+62	Cognomial	7 30E-02	3.91E+03	0H	
2-methylphenol	3.24E+00	3.99E+15	Norman Loginaria	2 10E-01	3.91E+02	no	
3- and 4-methylphenol	6.40E+00	9.25±+13	Lognormal	1.90E+02	4.69E+03	no	•
Acenaphthene	4.05E+02	5.72E+11	Lognormal	4.70E+01	4.69E+03	OI OI	
Acenaphthylenc	3.84E+02	4.195+00	Loguenna	1 006+03	2.35E+04	5	
Anthracene	1.62E+03	8.99E+17	Lognormai	0.305+03	8.75E-01	YES	YES - COPC
Benzo(a)anthracene	5.17E+02	1.56E+07	Lognormai	\$30E102	8.75E-02	YES	YES - COPC
Benzo(a)pyrene	2.98E+02	9.02E+05	Normal/Lognormal	5.005+02	8.75E-01	YES	YES - COPC
Benzo(b)fluoranthene	3.85E+02	1.50E+06	Normal/Lognorium	1 305+02	2.35E+03	Đ.	
Benzo(ghi)perylene	8.73E+01	2.25E+04	Normal/Lognorma	1.30E-102	8.75E+00	YES	YES - COPC
Benzo(k)fluoranthene	1.80E+02	6.89E+05	Normal/Lognormal	701306.7	1 19F+01	YES	YES - COPC
Carbazole	3.00E+02	1.23E+39	Normal/Lognormal	2.30E±02	8 75E+01	YES	YES - COPC
Chrysene	4.04E+02	3.19E+06	Normal/Lognormal	0.90E±02	8.75E-02	YES	YES - COPC
Dibenz(a,h)anthracene	3.95E+01	3.75E+04	Normal/Lognormal	0.40E+01	3 11 15+02	92	
Dibenzofuran	2.48E+02	7.02E+50	Lognormal	1.905+02	3 136+03	YES	YES - COPC
Fluoranthene	2.41E+03	3.17E+09	Lognorme	1 905±03	3 13E+03	OL	
Fluorene	9,37E+02	1.95E+16	Lognormal		8.75E-01	YES	YES - COPC
Indeno(1,2,3-cd)pyrene	1.51E+02	1.07E+05	Normal/Lognormal	2.305+02	6.45E+02	YES	YES COPC
Naphthalene	1.17E+03	-	Lognorma	•	1 10F+02	2	
N-nitrosodiphenylamine 3.24E+00	3.24E+00	_	Normal/Lognorma		2 15E+01	YES	YES - COPC
Phenanthrene	3.31E+03	9.46E+14	Lognormal	0.40E+03	2.35E+03	YES	YES - COPC

Tabratz Statistical Summary and Selection of COPCs in EU4 Soil (0-6' bgs) Kerr McGee, Hattiesburg, MS

		Total		蓋	Minimum Detection	Maximum Detection	Minimum	Minimum Detected	Mean	Logarithmic Mean	Maximum Detected	Maximum Detected	Location of Maximum	Standard Deviation
1	CAS	Number of Samples	Hits	Frequency %	Limit mg/kg	mg/kg	mg/kg	Qualiffer	mg/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Comivolatiles								•	60.77.	10000	9 005+00	_	GEO-21	3.16E+00
13 4 dimethylphenol	9-79-501	6	m	33.33	7.30E-02	9.90E+00	7.90E-02	-	1.63E+00	2.305-01	6.70E+03	•	GEO-21	4.93E+02
2,4-dimensylpherio	91-57-6	. •	00	88.89	4.00E-02	4.00E-02	6.20E-02		2.11E+02	1.916+00	7 205-03	-	GEO-19	8.70E-01
2-incluyinapumianan 12-methylphenol	95-48-7	6	-	11.11	3.70E-02	5.00E+00	7.30E-02	-, •	4.61E-01	8.755-02	2005-02 2 10E-01		GEO-19	1.72E+00
3- and 4-methylphenol	106-44-5	6		11.11	7.30E-02	9.90E+00	2.10E-01	, -	9.175-01	1.62E-01	1 70E+03	•	GEO-21	3.21E+02
Acenaphthene	83-32-9	8 2	6	20	4.00E-02	1.50E+03	9.70E-02	-, -	1.305-02	1 145+00	\$ 00E+01		GEO-21	1.76E+02
Acenaphthylene	208-96-8	∞_	7	38.89	3.80E-02	1.50E+03	8.305-02	- r	1.50C+07	1 9315+00	3,00E+03	2	GEO-48	8.06E+02
Anthracene	120-12-7	∞	4	77.78	2.60E-03	5.30E-02	1.20E-01	3 . –	0.1361.0	2 57E+00	9.30E+02	2	GEO-48	2.34E+02
Benzo(a)anthracene	56-55-3	<u>∞</u>	<u>«</u>	001	0.00E+00	0.00E+00	4.90E-03		5 715401	2.04E+00	5.00E+02	Z	GEO-48	1.29E+02
Benzo(a)pvrene	50-32-8	8 2	8 1	<u>00</u>	0.00E+00	0.00E+00	1.105-02	.,	7 005401	2 53F+00	5.30E+02	2	GEO-48	1.65E+02
Benzo(b)fluoranthene	205-99-2	18	8 2	<u>8</u>	0.00E+00	0.00E+00	1.10E-02	-, <u>:</u>	1 945.01	8 49E-01	1.30E+02	~	GEO-48	3.79E+01
Benzo(ghi)perylene	191-24-2	<u>8</u>	13	94.44	3.80E-02	3.805-02	8,905-03		1.60E/01	1.03E+00	2.90E+02	7	GEO-48	7.57E+01
Benzo(k)fluoranthene	207-08-9	<u>~</u>	9	88.89	3.80E-02	4.00E-02	3.0015-03	• -	0.27E-01	2.78E+00	6.20E+02		GEO-21	2.10E+02
Carbazole	86-74-8	6	œ	88.89	4.00E-02	4.00E-02	2.10E-01	- -	1012007	2.75E-00	6.90E+02	2	GEO-48	1.88E+02
Chrysene	218-01-9	<u>\$</u>	17	94.44	5.10E-03	5.10E-03	9.90E-03	-, -	7 475+00	2 96E-01	6.40E+01	-,	GEO-48	1.68E+01
Dibenz(a,h)anthracene	53-70-3	8 2	4	77.78	2.60E-03	4.00E-02	3.80E-03	, -	1 54E+02	2.43E+00	1 10E+03		GEO-21	3.61E+02
Dibenzofuran	132-64-9	6	60	88.89	4.00E-02	4.00E-02	20-30e./	, -	A 20E402	7.56E+00	4.60E+03	7	GEO-48	1.15E+03
Fjuoranthene	206-44-0	90	<u>~</u>	2	0.00E+00	0.00E+00	70-200	٠	3 000 5	1 40E+00	1.80E+03	2	GEO-48	5.31E+02
Fluorene	86-73-7	<u>&</u>	17	19.99	1.30E-02	2.60E-01	1.405-01	-, - -	2025-02	1 05E+00	2.50E+02	-	GEO-48	6.42E+01
Indeno(1.2,3-cd)pyrene 193-39-5	193-39-5	œ ,	13	94.44	6.00E-03	6.00E-03	9.00E-03	-	2 735407	2 99F+00	3.50E+03		GEO-21	9.37E+02
Naphthalene	91-20-3	<u>8</u>	13	66.67	4.00E-02	1.20E+01	7.60E-02	•	3.735.02	8 11E-02	2 00F-01		GEO-20	8.69E-01
N-nitrosodiphenylamine 86-30-6	e 86-30-6	5	-	1.1	3.70E-02	5.00E+00	2.00E-01	-	4.00E-01	4 3 E+00	6.40E+03	2	GEO-48	1.72E+03
Phenanthrene	85-01-8	<u>\$</u>	11	94 44	4.00E-02	4.00E-02	5.30E-03		3 775+02	7.72E+00	.4.40E+03		GEO-20	1.06E+03
Pyrene	179-00-0	<u>~</u>	æ	2	0.00E+00	0.00E+00	1.002-02	-	2.7.7.					

Statistical Summary and Selection of COPCs in EU4 Soil (0-6' bgs) Kerr McGee, Hattiesburg, MS Table 12

					T	le the	
					l ser i	20 1110	,000
		Logarithmic	Distribution	Logarithmic Distribution Exposure Point	Restricted Soil	Maximum	Is the 95%
	95% UCL	95% ticL	%66	Concentration	TRG	Detected >	, CC ,
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	- RC	- I
Semivolatiles							
2 4-dimethylphenol	3.59E+00	1.33E+02	Lognormal	8.90E+00	4.08E+04	ou u	
2,4-cillectify spiriting	\$.17E+02	1,40E+11	Lognormal	1.50E+03	8.18E+04	01	•
2 methylphenol	1.00E+00	1.71E+01	Lognormal	7.30E-02	1.02E+05	0u	
2 and 4 methylphonol	1 98E+00	3.49E+01	Lognormal	2.10E-01	1.02E+04	<u>о</u>	
Account them	2 61E+02	7.82E+05	Lognormal	1.20E+03	1.23E+05	<u>10</u>	
Accuapititions	1 215+02	8.90E+03	Lognormal	5.00E+01	1.23E+05	ou Ou	
Acculaptumytene	6 46F+02	3 29E+08	Lognormal	3.00E+03	6.13E+05	<u>о</u>	
Amimacene Occasional	1 03E402	1.43E+06	Lognormal	9.30E+02	7.84E+00	VES	YES - COPC
Denzo(a)anunacene	1 10F402	1 87E+05	Lognormal	5.00E+02	7.84E-01	YES	YES - COPC
Benzo(a)pyrene	1 A7E+03	5 68F+05	Lognormal	5.30E+02	7.84E+00	YES	YES - COPC
Benzo(Djiluolizilane	3.47E+01	2.74F+04	Lognormal	1.30E+02	6.13E+04	011	
Benzalgin peryicing	6 17E401	2 16E+05	Lognorma	2.90E+02	7.84E+01	YES	YES - COPC
Benzo(k)Huoraninene	3 205403	1 005+08	I nemorman	6.20E+02	2.86E+02	YES	YES - COPC
Carbazole	1 635403	3.02E+06	Lognormal	6.90E+02	7.84E+02	01	YES*
Chrysene	1.035.02	1 67F±04	Lognormal	6.40E+01	7.84E-01	YES	YES - COPC
Difference and an accure	3.78E+07	4.19E+09	Lognormal	1.10E+03	8.18E+03	no	
Dioentolian	E 00E403	1 07E+07	Lognormal	4.60E+03	8.17E+04	9	
Figoranticae	4 27F+02	4 71 E+07	Lognormal	1.80E+03	8.17E+04	no Ou	
riuorene Indonesia de de desenta		1 10F+05	Lognormal	2.50E+02	7.84E+00	YES	YES COPC
Indeno(1,4,3-cujpy) one		2.43E+07	Lognormal	3.50E+03	8.24E+02	YES	YES - COPC
Napiunaiciic Nt.orodi-fromdamina	-	2.748+01	Lognormal	2.00E-01	1.17E+03	2	
Diameter Section (1975)		6.44E+08	Lognormal	6.40E+03	6.13E+04	2	
Phenanintene	0.000		Lomormal	4 40E+03	6.13E+04	10	
Pyrene	8.10E+02	3.30ET 00	LOGINGIE				

Pyrene **Retained as a COPC, as per MDEQ Comments (8/2/2000): constituent is a member of carcinogenic PAH family, one of which has been retained as a COPC.

Table 13 Statistical Summary and Selection of COPCs in EU4 Soil (0-20' bgs) Kerr McGee, Hattlesburg, MS

		Number		Ē	Minimum Detection	Maximum Detection	Minimum	Minimum	_	Logarithmic Maximum		Maximum Detected	Location of Maximum	Standard Deviation
	CAS	.		Frequency	Limit me/ke	Limit me/kg	Detected mg/kg	Detected Qualifier	Mean mg/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Constituent	Number	Samples		*	0			-		100	0.005400		GEO-21	2.89E+00
Semivolatiles	106 67.0	=	4	36.36	7.30E-02	9.90E+00	7.90E-02	- ,	1.36E+00	10-366-1	1 SOF-03		GEO-21	4.47E+02
2,4-dimethylphenol	575-01	: =	9	.90.91	4.00E-02	4.00E-02	6.20E-02	- , .	1.792+02	7.715-02	7 30E-02	-	GEO-19	7.97E-01
2-methylnaphtnatene	05 48-7	: =	7	18.18	3.70E-02	5.00E+00	5.10E-02	- , '	3.83E-01	1,135,01	2 10F-01	-	GEO-19	1.58E+00
2-methylphenol	106-44-5	: =	. –	60.6	7.30E-02	9.90E+00	2.10E-01	- , ·	7.386-01	1,37E-01	1 20F+03		GEO-21	2.98E+02
3- and 4-methylphenor	81.32.9	53	12	57.14	4.00E-02	1.50E+03	9.70E-02	- , .	1.145.402	0.325.0	5.00E+0)		GEO-21	1,63E+02
Acetaphthene	308-96-8	7	00	38.1	3.80E-02	1.50E+03	8.30E-02	→ t	9.226701	2.00E+00	3.00E+03	2	GEO-48	7.51E+02
Acenaphthylene	120-12-7	212	17	80.95	2.60E-03	5.30E-02	1.205-01	7 .	2.715+02	2 535+00	9 30F+02	2	GEO-48	2.18E+02
Anthracene	2.55-45	71	21	901	0.00E+00	0.00E+00	4,90E-03	-, . •	8.425+01	1 935400	\$ 00E+02	2	GEO-48	1.21E+02
Benzo(a)animacene	50.17-8	7	21	001	0.00E+00	0.00E+00	1.10E-02	- > (4.938+01	7.37E±00	\$ 30F+02	2	GEO-48	1.55E+02
Henzo(a)pyrene	204-90-2	7.	21	<u>0</u>	0.00E+00	0.00E+00	1.10E-02	7 -	0.505701	7.03E-01	1 30F+02	-	GEO-48	3.56E+01
Benzo(o)nuulanuum	191-24-2	71	19	90.48	3.80E-02	4.00E-02	8.90E-03	۰, -	1015101	0.365.01	2.90E+02	2	GEO-48	7.07E+01
Benzo(galijperyleae	207-08-9	21	6	90.48	3.80E-02	4.00E-02	5.60E-03	-, -	0.105101	2.205-51 2.49F+00	6.20E+02		GEO-21	1.91E+02
Delizota Jingulanuman	86-74-8	=	10	16:06	4.00E-02	4.00E-02	2.10E-01	-, -	7.43E+01	2.29E+00	6.90E+02	7	GEO-48	1.76E+02
Cheusane	218-01-9	21	20	95.24	5.10E-03	5.10E-03	9.90E-03		4.486400	2.65E-01	6.40E+01	<u>.</u>	GEO-48	1.57E+01
Cili yacında Toitaanaria hisanthracene	53-70-3	21	9	61.92	2.60E-03	4.00E-02	3.808-03		1 105+07	2.74E+00	1.10E+03		GEO-21	3.27E+02
Dibonzofiiran	132-64-9	=	20	16:06	4.00E-02	4.00E-02	7.80E-02	•	3.72E+02	7.99E+00	4.60E+03	Z	GEO-48	1.07E+03
Fluoranthene	206-44-0	71	71	<u>8</u>	0.00E+00	0.005+00	1.00E-02		1.82E+02	1.76E+00	1.80E+03	7	GEO-48	4.94E+02
Fluorene	86-73-7	71	15	71.43	1.30E-02	2.60E-01	1.405-01		2.44E+01	9.11E-01	2.50E+02	- -	GEO-48	6.00E+01
Indepod 2 3-cd)pyrene	193-39-5	21	20	95.24	6.00E-03	6.005-03	9.006-03	, -	3.77F+02	3.63E+00	3.50E+03		GEO-21	8.72E+02
Nanhthalene	91-20-3	71	15	71.43	4.00E-02	1.20E+01	- (•	3 84F-01	6.25E-02	2.00E-01		GEO-20	7.98E-01
N-nilrosodinhenvlamine	86-30-6	=	_	60.6	3.70E-02	5.00E+00	•		\$ 68E+02	5.46E+00	6.40E+03	7	GEO-48	1.60E+03
Phenanthrene	8-10-58	21	50	95.24	4.00E-02	4.00E-02	2.505-03		7.48E-01	1 28E-01	1.00E-01	-	GEO-20	1.58E+00
Phenol	108-95-2	=	-	60'6	7.30E-02				3.26E+02	7.75E+00	4.40E+03	7	GEO-20	9.82E+02
Pyrenc	129-00-0	21	7	2	0.00E+00	0.00E+00	1.00E-02							

Statistical Summary and Selection of COPCs in EU4 Soil (0-20' bgs) Kerr McGee, Hattiesburg, MS Table 13

		Logarithmic	Distribution	Logarithmic Distribution Exposure Point	Restricted	Maximum	I. the 04%
	95% UCL	95% UCL	%66	Concentration	Soil TRG	Detected >	12 1 1 1 1 1 2 2 7 7 1 1 1 1 1 1 1 1 1 1
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	INC	
Cemivolatiles		-			1000	į	
A dimental phone	2 94F+00	2.48E+01	Lognormal	8.90E+00	4.08E+04	ē	
Z,4-uniremylphicirol	4 335403	4 OKE+08	Lognormal	1.50E+03	8.18E+04	ou Ou	
2-methylnaphthalene	4.235702	1,700 t	I sakaowa	7.30E-02	1.02E+05	00	
2-methylphenol	8.19E-01	3.985700	1 lakeout	2.10E-01	1.02E+04	202	•
3- and 4-methylphenoi	1.62E+00	9,14E+00	Cilkinomia	1 20E+03	1.23E+05	о и	
Acenaphthene	2.26E+02	1.388+03	Jugarouna.	\$ 10E+01	1.23E+05	ou	
Acenaphthylene	1.03E+02	2.70E+03	Lognorman	2,000	50+4119	E	
Anthracene	5.54E+02	1.16E+07	Lognormal	3.00E+03	7.945+00	VES	YES - COPC
Benzo(a)anthracene	1.66E+02	1.53E+05	Lognormal	9.305+02	1045	2 2	YES - COPC
Benzo(a)nvrene	9.47E+01	2.66E+04	Lognormal	5.00E+02	1.045-01		VES - COP
Denzo(h)fluoranthene	1.26E+02	6.79E+04	Lognormal	5.30E+02	7.84E+00	3	3
Benzo(p)nomanineae	2.95E+01	5.59E+03	Lognormal	1.30E+02	6.13E+04	or i	000000000000000000000000000000000000000
Benkatigan yasi yasi v	\$ 48E+01	2.80E+04	Lognormal	2.90E+02	7.84E+01	۲ بر ح	7000
Denzo(k junoranuche	1 965407	1 175+06	ognormal	6.20E+02	2.86E+02	YES	YES-COP
Carbazole	1.000.102	90.17	[comount	6 90F+02	7.84E+02	S.	*YES
Chrysene	1.40E+02	2.66E+U3		6 406401	7 84F-01	YES	YES - COPC
Dibenz(a,h)anthracene	1.24E+01	2,39E+03	Lognormal	0.405+01	0.1011.03		
Dibenzofittan	3.09E+02	3.01E+07	Lognormal	1.10E+03	8.188.403	2 1	
Hammeltone	7.73E+02	1.06E+06	Lognormal	4.60E+03	8.17E+04	о <u>г</u>	
Fluorenticing	3.68E+02	4.04E+06	Lognormal	1.80E+03	8.17E+04	2	J400 Julia
r norene	4 70E±01	1 535+04	Lognormai	2.50E+02	7.84E+00	YES	YES-COP
Indeno(1,2,3-cd)pyrene	4.705-01	10.300.	Learnmen	3.50E+03	8.24E+02	YES	YES - COPC
Naphthalene	0.335404	00:3C9:7	I Inknown	2.00E-01	1.17E+03	9	
N-nitrosodiphenylamine	8.20E-01	ο.	- Cuncing	6.40F+03	6.13E+04	OII	
Phenanthrene	1.17E+03	-	inghoma.	1.00E-01	1.23E+05	Q	
Phenol	1.612+00		CHAIRMIN	- •	6.13E+04	110	
6.96E+02 5.88E+U3 LOBIOTINAL Trace of	6.96E+02	5.884405	LOGING	201.1			

*Retained as a COPC, as per MDEQ Comments one of which has been retained as a COPC.

Table 14
Statistical Summary and Selection of COPCs in EUS Soil (0-1' bgs)
Kerr McGee, Hattiesburg, MS

Constituent Semivolatiles Semivolatiles 2,4-dimethylphenol 2-methylphenol 3- and 4-methylphenol 3- and 4-methylphenol Acenaphthene Acenaphthylphenol 208-96-8 Acenaphthylphenol 208-96-8	Samples 6 6 6	Hits	F	į				Mean	Mean	Detected		Concentration	me/kg
nol 105-67-9 91-57-6 95-48-7 nol 106-44-5 83-32-9 208-96-8	» טעעע		%	mg/kg	mg/kg	eng/kg	Oualifier	mg/kg	mg/kg	MEZIK			
	×0 0 0 0				!	t	-	1075-01	8 03E-02	1.105-01		GEO-30	8.38E-02
io i	~~~	_	16.67	7.60E-02	4.55E-01	1.106-01		1 685+00	1716-01	9.20E+00		GEO-30	3.69E+00
of Aphenol I	۵ ۵ ۵	4	66.67	3.80E-02	3.90E-02	3.10E-02		A 04E-03	1.77F-02	4.20F-02	_	GEO-30	3.92E-02
/Iphenol 1	œœ	_	16.67	3.80E-02	2.09E-01	4.205-02		1036-01	8 22E-02	1.40E-01	-	GEO-30	7.94E-02
. p	œ	_	16.67	7.60E-02	4.135-01	1.405-04		6 91E+00	1.92E-01	5.35E+01	-	GEO-33	1.88E+01
92	,	7	25	3 80E-02	2.40E+00	10-2001	.	2 61 E+00	4.28E-01	1.60E+01		GEO-33	5.47E+00
	0 0	Ś	62.5	3.80E-02	2.40E+00	4.00E-02	, <u>-</u>	1 07F+01	2.00E-01	7.97E+01		GEO-33	2.79E+01
	œ	4	20	1.00E-02	4.40E-02	10-305.1	- 1	1 305+01	1.39E+00	8.35E+01		GEO-33	2.87E+01
Renzo(abanthracene 56-55-3	∞	7	87.5	3.80E-02	3.80E-02	2.00E-01	۵ -	8 87E+00	1.38E+00	5.25E+01	-	GEO-33	1.79E+01
	∞	7	87.5	3.80E-02	3.80E-02	3.105-01	. h	1 38E+01	2.15E+00	7.95E+01		GEO-33	2.71E+01
Benzo(h)fluoranthene 205-99-2	œ	7	87.5	3.80E-02	3.80E-02	4.405-01	· -	4 30F+00	5.42E-01	2.55E+01		GEO-33	8.71E+00
	∞	ø	75	3.80E-02	3.80E-02	2.305-01		\$ 07F+00	1.01E+00	2.85E+01		GEO-33	9.68E+00
Renzotk) fluoranthene 207-08-9	œ	7	87.5	3.80E-02	3.80E-02	7.10E-01	a –	2 63F+00	2.10E-01	1.35E+01		GEO-33	5.36E+00
Carbazole 86-74-8	9	3	S0	3.80E-02	3.90E-02	3,300-01	• 1	1.35E+01	1.62E+00	8.25E+01		GEO-33	2.83E+01
Chrysene 218-01-9	0 0	7	87.5	3.80E-02	3.80E-02	2.70E-01	.	1.33E+00	3.02E-01	7,45E+00	-	GEO-33	2.53E+00
Dibenz(a,h)anthracene 53-70-3	ec	7	87.5	3.80E-02	3.80E-02	9.50E-02		4 94E+00	1.77E-01	2.90E+01		GEO-33	1.18E+01
Dibenzofuran 132-64-9	vo	4	66.67	3.80E-02	3.90E-02	3.90E-02	, -	\$ 01E+01	2.31E+00	3.55E+02		GEO-33	1.23E+02
Fluoranthene 206-44-0	80	7	87.5	3.80E-02	3.80E-02	1,305-01		8 10F+00	1.90E-01	6.30E+01		GEO-33	2.22E+01
Fluorenc 86-73-7	œ	4	20	3.80E-02	2.20E-02	3.305-01	, -	\$ 49E+00	1.02E+00	3,10E+01		GEO-33	1.05E+01
Indenoi 12 3-cd bytene 193-39-5	ρô	7	87.5	3.80E-02	3.80E-02	10-200.7	·	1 635+00	2.97E-01	6.85E+00		GEO-33	2.65E+00
Naphthalene 91-20-3	60	V)	62.5	3.80E-02	5.60E-01	7.505-02	· ` -	3.25E+01	7.56E-01	2.45E+02		GEO-33	8.59E+01
Phenanthrene 85-01-8	0 ¢	9	75	3.80E-02	3.90E-02	1.305-01	· -	1 00E-01	1.64E-01	3.80E-01		GEO-29	1.13E-01
-	9	ਾ ਵਾ	29.99	7.70E-02	4.13E-01	1.405-01		2 78E+01	2.54E+00	2.60E+02		GEO-33	9.01E+01
Pyrene 129-00-0	80	7	87.5	3.80E-02	3.80E-02	10-206.7		10.701.0					

Statistical Summary and Selection of COPCs in EU5 Soil (0-1' bgs) Kerr McGee, Hattiesburg, MS Table 14

					Ther I		
		Logarithmic	Distribution	Exposure Point	Unrestricted Soil	1. the Maximum	Is the 95%
	95% UCL	95% UCL	%66 	Concentration maybe	I KU ME/KE	Detected > TRG?	UCL > TRG?
Constituent	mg/kg	mg/kg	Continuence				
Semivolatiles	٠	1	1 1 1 1 1 1 1 1 1 1	1.108.01	1.56E+03	200	
2.4-dimethylphenol	1.76E-01	4.42E-01	Normal/Loginormal	10.101.0	112501	2	
- Line State of the lease	4 71 E+00	4.63E+04	Lognormal	9.20E+00	3.13.13.		
2 manual manuar 2	20 110 0	1.825-01	Normal/Lognormal	4.20E-02	3.916+03	2	
2-methylphenol	0.170-04	10 13 P	Normal/Lognormal	1.40E-01	3.91E+02	110	
3- and 4-methylphenol	1.745-01	4.356-01	Ivolitial Logical	5 355+01	4.69E+03	9	
Acenaphthene	1.95E+01	3.47E+04	Lognormai	i komin	4 69F+03	91	
Aconomhitwiene	6.27E+00	1.25E+03	Lognormal	1,000	10 Late 6	Š	
Occupation of the Control of the Con	3 045401	1.81E+07	Lognormal	7.97E+01	7.30E+04	2 ;	7000
Anthracene	10+0+6-7	701010	Loanorma	8.35E+01	8.75E-01	YES	YES-COL
Benzo(a)anthracene	3.23E+UI	9.516404		6 256401	8.75E-02	YES	YES - COPC
Renzo(a)ovrene	2.08E+01	2.16E+04	Lognorman	0.170	0 74E-01	YES	YES - COPC
Danger	3.20E+01	8.21E+04	Lognormal	/,95E+01	0.75.0	<u> </u>	
Belledoning	1010101	2 82F+04	Lognormal	2.55E+01	2.35E+03	21	7400
Benzo(ghi)peryiene	101011		l namorms!	2.85E+01	8.75E+00	YES	res-corc
Benzo(k)fluoranthene	1.105+01	5,740,103		1355+01	3.19E+01	55	
Carbazole	7.04E+00	8.43E+Ub	Logunium.	10.035.0	8 75E+01	011	YES*
Chrispie	3.25E+01	1.14E+05	Lognormal	8.235+01	0.75.0	. SEA	VES - COPC
Call Joseph Continued on a	3.02F+00	1.76E+02	Lognormal	7.45E+00	8.73E-02	3 :	
Lybenzia,n/allinacene	1.466+01	4 28F+06	Lognormal	2.90E+01	3.13E+02	01	
Dibenzoturan	130.00	3 03E+07	Loenormal	3.55E+02	3.13E+03	0L	
Fluoranthene	1.05ETU2	10.75.06	[ognorms]	6.30E+01	3,13E+03	110	1
Fluorene	2.30E+01	1.215.10	I company	3.10F+01	8.75E-01	YES	YES - COPC
Indeno(1,2,3-cd)pyrene	1.25E+01	3.34 E+03		COCETOD	6.45E+02	01	
Nanhthalene	3,41E+00	1.19E+03	Loggerman	0.605.00	0.155.0	Ę	
	9 00E+01	2.29E+07	Lognormal	2.45E+02	4.55E+05	2	
Prenamenc	ייייייי	7 135-01	Normal/Lognormal	3.80E-01	4.69E+04	ê	
Phenol	4.72E-VI	4 135406	I conomai	2.60E+02	2.35E+03	ᅋ	
Pyrene	9.82E+Ui	4.13ETU	9.82E+Ul 4.13E-VO Committee of continuous PAH family	Ten of naroin of	ic PAH family.		
POD or an Por	New MDEO Con	Trents (8/2/2009))); constituent is a risc	HILLER OF CARCING		-	

*Retained as a COPC, as per MDEQ Comments (8/2/2 one of which has been retained as a COPC.

	. 	Total		Ĭ	Minimum Detection	Maximum Detection	Minimom	Minimum		Logarithmic Maximum Maximum	Maximum	Maximum	Location of	Standard
	CAS	Number of	į	Frequency	Limit	Limit ma/kg	Detected mg/kg	Detected Oualifier	Mean mg/kg	Mean mg/kg	Detected mg/kg	Derected Qualifier	Concentration	mg/kg
Constituent	Number	Samples	E III	P.	W A	4: 24:						•	0	6 40E 03
Semivolatiles		:	•	1	1 500	A SSE-DI	105-01	-	6.17E-02	4.98E-02	1.10E-01		550	3.00E-02
2,4-dimethylphenol	105-67-9	<u>=</u>	_	2,56	70-20C'/	4.335.01	201.1	. =	6.21E-01	4 09F-07	9.20E+00		GEO-33	2.15E+00
2-methytnaphthalene	91-57-6	<u>oc</u>	Ś	27.78	3.80E-02	4.105-02	3.10E-02	•	10-71-01	7.440.00	4 20E-02	,	GEO-30	2.57E-02
2-methylphenol	95-48-7	8	-	5.56	3.80E-02	2.09E-01	4.20E-02		70-306.7	20-24-2	1 406.01	, –	GEO-30	5.46E-02
2- and 4-methylphonol	106-44-5	<u>∞</u>	-	5.56	7.50E-02	4.13E-01	1.40E-01	- ,	6.22E-02	5.02E-02	10-20-1	•	GEO-33	1.09E+01
S all 4 - monty promise	0.77.0	24	4	16.67	2.90E-02	2.40E+00	1.10E-01	-	2.53E+00	0.24E-02	3.335-01		000	2.265400
Acenaphthene	900 000	, ,		3,5	3 80E-02	2.40E+00	4.80E-02	<u>-</u>	9.59E-01	7.93E-02	1.60E+01		CEO-33	3,205-00
Acenaphthylene	9-96-807	* 7	۰ د	1	S 40E 04	6 OOF -02	1.30E-01	_	3.94E+00	4.33E-02	7.97E+01		GEO-33	1.038+01
Anthracene	120-12-7	24	0	3.	3.405-04	20-100.7	6 90E 02		4 81 5+00	115-01	8.35E+01		GEO-33	1.71E+01
Benzo(a)anthracene	56-55-3	24	<u>.</u>	54.17	3.80E-02	4.105-02	0.000-03	۱ ۵	2 175-100	1.15E-01	\$ 25E+01		GEO-33	1.07E+01
Benzo(a)nyrene	50-32-8	24	<u>~</u>	54.17	3.80E-02	4.10E-02	8.505-03	3 1	3,175,00	1 60 6 01	7.056+01	_	GEO-33	1.63E+01
Renzo(h) Unoranthene	205-99-2	24	4	58.33	3.80E-02	4.10E-02	9.00E-03	7	4.99E+00	1.395-01	2 656401	•	GEO-33	5.22E+00
Renzo(ohi)pervlene	191-24-2	24	15	20	3.80E-02	4.10E-02	6.70E-03	- (0013001	7.46E-02	2.22.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2		GEO-33	5.86E+00
Benzo(k)fluoranthene	207-08-9	24	14	58.33	3.80E-02	4.10E-02	4.70E-03	7	1.845-100	70-316-6	1 505-01		GEO-32	5.80E-02
Bis/2-ethylbexylbohthalate	117-81-7	2	7	1:1	7.50E-02	4.13E-01	1.40E-01	¬ ·	0.84E-02	3.41E-02	10000	-	GEO-33	3.17E+00
Corbarole	86-74-8	81	4	22.22	3.80E-02	4.10E-02	5.30E-01		9.78E-UI	3.32E-02	1,355.01	•	GEO-33	1.69E+01
Chrisens	218-01-9	24	4	58.33	3.80E-02	4.10E-02	2.40E-03	_	4.91E+00	1.165-01	7.450400		GEO-33	1.53E+00
Oilbenz(a.h)anthracene	53-70-3	24	13	50	3.80E-02	4.10E-02.	1.70E-03	- ·	4.89E-01	4.38E-02	3 005401		GEO-33	6.81E+00
Dibenzofuran	132-64-9	20	9	33.33	3.80E-02	4.10E-02	3.90E-02	- 1	1.825+00	3.87E-02	1 55E+02		GEO-33	7.23E+01
Fluoranthene	206-44-0	24	7	58.33	3.80E-02	4.10E-02	1.306-02	7 -	10.500.0	7. 12E 03	6 30F+01		GEO-33	1.28E+01
Fluorene	86-73-7	24	œ	33.33	2.90E-03	5.20E-02	3.60E-03	- , .	2.986+00	70-37/-6	105501		GEO-33	6.37E+00
Indeposit 2 3-rd/myrene	193-39-5	24	13	54.17	3.80E-02	4.10E-02	7.80E-03	-,	1.97E+00	9.08E-02	3.105-01		GEO-33	1.65E+00
Internal part of the state of t	01.20.3	24	9	25	2.90E-02	5.60E-01	7.50E-02	-	5.936-01	70-377-0	0.655		GEO 33	5.005+01
Naphinalcue	8.10.29	7	13	54.17	3.80E-02	4.10E-02	6.80E-03		1.215+01	1.17E-01	2.45E+02		00.030	8 68E-07
Prenaminano	108.05.7	×	13	72.22	7.50E-02	4 13E-0i	1.00E-01	-,	1.48E-01	1.22E-01	3.80E-01		GEO 13	5 30E+01
ru ci nos	200000	20	71	58.33	3.80E-02	4.10E-02	1.60E-02	ſ	1.39E+01	1.87E-01	7.00=+02		050-33	2.200
Pyrene	22.2	4.7												

Statistical Summary and Selection of COPCs in EU5 Soil (0-6' bgs) Kerr McGee, Hattiesburg, MS Table 15

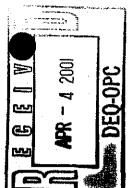
		Logarithmic	Distribution	Exposure Point	Tier 1 Restricted Soil TRG	is the Maximum is the 95% UCL >	the 95% UCL >
	yo% UCL me/ke	me/ke	Confidence	mg/kg	тд/кд	Detected > TRG?	TRG?
Constituent	4						
Setting United States	8 47E-02	7.85E-02	Unknown	7.85E-02	4.08E+04	2	
2,4-dilineuryiphenol	1 505+00	1 435+00	Unknown	1.43E+00	8,18E+04	91	,
2-methymaphulaiene	40111-02	3 69E-02	Unknown	3.69E-02	1.02E+05	100	
2-memyipnenoi	4.015-02 0 445 00	7 00E-07	Linknown	7.99E-02	1.02E+04	9	
3- and 4-methy/phenor	0.40E-02	1.21E+00	Tinknown	3.21E+00	1.23E+05	û	
Acenaphthene	0.335500	00.217.6	Thebrone	2 70F+00	1.23E+05	OU.	
Acenaphthylene	Z.10E+00	7.705+00	Telegon	6.15E+01	6.13E+05	2	
Anthracene	9.62E+00	6.15E+01	URKNOWIE	7.776+01	7.84F+00	YES	YES - COPC
Benzo(a)anthracene	1.08E+01	7.77E+01	Unknown	1013017	7.845-01	YES	YES COPC
Benzo(a)pyrene	6.93E+00	4.10E+01	Cuknown	4.10Erus	00:040:	200	VES. COPC
Renzo(h)fluoranthene	1.07E+01	1.30E+02	Unknown	7.95E+01	7.84E+00	2	3
Dennelahimendene	3.38E+00	8.53E+00	Unknown	8.53E+00	6.13E+04	<u>Q</u>	400.00
Deliging Bring Trains	1 80E+00	1.97E+01	Unknown	1.97E+01	7.84E+01	OE.	, ES
Benzolk kituwa minenie	001100	0 19F-02	Unknown	9.19E-02	4.09E+02	uo.	
Bis(2-ethylnexyl)phillialate	3.215-02	007777	Linknown	4.56E+00	2.86E+02	7.0	
Carbazole	2.265100	1.301.00	Traknona	8 25E+01	7.84E+02	00	YES*
Chrysene	1.08E+01	1.2/E+02	T T T	0.0000	7 84F-01	YES	YES - COPC
Dibenz(a,h)anthracene	1.02E+00	2.04E+00	Unknown	00.134C.4	2 18E+03	011	
Dibenzofuran	4.61E+00	4.75E+00	Unknown	4.735100	6 175+04	· C	
Fluoranthene	4.38E+01	7.28E+02	Unknown	3.55E+02	0.175704	2 1	
201011	7.47E+00	7.47E+00	Unknown	7,47E+00	8.17E+04	ou ,	Odon say
Indeport 2 3-red)norme	4.20E+00	1.716+01	Unknown	1.71E+01	7.84E+00	Y ES	restour
Mooney 1,445 ca.//3; cm	178+00	1.53E+00	Unknown	1.53E+00	8.24E+02	6	-
ivapilinaicire	2 04E±01	1.26E+02	Unknown	i.26E+02	6.13E+04	0£	
Frenammene	1 045 01) 27E 01	Normal/Lognormal	1. 2.27E-01	1.23E+05	2	
Phenol	10-346.1	4 645+02	Unknown	2.60E+02	6.13E+04	ou	
Pyrene	3.2415101		10 Jac	COBC as not MADEO Comments (8/2/2000); constituent is a	(8/2/2000): constitu	ent is a	

*Logarithmic 95% UCL is less than benchmark but retained as a COPC, as per MDEQ Comments (8/2/2000): member of carcinogenic PAH family, one of which has been retained as a COPC.



Table 16
Statistical Summary and Selection of COPCs in EU5 Soll (0-20' bgs)
Kerr McGee, Hattiesburg, MS

														,
					Minimum	Maximum				I accoult bearing Maximum	Movimum	Maximum	Location of	Standard
	CAS	Total Number of		Hit Frequency	Detection Limit	Detection Limit	Minimum Detected	Minimum	Mean	Mean	Detected		Maximum	Deviation
Constituent	Number	Samples	Hits	%	mg/kg	mg/kg	mg/kg	Qualifier	mg/kg	mg/kg	mg/kg	Qualither	Concentration	III WAR
Semivolatiles		į		,	1	i i	10 201 1	-	9 915.03	\$ \$7E.00	1 10F-01	ſ	GEO-30	1.34E-01
2,4-dimethylphenol	105-67-9	23	-	4.35	6.70E-02	1.30E+00	1.10E-01	- ·	201000	1 105-01	4.40F+02		SB-05	9.23E+01
2-methylnaphthalene	91-57-6	23	90	34.78	3.30E-02	4.10E-02	20105-02		6.30E.03	3.18E-02	4.20E-02	-	GEO-30	1.33E-01
2-methylphenol	95-48-7	23	_	4.35	3.80E-02	1.305.400	4.20E-02		1 105 01	6.17E-02	1.40F-01	, -,	GEO-30	2.04E-01
3- and 4-methylphenol	106-44-5	23	-	4.35	7.50E-02	2.005+00	10000		1 205-01	1.15E-01	2 90E+02		SB-05	5.34E+01
Acenaphthene	83-32-9	30	7	23.33	2.90E-02	2.405+00	1000-01		1.29E101	9 90E-02	1.60E+01		GEO-33	3.36E+00
Acenaphthylene	208-96-8	2	ø,	දු :	3.30E-02	2.40E+00	4.30E-02		7 18E+00	6.99E-02	9.80E+01		SB-05	2.26E+01
Anthracene	120-12-7	30	O,	9 1	5.40E-04	20-200°	1.300.1	• •	6.57E+00	1.56E-01	8.35E+01		GEO-33	1.93E+01
Benzo(a)anthracene	56-55-3	<u>e</u>	<u> </u>	56.67	3.30E-02	4.105-02	0.905-03	1 ^	3.56E+00	1.55E-01	5.25E+01	_	GEO-33	1.05E+01
	50-32-8	30	13	56.67	3.80E-02	0.705-02	9.30E-03	1 6	\$ 47E+00	2.09E-01	7.95E+01		GEO-33	1.59E+01
Benzo(b)fluoranthene	205-99-2	30	<u></u>	9	3.80E-02	0./UE-02	200E-03	1 -	1.51E+00	9 66F-02	2.55E+01		GEO-33	4.77E+00
Benzo(ghi)perylene	191-24-2	30	2	53.33	3.80E-02	0.70E-02	4 705 03		1 90F+00	1 32E-01	2.85E+01		GEO-33	5.64E+00
Benzo(k)fluoranthene	207-08-9	30	<u>∞</u>	8	3.80E-02	1.305-01	4.70E-03	7 -	0.405.03	6.04E-02	1 SOF-01	- ,	GEO-32	1.34E-01
Bis(2-ethylhexyt)phthalate	117-81-7	23	7	6.7	6.70E-02	1.305+00	10-20-1	, -	4 20E400	0.66E-07	6 90F±01		SB-05	1.45E+01
Carbazole	86-74-8	23	-	30,43	3.30E-02	4.10E-02	3.305-01	. -	4.23E400	1.50E-01	8 25E±01		GEO-33	1.85E+01
Chrysene	218-01-9	30	8 2	9	3.30E-02	4.10E-02	2.40E-03	٠.	0.53ETUV	10-345-01 6 40E 03	7 455+00		GEO-33	1.42E+00
Dibenz(a,h)anthracene	53-70-3	30	15	20	3.80E-02	3.30E-01	1.70E-03	- , ·	4.8/E-U1	3.48E-02	0013011		SB-05	5.62E+01
Dibenzofuran	132-64-9	23	6	39.13	3.30E-02	4.10E-02	3.90E-02	I	1.4/6+01	10-357	4 305.03		SR-05	9.95E+01
Fluoranthene	206-44-0	30	82	જ	3.30E-02	4.10E-02	1.30E-02	7	3.135+01	10-379.7	4.305.02		SB-05	6.11E+01
Fhorene	86-73-7	30	=	36.67	2.90E-03	5.20E-02	3.60E-03	7	1.526+01	8.6/E-02	3.306.02		GEO 33	5 84F+00
indeno(1.2.3-cd)pyrene	193-39-5	30	17	56.67	3.80E-02	6.70E-02	7.80E-03	- , ·	1.92E+00	1.226-01	3.105+01		SB-05	1.68E+02
Naphthalene	91-20-3	30	6	8	2.90E-02	5.60E-01	7.50E-02	-, .	3.805+01	1,336-01	7 105107		SB-05	1.36E+02
Phenanthrene	85-01-8	8	17	26.67	3.30E-02	4.10E-02	6.80E-03	_, -	10-27/10	0.66E-01	1 80E-01		GEO-29	9.90E-02
Phenoi	108-95-2	23	E	56.52	3.30E-02	6.70E-01	1000-01	- , •	1,205-01	70-700.c	2.60E+03		GEO-33	6.43E+01
Pyrene	129-00-0	8	8 2	9	3.80E-02	6.70E-02	1.60E-02	-,	2.04E+01	10-25-01	7007) - - -	
Volatiles							1000	Ė	4 405 00	2 05E-07	1 OOF-01	_	SB-05	3.79E-02
Acetone	67-64-1	'n	S	100	0.000	0.00E+00	9.00E-03	-, ·	4.40E-02	1 145 03	7,005,03	. -	SB-05	3.09E-03
Вепхеле	71-43-2	S,	7	4	1.00E-03	1.00E-03	5.00E-03	-	2.70E-03	1.346.03	1,000,0	•	SR-05	4.95E-02
Ethylbenzene	100-41-4	٧١	3	· 8	1.00E-03	1.00E-03	2.40E-02		3.825-02	6.02E-03	1000		SB-05	4.45E-02
Styrene	100-42-5	S	-	2	1.00E-03	1.00E-03	1.001-01	` :	2.04E-02	60-046-03	1,005-01		SB-05	5.98E-02
Toluene	108-88-3	5	0	9	1.00E-03	1.00E-03	1.30E-02		3.38E-02	3.635-03	7.805.01		SB-05	3.30E-01
Xylene (total)	1330-20-7	\$	~	8	1.00E-03	1.00E-03	7.50E-02		7.7.1E-01	2.105-02	1.00.7		 	



Statistical Summary and Selection of COPCs in EUS Soil (0-20' bgs) Kerr McGee, Hattiesburg, MS Table 16

	95% UCL	Logarithmic 95% UCL	Distribution 99%	Exposure Point Concentration	Exposure Point Tier I Restricted Concentration Soil TRG	Is the Maximum Is the 95% UCL	is the 95% UCL
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	Detected > TRG?	> 1 KG:
Semivolatiles							÷
2.4-dimethylphenol	1.36E-01	1.12E-01	Unknown	1.10E-01	4.08E+04	2	
2-methylnaphthalene	5.67E+01	6.89E+02	Unknown	4.40E+02	8.18E+04	2	
2-methylphenol	1.11E-01	7.64E-02	Unknown	4.20E-02	1.02E+05	92	
3- and 4-methylphenol	1.83E-01	1.37E-01	Unknown	1.37E-01	1.02E+04	0 0	
Acenaphthene	2.95E+01	8.04E+01	Unknown	8.04E+01	1.23E+05	D	
Acenaphthylene	2.19E+00	3.82E+00	Unknown	3.82E+00	1.23E+05	110	
Anthracene	1.42E+01	4.31E+02	Unknown	9.80E+01	6.13E+05	017	!
Benzo(a)anthracene	1.25E+01	1.52E+02	Unknown	8.35E+01	7.84E+00	Yes	YES-COPC
Benzo(a)nvrene	6.82E+00	4.42E+01	Unknown	4.42E+01	7.84E-01	Yes	YES-COPC
Benzo(b)fluoranthene	1.04E+01	1.19E+02	Unknown	7.95E+01	7.84E+00	Yes	YES-COPC
Benzo(ghi)perylene	2.99E+00	7.40E+00	Unknown	7.40E+00	6.13E+04	uo u	
Benzo(k)fluoranthene	3.74E+00	1.68E+01	Unknown	1.68E+01	7.84E+01	<u>0</u>	t) COLC
Bis(2-ethylhexyl)phthalate	1.42E-01	1.24E-01	Unknown	1.24E-01	4.09E+02	OU.	
Carbazole	9,49E+00	6.44E+01	Unknown	6.44E+01	2.86E+02	DO INO	!
Chrysene	1.21E+01	2.00E+02	Unknown	8.25E+01	7.84E+02	Yes	YES-COPC
Dihenz(a.h)anthracene	9.29E-01	1.53E+00	Unknown	1.53E+00	7.84E-01	90	COPC
Dibenzofuran	3.48E+01	4.46E+02	Unknown	2.70E+02	8.18E+03	00	-
Fluoranthene	6.22E+01	3.34E+03	Unknown	4.30E+02	8.17E+04	<u>о</u> п	٠
Fluorene	3.42E+01	2.24E+02	Unknown	2.24E+02	8.17E+04	ou	;
Indeno(1.2.3-cd)pyrene	3.73E+00	1.32E+01	Unknown	1.32E+01	7.84E+00	110	COPC
Nanhthalene	9.01E+01	2.69E+02	Unknown	2.69E+02	8.24E+02	90	
Phenanthrene	7.98E+01	2.37E+03	Unknown	7.10E+02	6.13E+04	00	
Phenol	1.72E-01	2.53E-01	Normal/Lognormal	- •	1.23E+05	OĽ	
Pyrene	4.03E+01	1.08E+03	Unknown	2.60E+02	6.13E+04	2	
Volatiles			-			i	
Acetone	8.01E-02	9.07E-01	Normal/Lognormal	•	1.04E+05	2	
Benzene	5.65E-03	2.77E-01	Normal/Lognormal	_	1.36E+00	2	
Ethylbenzene	8.54E-02	1.58E+06	Normal/Lognormal	_	3.95E+02	2	
Styrene	6.28E-02	1.19E+04	Unknown	1.00E-01	3.84E+02	2	
Toluene	9.08E-02	1.16E+05	Lognormal	1 40E-01	3.80E+01	2	
	10 247 9		Normall companie	1 7 80E-01	3.18E+02	2	

*Logarithmic 95% UCL is less than benchmark but retained as a COPC, as per MDEQ Comments (8/2/2000): constituent is a member of carcinogenic PAH family, one of which has been retained as a COPC.

Table 17
Statistical Summary and Selection of COPCs in EU6 Sediment
Kerr McGee, Hattiesburg, MS

				į	Minimums	Махушаш	Affinisms	Minimian		Logarithmic	Maximum	Maximum	Location of	Standard
	Č	Total		Fremence	Detection	Limit	Detected	Detected	Mean			Detected	Maximum	Deviation
	Number	Samples	H	% ************************************	mg/kg	mg/kg	mg/kg	Qualifier	mg/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Semivolatiles							1			CO 337 3	A 005.01		SD-04	2.19E-01
1.2.4-trichlorobenzene	120-82-1	m	-	33.33	4.20E-02	4.30E-02	4.00E-01		1.465-01	20.00.02	4 00 10		SD-04	2.19E-01
1.2-dichlorobenzene	95-50-1	æ	-	33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-01	3.035-02	4.00E-01		SD-04	2.19E-01
1 3 dichlorohenzene	541-73-1	£	_	33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-01	5.655-02	4.006-01		200	2 105 01
A distinguishment	106.46.7	-	_	33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-01	5.65E-02	4.00E-01		500	100000
11,4-dremovoenzene	1.08-60-1	. ~	_	33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-01	5.65E-02	4.00E-01		SD-04	2.196-01
2,2-oxyots (1-cmoropropane)	1-00-001	, -		13 13	8.40E-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01	i	SD-04	4.3/E-01
2,4,5-trichlorophenol	93-93-4	n •		12.13	8 40F-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01		SD-04	4.37E-01
2,4,6-trichlorophenol	2-90-99	9 5		13.13	8 40F-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01		SD-04	4.37E-01
2,4-dichlorophenol	7-68-071	n r		13.23	8 40E-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01		SD-04	4.37E-01
2,4-dimethylphenol	6-/9-001	n (13.23	2 405-01	2 50E-01	2.30E+00		8.48E-01	3.26E-01	2.30E+00		SD-04	1.26E+00
2,4-dinitrophenol	C-87-1C	n (0 405 0	9 SOE-02	4 00F-01		1.62E-01	8.94E-02	4.00E-01		SD-04	2.07E-01
2,4-dinitrotoluene	121-14-2	m ·		55.55	4.205.02	10000	100501		48F-01	5.65E-02	4.00E-01		SD-04	2.19E-01
2,6-dinitrotoluene	606-20-2	m	_	33.33	4.20E-02	4.305-02	10000		A8E 0	\$ 65E-02	4.00E-01		SD-04	2.19E-01
2-chloronaphthalene	61-58-7	m		33.33	4.20E-02	4.30E-02	4.00E-01		10000	\$ 65E-07	4 00E-01		SD-04	2.19E-01
2-chlorophenol	95-57-8	m	-	33.33	4.20E-02	4.30E-02	4.00E-01	•	10-365.	1.156100	1 80E+01		SD-04	2.18E+01
2-methylnanhthalene	91-57-6	eń.	m	001	0.00E+00	0.00E+00	9.10E-02	_	1.285.+01	1.135+00	A DOE OF		SD-02	2.19E-01
2-methylphenol	95-48-7	3	-	33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-0	20-350.0	4.00E-01		500	2 19E-01
2-nitroaniline*	88-74-4	m		33.33	4.20E-02	4.30E-02	4:00E-01	-	1.48E-01	5.65E-02	9.00E-01		SD-04	4.37E-01
2. reference 1.	88-75-5	m	-	33.33	8.40E-02	8.50E-02	8.00E-01		2.95E-01	1.136-01	9.00E-01		000	4 03E-01
Z-min Omeron 3- and 4-methylphenol	106-44-5	m	•	001	0.00E+00	0.00E+00	9.30E-02	-	3.34E-01	2.025-01	8.008-01		1000 1000	4 17E-01
2 disherensidine	91-94-1	(~)	-	33.33	8.40E-02	8.50E-02	8.00E-01		2.95E-01	10-251.1	8.00E-01		200	4.175.01
5,5 -dictionalise*	99.09.2	•	-	33.33	8.40E-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01		900s	1.005+00
12-mirodomine 14 / 12-in- 3 mosterialment	534.52.1	•	_	33,33	2.10E-01	2.10E-01	2.00E+00		7.37E-01	2.80E-01	2.00E+00		3 6	A 275 A
to entitle - 2-included of the	101.55.1	ý r	-	33,33	8.40E-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01		00.00	4.375-01
4-bromophenyiphenyiether	50.50.7) (**		33.33	8.40E-02	8.50E-02	8.00E-01		2.95E-01	1.136-01	8.00E-01		SD-04	4.575-01
4-chlore-3-methyphenor	100-60	n =	-	33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-01	5.65E-02	4.00E-01		SD-04	2.19E-01
4-chloroantline	7005	, 	-	33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-01	5.65E-02	4.00E-01		SD-04	10-361-7
4-chlorophenylphenylemer	571-C007	י פי	-	33.33	8.40E-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01		SD-04	4.375-01
4-nitroaniline	20001) P*	-	33.33	2.10E-01	2.10E-01	2.00E+00		7.37E-01	2.80E-01	2.00E+00		50-04 50-04	0.700
4-nitrophenol	1-70-001	۰ ۰		S	1.80E+00	3.50E+00	1.00E-01	_	1.89E+01	1.96E+00	1.40E+02	· •	SD-04	4.90E+01
Acenaphthene	83-32-9	•	* "	3 1	1 80E+00	3 SOE+00	1.70E-01	•	2.92E+00	1.69E+00	8.90E+00		SD-03	3.14E+00
Acenaphthylene	8-96-807	ю (n 1	7 4 6	4 57E 01	A STE-DI	8 80F-01		6.08E+00	2.86E+00	2.39E+01	Z	SD-16	7.83E+00
Anthracene	120-12-7		-	87.3	4.375-01	10.770.4	10000		1 855+01	4.83E+00	1.00E+02	-	SD-04	3.41E+01
Benzo(a)anthracene	56-55-3	••	∞	00 :	0.00E+00	0.005+00	9.305-01	-	1 376401	\$.59E+00	4.90E+01	_	SD-03	1.80E+01
Benzo(a)pyrene	50-32-8	00	60	2	0.00=+00	0.00E+00		•	1000	7 10F+00	7.80E+01		SD-03	2.82E+01
Benzo(b) fluoranthene	205-99-2	0 0	oc	<u>8</u>	0,00E+00	0.00E+00			6.50E+00		3.20E+01	-	SD-03	1.07E+01
Renzo(ghimerylene	191-24-2	60	æ	<u>8</u>	0.00E+00	0.00=+00	4.20E-01		00 E 00 E	•	2 10F+01		SD-03	8.76E+00
Benzo(k)fluoranthene	207-08-9	•c	.	001	0.00E+00	0.00E+00	3.00E-01		2.046.01	1.13E01	8.00E-01	٠	SD-04	4.37E-01
Bis/2-chivroethoxy)methane*	1-16-111	m	-	33.33	8.40E-02	8.50E-02	8.00E-01	٠,	10-305-01	< 65E-02	4 00E-01		SD-04	2.19E-01
Disco allower that her	111-44-4	,,,	-	11 11	4 20E-02	4.30E-02	4.00E-01		1.485-01	20.00.0	100:1			

Table 17 Statistical Summary and Selection of COPCs in EU6 Sediment Kerr McGee, Hattiesburg, MS

		Locarithmic	Distribution	Exposure Point	Unrestricted Soil	-	-
	95% UCL	35% UCL	%66	Concentration	TRG	Is the Maximum	Is the
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	Detected > IRG?	IRG
				A 00E-01	\$ 27F+07	Ou	
1,2,4-trichlorobenzene	5.16E-01	7.97E+10	Lognorman	10000	3 70E+03	çu	
1,2-dichlorobenzene	5.16E-01	7.9/E+10	Lognormai	10-200-0	10:07:07	: :	
1,3-dichlorobenzene	5.16E-01	7.97E+10	Cognormal	4.00E-01	COTACE.2	2 1	
1.4-dichlorobenzene	5.16E-01	7.97E+10	Lognormal	4.00E-01	2.00E+UI	2 .	-
2 2'-ovykis (1-chlomoropane)	5.16E-01	7.97E+10	Lognormal	4.00E-01	5.93E+00	Ou	
2,4 CASUS (1-cinotopiopio)	1.016+00	1.778+11	Unknown	8.00E-01	7.82E+03	00	
Z,4,5-thenenenene	0012601	1 776+11	Unknown	8.00E-01	5.81E+01	OU	
2,4,6-trichlorophenol	1.035100	775.11	Linknown	8 00E-01	2.35E+02	0µ	
2,4-dichlorophenol	1.03E+00	1.775+11	Clikildwii	9 000	1 \$65+01	110	
2,4-dimethylphenol	1.03E+00	1.77E+11	Unknown	8.000-01	0.100	<u> </u>	
2,4-dinitrophenol	2.97E+00	4.39E+11	Lognormal	2.30E+00	70+3001	2 :	•
2.4-dinitratoluene	5.10E-01	1.19E+06	Lognormal	4.00E-01	1.56E+02	о ц	
2 6-dinitrolohiene	5.16E-01	7.97E+10	Lognormal	4.00E-01	7.82E+01	9	
2 altonomenhinelene	5.16E-01	7.97E+10	Lognormal	4.00E-01	6.26E+03	20	
2 chooseband	5.16E-01	7.97E+10	Lognormal	4.00E-01	3.91E+02	00	
Z-Cillotophenol	4 96E+01.	3.37E+41	Normal/Lognormal	3.80E+01	3.13E+03	100	
C-Incinymaphinary	5.16E-01	7.97E+10	Lognormal	4.00E-01	3.91E+03	no	
2-menny dynamic	5.16E-01	7.97E+10	Lognormal	4.00E-01	¥ X		-
	1.03E+00	1.77E+11	Unknown	8.00E-01	٧X		
2 mad A washulahan	1.01E+00	2.30E+05	Normal/Lognormal	11 8.00E-01	3.91E+02	1 0	
1.2' dichtombenzidine	1.03E+00	1,776+11	Unknown	8.00E-01	1.42E+00	04	
2 mitropuiline	1.03E+00	1.77E+11	Unknown	8.00E-01	¥		
A 6-dinitro-2-methylphenol	2.58E+00	4.94E+1:1	Unknown	2.00E+00	7.82E+00	0	
4-bromonhenvinhenviether*	1.03E+00	1.77E+11	Unknown	8.00E-01	Y Z		
4-chloro-3-methylphenol*	1.03E+00	1.77E+11	Unknown	8,00E-01	ΥX		
4-chlorospiline	5.16E-01	7.97E+10	Lognorma	4.00E-01	3.13E+02	Q E .	
4-chlorophenylphenylether*	5.16E-01	7.97E+10	Lognormal	4.00E-01	¥2		
4-nitroaniline*	1.03E+00	1.77E+11	Unknown	8.00E-01	¥Z.	-	
4-nitronitenoi	2.58E+00	4.94E+11	Unknown	2.00E+00	6.26E+02	2	
Acenanhthene	5.17E+01	1.82E+03	Lognormal	1.40E+02	4.69E+03	Q 1	
Acemonializations	5.02E+00	2.23E+01	Normal/Lognormal	al 8.90E+00	4.69E+03	온	
Accompany	136401	1.03E+02	Lognormal	2.39E+01	2.35E+04	9	!
Antinacene	4 14F+0I	7.51E+02	Lognormal	1.00E+02	8.75E-01	YES	YES - COPC
Benzo(a)antinacene	2 535+01	1.63E+02	Lognormal	4.90E+01	8.75E-02	YES	YES - COPC
Benzo(a)pyrene	3 70EHO!	2.88E+02	Lognormal	7,80E+01	8.75E-01	YES	YES - COPC
Benzo(b)nuoranunene	1 175+01	6.89E+01	Lognormal	3.20E+01	2.35E+03	no	- 1
Demo(b) Geomethene	1.28E+01	8.18E+01	Lognormal	2.30E+01	8.75E+00	YES	YES - COPC
Delica changehoustmathans*	1.03E+00		Unknown	8.00E-01	¥		0000
Bis(z-chighoculoxy) inclination	5 165-01	•	Lognormal	4.00E-01	2.73E-01	YES	YES - COPC

Table 17
Statistical Summary and Selection of COPCs in EU6 Sediment
Kerr McGee, Hattiesburg, MS

					Minimum	Maximum						Maylman	Location of	Standard
		Total		Ī	Detection	Detection	_	Minimum	- - -	Logarithmic Mean	Detected	Detected	Maximum	Deviation
	CAS	Number of		Frequency	E ·		Detected ma/kg	Onelifier	mg/kg	mg/kg	mg/kg	Qualiffer	Concentration	mg/kg
Constituent	Number	Samples	His	28	mg/kg	2 40E 01	8 80F-01		3.60E-01	2.02E-01	8.80E-01		SD-04	4.516-01
Ris(?-ethylhexyl)phthalat	117-81-7	m	_	33.33	1.505-01	0.505.03	8 OOF -01		2.95E-01	1.13E-01	8.00E-01		SD-04	4.3/E-01
Butylbenzviohthalate	85-68-7	m	_	33.33	8.405-02	8.30E-02	7 205-01		3.37E+01	2.77E+00	1.00E+02	-	SD-04	5.74E+01
Corposole	86-74-8	ю	m	001	0.005+00	0.005400	1 305100		1.82E+01	4.61E+00	7.60E+01	-	SD-03	2.75E+01
	218-01-9	∞	9	75	9.40E-01	1.205700	10000	-	2.03E+00	8.14E-01	9.60E+00		SD-04	3.23E+00
Call years	53-70-3	80	5 0	<u>8</u>	0.00E+00	0.00E+00	1.50E-01		5 07E+01	1.935400	1.50E+02		SD-04	8.64E+01
Dioenzia, n januni accine	132-64-9	m		200	0.00E+00	0.00E+00	1.005-03	•	1056.01	1.135-01	8.00E-01		SD-04	4.37E-01
Dibenzoluran	84-66-7	er)	_	33.33	8.40E-02	8.50E-02	8.005-01		2.93E-01	1.135-01	8 00E-01		SD-04	4.37E-01
Dietnyiphimalaie	131-11-3	m		33.33	8.40E-02	8.50E-02	8.00E-01		2.935-01	1,135,01	8 00E-01	,	SD-04	4.37E-01
Dimethylphthalate	C-11-151	יי נ	_	33,33	8.40E-02	8.50E-02	8.00E-01		7.956-01	10-3611	0.000		SD-04	4.37E-01
Di-n-butylphthalate	2-41-48	י ר	-	33 13	8 40E-02	8.50E-02	8.00E-01		2.95E-01	1.13E-01	8.00E-01		50-03	1.63E+02
Di-n-octylphthalate	117-84-0	n (- 6		0.005±00	0.00E+00	9.20E-01	7	6.71E+01	8.91 E+00	4.70E+U2		5000	0 166+01
Figuranthene	206-44-0	20	x	3 ;	0.000	1 305.0	1 80F-01	_	3,32E+01	1.07E+00	2.60E+02	•	SD-04	10.701.6
	86-73-7	œ	9	75	3.20E-01	3.305-01	10000	,	148E-01	5.65E-02	4.00E-01		SD-04	10-361.7
Timorene IIbitechantene	118-74-1	m	-	33.33	4.20E-02	4.30E-02	4.00E-01		2 95E-01	1.13E-01	8.00E-01		SD-04	4.37E-01
recachiotomical con-	87-68-3	m	-	33.33	8.40E-02	8.50E-02	8.00E-01		7.27E-01	2.80E-01	2.00E+00		SD-04	1.09E+00
Hexachiorobulguiche	77-47-4	ĸ		33.33	2.10E-01	2.10E-01	2.00E+00		1.375-01	5.655-03	4 00E-01		SD-04	2.19E-01
Hexachlorocyclopentagrene	67.72-1	i' er	_	33.33	4.20E-02	4.30E-02	4.00E-01		1,485-01	20-20-0	1 00E+01		SD-03	1.30E+01
Hexaculoroethane	103,20-6	, oc	oc	100	0.00E+00	0.00E+00	5.40E-01		8.32E+00	3.338+00	A MOE A		SD-04	2.19E-01
Indeno(1,2,3-cd)pyrene	70 50.1	. ~		33.33	4.20E-02	4.30E-02	4.00E-01		1.48E-01	3.035-02	1.005-01		SD-04	4.52E+00
Isophorone	19-22-1	• •	ام.	37.5	1.80E+00	3.50E+00	1.60E-01		2,916+00	1.486700	A 00E 01		SD-04	2.19E-01
Naphthalene	20.00) FF	-	33.33	4.20E-02	. 4.30E-02	4.00E-01		1.48E-01	3.03E-02	4.00E-01		SD-04	2.19E-01
Nitrobenzene	20-23-3	, p.	. 	33.33	4.20E-02	4.30E-02	4.00E-01		1,48E-01	20-350-02	10-200.4		SD-04	2.19E-01
N-nitrosodi-n-propylamine	7-40-170	· "	-	33,33	4.20E-02	4.30E-02	4.00E-01		.48E-01	2.65E-02	4.00E-01		SD-04	1.09E+00
N-nitrosodiphenylanine	80-30-0	n (3 105-01	2.10E-01	2,00E+00		7.37E-01	2.80E-01	2.00E+00			3 07E±02
Pentachlorophenol	87-86-5	- 0	- •	55.55	10001.	1 205+00	6.60E-01		1.10E+02	I.84E+00	8.70E+02		SD-04	20.070.0
Phenanthrene	82-01-8	••	vn ·	5.29	1.305-01	0 - 707 J	8.00E-01		2.95E-01	1.13E-01	8.00E-01		SD-04	4.376-01
Pheno	108-95-2	m	_	33.33	8.40E-02				4.88E+01	1.16E+01	3.00E+02		SD-04	1.02E+02
Pyrene	129-00-0	BC	œ	001	0.00E+00	ı	l				İ			

Statistical Summary and Selection of COPCs in EU6 Sediment Kerr McGee, Hattiesburg, MS Table 17

					Tier I	٠,	
-		Logarithmic	Distribution	Exposure Point	Exposure Point Unrestricted Soil	Is the Maximum	Le the 95% UCL >
	95% UCL	95% UCL	%66	Concentration	IKC marke	Detected > TRG?	
Concession	mg/kg	mg/kg	Confidence	mg/Kg	Su /Sus		
Disco atherhouse habitalat	1 12E+00	2.81E+06	Normal/Lognormal	8.80E-01	4.566+0	2	
Dis(z-emyinekyi)prunalar	035+00	1.776+11	Unknown	8.00E-01	9.28E+02	2	0400
Butylbenzyiphthalate	1,005,00	1756+43	Norms!/1.oenormal	1.00E+02	3.19E+01	VES	YES-COPC
Carbazole	1.305704	0.0000	1 comormel	7.60E+01	8.75E+01	04	YES**
Chrysene	3.66E+01	2.31E+03	Logilotinat	0.406400	8 75F-02	YES	YES - COPC
Dibenz(a,h)anthracene	4.20E+00	2.18E+01	Lognormal	9.005.00	0.73E-04	·	
Diberrofitzan	1.96E+02	1.09E+63	Lognormal	1.50E+02	3.135702	2 :	
to the desired	1035-100	1.77E+11	Unknown	8.00E-01	1.97E+0.3	2	
Demylphinatale	0016400	1.775+11	Unknown	8.00E-01	7.82E+05	2	
Unmemyiphinaate	00+3601	1 775+11	Linknown	8.00E-01	2.28E+03	0u	
Di-n-butylphthalate	00.000	1 775+11	Inknown	8.00E-01	1.56E+03	01	
Di-n-octylphthalate	00.25.03		lognormal	4.70E+02	3.13E+03	20	
Fluoranthene	1.76E+02	6.55E+03		2 60F+02	3.13E+03	2	
Fluorene	9.46E+01	1.95E+04	Cognomia	10.700.4	1 00 101	YES	YES COPC
Hexachlorobenzene	5.16E-01	7.97E+10	Lognormai	4.005-01	6 97E-03	YES	01
Hexachlorobutadiene	1.03E+00	1.77E+11	Unknown	8.005-01	20-025-02	, Y	YES - COPC
Transfilmonymonentadiene	2.58E+00	4.94E+11	Unknown	2.00E+00	9.51E-01	G.	2
Hexaciiotycicpements	\$ 16E-01	7.97E+10	Lognormal	4.00E-01	4.56E+01	OE	4
Hexachiorochane	1 705+01	8.48E+01	Lognormal	3.90E+01	8.75E-01	YES	YES
Indeno(1,4,3-ca)pyrene	6 16E-01	7 976+10	Lognormal	4.00E-01	6.72E+02	足	
Isophorone	4 03E+00	1 075+01	Lognormal	1.40E+01	6.45E+02	0u	
Naphthalene	20.77.00	0111100	Lomornal	4,00E-01	8.41E+00	no.	
Nitrobenzene	5.105-01	7.976+10	Loonormal	4.00E-01	9.12E-02	YES	YES - COPC
N-nitrosodi-n-propylamine	3.15E-01	0173/6/		4 POF-01	1.30E+02	ON ON	
N-nitrosodiphenylamine	5.16E-01	13/E+10	Logucatua	10001001	2 66F±00	92	
Pentachlorophenol	2.58E+00	4,94E+11	Unknown	00.000.0	3 365403	2	
Phenanthrene	3.16E+02	1.66E+06	Lognormal	8.70=+02	6.335403	2 2	
Green	1,03E+00	1,776+11	Unknown	8.00E-01	4.09E+U4	2	
	1 175+02	1 895+03	Lognormal	3.00E+02	2.35E+03	00	
Pyrene	10.71	1					

NA - Not Available

* Constituent will be retained as a COPC due to lack of Tier I TRG.

**Retained as a COPC, as per MDEQ Comments (8/2/2000); constituent is a member of carcinogenic PAH family, one of which has been retained as a COPC.
***Logarithmic 95% UCL is less than benchmark but retained as a COPC, as per MDEQ Comments (8/2/2000); constituent is a member of carcinogenic PAH fami

one of which has been retained as a COPC.

Table 18
Statistical Summary and Selection of COPCs in EU6 Surface Water
Kerr McGee, Hattlesburg, MS

					Minimum	Maximum			İ				Je mettern B	Standerd
		Total	1	ij	Detection	Detection	Minimum Detected	Minimum Detected	Mean	Logarithmic Mean	Maximum Detected	Maximum Detected	Maximum	Deviation
	CAS	CAS Number of	-	requency %	mg/l.	mg/L	mg/L	Oualifier	mg/L	mg/L	mg/L	Oualifier	Concentration	
Senivolatiles Accessphthene Benzo(a)parthracene Benzo(a)pyrene	83-32-9 56-55-3 50-32-8	пппп	-00-	50 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.00E-03 1.00E-03 1.00E-03	1.00E-03 1.00E-03 1.00E-03	9.00E-03 0.00E+00 0.00E+00 9.00E-03	- 2 2 - 3	4.75E-03 5.00E-04 4.75E-03	2.12E-03 5.00E-04 5.00E-04 2.12E-03 5.00E-04	9,00E-03 0,00E+00 0,00E+00 9,00E-03	- 2 2 - 2	SW-03 SW-03 SW-03 SW-03	6.01E-03 0.00E+00 0.00E+00 6.01E-03
Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene	207-08-9 218-01-9 53-70-3		000	000	1.00E-03 1.00E-03 1.00E-03	1.00E-03 1.00E-03 1.00E-03	0.00E+00 0.00E+00 0.00E+00	V V V Z Z Z	5.00E-04 5.00E-04 1.25E-02	5.00E-04 5.00E-04 1.25E-02	0.00E+00 0.00E+00 1.30E-02	A X	SW-03 SW-03 SW-03	0.00E+00 0.00E+00 7.07E-04
Fluoranthene Fluoranthene Fluorene	206-44-0	~~~	7 - 0	92 S2 c	0.00E+00 1.00E-03 1.00E-03	0.00E+00 1.00E-03 1.00E-03	1.10E-02 1.10E-02 0.00E+00	Ϋ́	5.75E-03 5.00E-04	2.35E-03 5.00E-04	1.10E-02 0.00E+00	₹ Z	SW-03 SW-03	7.42E-03 0.00E+00
Indeno(1,2,3-cd)pyrene	26-561	, I	,											

NA - Not applicable: constituent not detected in media.

Table 18
Statistical Summary and Selection of COPCs in EU6 Surface Water
Kerr McGee, Hattiesburg, MS

	95% UCL	Logarithmic 95% UCL	Distribution 99%	Exposure Point Concentration	Logarithmic Distribution Exposure Point Consumption of Water Is Maximum 95% UCL 99% Concentration & Organisms AWQC Detected > 95% UCL AWQC	Is Maximum Detected > AWOC?
Constituent	mg/L	mg/L	Confidence	mg/L	7/3	
Semivolatiles			1.0	0.00E.03	1.20E+00	0
A commembations	3.16E-02	6.39E+48	Chknown	7.00E-00	30 100	VEC.
Accuapiment	FO 200 8	\$ 00F.04	Unknown	S.00E-04	4.40E-00	3
Benzo(a)anthracene	3,000-04	2000	Thenous	\$ 00E-04	4.40E-06	VES*
[Renzo(a)ovrene	5.00E-04	5.00E-04	CHRIST		A 40E-06	VES - COPC
Daniel C. Minamarihane	3.16E-02	6.39E+48	Unknown	9.00E-03	00-10t't	VEC
Benzolojinoranicas	FO 100 1	\$.00E.04	Unknown	5.00E-04	4.40E-06	22
Benzo(k)fluoranthene	5:00E-04	3.00E-04	The factor of	\$ 00E-04	4.40E-06	YES.
Chrysene	5.00E-04	5.00E-04	CIRKINGWII	2000	4 40E-06	YES*
Dihenzía hanthracene	5.00E-04	5.00E-04	Unknown	3.005-04	2 OOE-01	פנו
	1.57E-02	1.53E-02	Unknown	1.305-02	3,000-01	: 1
Filloraninenc	י ממו מ	1 97E+56	Inknown	1.10E-02	1.306+00	2 .
Fluorene	3,695-02	20.000	The factoring	\$ 00E-04	4.40E-06	YES
Indonest 2 2-ediment	5.00E-04 S.00E-04 Ollatiowii	3.00E-04	CIINIDWII	2000		

*Retained as a COPC, as per MDEQ Comments (8/2/2000): constitute of which has been retained as a COPC.



Table 19
Summary of Human Health Exposure Parameters
Kerr McGee, Hattiesburg, MS

Receptors:		Adolescent Visitor		Maintenance Worker		Construction Worker		Off-Site Resident Child		Off-Site Resident Adult	
Parameter	Units										
Surface area available for exposure - soil	cm²/day	3052	1	3000	1	5560	1	1724	1	4780	- 1
Surface area available for exposure - sed. & sw	cm ² /day	3945	1	3000	1	3000	1	2229	ī	6180	1
Total skin surface area	cm ²	12768.3	2	20000	2	20000	2	7213	2	20000	2
Skin surface area available for exposure - soil	%	23.9%	2	15%	2	27.8%	2	23.9%	2	23.9%	2
Skin surface area available for exposure - sed. & sw	%	30.9%	2	15.0%	2	15.0%	- 2	30.9%	2	30.9%	2
Adherence factor - soil	mg/cm ²	0.026	2	0.038	2	0.1	2	0.026	2	0.026	2
Adherence factor - sed.	mg/cm ³	0.33	2	0.038	2	0.13	2	0.33	2	0.33	2
Dermal absorption factor - cPAHs		0.03	3	0.03	3	0.03	3	0.03	3	0.03	3
Dermal absorption factor - other SVOCs		0.1	3	0.1	3	0.1	3	0.1	3	0.1	3
	hours/day	1	5	1	5	1	5	1	5	1	5
Exposure frequency - soils	days/year	12	5	150	5	10/70*	5	NA		NA	ļ
Exposure frequency - soils (EU4)	days/year	12	5	30	5	. 10/70*	5	NA		NA	
Exposure frequency - sed. & sw	days/year	12	5	.30	5	. 8	5	40	.5	40	5
Exposure duration	years	10	6	25	6	1	5	· · 6 ·	6	24	6
Body weight	kg	45	6	70	6	70	6	15	. 7	70	. 6
Averaging time - noncarcinogenic	days	3650	7	9125	7	365	7	2190	7	8760	7
Averaging time - carcinogenic	days	25550	7	25550	7 -	25550	7	25550	7	25550	7
Ingestion rate - soil	mg/day	100	2	100	. 2	480/100*	2	200	2	100	2
Ingestion rate - surface water	L/hour	0.01	- 6	0.01	. 6	0.01	5	0.05	6	0.04	6
Matrix effect - PAHs		. 1	. 5	1. E	5	. 1	5.	1.	5	4.	5
Inhalation rate	m³/day	NA		NA		20	6	NA:		NA	
Retention factor - semivolatiles		NA		NA	•	0.75	8	NA		NA .	

- 1 Calculated
- 2 USEPA 1997, Exposure Factors Handbook
- 3 USEPA 1995, Region III Technical Guidance Manual: Assessing Dermal Exposure to Soil
- 4 USEPA 1992, Dermal Exposure Assessment
- 5 Reasonable Maximum
- 6 USEPA 1995, Region IV
- 7 USEPA 1991, HHEM Supplemental Guidances
- 8 International Commission on Radiological Protection, 1968
- *Exposure Scenario A/Exposure Scenario B

Table 20
Particulate Emission Rate for Vehicular Movement and Excavation
Kerr McGee, Hattiesburg, MS

Vehicular Movem	ent		
= k * (5.9) * (s/1)	2)(S/30) * (V	$V/3$)^0.7((w/4)^0.5) * ((365-p)/365) = 16.49 lbs/vehicl	e mile
E =	16.49	particulate emission rate (lbs/vehicle mile - 30 miles travelled total over	er 80 - 8 hr days)
k =	0.5	particle size multiplier	US EPA AP-42, 1996
s =	50	percent silt content	Site Specific
S =	15	mean vehicle speed (mi/hr)	US EPA SEAM, 1988
. W=	12.5	mean vehicle weight (ton)	US EPA SEAM, 1988
W=	8	mean number of wheels per vehicle	US EPA SEAM, 1988
, . p=	110	mean number of days with ≥0.01 inches of precipitation per year	US EPA SEAM, 1988
Emission Rate	lbs/sec =	(E lbs/mi) * (30 mi/job) * (job/80 days) * (1 day/8 hrs) * (1 hr/3600 s	ec)
	2.15E-04	lbs/sec	
	9.74E-02	g/sec	•
	0.00010	kg/sec	
Excavation			
$E = (1.0 * s^{1.5})/M^{1}$	' *=	7.90E+00 lbs/hour	
E=	7.90E+00	particulate emission factor (lbs/hr)	
s =	50	percent silt content	Site Specific
M =	15.1	percent soil moisture content	Site Specific
Emission Rate =	2.20E-03	lbs/sec	
	0.996	g/sec	•
	0.000996	kg/sec	



GRAPHICAL EXPOSURE MODELING SYSTEM STAR STATION JACKSON/THOMPSON, MS 1974-1978

DIRECTION	FREQUENCY	WINDSPEED	DIRECTION	FREQUENCY	WINDSPEED
N	3,33325	0.03	Ş	0.05336	3.08
NNE	1.89301	0.03	SSW	0.09995	3.29
NE	3.56791	0.07	sw	0.10061	3.65
ENE	0.12132	4.04	wsw	0.14723	3.93
ENE E	0.04843	3.39	w	0.05047	3.7
E ESE	0.04328	3.12	WNW	0.04341	3.51
,	0.03686	3.12	NW	0.02908	3.25
SE SSE	0.05274	2.99	WNW	0.0406	3.26
STABILITY	FREQUENCY	WINDSPEED	AUXILIARY VARIABLES		
1	259.2	0.13	Afternoon mixing height (meters)	1409	
1	0.053	0.24	Nocturnal mixing height (meters)	472	•
2	11.3	1	Ambient air temperature (Kelvin)	303.6	
3	0.01264	2.17	Precipitation frequency (fraction)	289.8	· ·
4	0.08137	2.98	Precipitation intensity (mm/hour)	73.66	i tarang kalang dari
5	0.1315	3.91	Grand average windspeed (m/s)	4.69	7



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٠.		-
	,	

Kerr McGee, Hattiesburg, MS Summary of Toxicity Values

Table 22

									-			,						
	Oral		Inhalation		Range of		Derma	Ora		Inhalation		Dermal			Derma			
	Chronic		Chronic	•	Absorption		Chronic	Subchronic	V 2	Subchronic		Subchronic	CSF	_		_		
	Rið		KID Course mailtandes Course	0	ان ورا ا	Somes	KID mo/ke-dav	KID mo/ke-day	Source	Source mg/kg-day Source mg/kg-day	Source	me/ke-day	day)	Source		Source	day)	Source
Semivolatiles	THE WE THE		Cur Gu /Gu	33 1000														
2-Methylnaphthalene	2.00E-02	ш			0.5	Region IV	1.00E-02											
2 Mitmonilino		ı	< 70F-05	=		Region IV				5.70E-04	HE							
2-1711 Cam Inter-			2.145	:	9 6	Position IV					!							
Z-Nitrophenol					0.1	KEGICAL IV	•											
3-Nitroaniline					0.5	Region IV												
4-Bromophenylphenylether	5.80E-02	0			0.5	Region IV	2.90E-02											
4-Chloro-3-methylphenol					0.5	Region IV												
4-Chlorophenylphenylether					0.5	Region IV												
4-Nitroaniline					0.5	Region IV												
Acenaphthylene					0.5	Region IV												
O					9.0	Degion IV							7.30E-01	ш	1.46E+00 MDEO	MDEO	3.10E-01	ш
Benzo(a)anunacene					9 6	Negion IV							2 30F+00	IRIS	1 46F+01 MDEO		3.10E+00	(12)
Henzo(a)pyrene					Ç	Kegion IV							20.700.7	} .	10.1104		100.01	, η
Benzo(b)fluoranthene					6.5	Region IV							7.30E-01	Ľ	1.46E+UO MUEQ	MUEC	3.105-01	u
Benzo(g,h,i)perylene					0.5	Region IV								١			6	L
Benzo(k)fluoranthene					0.5	Region IV							7.30E-02	ī	1.46E-01 MDEQ		3.10E-02	n
Bis(2-chloroethoxy)methane					0.5	Region IV							;	9				9
Bis(2-chloroethyl)ether					0.5	Region IV							1.10E+00	IRIS			1.10E+00	Z ,
Bis(2-ethylhexyl) phthalate	2.00E-02	IRIS			0.5	Region IV	1.00E-02	2.00E-02	≱			1.00E-02	1.40E-02	IRIS			1.40E-02	11
Carbazole					0.5	Region IV							2.00E-02	Ξ		1	:	
Chrysene					0.5	Region IV							7.30E-03	<u>т</u>	1.46E-02		3.10E-03	цı
Dibenz(a,h)anthracene					0.5	Region IV							7.30E+00	ш	1.46E+01 MDEQ		3.10E+00	n
Dibenzofuran	4.00E-03	m			0.5	Region IV	2.00E-03											
Fluoranthene	4.00E-02	IRIS			0.5	Region IV	2.00E-02	4.00E-01	Ξ			2.00E-01						
Fluorene	4.00E-02	IRIS			0.5	Region IV	2.00E-02	4.00E-01	I			2.00E-01	;					9
Hexachiorobenzene	8.00E-04	IRIS			0.5	Region IV	4.00E-04						1.60E+00	IRIS			1.60E+00	<u> </u>
Hexachlorocyclopentadiene	7.00E-03	IRIS	2.00E-05	I	0.5	Region IV	3.50E-03											I
Indeno(1,2,3-cd)pyrene					0.5	Region IV							7.30E-01		1.46E+00 MDEQ	MDEQ	3.10E-01	ш
N-nitrosodi-n-propylamine					0.5	Region IV		;					7.00E+00	IRIS				
Naphthalene	2.00E-02	IRIS	9.00E-04	IRIS	0.5	Region IV	1.00E-02											
Phenanthrene					0.5	Region IV				-		:						-
Pyrene	3.00E-02	IRIS			0.5	Region IV	1.50E-02	3.00E-01	Ξ,			1.50E-01						
										,	}							

E - EPA-NCEA Regional Support provisional value from Region III RBC Tables, April 2000

H - Values are published in HEAST, 1997

IRIS - Values are available in IRIS, 2000

MDEQ - Based on MDEQ's recommendation of using the Oral CSF with an absorption efficiency of 50%.

O - Values are withdrawn from other EPA documents as presented in the Region III RBC Tables, April 1999

Region IV - Region IV defauit value, 1995 W - Withdrawn from IRIS or HEAST 7toxvals.xls \tox-fhl

Page 1 of 1

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

Source/Pathway	Potentially Exposed Population	Total Hazard Index	Total Cancer Risk	Driving Constituent	Table Referenced
Dermal Exposure to Sediment in EU1	Visitor	NA	4E-08		24
Oral Exposure to Sediment in EU1	Visitor	NA	SE-08		25
Oral Exposure to Sediment in EO1	Sub-Total	NA.	8E-08		
D	Visitor	NA	4E-07		26
Dermal Exposure to Surface Water in EU1 Oral Exposure to Surface Water in EU1	Visitor	NA NA	9E-09		27
Oral Exposure to Surface Water III EOI	Sub-Total	NA NA	4E-07		
Dermal Exposure to Surface Soil in EU2	Visitor	· NA	3E-08		28
Oral Exposure to Surface Soil in EU2	Visitor	NA	6E-07		29
Ciai Exposure to our acc our in 202	Sub-Total	NA	6E-07		
Dermal Evnosure to Surface Soil in FU3	Visitor	NA	4E-09		30
Dermal Exposure to Surface Soil in EU3 Dral Exposure to Surface Soil in EU3	Visitor	NA	9E-08		31
	Sub-Total	NA	9E-08		
Dermal Exposure to Sediment in EU4	Visitor	7E-02	1E-05	cPAHs	32
Oral Exposure to Sediment in EU4	Visitor	3E-02	2E-05		33
[]	Sub-Total	1E-01	3E-05		
T. C. C. W. Fild	\$ 17 - 4	2E-04	9E-07		34′
Dermal Exposure to Surface Water in EU4	Visitor	2E-04 2E-05	9E-07 2E-08		35
Oral Exposure to Surface Water in EU4	Visitor Sub-Total	3E-04	9E-07		
	Visian	4E-03	3E-06		36
Dermal Exposure to Surface Soil in EU4	Visitor Visitor	4E-03	3E-05	cPAHs	37
Oral Exposure to Surface Soil in EU4	Visitor Sub-Total	3E-02	6E-05	CFARS	31
		21.	75.62		70
Dermal Exposure to Surface Soil in EUS	Visitor	, NA	3E-07	D-===(-)=====	38 e 39
Oral Exposure to Surface Soil in EU5	Visitor	NA NA	6E-06	Benzo(a)pyren	ב אי
·	Sub-Total	NA.	6E-06		

Visitor Total: 1E-01 9E-05

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

Source/Pathway	Potentially Exposed Population	Total Hazard Index	Totai Cancer Risk	Driving Constituent	Table Referenced
Dermal Exposure to Sediment in EU1	Maintenance Worker	NΑ	1E-08		40
Oral Exposure to Sediment in EU1	Maintenance Worker	NA	2E-07		41
	Sub-Total	NA	2E-07		
Dermal Exposure to Surface Water in EU1	Maintenance Worker	NA	1E-06	•	42
Oral Exposure to Surface Water in EU1	Maintenance Worker	NA.	4E-08		43
Oral Explosure to Surface water in EU1	Sub-Total	NA NA	1E-06		
Dermal Exposure to Surface Soil in EU2	Maintenance Worker	NA	5E-07		44
Oral Exposure to Surface Soil in EU2	Maintenance Worker	NA	7E-06	cPAHs	45
Control of Surface Soli in 202	Sub-Total	NA	7E-06		
Dermal Exposure to Sediment in EU4	Maintenance Worker	1E-02	4E-06	Benzo(a)pyrene	46
Dermal Exposure to Sediment in EU4 Dral Exposure to Sediment in EU4	Maintenance Worker	5E-02	6E-05	cPAHs	47
	Sub-Total	6E-02	7E-05		
Dermal Exposure to Surface Water in EU4	Maintenance Worker .	3E-04	3E-06	•	48
Oral Exposure to Surface Water in EU4	Maintenance Worker	3E-05	9E-08		49
	Sub-Total	3E-04	3E-06		
Dermai Exposure to Surface Soil in EU4	Maintenance Worker	5E-03	2E-05	cPAHs	50
Oral Exposure to Surface Soil in EU4	Maintenance Worker	2E-02	2E-04	cPAHs	51
Γ	Sub-Total	3E-02	2E-04		
Dermal Exposure to Surface Soil in EUS	Maintenance Worker	NA	6E-06	Benzo(a)pyrene	52
Oral Exposure to Surface Soil in EU5	Maintenance Worker	NA	9E-05	cPAHs	53
Γ	Sub-Total	NA	1E-04		

Maintenance Worker Total: 8E-02 4E-04

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

Source/Pathway	Potentially Exposed Population	Total Hazard Index	Total Cancer Risk	Driving Constituent	Table Referenced
Dermal Exposure to Sediment in EU1	Construction Worker	NA	5E-10		54
Oral Exposure to Sediment in EU1	Construction Worker	NA	9E-09		55
Oral Exposure to Sediment in EO1	Sub-Total	NA NA	1E-08		7,7
				•	
Dermal Exposure to Surface Water in EU1	Construction Worker	NA	1E-08		- 56
Oral Exposure to Surface Water in EU1	Construction Worker	NA	4E-10	•	57
	Sub-Total	NA	1E-08		
			•		
Dermal Exposure to Soil in EU2	Construction Worker	NA	4E-07		58
Oral Exposure to Soil in EU2	Construction Worker	NA	2E-06	• .	59
inhalation of Fugitive Dust in EU2	Construction Worker	NA	7E-08		- 60
	Sub-Total	NA	2E-06		
Dermal Exposure to Sediment in EU4	Construction Worker	NΑ	2E-07		61
Dermal Exposure to Sediment in EU4 Oral Exposure to Sediment in EU4	Construction Worker	NA	3E-06	Benzo(a)pyrene	62
	Sub-Total	NA	3E-06		
			35.00		43
Dermal Exposure to Surface Water in EU4	Construction Worker	9E-07	3E-08		63
Oral Exposure to Surface Water in EU4	Construction Worker	5E-07	9E-10		64
	Sub-Total	1E-06	3E-08	· · · · · · · · · · · · · · · · · · ·	
Dermal Exposure to Soil in EU4	Construction Worker	NA	8E-06	Benzo(a)pyrene	65
Oral Exposure to Soil in EU4	Construction Worker	NA	4E-05	cPAHs	66
Inhalation of Fugitive Dust in EU4	Construction Worker	NA	1E-06	Benzo(a)pyrene	67
	Sub-Total	NA	5E-05		
			75 A-		40
Dermal Exposure to Soil in EU5	Construction Worker	NA	7E-07	D(-) : :	68
Oral Exposure to Soil in EU5	Construction Worker	NA	3E-06	Benzo(a)pyrene	
Inhalation of Fugitive Dust in EU5	Construction Worker	NA NA	1E-07		70
· ·	Sub-Total Construction Worker Total:	NA 1E-06	4E-06 5E-05		

Dermal Exposure to Sediment in EU6	Child Off-Site Resident	NA -	2E-05	cPAHs	71
Oral Exposure to Sediment in EU6	Child Off-Site Resident	NA	7E-05	cPAHs	72
<u> </u>	Sub-Total	NA	9E-05		
Dermal Exposure to Sediment in EU6	Adult Off-Site Resident	5E-04	4E-05	cPAHs	73
Oral Exposure to Sediment in EU6	Adult Off-Site Resident	1E-04	3E-05	cPAHs	74
	Sub-Total	6E-04	7E-05		
Dermal Exposure to Surface Water in EU6	Child Off-Site Resident	NA	2E-06	. •	75
Oral Exposure to Surface Water in EU6	Child Off-Site Resident	NA.	5E-07		76
, · · · · · · · · · · · · · · · · · · ·	Sub-Total	NA	3E-06		
Dermal Exposure to Surface Water in EU6	Adult Off-Site Resident	NA	5E-06	•	77
Oral Exposure to Surface Water in EU6	Adult Off-Site Resident	NA	8E-08		78
	Sub-Total	NA	5E-06		1
	Off-Site Resident Total:	6E-04	2E-04		

^{*}Estimated carcinogenic risk level is below de minimis level as no single constituent exceeded 1x10⁻⁶ and the cumulative site carcinogenic risk is below 1x10⁻⁴ (Section 501, MCEQ, 1999).

Table 24

Dermal Exposure to EU1 Sediment by an Adolescent Visitor (Aged 7-16 years)

Kerr McGee, Hattiesburg, MS

$Intake (mg/kg-day) = \underline{Cs*SA*}$	AH*ABS*EF	*ED*CF	-
•	BW*AT		•
Cs - Concentration in sediment =	mg∕kg	chem. spec.	
SA - Surface area available for exposure =	cm ² /day	3945	calculated
SA ₁ - Total skin surface area =	cm ²	12768.3	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm²	0.33	USEPA 1997, EFH
ABS _p - Absorption - cPAHs ≈	•	0.03	USEPA 1995, Region III
EF - Exposure frequency =	days/year	12	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _a - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermat Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		•					,
Benzo(a)anthracene	5.90E-01	1.68E-08	NA	NA	2.41E-09	1.46E+00	3.51E-09
Benzo(a)pyrene	3.90E-01	1.11E-08	NA	NA -	1.59E-09	1.46E+01	2.32E-08
Benzo(b)fluoranthene	5.80E-01	1.66E-08	NA	NA	2.36E-09	1.46E+00	3.45E-09
Benzo(k)fluoranthene	1.90E-01	5.42E-09	NA	NA	7.75E-10	1.46E-01	1.13E-10
Chrysene	5.30E-01	1.51E-08	NA NA	NA	2.16E-09	1.46E-02	3.15E-11
Dibenz(a,h)anthracene	6.20E-02	1.77E-09	NA	NA	2.53E-10	1.46E+01	3.69E-09
Indeno(1,2,3-cd)pyrene	2.20E-01	6.28E-09	NA	NA	8,97E-10	1.46E+00	1.31E-09

NA - Not Available Total Cancer Risk = 3.53E-08

Table 25

ral Exposure to EU1 Sediment by an Adolescent Visitor (Aged 7-16 years)

Kerr McGee, Hattiesburg, MS

	(mg/kg-day) = Cd*In	R*EF*ED*C BW*AT		
Cd	- Concentration in sediment =	mg/kg	see below	
1	ngR - Ingestion rate for soil =	mg/day	100	USEPA 1994, Region I
	EF - Exposure frequency =	days/year	12	USEPA 1991, HHEM
	ED - Exposure duration =	years	10	reasonable assumption
•	CF - Conversion factor =	kg/mg	1.00E-06	•
	ME - Matrix effect =	•	.1	reasonable assumption
•	BW - Body weight =	kg	45	USEPA 1997, EFH
AT _n - Avera	ging time - noncarcinogenic =	days	3650	reasonable assumption
· · · · · · · · · · · · · · · · · · ·	veraging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
emivolatiles		<u>_</u>			_	·	
Benzo(a)anthracene	5.90E-01	4.31E-08	NA	NA	6.16E-09	7.30E-01	4.50E-09
Benzo(a)pyrene	3.90E-01	2.85E-08	NA	NA	4.07E-09	7.30E+00	2.97E-08
Benzo(b)fluoranthene	5.80E-01	4.24E-08	NA	NA	6.05E-09	7.30E-01	4.42E-09
Benzo(k)fluoranthene	1.90E-01	1.39E-08	. NA	NA	1.98E-09	7.30E-02	1.45E-10
hrysene	5.30E-01	3.87E-08	NA	NA	5.53E-09	7.30E-03	4.04E-11
Dibenz(a,h)anthracene	6.20E-02	4.53E-09	NA NA	NA	6.47E-10	7.30E+00	4.72E-09
ndeno(1,2,3-cd)pyrene	2.20E-01	1.61E-08	NA	NA	2.30E-09	7.30E-01	1.68E-09

Total Cancer Risk = 4.52E-08

Table 26

Dermal Exposure to EUI Surface Water by an Adolescent Visitor (aged 7-16 years)

Kerr McGee, Hattiesburg, MS

$Intake (mg/kg-day) = \underline{Cw*SA*Kp}$	*ABS*ET*I	F*ED*CF	
	BW*AT		
Cw - Concentration in surface water =	mg/L	see below	
SA - Surface area available for exposure =	cm ²	3945	calculated
SA _t - Total skin surface area =	cm ²	12768.3	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
Kp - Dermal permeability constant =	cm/hr	see below	
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessment
EF - Exposure frequency =	days/year	12	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
CF - Conversion factor =	L/cm³	1-00E-03	
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Kp cm/hr	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles								
Benzo(a)anthracene	1:00E-03	8.10E-01	7.00E-08	NA	NA	1.00E-08	1.46E+00	1.46E-08
Benzo(a)pyrene	5.00E-04	1.20E+00	5.19E-08	NA	NA	7.41E-09	1.46E+01	1.08E-07
Benzo(b)fluoranthene	5.00E-04	1.20E+00	5.19E-08	NA	NA	7.41E-09	1.46E+00	1.08E-08
Benzo(k)fluoranthene	5.00E-04	4.48E+01	1.94E-06	NA	NA	2.77E-07	1.46E-01	4.04E-08
Chrysene	5.00E-04	8.10E-01	3.50E-08	NA	NA	5.00E-09	1.46E-02	7.30E-11
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	1.17E-07	NA	NA	1.67E-08	1.46E+01	2.43E-07
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	8.22E-08	NA	NA	1.17E-08	1.46E+00	1.71E-08

Total Cancer Risk = 4.35E-07





Intake (mg/kg-day) = <u>Csw</u>	*IngR*EF*ED BW*AT	<u>/ El</u>	
Csw - Concentration in surface water =	mg/L	see below	
IngR - Ingestion rate for surface water =	L/hour	0.01	USEPA 1995, Region IV
EF - Exposure frequency =	days/year	12	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessmen
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	1.00E-03	7.31E-09	NA	NA	1.04E-09	7.30E-01	7.62E-10
Benzo(a)pyrene	5.00E-04 .	3.65E-09	NA	NA ·	5.22E-10	7.30E+00	3.81E-09
Benzo(b)fluoranthene	5.00E-04	3.65E-09	NA NA	NA	5.22E-10	7.30E-01	3.81E-10
Benzo(k)fluoranthene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E-92	. 3.81E-11
Chrysene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E-03	3.81E-12
Dibenz(a,h)anthracene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E+00	3.81E-09
Indeno(1,2,3 cd)pyrene	5.00E-04	3.65E-09	NA .	NA	5.22E-10	7.30E-01	3.81E-10

Total Cancer Risk = 9.18E-09

Table 28

Dermal Exposure to EU2 Surface Soil (0-1') by an Adolescent Visitor (aged 10-16 years)

Kerr McGee, Hattiesburg, MS

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
	AT _c - Averaging time -	carcinogenic =	days	25550	USEPA 1991, HF	IEM	
A	T _n - Averaging time - non	-	days	3650	USEPA 1991, HF		
l	BW-	Body weight =	kg	45	USEPA 1995, Re	gion IV	
•,	CF - Conv	ersion factor =	kg/mg	1.00E-06		-	
	EF - Exposure frequency = ED - Exposure duration =			10	USEPA 1995, Region IV		
				days/year 12 reasonable assumption			
	ABS _p - Absorption - cPAHs			0.020	USEPA 1995, Re		
LS - LISCOON OF S		erence factor =	mg/cm ²	0.026	USEPA 1997, EF		
E. E. tien of	SA _t - Total skin kin surface area available		Cm	12768.3 23.9%	USEPA 1997, EF		
S.	A - Surface area available	•	cm²/day cm²	3052	calculated		
_		tration in soil =	mg/kg	chem. spec.	,		•
	·, • • • ·		BW*AT				

NA - Not Available Total Cancer Risk = 2.75E-08

NA

ΝA

NA

1.26E-09

2.29E-09

7.28E-10

1.99E-09

1.22E-10

9.19E-10

1.84E-08

3.34E-09

1.06E-10

2.90E-11

1.79E-09

1.34E-09

1.46E+01

1.46E+00

1.46E-01

1.46E-02

1.46E+01

1.46E+00

Benzo(a)pyrene

Chrysene

Benzo(b)fluoranthene

Benzo(k)fluoranthene

Dibenz(a,h)anthracene

Indeno(1,2,3-cd)pyrene

5.08E+00

9.20E+00

2.93E+00

8.00E+00

4.93E-01

3.70E+00

8.83416E-09

1.60E-08

5.10E-09

1.39121E-08

8.57E-10

6.43E-09

Table 29
Oral Exposure to EU2 Surface Soil (0-1') by an Adolescent Visitor (aged 10-16 years)
Kerr McGee, Hattiesburg, MS

	Intake (mg/kg-day) =	<u>Cd*ln</u>	gR*EF*ED*CF BW*AT	<u>*M</u> E			
,	Cd - Concentration i	in sediment =	mg/kg	see below			
	ingR - ingestion	rate for soil =	mg/day	100	USEPA 1997, EF		
	EF - Exposure	e frequency =	days/year	12	reasonable assum	•]	
	ED - Exposu	ire duration = `	years	10	USEPA 1995, Re	gion IV	
		rsion factor =	kg/mg	1.00E-06			
	ME - M	latrix effect =	•	1	Magee, et al., 199		-
BW - Body weight =		kg	45	USEPA 1995, Ro	•	A	
AT _n	AT_p - Averaging time - noncarcinogenic = AT_c - Averaging time - carcinogenic =		days	3650	USEPA 1991, HI	-	
7			days	25550	USEPA 1991, H	HEM	
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RM mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles				×	< 00F 0B	7.30E-01	5.10E-08
Benzo(a)anthracene	6.70E+00	4.89E-07	NA	NA	6.99E-08	7.30E+00	3.10E-08
Benzo(a)pyrene	5.08E+00	3.71E-07	NA	NA	5.30E-08	7.30E-01	7.01E-08
Benzo(b)fluoranthene	9.20E+00	6.72E-07	NA	NA	9.60E-08	7.30E-01	2.23E-09
Benzo(k)fluoranthene	2.93E+00	2.14E-07	AM	NA	3.06E-08	7.30E-02 7.30E-03	6.10E-10
Chrysene	8.00E+00	5.84E-07	NA	NA	8.35E-08	7.30E+00	3.76E-08
Dibenz(a,h)anthracene	4.93E-01	3.60E-08	NA	NA	5.15E-09		2.82E-08
Indeno(1,2,3-cd)pyrene	3.70E+00	2.70E-07	NA	NA	3.86E-08	7.30E-01	Z-8/E+U0

Total Cancer Risk = 5.77E-07

Table 30

Dermal Exposure to EU3 Surface Soil (0-1') by an Adolescent Visitor (aged 10-16 years)

Kerr McGee, Hattiesburg, MS

$lntake (mg/kg-day) = \underline{Cs*SA*}$	AH*ABS*EF	ED*CF	· ·	
	BW*AT		•	
Cs - Concentration in soil =	mg/kg	chem. spec.		
SA - Surface area available for exposure =	cm ² /day	3052	calculated	
SA ₁ - Total skin surface area =	cm ²	12768.3	USEPA 1997, EFH	
Fs - Fraction of skin surface area available for exposure =		23.9%	USEPA 1997, EFH	•
AH - Adherence factor =	mg/cm ²	0.026	USEPA 1997, EFH	
ABS _{bap} - Absorption - cPAHs =		0.03	USEPA 1995, Region III	
EF - Exposure frequency =	days/year	12	reasonable assumption	
ED - Exposure duration =	years	10	USEPA 1995, Region IV	
CF - Conversion factor =	kg/mg	1.00E-06		
BW - Body weight =	kg	45	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					• .		
Benzo(a)anthracene	5.40E-01	9.39E-10	NA	NA	1.34E-10	1.46E+00	1.96E-10
Benzo(a)pyrene	7.10E-01	1.23E-09	· NA	NA	1.76E-10	1.46E+01	2.58E-09
Benzo(b)fluoranthene	1.40E+00	2.43E-09	NA	NA	3.48E-10	1.46E+00	5.08E-10
Benzo(k)fluoranthene	4.90E-01	8.52E-10	NA	NA.	1.22E-10	1.46E-01	1.78E-11
Chrysene	8.70E-01	1.51E-09	NA	NA	2.16E-10	1.46E-02	3.16E-12
Dibenz(a,h)anthracene	1.60E-01	2.78E-10	NA	NA	3.97E-11	1.46E+01	5.80E-10
Indeno(1,2,3-cd)pyrene	6.00E-01	1.04E-09	NA	NA	1.49E-10	1.46E+00	2.18E-10

NA - Not Available Total Cancer Risk = 4.10E-09

Table 31
Oral Exposure to EU3 Surface Soil by an Adolescent Visitor (aged 10-16 years)
Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = Cd*In	gR*EF*ED*C	F*ME		
	BW*AT			
Cd - Concentration in sediment =	mg/kg	see below		
lngR - lngestion rate for soil =	mg/day	100	USEPA 1997, EFH	
EF - Exposure frequency =	days/year	12	reasonable assumption	
ED - Exposure duration =	years	10	USEPA 1995, Region IV	
CF - Conversion factor =	kg/mg	1.00E-06		
ME, - Matrix effect - PAHs =		1	Magec, et al., 1996	
BW - Body weight =	kg	45	USEPA 1995, Region IV	
AT _a - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							4117 00
Benzo(a)anthracene	5.40E-01	3.95E-08	NA	NA	5.64E-09	7.30E-01	4.11E-09
	7.10E-01	5.19E-08	NA .	NA	7.41E-09	7.30E+00	5.41E-08
Benzo(a)pyrene	1.40E+00	1.02E-07	NA	NA	1.46E-08	7.30E-01	1.07E-08
Benzo(b)fluoranthene		3.58E-08	NA ·	NA	5.11E-09	7.30E-02	3.73E-10
Benzo(k)fluoranthene	4.90E-01		•		9.08E-09	7.30E-03	6.63E-11
Chrysene	8.70E-01	6.36E-08	NA	NA			1.22E-08
Dibenz(a,h)anthracene	1.60E-01	1.17E-08	NA NA	NA	1.67E-09	7.30E+00	
Indeno(1,2,3-cd)pyrene	6.00E-01	4.38E-08	NA	NA	6.26E-09	7.30E-01	4.57E-09

Total Cancer Risk = 8.61E-08



Table 32

Dermal Exposure to EU4 Sediment by an Adolescent Visitor (Aged 7-16 years)

Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = $\underline{Cs*SA*}$	AH*ABS*EF BW*AT	<u>*ED*CF</u>	
Cs - Concentration in sediment = SA - Surface area available for exposure = SA ₁ - Total skin surface area = Fs - Fraction of skin surface area available for exposure =	mg/kg cm²/day cm²	chem. spec. 3945 12768.3 30.9%	calculated USEPA 1997, EFH USEPA 1997, EFH
AH - Adherence factor = ABS_p - Absorption - cPAHs = ABS_s - Absorption - other SVOCs =	mg/cm²	0.33 0.03 0.1	USEPA 1997, EFH USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	days/year years kg/mg	12 10 1.00E-06	reasonable assumption USEPA 1995, Region IV
$BW - Body weight =$ $AT_n - Averaging time - noncarcinogenic =$ $AT_c - Averaging time - carcinogenic =$	kg days days	45 3650 25550	USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							·
Benzo(a)anthracene	3.30E+02	9.42E-06	NA	NA	1.35E-06	1.46E+00	1.96E-06
Benzo(a)pyrene	1.30E+02	3.71E-06	NA	NA	5.30E-07	1.46E+01	7.74E-06
Benzo(b)fluoranthene	1.80E+02	5.14E-06	NA .	NA	7.34E-07	1.46E+00	1,07E-06
Benzo(k)fluoranthene	6.40E+01	1.83E-06	NA:	NA	2.61E-07	1.46E-01	3.81E-08
Carbazole	5.90E+02	5.61E-05	NA	NA	8.02E-06	NA.	NA
Chrysene	2.90E+02	8.28E-06	NA	NA	1.18E-06	1.46E-02	1.73E-08
Diberiz(a,h)anthracene	1.20E+01	3.42E-07	NA'	NA	4.89E-08	1.46E+01	7.14E-07
Dibenzofuran	9.40E+02	8.94E-05 -	2.00E-03	4.47E-02	1.28E-05	NA	NA
Irideno(1,2,3-cd)pyrene	4.70E+01	1.34E-06	NA	NA	1.92E-07	1.46E+00	2.80E-07
Naphthalene	3.00E+03	2.85E-04	1.00E-02	2.85E-02	4.08E-05	NA	NA
Phenanthrene	3.20E+03	3.04E-04	NA	NA	4.35E-05	NA .	NA

Total Hazard Index = 7.32E-02

Total Cancer Risk = 1.18E-05

Table 33
Oral Exposure to EU4 Sediment by an Adolescent Visitor (Aged 7-16 years)
Kerr McGee, Hattiesburg, MS

CF - Conversion factor = kg/mg 1.00E-06 ME - Matrix effect = 1 Magee, et al., 1996	Intake (mg/kg-day) = Cd*In	gR*EP*ED*C BW*AT	F*ME	
ME - Matrix effect = 1 Magee, et al., 1996 BW - Body weight = kg 45 USEPA 1995, Region IV AT _n - Averaging time - noncarcinogenic = days 3650 USEPA 1991, HHEM	IngR - Ingestion rate for sediment = EF - Exposure frequency = ED - Exposure duration =	mg/day days/year years	100 12 10	•
	 ME - Matrix effect = BW - Body weight = AT _n - Averaging time - noncarcinogenic =	kg days	1 45 3650	USEPA 1995, Region IV USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day_	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	3.30E+02	2.41E-05	NA	, NA	3.44E-06	7.30E-01	2.51E-06
Benzo(a)pyrene	1.30E+02	9.50E-06	NA	NΑ	1.36E-06	7.30E+00	9.90E-06
Benzo(b)fluoranthene	1.80E+02	1.32E-05	NA	NA	1.88E-06	7.30E-01	1.37E-06
Benzo(k)fluoranthene	6.40E+01	4.68E-06	NA	NA	6.68E-07	7.30E-02	4.88E-08
Carbazole	5.90E+02	4.31E-05	NA	NA	6.16E-06	2.00E-02	1.23E-07
Chrysene	2.90E+02	2.12E-05	NA	NA -	3.03E-06	7.30E-03	2.21E-08
Dibenz(a,h)anthracene	1.20E+01	8:77E-07	NA.	NA	1.25E-07	7.30E+00	9.14E-07
Dibenzofuran	9.40E+02	6.87E-05	4.00E-03	1.72E-02	9.81E-06	NA	NA -
Indeno(1,2,3-cd)pyrene	4.70E+01	3.43E-06	NA	NA	4.91E-07	7.30E-01	3.58E-07
Naphthalene	3.00E+03	2.19E-04	2.00E-02	1.10E-02	3.13E-05	NA	NA
Phenanthrene	3.20E+03	2.34E-04	NA	NA	3.34E-05	NA	NA

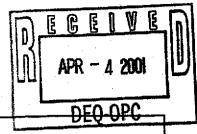
Total Hazard Index = 2.81E-02

Total Cancer Risk = 1.53E-05

Table 34

Dermal Exposure to EU4 Surface Water by an Adolescent Visitor (aged 7-16 years)

Kerr McGee, Hattiesburg, MS



Intake (mg/kg-day) =	Cw*SA*Kp*ABS*ET BW*AT		
Cw - Concentration in sur SA - Surface area available fo SA _t - Total skin surface area available fo	r exposure = cm² urface area = cm² r exposure =	see below 3945 12768.3 30.9% see below	calculated USEPA 1997, EFH USEPA 1997, EFH
Kp - Dermal permeabilit ABS _p - Absorptio ABS _s - Absorption - oth	n - cPAHs =	0.03 0.1	USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure ED - Exposu			USEPA 1992, Dermal Exposure Assessment reasonable assumption USEPS 1995, Region IV
•	ody weight = kg arcinogenic = days	45 3650 25550	USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM
Tric Tribinging time of	auys auys	23350	

Constituent	Concentration in Surface Water mg/L	Kp em/hr	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Dally Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						,		
Benzo(a)anthracene	5.00E-03	8.10E-01	3.50E-07	NA	NA	5.00E-08	1.46E+00	7.30E-08
Benzo(a)pyrene	5.00E-04	1.20E+00	5.19E-08	NA	NA	7.41E-09	1.46E+01	1.08E-07
Benzo(b)fluoranthene	1.20E-02	1.20E+00	1.25E-06	NA -	NA	1.78E-07	1.46E+00	2.60E-07
Benzo(k)fluoranthene	2.00E-03	4.48E+01	7.74E-06	NA	NA	1.11E-06	1.46E-01	1.62E-07
Bis(2-ethylhexyl)phthalate	3.00E-03	3.30E-02	2.85E-08	1.00E-02	2.85E-06	4.08E-09	NA	NA
Carbazole	1.00E-02	3.57E-02	1.03E-07	NA	NA	1.47E-08	NA.	· NA
Chrysene	6.00E-03	8.10E-01	4.20E-07	NA	NA	6.00E-08	1.46E-02	8.77E-10
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	1.17E-07	NA	NA	1.67E-08	1.46E+01	2.43E-07
Dibenzofuran	1.10E-02	1.51E-01	4.79E-07	2.00E-03	2.40E-04	6.84E-08	NA	NA NA
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	8.22E-08	NA	NA	1.17E-08	1.46E+00	1.71E-08
Phenanthrene	1.70E-02	2.30E-01	1.13E-06	NA	NA	1.61E-07	NA	NA

NA - Not Available Total Hazard Index = 2.42E-04 Total Cancer Risk =

Table 35
Oral Exposure to EU4 Surface Water by an Adolescent Visitor (aged 7-16 years)
Kerr McGee, Hattiesburg, MS

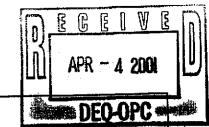
	Intake (mg/kg-day) = <u>Csw</u>	IngR*EF*ED BW*AT		
	Csw - Concentration in surface water =	mg/L	see below	•
	lngR - Ingestion rate for surface water =	L/hour	10.0	USEPA 1995, Region IV
	EF - Exposure frequency =	days/ycar	12	reasonable assumption
	ED - Exposure duration =	years	10	USEPA 1995, Region IV
	ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessmen
	BW - Body weight =	kg	45	USEPA 1995, Region IV
•	AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
	AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					5 4 4 E D D	7 205 01	3.81E-09
Benzo(a)anthracene	5.00E-03	3.65E-08	NA	NΑ	5.22E-09	7,30E-01	
Benzo(a)pyrene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E+00	3.81E-09
Benzo(b)fluoranthene	1.20E-02	8.77E-08	NA	NA	1.25E-08	7.30E-01	9.14E-09
Benzo(k)fluoranthene	2.00E-03	1.46E-08	NA	- NA	2.09E-09	7.30E-02	1.52E-10
Bis(2-ethylhexyl)phthalate	3.00E-03	2.19E-08	2.00E-02	1.10E-06	3.13E-09	1.40E-02	4.38E-11
Carbazole	1.00E-02	7.31E-08	NA	NA	1.04E-08	2.00E-02	2.09E-10
	6.00E-03	4.38E-08	NA	NA	6.26E-09	7.30E-03	4.57E-1.1
Chrysene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E+00	3.81E-09
Dibenz(a,h)anthracene	1.10E-02	8.04E-08	4.00E-03	2.01E-05	1.15E-08	NA ·	NA
Dibenzofuran		•	NA	NA NA	5.22E-10	7.30E-01	3.81E-10
Indeno(1,2,3-cd)pyrene	5.00E-04	3.65E-09		NA.	1.77E-08	NA.	NA
Phenanthrene	1.70E-02	1.24E-07	NA	NA	1.77E-06	1975	

Total Hazard Index = 2.12E-05

Total Cancer Risk = 2.14E-0

Table 36 Dermal Exposure to EU4 Surface Soil (0-1') by an Adolescent Visitor (Aged 7-16 years) Kerr McGee, Hattiesburg, MS



$lntake (mg/kg-day) = Cs*SA*_{-}$	4H*ABS*EF*	ED*CF	, i	- Anthony Company
	BW*AT			
Cs - Concentration in soil = SA - Surface area available for exposure = SA _t - Total skin surface area = Fs - Fraction of skin surface area available for exposure =	mg/kg cm²/day cm²	chem. spec. 3052 12768.3 23.9%	calculated USEPA 1997, EFH USEPA 1997, EFH	
AH - Adherence factor = ABS_p - Absorption - cPAHs =	mg/cm²	0.026 0.03	USEPA 1997, EFH USEPA 1995, Regio	
ABS, - Absorption - other SVOCs = EF - Exposure frequency = ED - Exposure duration =	days/year years	0.1 12 10 1.00E-06	USEPA 1995, Regio reasonable assumpti USEPA 1995, Regio	on ·
CF - Conversion factor = BW - Body weight = AT _n - Averaging time - noncarcinogenic = ATc - Averaging time - carcinogenic =	kg/mg kg days days	45 3650 25550	USEPA 1995, Region USEPA 1991, HHE USEPA 1991, HHE	М
V-10 - MaciaBing fills - CarcinoBrine	24,0			·

Constituent	Concentration In Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							2 27F 07
Benzo(a)anthracene	9.30E+02	1.62E-06	NA	NA	2.31E-07	1.46E+00	3.37E-07
Вепло(а)ругене	5.00E+02	8.70E-07	NA	NA	1.24E-07	1.46E+01	1.81E-06
Benzo(b)fluoranthene	5.30E+02	9.22E-07	NA	NA	1.32E-07	1.46E+00	1.92E-07
Benzo(k)fluoranthene	2.90E+02	5.04E-07	NA ·	NA	7.20E-08	1.46E-01	1.05E-08
Carbazole	2.30E+02	1.33E-06	NA .	NA	1.90E-07	NA	NA
Chrysene :	6.90E+02	1.20E-06	NA	NA	1.71E-07	1.46E-02	2.50E-09
Dibenz(a,h)anthracene	6.40E+01	1.11E-07	ŇA	NA	1.59E-08	1.46E+01	2.32E-07
	4.60E+03	2.67E-05	2.00E-02	1.33E-03	3.81E-06	NA	NA
Fluoranthene	2.50E+02	4.35E-07	NA NA	NA	6.21E-08	1.46E+00	9.07E-08
Indeno(1,2,3-cd)pyrene	2.20E+03	1.28E-05	1.00E-02	1.28E-03	1.82E-06	NA .	NA
Naphthalenc		3.71E-05	NA	NA	5.30E-06	NA	NA
Phenanthrene Pyrene	6.40E+03 4.40E+03	2.55E-05	1.50E-02	1.70E-03	3.64E-06	NA	NA.

Total Hazard Index = 4.31E-03

Total Cancer Risk =

2.68E-06

Table 37 Oral Exposure to EU4 Surface Soil (0-1') by an Adolescent Visitor (Aged 7-16 years) Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = $\frac{\text{Cd*ln}}{}$	eR*EF*ED*C	F*ME	
	BW*AT		
Cd - Concentration in soil =	mg/kg	see below	
lngR - lngestion rate for soil =	mg/day	100	USEPA 1997, EFH
EF - Exposure frequency =	days/year	12	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
ME - Matrix effect =		1	Magec, et al., 1996
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						·	
Benzo(a)anthracene	9.30E+02	6.79E-05	NA	NA	9.71E-06	7.30E-01	7.09E-06
Benzo(a)pyrene	5.00E+02	3.65E-05	NA	NA -	5.22E-06	7.30E+00	3.81E-05
Benzo(b)fluoranthene	5.30E+02	3.87E-05	NA	NA	5.53E-06	7.30E-01	4.04E-06
Benzo(k)fluoranthene	2.90E+02	2.12E-05	NA	NA	3.03E-06	7.30E-02	2.21E-07
Carbazole	2.30E+02	1.68E-05	NA	NA	2.40E-06	2.00E-02	4.80E-08
Chrysene	6.90E+02	5.04E-05	NA	NA	7.20E-06	7.30E-03	5.26E-08
Dibenz(a,h)anthracene	6.40E+01	4.68E-06	NA	NA	6.68E-07	7.30E+00	4.88E-06
Fluoranthene	4.60E+03	3.36E-04	4.00E-02	8.40E-03	4.80E-05	NA	NA
Indeno(1,2,3-cd)pyrene	2.50E+02	1.83E-05	NA	NA	2.61E-06	7.30E-01	1.90E-06
Naphthalene	2.20E+03	1.61E-04	2.00E-02	8.04E-03	2.30E-05	NA	. NA
1 '	3.20E+03	2.34E-04	NA	NA	3.34E-05	NA	NA
Phenanthrene Pyrene	4.40E+03	3.21E-04	3.00E-02	1.07E-02	4.59E-05	NA	NA .

Total Hazard Index = 2.72E-02

Total Cancer Risk =

5.63E-05

Table 38

Dermal Exposure to EU5 Surface Soil (0-1') by an Adolescent Visitor (Aged 7-16 years)

Kerr McGee, Hattiesburg, MS

lntake (mg/kg-day) = Cs*SA*A	H*ABS*EF BW*AT	*ED*CF		
Cs - Concentration in soil = SA - Surface area available for exposure = SA_1 - Total skin surface area =	mg/kg cm²/day cm²	chem. spec. 3052 12768.3	calculated USEPA 1997, EFH	
Fs - Fraction of skin surface area available for exposure = AH - Adherence factor = ABS _p - Absorption - cPAHs =	mg/cm²	23.9% 0.026 0.03	USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III	
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	days/year years kg/mg	12 10 1.00E-06	reasonable assumption USEPA 1995, Region IV	
BW - Body weight = AT_n - Averaging time - noncarcinogenic =	kg days	45 3650	USEPA 1995, Region IV USEPA 1991, HHEM	
 AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	8.35E+01	1.45E-07	NA	NA	2.07E-08	1.46E+00	3.03E-08
Benzo(a)pyrene	5.25E+01	9.13E-08	NA	NA	1.30E-08	1.46E+01	1.90E-07
Benzo(b)fluoranthene	7.95E+01	1.38E-07	NA	NA	1.98E-08	1.46E+00	2.88E-08
Benzo(k)fluoranthene	2.85E+01	4.96E-08	NA	NA	7.08E-09	1.46E-01	1.03E-09
Chrysene	8.25E+01	1.43E-07	NA	NA	2.05E-08	1.46E-02	2.99E-10
Dibenz(a,h)anthracene	7.45E+00	1.30E-08	NA	NA	1.85E-09	1.46E+01	2.70E-08
Indeno(1,2,3-cd)pyrene	3.10E+01	5.39E-08	NA	NA	7.70E-09	1.46E+00	1.12E-08

Total Cancer Risk = 2.89E-07

Table 39
Oral Exposure to EU5 Surface Soil (0-1') by an Adolescent Visitor (Aged 7-16 years)
Kerr McGee, Hattiesburg, MS

CF - Conversion ME - Matri			years kg/mg kg days days	10 1.00E-06 1 45 3650 25550	USEPA 1995, Region IV Magee, et al., 1996 USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM			
	A1, - Averaging time -	AT _c - Averaging time - carcinogenic =						
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Ris	
Semivolatiles					2 2 2 2 2 2	7.205.01	6 24E /	
Benzo(a)anthracene	8.35E+01	6.10E-06	NA	NA	8.71E-07	7.30E-01	6.36E-	
Benzo(a)pyrene	5.25E+01	3.84E-06	NA	NA	5.48E-07	7.30E+00	4.00E-	
				314	8.30E-07	7.30E-01	6.06E-	
Benzo(b)fluoranthene	7.95E+01	5.81E-06	NA	NA	6.30E-07	7.500-01		
Benzo(b)fluoranthene Benzo(k)fluoranthene		5.81E-06 2.08E-06	NA NA	na Na	2.97E-07	7.30E-02	2.17E-	

NA

NA

NA

6.03E-06

5.44E-07

2.26E-06

8.25E+01

7.45E+00

3.10E+01

NA - Not Applicable

Dibenz(a,h)anthracene

Indeno(1,2,3-cd)pyrene

Chrysene

Total Cancer Risk = 6.07E-06

7.30E-03

7.30E+00

7.30E-01

8.61E-07

7.78E-08

3.24E-07

NΑ

NA

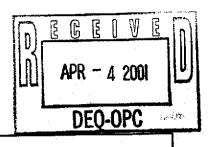
NA

6.29E-09

5.68E-07

2.36E-07



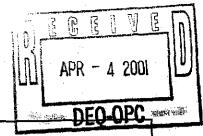


Intake (mg/kg-day) = <u>Cs*SA*/</u>	AH*ABS*EF BW*AT	<u>-ED-Cr</u>	
Cs - Concentration in soil =	mg/kg cm²/day	chem. spec.	calculated
SA - Surface area available for exposure = SA, - Total skin surface area =	cm /day	3000 20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure = AH - Adherence factor =	mg/cm²	15.0% 0.038	USEPA 1997, EFH USEPA 1997, EFH
ABSp - Absorption - cPAHs =		0.03	USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration =	days/year years	30 25	reasonable assumption USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	NGPD 1005 Davies D/
BW - Body weight = AT _n - Averaging time - noncarcinogenic =	kg days	70 9125	USEPA 1995, Region IV USEPA 1991, HHEM
AT _e - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatil e s			•				
Benzo(a)anthracene	5.90E-01	2.37E-09	NA	NA	8.46E-10	1.46E+00	1.24E-09
Benzo(a)pyrene	3.90E-01	1.57E-09	NA ·	NA	5.59E-10	1.46E+01	8.17E-09
Benzo(b)fluoranthene	5.80E-01	2.33E-09	NA	NA	8.32E-10	1.46E+00	1.21E-09
Benzo(k)fluoranthene	1.90E-01	7.63E-10	NA	NA	2.72E-10	1.46E-01	3.98E-11
Chrysene	5.30E-01	2.13E-09	NA	NA	7.60E-10	1.46E-02	1.11E-11
Dibenz(a,h)anthracene	6.20E-02	2.49E-10	NA	NA	8.89E-11	1.46E+01	1.30E-09
Indeno(1,2,3-cd)pyrene	2.20E-01	8.83E-10	NA	NA	3.16E-10	1.46E+00	4.61E-10

Total Cancer Risk = 1.24E-08

Table 41
Oral Exposure to EU1 Sediment by a Maintenance Worker
Kerr McGee, Hattiesburg, MS



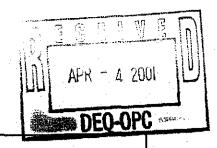
Intake (mg/kg-day) = \underline{G}	d*IngR*EF*ED*C BW*AT	<u>F*ME</u>	t .
Cd - Concentration in sedimen IngR - Ingestion rate for soi EF - Exposure frequency ED - Exposure duration CF - Conversion factor	l = mg/day y = days/year n = years	see below 100 30 25 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV
ME - Matrix effect		1	Magee, et al., 1996
BW - Body weight	t = kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogeni	c = days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogeni		25550	USEPA 1991, HHEM

Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
		•				
5.90E-01	6.93E-08	NA	NA	2.47E-08	7.30E-01	1.81E-08
3.90E-01	4.58E-08	NA	NA	1.64E-08	7.30E+00	1.19E-07
5.80E-01	6.81E-08	NA	NA	2.43E-08	7.30E-01	1.78E-08
	2.23E-08	NA	NA	7.97E-09	7.30E-02	5.82E-10
		NA.	NA	2.22E-08	7.30E-03	1.62E-10
		NA	NA	2.60E-09	7.30E+00	1.90E-08
2-20E-01	2.58E-08	NA	. NA	9.23E-09	7.30E-01	6.73E-09
	5.90E-01 3.90E-01 5.80E-01 1.90E-01 5.30E-01 6.20E-02	Sediment mg/kg Intake mg/kg-day 5.90E-01 6.93E-08 3.90E-01 4.58E-08 5.80E-01 6.81E-08 1.90E-01 2.23E-08 5.30E-01 6.22E-08 6.20E-02 7.28E-09	Sediment mg/kg Intake mg/kg-day RfD mg/kg-day 5.90E-01 6.93E-08 NA 3.90E-01 4.58E-08 NA 5.80E-01 6.81E-08 NA 1.90E-01 2.23E-08 NA 5.30E-01 6.22E-08 NA 6.20E-02 7.28E-09 NA	Sediment mg/kg Intake mg/kg-day RfD mg/kg-day Hazard Index 5.90E-01 6.93E-08 NA NA 3.90E-01 4.58E-08 NA NA 5.80E-01 6.81E-08 NA NA 1.90E-01 2.23E-08 NA NA 5.30E-01 6.22E-08 NA NA 6.20E-02 7.28E-09 NA NA	Concentration in Sediment Average Daily Intake mg/kg day Oral Chronic RfD wg/kg-day Lifetime Daily Intake mg/kg-day Lifetime Daily Intake mg/kg-day 5.90E-01 6.93E-08 NA NA 2.47E-08 3.90E-01 4.58E-08 NA NA 1.64E-08 5.80E-01 6.81E-08 NA NA 2.43E-08 1.90E-01 2.23E-08 NA NA 7.97E-09 5.30E-01 6.22E-08 NA NA 2.22E-08 6.20E-02 7.28E-09 NA NA 2.60E-09	Concentration in Average Daily Oral Chronic RfD Hazard Intake mg/kg mg/kg-day mg/kg-day Index mg/kg-day Index mg/kg-day Index mg/kg-day Index mg/kg-day Index mg/kg-day I/(mg/kg-day)

NA - Not Available

Total Cancer Risk = 1.82E-07

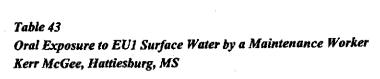


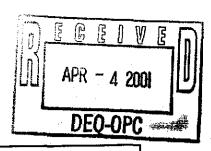


Intake (mg/kg-day) = $\underline{Cw*SA*K}$	p*ABS*ET* BW*AT	EF*ED*CF	
Cw - Concentration in surface water = SA - Surface area available for exposure = SA _t - Total skin surface area =	cm² cm²	see below 3000 20000	calculated USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure = Kp - Dermal permeability constant = ABSp - Absorption - cPAHs =	em/hr	15.0% see below 0.03	USEPA 1997, EFH USEPA 1995, Region III
ET - Exposure time = EF - Exposure frequency = ED - Exposure duration =	days/year	25	USEPA 1992, Dermal Exposure Assessment reasonable assumption USEPA 1995, Region IV
CF - Conversion factor = BW - Body weight = AT _n - Averaging time - noncarcinogenic =	= kg	1.00E-03 70 9125	USEPA 1995, Region IV USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =		25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Kp em/hr	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Dally Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles								
Benzo(a)anthracene	1.00E-03	8.10E-01	8.56E-08	NA	NA	3.06E-08	1.46E+00	4.46E-08
Benzo(a)pyrene	5.00E-04	1.20E+00	6.34E-08	NA	NA	2.26E-08	1.46E+01	3.31E-07
Benzo(b)fluoranthene	5.00E-04	1.20E+00	6.34E-08	NA	NA	2.26E-08	1.46E+00	3.31E-08
Benzo(k)fluoranthene	5.00E-04	4.48E+01	2.37E-06	NA	NA	8.45E-07	1.46E-01	1.23E-07
Chrysene	5.00E-04	8.10E-01	4.28E-08	NA	NA	1.53E-08	1.46E-02	2.23E-10
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	1.43E-07	NA	NA	5.10E-08	1.46E+01	7.44E-07
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	1.00E-07	NA	NA	3.59E-08	1.46E+00	5.23E-08

Total Cancer Risk = 1.33E-06





	Intake (mg/kg-day) ≈	Sw*IngR*EF*ED BW*AT	<u>**ET</u>	
	Csw - Concentration in surface water	= mg/L	see below	
	IngR - Ingestion rate for surface water	≖ L/hour	0.01	USEPA 1995, Region IV
	EF - Exposure frequency:		30	reasonable assumption
	ED - Exposure duration	= years	25	USEPA 1995, Region IV
	ET - Exposure time		1	USEPA 1992, Dermal Exposure Assessment
	BW - Body weight		70	USEPA 1995, Region IV
٠	AT _n - Averaging time - noncarcinogenic		9125	USEPA 1991, HHEM
	AT _c - Averaging time - carcinogenic		25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles			<u> </u>				
Benzo(a)anthracene	1.00E-03	1.17E-08	NA	NA	4.19E-09	7.30E-01	3.06E-09
Benzo(a)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Benzo(b)fluoranthene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-01	1.53E-09
Benzo(k)fluoranthene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-02	1.53E-10
Chrysene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-03	1.53E-11
Dibenz(a,h)anthracene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Indeno(1,2,3-cd)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-01	1.53E-09

NA - Not Available Total Cancer Risk = 3.69E-08

Table 44

Dermal Exposure to EU2 Surface Soil (0-6') by a Maintenance Worker Kerr McGee, Hattiesburg, MS

2.39E-01

1.97E+00

4.80E-09

3.96E-08

	Laules (mailing days) =	Ce*SA*	AH*ABS*EF*	FD*CF			
	Intake (mg/kg-day) =	Cs DY	BW*AT	<u> </u>			
	Cs - Conce	ntration in soil =	mg/kg	chem. spec.			,
S	SA - Surface area available for exposure = cm ² /day 3000 calculated						
	·	in surface area =	cm²	20000	USEPA 1997, EFH		
Fe . Fraction of	ction of skin surface area available for exposure =				USEPA 1997, EFH		
19 - 1 (#6000) 01		iherence factor =	mg/cm ²	0.038	USEPA 1997, EFH		4
	ABSp - Absorption - cPAHs =			0.03	USEPA 1995, Region III	n III	
EF - Exposure frequency =			days/year	150	reasonable assumption	on	
	ED - Exposure duration = years 25 CF - Conversion factor = kg/mg 1.00 BW - Body weight = kg 70			25	USEPA 1995, Region IV		
			kg/mg	1.00E-06	•		
			BW - Body weight = kg 70	70	USEPA 1995, Regio	on IV	
			9125	USEPA 1991, HHEM			
	, -		25550	USEPA 1991, HHEM			
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		-					
Benzo(a)anthracene	2.80E+00	5.62E-08	NA	NA	2.01E-08	1.46E+00	2.93E-0
Benzo(a)pyrene	2.64E+00	5.30E-08	NA	NA	1.89E-08	1.46E+01	2.76E-0
Benzo(b)fluoranthene	9.20E+00	1.85E-07	NA .	NA -	6.60E-08	1.46E+00	9.63E-4
Benzo(k)fluoranthene	1.84E+00	3.69E-08	NA	NA	1.32E-08	1.46E-01	1.93E-
Chrysene	5.33E+00	1.07E-07	NA	NA	3.82E-08	1.46E-02	5.58E-
	-	4 005 00	214	3.1 4	. 1715-00	1 465+01	2 5054

NΑ

NA

NA - Not Available

Dibenz(a,h)anthracene

Indeno(1,2,3-cd)pyrene

Total Cancer Risk = 4.50E-07

2.50E-08

2.06E-08

1,46E+01

1.46E+00

1.71E-09

1.41E-08

NA

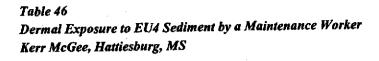
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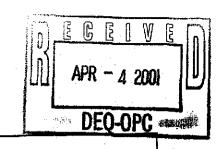
Table 45
Oral Exposure to EU2 Surface Soil (0-6') by a Maintenance Worker
Kerr McGee, Hattiesburg, MS

intake (mg/kg-day) =	<u>Ca*Ing</u>	R*EF*ED*C BW*AT	<u> TME</u>		
		D. 11.1		•	
Cd - Concentration in s	ediment =	mg/kg	see below		
IngR - Ingestion rate	for soil =	mg/day	100	USEPA 1997, EFH	
EF - Exposure fn	equency =	days/year	150	reasonable assumption	
ED - Exposure	duration =	years	25	USEPA 1995, Region IV	
CF - Conversion	on factor =	kg/mg	1.00E-06		
ME - Matr	ix effect =		1	Magee, et al., 1996	
BW - Body	weight =	kg	70	USEPA 1995, Region IV	
AT _n - Averaging time - noncare	inogenic =	days	9125	USEPA 1991, HHEM	
AT - Averaging time - carci	inogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soll mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Caucer Risk
Semivolatiles							
Benzo(a)anthracene	2.80E+00	1.64E-06	NA	NA	5.87E-07	7.30E-01	4.29E-07
Benzo(a)pyrene	2.64E+00	1.55E-06	NA	NA	5.54E-07	7.30E+00	4.04E-06
Benzo(b)fluoranthene	9.20E+00	5.40E-06	NA	NA.	1.93E-06	7.30E-01	1.41E-06
Benzo(k)fluoranthene	1.84E+00	1.08E-06	NA.	NA	3.86E-07	7.30E-02	2.82E-08
Chrysene	5.33E+00	3.13E-06	NA	NA	1.12E-06	7.30E-03	8.16E-09
Dibenz(a,h)anthracene	2.39E-01	1.40E-07	NA	NA	5.01 E-08	7.30E+00	3.66E-07
indeno(1,2,3-cd)pyrene	1.97E+00	1.16E-06	NA	NA	4.13E-07	7.30E-01	3.02E-07
						_	

Total Cancer Risk = 6.58E-06





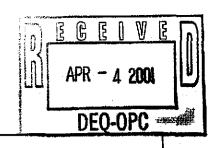
Intake (mg/kg-day) = Cs*SA*A	<u>H*ABS*EF</u> BW*AT	*ED*CF	
Cs - Concentration in sediment = SA - Surface area available for exposure = SA, - Total skin surface area = Fs - Fraction of skin surface area available for exposure = AH - Adherence factor = ABS _p - Absorption - cPAHs =	mg/kg cm²/day cm² mg/cm²	chem. spec. 3000 20000 15.0% 0.038 0.03	calculated USEPA 1997, EFH USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III
ABS _s - Absorption - other SVOCs = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor = BW - Body weight = AT _a - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	days/year years kg/mg kg days	0.1 30 25 1.00E-06 70 9125 25550	USEPA 1995, Region III reasonable assumption USEPA 1995, Region IV USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Dally Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					4 50 5 05	1.46E+00	6.91E-07
Benzo(a)anthracene	3.30E+02	1.33E-06	NA	NA	4.73E-07	•	
Benzo(a)pyrene	1.30E+02	5.22E-07	NA	N.A	1.86E-07	1.46E+01	2.72E-06
Benzo(b)fluoranthene	1.80E+02	7.23E-07	NA	NA	2.58E-07	1.46E+00	3.77E-07
Benzo(k)fluoranthene	6.40E+01	2.57E-07	NA	NA	9.18 E-0 8	1.46E-01	1.34E-08
Carbazole	5.90E+02	7.90E-06	NA	NA	2.82E-06	NA	ŅA
Chrysene	2.90E+02	1.16E-06	NA	NA	4.16E-07	1.46E-02	6.07E-09
Dibenz(a,h)anthracene	1.20E+01	4.82E-08	NA	NA	1.72E-08	1.46E+01	2.51E-07
	9.40E+02	1.26E-05	2.00E-03	6.29E-03	4.49E-06	NA	- NA
Dibenzofuran	4.70E+01	1.89E-07	NA.	NA	6.74E-08	1.46E+00	9.84E-08
Indeno(1,2,3-cd)pyrene	3.00E+03	4.02E-05	1.00E-02	4.02E-03	1.43E-05	NA NA	NA
Naphthalene Phenanthrene	3.20E+03	4.28E-05	NA	NA	1.53E-05	NA	NA

Total Hazard Index = 1.03E-02

Total Cancer Risk = 4.16E-06



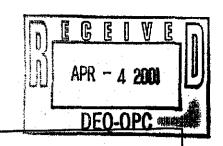


Intake (mg/kg-day) = Cd*	lngR*EF*ED*C BW*AT	F*ME	·
Cd - Concentration in sediment = lngR - Ingestion rate for soil = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	days/year years	see below 100 30 25 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV
ME - Matrix effect = BW - Body weight =	kg	1 70 9125	Magec, et al., 1996 USEPA 1995, Region IV USEPA 1991, HHEM
AT_n - Averaging time - noncarcinogenic = AT_n - Averaging time - carcinogenic =		25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles	<u> </u>						
Benzo(a)anthracene	3.30E+02	3.87E-05	NA	NA	1.38E-05	7.30E-01	1.01E-05
Benzo(a)pyrene	1.30E+02	1.53E-05	NA	NA	5.45E-06	7.30E+00	3.98E-05
Benzo(b)fluoranthene	1.80E+02	2.11E-05	NA	NA	7.55E-06	7.30E-01	5.51E-06
Benzo(k)fluoranthene	6.40E+01	7.51E-06	NA	NA	2.68E-06	7.30E-02	1.96E-07
Carbazole	5.90E+02	6.93E-05	NA '	NA	2.47E-05	2.00E-02	4.95E-07
Chrysene	2.90E+02	3.41E-05	NA	NA	1.22E-05	7.30E-03	8.88E-08
Dibenz(a,h)anthracene	1.20E+01	1.41E-06	NA.	NA	5.03E-07	7.30E+00	3.67E-06
Dibenzofuran	9.40E+02	1.10E-04	4.00E-03	2.76E-02	3.94E-05	NA	NA
Indeno(1,2,3-cd)pyrene	4.70E+01	5.52E-06	NA	NA.	1.97E-06	7.30E-01.	1.44E-06
Naphthalene	3.00E+03	3.52E-04	2.00E-02	1.76E-02	1.26E-04	NA	NA
Phenanthrene	3.20E+03	3.76E-04	NA	NA	1.34E-04	NA	-NA

NA - Not Available Total Hazard Index = 4.52E-02 Total Cancer Risk = 6.13E-05





Intake (mg/kg-day) = $\frac{Cw*SA*Kp}{}$	*ABS*ET* BW*AT	EF*ED*CF	
Cw - Concentration in surface water = SA - Surface area available for exposure = SA _t - Total skin surface area = Fs - Fraction of skin surface area available for exposure = Kp - Dermal permeability constant = ABS _p - Absorption - cPAHs = ABS _s - Absorption - other SVOCs =	mg/L cm² cm² cm/hr	see below 3000 20000 15.0% see below 0.03 0.1	calculated USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III USEPA 1995, Region III
ET - Exposure time = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor = BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	hrs/day days/year years L/cm² kg days days	1 30 25 1.00E-03 70 9125 25550	USEPA 1992, Dermal Exposure Assessment reasonable assumption USEPA 1995, Region IV USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

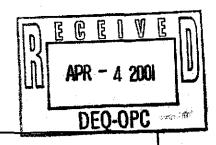
Constituent	Concentration in Surface Water mg/L	Kp em/hr	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						1 05	1.465.00	2.23E-07
Benzo(a)anthracene	5.00E-03	8.10E-01	4.28E-07	NA	NA	1.53E-07	1.46E+00	
Веп20(а)ругепе	5.00E-04	1.20E+00	6.34E-08	NA	NA ·	2.26E-08	1.46E+01	3.31E-07
Benzo(b)fluoranthene	1.20E-02	1.20E+00	1.52E-06	NA .	NA:	5.43E-07	1.46E+00	7.93E-07
Benzo(k)fluoranthene	2.00E-03	4.48E+01	9.46E-06	NA	NA	3.38E-06	1.46E-01	4.93E-07
Bis(2-ethylhexyl)phthalate	3.00E-03	3.30E-02	3.49E-08	1.00E-02	3.49E-06	1.25E-08	NA	NA
Carbazole	1.00E-02	3.57E-02	1.26E-07	NA	NA	4.50E-08	NA	NA
Chrysene	6.00E-03	8.10E-01	5.14E-07	NA	NA	1.83E-07	1.46E-02	2.68E-09
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	1.43E-07	NA	NA:	5.10E-08	1.46E+01	7.44E-07
Dibenz(a,n)antinacene Dibenzofuran	1.10E-02	1.51E-01	5.85E-07	2.00E-03	2.93E-04	2.09E-07	NA	NA
	5.00E-04	1.90E+00	1.00E-07	NA	NA	3.59E-08	1.46E+00	5.23E-08
Indeno(1,2,3-cd)pyrene Phenanthrene	1.70E-02	2.30E-01	1.38E-06	NA	NA.	4.92E-07	NA :	NA

Total Hazard Index ≈ 2.96E-04

Total Cancer Risk =

2.64E-06





Intake (mg/kg-day) =	Csw*ingR*EF*ED BW*AT	*ET	
Csw - Concentration in surface water IngR - Ingestion rate for surface water EF - Exposure frequency ED - Exposure duration ET - Exposure time BW - Body weight AT _a - Averaging time - noncarcinogenic AT _c - Averaging time - carcinogenic	= <i>L/hour</i> = days/year = years = hrs/day = kg = days	see below 0.01 30 25 1 70 9125 25550	USEPA 1995, Region IV reasonable assumption USEPA 1995, Region IV USEPA 1992, Dermal Exposure Assessment USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

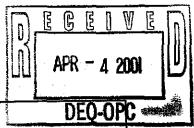
Constituent	Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					•		
Benzo(a)anthracene	5.00E-03	5.87E-08	NA	NA	2.10E-08	7.30E-01	1.53E-08
Benzo(a)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Benzo(b)fluoranthene	1.20E-02	1.41E-07	NA	NA	5.03E-08	7.30E-01	3.67E-08
Benzo(k)fluoranthene	2.00E-03	2.35E-08	NA	NA	8.39E-09	7.30E-02	6.12E-10
Bis(2-ethylhexyl)phthalate	3.00E-03	3.52E-08	2.00E-02	1.76E-06	1.26E-08	1.40E-02	1.76E-10
Carbazole	1.00E-02	1.17E-07	NA	NA	4.19E-08	2.00E-02	8.39E-10
Chrysene	6.00E-03	7.05E-08	NΑ	NA	2.52E-08	7.30E-03	1.84E-10
Dibenz(a,h)anthracene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Dibenzofuran	1.10E-02	1.29E-07	4.00E-03	3.23E-05	4.61E-08	NA	· NA
Indeno(1,2,3-cd)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-01	1.53E-09
Phenanthrene	1.70E-02	2.00E-07	NA	NA	7.13E-08	NA	NA

Total Hazard Index = 3.41E-05

Total Cancer Risk = 8.60E-08

Table 50

Dermal Exposure to EU4 Surface Soil (0-6') by a Maintenance Worker Kerr McGee, Hattiesburg, MS



$Intake (mg/kg-day) = \underline{Cs*SA*A}$	H*ABS*E	*ED*CF	
	BW*AT		
Cs - Concentration in soil = SA - Surface area available for exposure =	mg/kg cm²/day	chem. spec.	calculated
SA Total skin surface area =	em²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm²	0.038	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS, - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/ycar	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.30E+02	3.73E-06	N.A	NA	1.33E-06	1.46E+00	1.95E-06
Benzo(a)pyrene	5.00E+02	2.01E-06	NA	NA	7.17E-07	1.46E+01	1.05E-05
Benzo(b)fluoranthene	5.30E+02	2.13E-06	NA	NA	7.60E-07	1.46E+00	1.11E-06
Benzo(k)fluoranthene	2.90E+02	1.16E-06	NA	NA	4.16E-07	1.46E-01	6.07E-08
Carbazole	6,20E+02	8.30E-06	NA	NA	2.96E-06	NA	NA
Chrysene	6.90E+02	2.77E-06	NA	NA	9.90E-07	1.46E-02	1.44E-08
Dibenz(a,h)anthracene	6.40E+01	2.57E-07	NA	NA	9.18E-08	1.46E+01	1.34E-06
Indeno(1,2,3-cd)pyrene	2.50E+02	1.00E-06	NA	NA	3.59E-07	1.46E+00	5.23E-07
Naphthalene	3.50E+03	4.68E-05	1.00E-02	4.68E-03	1.67E-05	NA	NA

Total Hazard Index = 4.68E-03

Total Cancer Risk = 1.55E-05

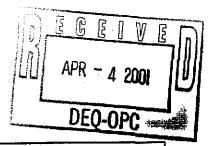


Table 51

Oral Exposure to EU4 Surface Soil (0-6') by a Maintenance Worker

Kerr McGee, Hattiesburg, MS

$Intake (mg/kg-day) = \underline{Cd*In}$	gR*EF*ED*C	P-IVIE		
	BW*AT			
Cd - Concentration in soil =	mg/kg	see below		
IngR - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH	•
EF - Exposure frequency =	days/year	30	reasonable assumption	
ED - Exposure duration =	years	25	USEPA 1995, Region IV	
CF - Conversion factor =	kg/mg	1.00E-06		
ME - Matrix effect =	•	1	Magee, et al., 1996	
BW - Body weight =	kg	70	USEPA 1995, Region IV	
AT _a - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soil mg/kg	Average Dally Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.30E+02	1.09E-04	NA -	NA	3.90E-05	7.30E-01	2.85E-05
Benzo(a)pyrene	5.00E+02	5.87E-05	NA	NA	2.10E-05	7.30E+00	1.53E-04
Benzo(b)fluoranthene	5.30E+02	6.22E-05	NA	NA	2.22E-05	7.30E-01	1.62E-05
Benzo(k)fluoranthene	2.90E+02	3.41E-05	NA	NA	1.22E-05	7.30E-02	8.88E-07
Carbazole	6.20E+02	7.28E-05	NA	NA	2.60E-05	2.00E-02	5.20E-07
Chrysene	6.90E+02	8.10E-05	NA	NA	2.89E-05	7.30E-03	2.11E-07
Dibenz(a,h)anthracene	6.40E+01	7.51E-06	NA	NA	2.68E-06	7.30E+00	1.96E-05
Indeno(1,2,3-cd)pyrene	2.50E+02	2.94E-05	NA	NA	1.05E-05	7.30E-01	7.65E-06
Naphthalene	3.50E+03	4.11E-04	2.00E-02	2.05E-02	1.47E-04	NA	NA

Total Hazard Index = 2.05E-02

Total Cancer Risk = 2.27E-04

Table 52

Dermal Exposure to EU5 Surface Soil (0-6') by a Maintenance Worker Kerr McGee, Hattiesburg, MS

Îr	take (mg/kg-đay) ≖	Cs*SA*/	AH*ABS*EF* BW*AT	ED*CF			
SA - S	Cs - Concent urface area available SA Total skin	•	mg/kg cm²/day cm²	chem. spec. 3000 20000	calculated USEPA 1997, EFF	I	
Fs - Fraction of skin s	urface area available AH - Adh	lable for exposure # 15% Adherence factor = mg/cm ² 0.038 escription - cPAHs = 0.03	0.038	USEPA 1997, EFF USEPA 1997, EFF USEPA 1995, Reg			
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =			days/year years kg/mg	150 25 1.00E-06	reasonable assum USEPA 1995, Reg	rion IV	
-	BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =		AT _n - Averaging time - noncarcinogenic = days 9125	70 9125 25550	USEPA 1995, Reg USEPA 1991, HH USEPA 1991, HH		
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	7.77E+01	1.56E-06	NA	NA	5.57E-07	1.46E+00	8.13E-07
Benzo(a)pyrene	4.10E+01	8.23E-07	NA	NA	2.94E-07	1.46E+01	4.29E-0
Benzo(b)fluoranthene	7.95E+01	1.60E-06	NA	NA	5.70E-07	1.46E+00	8.32E-0
Benzo(k)fluoranthene	1.97E+01	3.96E-07	NA	NA	1.41E-07	1.46E-01	2.06E-0
Chrysene	8.25E+01	1.66E-06	NA.	NA	5.92E-07	1.46E-02	8.64E-0
Dibenz(a,h)anthracene	2.04E+00	4.10E-08	NA	NA	1.46E-08	1.46E+01	2.14E-0
Indeno(1,2,3-cd)pyrene	1.71E+01	3.43E-07	NA	NA	1.23E-07	1.46E+00	1.79E-0

Total Cancer Risk = 6.36E-06

Table 53
Oral Exposure to EU5 Surface Soil (0-6') by a Maintenance Worker
Kerr McGee, Hattiesburg, MS

	Intake (mg/kg-day) =	70 mg	R*EF*ED*CF' BW*AT		•	
	•					
	Cd - Concentration in sedimer	:nt =	mg/kg	see below		
	IngR - Ingestion rate for so	oil =	mg/day	100	USEPA 1997, EFH	
	EF - Exposure frequence	cy =	days/year	150	reasonable assumption	*
•	ED - Exposure duration	on =	years	25	USEPA 1995, Region IV	
	CF - Conversion fact		kg/mg	1.00E-06		
	ME - Matrix effe	ect =	. •	1	Magee, et al., 1996	
	BW - Body weigh	ht =	kg	70	USEPA 1995, Region IV	4
•	AT _n - Averaging time - noncarcinogen	•	days	9125	USEPA 1991, HHEM	
	AT, - Averaging time - carcinogen		days	25550	USEPA 1991, HHEM	
•						
	Concentration in Average D	Jaily (Oral Chronic		Average Lifetime Oral Cand Daily Intake Slope Fac	

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					•	**	
Benzo(a)anthracene	7.77E+01	4.56E-05	NA	NA	1.63E-05	7.30E-01	1.19E-05
Benzo(a)pyrene	4.10E+01	2.41E-05	NA	NA	8.60E-06	7.30E+00	6.28E-05
Benzo(b)fluoranthene	7.95E+01	4.67E-05	NA	NA	1.67E-05	7.30E-01	1.22E-05
Benzo(k)fluoranthene	1.97E+01	1.16E-05	NA	NA	4.13E-06	7.30E-02	3.02E-07
- • •	8.25E+01	4.84E-05	NA	NA	1.73E-05	7.30E-03	1.26E-07
Chrysene Dibenz(a,h)anthracene	2.04E+00	1.20E-06	NA	NA	4.28E-07	7.30E+00	3.12E-06
Indeno(1,2,3-cd)pyrene	1.71E+01	1.00E-05	NA	NA	3.59E-06	7.30E-01	2.62E-06

Total Cancer Risk = 9.30E-05

Table 54

Dermal Exposure to EU1 Sediment by a Construction Worker

Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = Cs*SA*	AH*ABS*EF*			
	BW*AT			
				**
Cs - Concentration in sediment =	mg/kg	chem. spec.		
SA - Surface area available for exposure =	cm²/day	3000	calculated	
SA ₁ - Total skin surface area =	cm²	20000	USEPA 1997, EFH	
Fs - Fraction of skin surface area available for exposure =		15.0%	USEPA 1997, EFH	
AH - Adherence factor =	mg/cm ²	0.13	USEPA 1997, EFH	
ABS _p - Absorption - cPAHs =	•	0.03	USEPA 1995, Region III	
EF - Exposure frequency =	days/year	8	reasonable assumption	
ED - Exposure duration =	years	1	reasonable assumption	
CF - Conversion factor =	kg/mg	1.00E-06	•	
BW - Body weight =	kg	70	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RID mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	5.90E-01	2.16E-09	NA	NA	3.09E-11	1.46E+00	4.51E-11
Benzo(a)pyrene	3.90E-01	1.43E-09	NA	NA	2.04E-11	1.46E+01	2.98E-10
Benzo(b)fluoranthene	5.80E-01	2.12E-09	NA	NA	3.04E-11	1.46E+00	4.43E-11
Benzo(k)fluoranthene	1.90E-01	6.96E-10	NA	NA	9.94E-12	1.46E-01	1.45E-12
Chrysene	5.30E-01	1.94E-09	NA	NA	2.77E-11	1.46E-02	4.05E-13
Dibenz(a,h)anthracene	6.20E-02	2.27E-10	NA	NA	3.24E-12	1.46E+01	4.74E-11
Indeno(1,2,3-cd)pyrene	2.20E-01	8.06E-10	NA	NA	1.15E-11	1.46E+00	1.68E-11

Total Cancer Risk = 4.53E-10

Table 55

Oral Exposure to EUI Sediment by a Construction Worker

Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) =	Cd*IngR*EF*I BW*			÷
Cd - Concentration in sedi- lngR - Ingestion rate for EF - Exposure frequ ED - Exposure dur CF - Conversion f ME - Matrix of BW - Body wo AT _a - Averaging time - noncarcino	r soil = mg/d ency = days/y ation = year actor = kg/n effect = kg eight = kg genic = day	year 8 rs 1 ng 1.00E-06 1 70 rs 365	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV Magee, et al., 1996 USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						•	
Benzo(a)anthracene	5.90E-01	8.87E-08	NA	NA	1.27E-09	7.30E-01	9.25E-10
Benzo(a)pyrene	3.90E-01	5.86E-08	NA	NA	8.37E-10	7.30E+00	6.11E-09
Benzo(b)fluoranthene	5.80E-01	8.72E-08	NA	NA	1.25E-09	7.30E-01	9.09E-10
Benzo(k)fluoranthene	1.90E-01	2.86E-08	NA	NA ·	4.08E-10	7.30E-02	2.98E-11
•	5.30E-01	7.97E-08	NA.	NA	1.14E-09	7.30E-03	8.31E-12
Chrysene	6.20E-02	9.32E-09	NA.	NA	1.33E-10	7.30E+00	9.72E-10
Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene	2.20E-01	3.31E-08	NA.	NA	4.72E-10	7.30E-01	3.45E-10
I						· · · · · · · · · · · · · · · · · · ·	

Total Cancer Risk = 9.30E-09

Table 56

Dermal Exposure to EU1 Surface Water by a Construction Worker

Kerr McGee, Hattiesburg, MS

	take (mg/kg-day) =		Cw*SA*K	BW*AT	*ED*CF			
	SA - Surface	area available	turface water = for exposure = surface area =	mg/L cm² cm²	see below 3000 20000	calculated USEPA 1997, EFH		
Fs - Ft	action of skin surface Kp - De	area available mal permeab	for exposure = ility constant =	cm/hr see below		USEPA 1997, EFH		
	<i>,</i>	ET - Exposi	tion - cPAHs = kposure time = ure frequency = sure duration =	hrs/day days/year years	0.03 1 8 1	USEPA 1995, Region USEPA 1992, Derma reasonable assumption reasonable assumption	l Exposure Assess n	ment
	CF - Conversion factor = BW - Body weight = AT _a - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =		L/cm² kg days days	1.00E-03 70 365 25550	USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM			
Constituent	Concentration in Surface Water mg/L	Kp cm/hr	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Canter Slope Factor 1/(mg/kg-day)	Cancer Ri
Semivolatiles					-			4545.40
lenzo(a)anthracene	1.00E-03	8.10E-01	2.28E-08	NA	NA	3.26E-10	1.46E+00	4.76E-10
lenzo(a)pyrene	5.00E-04	1.20E+00	1. 69E-0 8	NA	NA	2.42E-10	1.46E+01	3.53E-09 3.53E-10
Senzo(b)fluoranthene	5.00E-04	1.20E+00	1.69E-08	NA	NA	2.42E-10	1.46E+00	1.32E-0
	5.00E-04	4.48E+01	6.31E-07	NA	NA .	9.02E-09	1.46E-01	2.38E-1
Benzo(k)fluoranthene		8.10E-01	1.14E-08	NA	NA	1.63E-10	1.46E-02	
Benzo(k)fluoranthene Chrysene	5.00E-04 5.00E-04	2.70E+00	3.80E-08	NA	NA	5.43E-10	1.46E+01	7.93E-09

Table 57

Oral Exposure to EUI Surface Water by a Construction Worker Kerr McGee, Hattiesburg, MS

	Intake (mg/kg-day) =	Çs	w*IngR*EF*ED*I BW*AT	<u>ET</u>			• .
	Csw - Concentration in surface water lngR - Ingestion rate for surface water EF - Exposure frequency ED - Exposure duration ET - Exposure time BW - Body weight AT _n - Averaging time - noncarcinogenic AT _c - Averaging time - carcinogenic		· <u>-</u>	see below 0.01 8 1 1 70 365 25550	USEPA 1995, Region IV reasonable assumption USEPA 1995, Region IV USEPA 1992, Dermal Exposure Assessment USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM		
	Concentration in Surface Water	Average Daily Intake	Oral Subchronic RfD	Hazard	Average Lifetime Daily Intake	Oral Cancer Slope Factor	
Constituent	mg/L	mg/kg-day	mg/kg-day]ndex	mg/kg-day	1/(mg/kg-day)	Cancer Risk
Constituent Semivolatiles	- -	mg/kg-day	mg/kg-day	Index			· · · · ·
	- -	mg/kg-day 3.13E-09	mg/kg-day	Index NA	4.47E-11	7.30E-01	3.27E-11
Semivolatiles Benzo(a)anthracene	mg/L				4.47E-11 2.24E-11	7.30E-01 7.30E+00	3.27E-11 1.63E-10
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene	mg/L 1.00E-03	3.13E-09	NA	NA	4.47E-11 2.24E-11 2.24E-11	7.30E-01 7.30E+00 7.30E-01	3.27E-11 1.63E-10 1.63E-11
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene	mg/L 1.00E-03 5.00E-04	3.13E-09 1.57E-09	NA NA	NA NA	4.47E-11 2.24E-11 2.24E-11 2.24E-11	7.30E-01 7.30E+00 7.30E-01 7.30E-02	3.27E-11 1.63E-10 1.63E-11 1.63E-12
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene	mg/L 1.00E-03 5.00E-04 5.00E-04	3.13E-09 1.57E-09 1.57E-09	NA NA NA	NA NA NA	4.47E-11 2.24E-11 2.24E-11 2.24E-11 2.24E-11	7.30E-01 7.30E+00 7.30E-01 7.30E-02 7.30E-03	3.27E-11 1.63E-10 1.63E-11 1.63E-12 1.63E-13
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene	mg/L 1.00E-03 5.00E-04 5.00E-04 5.00E-04	3.13E-09 1.57E-09 1.57E-09 1.57E-09	NA NA NA	NA NA NA	4.47E-11 2.24E-11 2.24E-11 2.24E-11	7.30E-01 7.30E+00 7.30E-01 7.30E-02	3.27E-11 1.63E-10 1.63E-11 1.63E-12

Total Cancer Risk = 3.94E-10

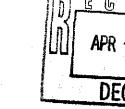


Table 58 Dermal Exposure to EU2 Soil (0-10') by a Construction Worker Kerr McGee, Hattiesburg, MS

	-						
	Intake (mg/kg-day) =	Cs*SA*	AH*ABS*EF*	ED*CF			* * * * * * * * * * * * * * * * * * * *
			BW*AT		÷*		
	Co Conos	entration in soil =	mg/kg	chem. spec.		A STATE OF THE STA	
c	Cs - Collect A - Surface area availab		cm²/day	5560	calculated	•	
3.		in surface area =	cm ²	20000	USEPA 1997, E	FH.	
T . T	•			27.8%	USEPA 1997, E		
rs - Fraction of s	kin surface area availab	dherence factor =	mg/cm²	0.1	USEPA 1997, E		
•			mg-cm	0.03	USEPA 1995, R		1
•		rption - cPAHs =	days/year	80			
	EF - Exposure frequency = ED - Exposure duration =				reasonable assur		
	years kg/mg	1.00E-06	reasonadie assur	ւփոջո			
	CF - Conversion factor = BW - Body weight =			70	USEPA 1995, R	enion TV	
				365	USEPA 1991, H	•	
. А	AT _n - Averaging time - noncarcinogenic =		days	-	,		
	AT _c - Averaging time - carcinogenic =	AT _c - Averaging time - carcinogenic = days 255.	- carcinogenic =	25550	550 USEPA 1991, HHEM	IUCM	•
	Concentration in Soil	Average Daily Intake	Dermal Subchronic RfD	Hazard	Average Lifetime Daily Intake	Cancer Slope Factor	Cancer
Constituent	mg/kg	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Risk
Semivolatiles				••••			
Benzo(a)anthracene	6.10E+01	3.19E-06	NA	NA	4.55E-08	1.46E+00	6.64E-0
Benzo(a)pyrene	2.17E+01	1.13E-06	NA	NA	1.62E-08	1.46E+01	2.36E-0
Benzo(b)fluoranthene	3.30E+01	1.72E-06	NA	NA	2.46E-08	1.46E+00	3.59E-0
Benzo(k)fluoranthene	1.10E+01	5.74E-07	NA	NA	8.21E-09	1.46E-01	1.20E-09
Chrysene	5.20E+01	2.72E-06	NA	NA	3.88E-08	1.46E-02	5.66E-1
Dibenz(a,h)anthracene	1.69E+00	8.82E-08	NA	NA	1.26E-09	1.46E+01	1.84E-0
Indeno(1,2,3-cd)pyrene	8.70E+00	4.54E-07	NA	NA	6.49E-09	1.46E+00	9.48E-0
· · · · · · · · · · · · · · · · · · ·							

NA - Not Available

Total Cancer Risk = 3.68E-07

Tral Exposure to EU2 Soil (0-10') by a Construction Worker Kerr McGee, Hattlesburg, MS

NA - Not Available

NA - Not Available



intake (mg/kg-day) =	Cd*IngR*EF*ED*C	*ME	•	
	BW*AT			
Cd - Concentration in s	soil = mg/kg	see below		
IngR _a - Ingestion rate for s	soil = mg/day	480	USEPA 1997, EFH	
IngR _b - Ingestion rate for		100	USEPA 1997, EFH	·
EF, - Exposure frequen		10	reasonable assumption	
EF _b - Exposure frequen		70	reasonable assumption	
ED - Exposure durat		1	USEPA 1995, Region IV	• .
CF - Conversion fac	ctor= kg/mg	1.00E-06		* .
ME - Matrix ef	Tect =	1	Magee, et al., 1996	•
BW - Body wei	ght = kg	70	USEPA 1995, Region IV	
ATn - Averaging time - noncarcinoge	enic = days	365	USEPA 1991, HHEM	·.
AT _c - Averaging time - carcinoge		25550	USEPA 1991, HHEM	

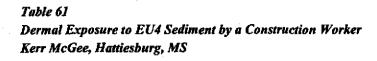
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Orat Cancer Slope Factor 1/(mg/kg-day)	Cancer Risi
Semivolatiles						# 20E 01	1.20E-07
nzo(a)anthracene	6.10E+01	1.15E-05	NA	NA	1.64E-07	7.30E-01	
senzo(a)pyrene	2.17E+01	4.07E-06	NA	NA	5.82E-08	7.30E+00	4.25E-07
Benzo(b)fluoranthene	3.30E+01	6.20E-06	NA	NA	8.86E-08	7.30E-01	6.47E-08
Benzo(k)fluoranthene	1.10E+01	2.07E-06	· NA	NA	2.95E-08	7.30E-02	2.16E-09
Chrysene	5.20E+01	9.77E-06	NA	NA	1.40E-07	7.30E-03	1.02E-09
Dibenz(a,h)anthracene	1.69E+00	3.17E-07	NA	NA	4.53E-09	7.30E+00	3.31E-08
Indeno(1,2,3-cd)pyrene 8.70E+00	1.63E-06	NA	NA	2.33E-08	7.30E-01	1.70E-08	
NA - Not Available						Cancer Risk =	6.62E-07

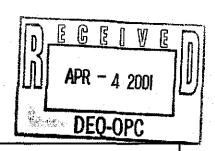
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risi
Semivolatiles							
Benzo(a)anthracene	6.10E+01	1.67E-05	NA	NA	2,39E-07	7.30E-01	1.74E-07
Benzo(a)pyrene	2.17E+01	5.94E-06	NA	NA	8.48E-08	7.30E+00	6.19E-07
Benzo(b)fluoranthene	3.30E+01	9.04E-06	NA	NA	1.29E-07	7.30E-01	9.43E-08
Benzo(k)fluoranthene	1.10E+01	3.01E-06	NA	NA	4.31E-08	7.30E-02	3.14E-09
	5.20E+01	1.42E-05	NA	NA -	2.04E-07	7.30E-03	1.49E-09
Chrysene	1.69E+00	4.63E-07	NA.	NA	6.61E-09	7.30E+00	4.83E-08
Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene	8.70E+00	2.38E-06	NA	NA	3.41E-08	7.30E-01	2.49E-08
NA . Not Available						Cancer Risk =	9.65E-07

Total Cancer Risk = 1.63E-06

Exposure to Construction Workers from Inhalation of Fugitive Dust in EU2 Kerr McGee, Hattiesburg, MS Table 60

	Intake (mg/kg-day) = La Illink Er ED KK BW*AT	BW*AT	FD.Kr						
Ca	Ca - Concentration in air = Inhalation Rate =	mg/m² m²(shìft	chem.spec. 20	USEPA 1995, Region IV	egion IV	ë - Em	Ca = Concentrati	Ca ≈ Concentration in Air (mg/m) = Ei / (Hb · w · v) Ei - Emission Rate of Component (mg/sec) = see below	/ (FIB * W * V) E below
49	EF - Exposure Frequency =	shifts/year	80	reasonable assumption reasonable assumption	nption nption		을	Hb - Downwind rit (iii) = 4.6 W - Width (iii) = 50	
RF. Retention	EU - Exposure Duranou - EXPosure Duranou - EXP Retention Factor - semivolatiles =		0.75	ICRP, 1968			* ->	V - Wind speed (m/sec) = 4.69	69
AT, - Averaging	AT Averaging Time noncarcinogenic =	days	365	USEPA 1991, HHEM	НЕМ		Length (downy	Length (downwind distance) (m) = 50	
AT _c - Averag	ATc - Averaging Time carcinogenic =	days	25550	USEPA 1991, HHEM	нем		 .	r - Roughness Ht. (m) = 0.20	Q
	BW - Body Weight =	38.	97	USEPA 1995, Region IV	egion IV	z = 6.25i	z - down r[Hb/r * Ln(Hb/r)	z - downwind distance (m) = 50 z = 6.25r[Hb/r * Ln(Hb/r) - 1.58*Hb/r + 1.58]	
ਜ - ਜੁ	E_i - Emission Rate (mg/sec) = $Cs^*(PERv+PERe)$	3s*(PERv+P	ERe)	ř					
, S	Cs - Concentration in soil =	mg/kg	chem.spec.	• .					
							Average	Inhotation Cancer	
	Concentration in Soil	Emission Rafe	Concentration in Air	Concentration Average Daily in Air Intake	Innalation Subchronic RTD	Hazard	Intake	Slope Factor	
Chemicals	mg/kg	mg/sec	mg/m³	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Cancer Kisk
Semivolatiles			;		ž	7	2 075 08	1 105-01	1.23E-08
Benzo(a)anthracene	6.10E+01	6.67E-02	5.92E-05	2.78E-06	<u> </u>		1 415 08	1 10F+00	4 37F-08
Benzo(a)pyrene	2.17E+01	2.37E-02	2.10E-05	9.88E-07	£ ;	2 2	90-315-1	3.10E-01	6.668-09
Benzo(b)fluoranthene	3.30E+01	3.61E-02	3.20E-05	1.50E-06	₹ ;	Š :	2.15E 00	3,105-03	2.22E-10
Benzo(k)fluoranthene	1.10E+01	1.20E-02	1.07E-05	5.01E-07	¥ ;	¥ ;	7.10E-07	1 108-03	1 05E-10
Chrysene	5.20E+01	S.69E-02	5.05E-05	2.37E-06	Š;	¥ ;	3.396-00	3.105-00	3.41E-09
Dibenz(a,h)anthracene	1.69E+00	1.85E-03	1.64E-06	7.70E-08	V Z	NA V	1.10E-09 5.666.00	3.10E-01	1.76E-09
Indepo(1.2.3-cd)byrene	8.70E+00	9.51E-03	8.44E-06	3.96E-07	¥	Š	3.000-03	2000	1





	BW*AT		
Cs - Concentration in sediment = SA - Surface area available for exposure SA₁ - Total skin surface area =	mg/kg cm²/day cm²	chem. spec. 3000 20000	calculated USEPA 1997, EFH
s - Fraction of skin surface area available for exposure = AH - Adherence factor = ABS _p - Absorption - cPAHs =	mg/cm²	15.0% 0.13 0.03	USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III
ABS _s - Absorption - other SVOCs = EF - Exposure frequency = ED - Exposure duration =	days/year years	0.1 8 1	USEPA 1995, Region III reasonable assumption reasonable assumption
CF - Conversion factor \approx BW - Body weight \approx AT _n - Averaging time - noncarcinogenic \approx	kg/mg kg days	1.00E-06 70 365	USEPA 1995, Region IV USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	3.30E+02	1.21E-06	NA	NA	1.73E-08	1.46E+00	2.52E-08
Benzo(a)pyrene	1.30E+02	4.76E-07	NA	NA	6.80E-09	1 46E+01	9.93E-08
Benzo(b)fluoranthene	1.80E+02	6.59E-07	NA	NA	9.42E-09	1.46E+00	1.38E-08
Benzo(k)fluoranthene	6.40E+01	2.34E-07	NA	NA	3.35E-09	1.46E-01	4.89E-10
Carbazole	5.90E+02	7.20E-06	NA	NA	1.03E-07	NA	NΑ
Chrysene	. 2.90E+02	1.06E-06	NA	NA	i.52E-08	1.46E-02	2.22E-10
Dibenz(a,h)anthracene	1.20E+01	4.40E-08	NA	NA	6.28E-10	1.46E+01	9.17E-09
Dibenzofuran	9.40E+02	1.15E-05	NA	NA	1.64E-07	NA	NA
Indeno(1,2,3-cd)pyrene	4.70E+01	1.72E-07	NA	NA	2.46E-09	1.46E+00	3.59E-09
Naphthalene	3.00E+03	3.66E-05	NA	NA	5.23E-07	NA	NA
Phenanthrene	3.20E+03	3.91E-05	NA	NA	5.58E-07	NA	NA

Total Cancer Risk = 1.52E-07

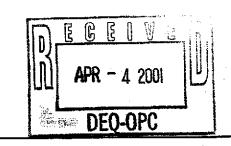
Table 62
Oral Exposure to EU4 Sediment by a Construction Worker
Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = Cd*ing	R*EF*ED*(BW*AT	CF*ME	+ + + - +
Cd - Concentration in sediment = lngR - lngestion rate for sediment = EF - Exposure frequency =	mg/kg mg/day days/year	see below 480 8	USEPA 1997, EFH reasonable assumption
ED - Exposure duration = CF - Conversion factor = ME - Matrix effect =	years kg/mg	1 1.00E-06 1	USEPA 1995, Region IV Magee, et al., 1996
BW - Body weight = AT_n - Averaging time - noncarcinogenic =	kg days	70 365	USEPA 1995, Region IV USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles	:		•				
Benzo(a)anthracene	3.30E+02	4.96E-05	NA	NA	7.09E-07	7.30E-01	5.17E-07
Benzo(a)pyrene	1.30E+02	1.95E-05	· NA	NA	2.79E-07	7.30E+00	2.04E-06
Benzo(b)fluoranthene	1.80E+02	2.71E-05	NA	NA	3.86E-07	7.30E-01	2.82E-07
Benzo(k)fluoranthene	6.40E+01	9.62E-06	NA	NA	1.37E-07	7.30E-02	1.00E-08
Carbazole	5.90E+02	8.87E-05	NA	NA	1.27E-06	2.00E-02	2.53E-08
Chrysene	2.90E+02	4.36E-05	NA	NA	6.23E-07	7.30E-03	4.55E-09
Dibenz(a,h)anthracene	1.20E+01	1.80E-06	NA	NA	2.58E-08	7.30E+00	1.88E-07
Dibenzofuran	9.40E+02	1.41E-04	NA	NA	2.02E-06	NA	NA-
Indeno(1,2,3-cd)pyrene	4.70E+01	7.06E-06	NA	NA	1.01E-07	7.30E-01	7.37E-08
Naphthalene	3.00E+03	4.51E-04	NA	NA	6.44E-06	NA	NA
Phenanthrene	3.20E+03	4.81E-04	NA	NΑ	6.87E-06	NA	NA .

Total Cancer Risk = 3.14E-06

Table 63 Sermal Exposure to EU4 Surface Water by a Construction Worker Kerr McGee, Hattiesburg, MS



Intake (mg/kg-day) =	Cw*SA*K	*ABS*ET*E BW*AT	F*ED*CF		
Cw - Concentration SA - Surface area avail:		mg/L cm²	see below	calculated	
	skin surface area =	cm ²	20000	USEPA 1997, EFH	
Fs - Fraction of skin surface area avail Kp - Dermal perm	able for exposure = reability constant =	em/hr	15.0% see below	USEPA 1997, EFH	
•	sorption - cPAHs =		0.03	USEPA 1995, Region III	
• •	on - other SVOCs =		0.1	USEPA 1995, Region III	
EF - Ex ED - F	- Exposure time = posure frequency = exposure duration =	hrs/day days/year years	1 8 1	USEPA 1992, Dermal Exposure reasonable assumption reasonable assumption	Assessment
В	Conversion factor = W - Body weight =	L/cm³ kg	1.00E-03 70	USEPA 1995, Region IV	*
AT _n - Averaging time - AT _c - Averaging time	noncarcinogenic = me - carcinogenic =	days days	25550	USEPA 1991, HHEM USEPA 1991, HHEM	
				e .	· · ·

							T. 4	
pnstituent	Concentration in Surface Water mg/L	Kp cm/hr	'Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
emivolatiles	···		_					
Benzo(a)anthracene	5.00E-03	8.10E-01	1.14E-07	NA	NA	1.63E-09	1.46E+00	2.38E-09
Benzo(a)pyrene	5.00E-04	1.20E+00	1.69E-08	NA	NA	2.42E-10	1.46E+01	3.53E-09
Benzo(b)fluoranthene	1.20E-02	1.20E+00	4.06E-07	NA	NA	5.80E-09	1.46E+00	8.46E-09
enzo(k)fluoranthene	2.00E-03	4.48E+01	2.52E-06	NA	NA	3.60E-08	1.46E-01	5.26E-09
lis(2-ethylhexyl)phthalate	3.00E-03	3.30E-02	9.30E-09	1.00E-02	9.30E-07	1.33E-10	NA	NA
arbazole	1.00E-02	3.57E-02	3.36E-08	NA	NA -	4.80E-10	NA	NA
Chrysene	6.00E-03	8.10E-01	1.37E-07	NA	NA	1.96E-09	1.46E-02	2.86E-11
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	3.80E-08	NA	NA	5.43E-10	1.46E+01	7.93E-09
Dibenzofuran	1.10E-02	1.51E-01	1.56E-07	NA	NA ·	2.23E-09	NA	NA
ndeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	2.68E-08	NA	NA	3.82E-10	1.46E+00	5.58E-10
Phenanthrene	1.70E-02	2.30E-01	3.67E-07	NA	· NA	5.25E-09	NA	NA

NA - Not Available

Total Hazard Index = 9.30E-07

Total Cancer Risk = 2.82E-08

Table 64
Oral Exposure to EU4 Surface Water by a Construction Worker
Kerr McGee, Hattiesburg, MS

6.00E-03

5.00E-04

1.10E-02

5.00E-04

1.70E-02

·	·				······································		
	Intake (mg/kg-day) =	Cs	sw*lngR*EF*ED*I	ET			
~	name (mg mgy)	· -	BW•AT	-	•		
	Csw - Concentration in s	surface water =	mg/L	see below			
	IngR - Ingestion rate for s	surface water =	-	0.01	USEPA 1995, Regio	on IV	
		ure frequency =		8	reasonable assumpti	ion .	
r.		sure duration =		1	USEPA 1995, Regio	on IV	
	•	xposure time =	-	1	USEPA 1992, Derm	nal Exposure Asses	sment
		Body weight =	. =	70	USEPA 1995, Regio	on IV	
	AT _n - Averaging time - non		-	365	USEPA 1991, HHE	.М	4
	AT _c - Averaging time - carcinogenic =			25550	USEPA 1991, HHE	M	
							•
Constituent	Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Ris
Semivolatiles					2.245.10	2 20E AI	1.63E-10
Benzo(a)anthracene	5.00E-03	1.57E-08	NA	NA	2.24E-10	7.30E-01	1.63E-10
Benzo(a)pyrene	5.00E-04	1.57E-09	NΑ	NA	2.24E-11	7.30E+00	
Benzo(b)fluoranthene	1.20E-02	3.76E-08	NA	NA	5.37E-10	7.30E-01	3.92E-10
Benzo(k)fluoranthene	2.00E-03	6.26E-09	NA	NA	8.95E-11	7.30E-02	6.53E-12
Bis(2-ethylhexyl)phthalate	3.00E-03	9.39E-09	2.00E-02	4.70E-07	•	1.40E-02	1.88E-12
Carbazole	1.00E-02	3.13E-08	NA	NA	4.47E-10	2.00E-02	8.95E-12

NA - Not Applicable

Dibenz(a,h)anthracene

Indeno(1,2,3-cd)pyrene

Chrysene

Dibenzofuran

Phenanthrene

Total Hazard Index = 4.70E-07

NA

NA

NA

NA

NA

1.88E-08

1.57E-09

3.44E-08

1.57E-09

5.32E-08

NA

NA

NA

NA

NA

2.68E-10

2.24E-11

4.92E-10

2.24E-11

7.60E-10

Total Cancer Risk =

7.30E-03

7.30E+00

NA

7.30E-01

NΑ

NA 9.17E-10

1.96E-12

1.63E-10

NA

1.63E-11

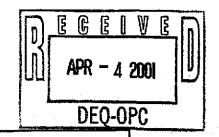


Table 65	•		
Dermal Exposure to EU4 Soi	l (0-20') by a	Construction	Worker
Kerr McGee, Hattiesburg, M.	5		

Intake (mg/kg-day) = $\frac{C_s * SA^*}{}$	AH*ABS*EF BW*AT	*ED*CF	
Cs - Concentration in soil = SA - Surface area available for exposure = SA ₁ - Total skin surface area = Fs - Fraction of skin surface area available for exposure = AH - Adherence factor =	mg/kg cm²/day cm² mg/cm²	chem. spec. 5560 20000 27.8%	calculated USEPA 1997, EFH USEPA 1997, EFH USEPA 1997, EFH
ABS _p - Absorption - cPAHs = ABS _s - Absorption - other SVOCs =	myem	0.03 0.1	USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	days/year years kg/mg	80 t 1.00E-06	reasonable assumption reasonable assumption
BW - Body weight = AT _n - Averaging time - noncarcinogenic =	kg days	70 365	USEPA 1995, Region IV USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soll mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							: "
Benzo(a)anthracene	9.30E+02	4.86E-05	NA	NA	6.94E-07	1.46E+00	.1.01E-06
Benzo(a)pyrene	5.00E+02	2.61E-05	NA	NA	3.73E-07	1.46E+01	.5.45E-06
Benzo(b)fluoranthene	5.30E+02	2.77E-05	NA	NA	3.95E-07	1.46E+00	5.77E-07
Benzo(k)fluoranthene	2.90E+02	1.51E-05	NA	NA	2.16E-07	1.46E-01	3.16E-08
Carbazole	6.20E+02	1.08E-04	NA	NA	1.54E-06	NA	NA
Chrysene	6.90E+02	3.60E-05	NA	NA	5.15E-07	1.46E-02	7.52E-09
Dibenz(a,h)anthracene	6.40E+01	3.34E-06	NA	NA	4.78E-08	1.46E+01	6.97E-07
Indeno(1,2,3-cd)pyrene	2.50E+02	1.31E-05	NA	NA	1.87E-07	1.46E+00	2.72E-07
Naphthalene	3.50E+03	6.09E-04	NA	NA	8.70E-06	NA	NA

Total Cancer Risk = 8.05E-06

Table 66

Oral Exposure to EU4 Soil (0-20') by a Construction Worker
Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = Cd*ln	gR*EF*ED*C	<u>F*ME</u>	<i>.</i>	
	BW*AT	÷	· · · · · · · · · · · · · · · · · · ·	
Cd - Concentration in soil =	mg/kg	see below	•	
lngR _a - lngestion rate for soil =	mg/day	480	USEPA 1997, EFH	
lngR _b - lngestion rate for soil =	mg/day	100	USEPA 1997, EFH	
EF _a - Exposure frequency =	days/year	10	reasonable assumption	
EF _b - Exposure frequency =	days/year	70	reasonable assumption	
ED - Exposure duration =	years	I	USEPA 1995, Region IV	
CF - Conversion factor =	kg/mg	1.00E-06		•
ME - Matrix effect =	•	1	Magee, et al., 1996	
BW - Body weight =	kg	70	USEPA 1995, Region IV	
AT _π - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.30E+02	1.75E-04	. N A	NA	2.50E-06	7.30E-01	1.82E-06
Benzo(a)pyrene	5.00E+02	9.39E-05	NA	NA	1.34E-06	7.30E+00	9.80E-06
Benzo(b)fluoranthene	5.30E+02	9.96E-05	NA	NA	1.42E-06	7.30E-01	1.04E-06
Benzo(k)fluoranthene	2.90E+02	5.45E-05	NA NA	NA	7.78E-07	7.30E-02	5.68E-08
Carbazole	6.20E+02	1.16E-04	. NA	NA	1.66E-06	2.00E-02	3.33E-08
Chrysene	6.90E+02	1.30E-04	NA NA	NA	1.85E-06	7.30E-03	1.35E-08
Dibenz(a,h)anthracene	6.40E+01	1.20E-05	NA	NA	1.72E-07	7.30E+00	1.25E-06
Indeno(1,2,3-cd)pyrene	2.50E+02	4.70E-05	NA	NA	6.71E-07	7.30E-01	4.90E-01
Naphthalene	3.50E+03	6.58E-04	NA	NA	9.39E-06	NA	NA

Cancer Risk = 1.45E-05

Exposure Level B

Constituent	Concentration in Soll mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		-					
Benzo(a)anthracene	9.30E+02	2.55E-04	NA	NA	3.64E-06	7.30E-01	2.66E-06
Benzo(a)pyrene	5.00E+02	1.37E-04	NA	NA	1.96E-06	7.30E+00	1.43E-05
Benzo(b)fluoranthene	5.30E+02	1.45E-04	NA	NA	2.07E-06	7.30E-01	1.51E-06
Benzo(k)fluoranthene	2.90E+02	7.95E-05	NA	NA	1.14E-06	7.30E-02	8.29E-08
Carbazole	6.20E+02	1.70E-04	NA	NA	2.43E-06	2.00E-02	4.85E-08
Chrysene	6.90E+02	1.89E-04	NA	NA	2.70E-06	7.30E-03	1.97E-08
Dibenz(a,h)anthracene	6.40E+01	1.75E-05	NA	NA	2.50E-07	7.30E+00	1.83E-06
Indeno(1,2,3-cd)pyrene	2.50E+02	6.85E-05	NA	NA.	9.78E-07	7.30E-01	7.14E-07
Naphthalene	3.50E+03	9.59E-04	NA	NA	1.37E-05	NA	- NA

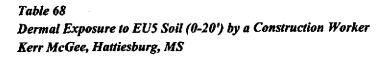
NA - Not Applicable

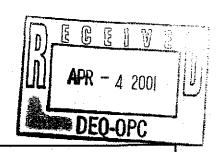
Cancer Risk = 2.12E-05

Total Cancer Risk = 3.57E-05

Exposure to Construction Workers from Inhalation of Fugitive Dust in EU4 Kerr McGee, Hattlesburg, MS Table 67

Inta	Intake (mg/kg-day) =		Ca*inhR*EF*ED*RF BW*AT	D*RF				4	
Ca - Concentration in air == InhR - Inhalation Rate == EF - Exposure Frequency == ED - Exposure Duration == RF _s - Retention Factor - semivolatiles == AT _n - Averaging Time noncarcinogenic == AT _c - Averaging Time carcinogenic ==	Ca - Concentration in air ** InhR - Inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = ion Factor - semivolatiles = ng Time noncarcinogenic = ng Time carcinogenic = BW - Body Weight ==	mg/m² n²/shift shifts/years years days days	sec below 20 80 1 1 0.75 365 25550 70	USEPA 1995, Region IV reasonable assumption reasonable assumption ICRP, 1968 USEPA 1991, HHEM USEPA 1995, Region IV	Бі - Ем 2 = 6.25	Concentration Rate of Corr Hb - D V - Will r - Re z - downw	Ca = Concentration in Air (mg/m²) = Est (110 * w * v) Ei - Emission Rate of Component (mg/sec) = see below Hb - Downwind Ht (m) = 4.81 W - Width (m) = 50 V - Wind speed (m/sec) = 4.69 Length (downwind distance) (m) = 50 r - Roughness Ht. (m) = 0.20 z - downwind distance (m) = 50 z - downwind distance (m) = 50 z - downwind distance (m) = 50	Es (Hb - W - V) sec below 4.81 50 50 50 50 50 50	
E _i - Emissio Cs - Conc	E_i - Emission Rate (mg/sec) = Cs ⁴ Cs - Concentration in soil = $\frac{1}{2}$	Cs*(PERv+PERe) mg/kg see b	PERe) see below						
	,		Concentration in		Inhalacion	}	Average Lifetime	Inhalation Cancer Slope	
	Concentration in Soil	Emission . Rate	Air	ntake	Subchronic RfD	Hazard	Daily Intake	Factor [/(mg/kg-day)	Cancer Risk
Chemicals	mg/kg	mg/sec	mg/m	mg/kg-uay	nig/ kg"uay		6 A		
Semivolatiles	1000	00.5	0.075.04	4 24E-05	¥Z.	٧×	6.05E-07	3.10E-01	1.88E-07
Benzo(a)anthracene	9.30E+02	10.257.1.		2.28E-05	¥Z.	×z	3.26E-07	3.10E+00	1.01E-06
Benzo(a)pyrene	5.00E+02 \$ 20E+03	5.47E-01	\$ 14E-04	2.42E-05	Y.	Ϋ́	3,45E-07	3.10E-01	1.07E-07
Benzo(b)nuoranthene	2.305+02	3.17E-01	2.81E-04	1.32E-05	Ž	NA	1.89E-07	3.10E-02	5.85E-09
Benzo(K)Huorannene	6.20E+02	6.78E-01	6.02E-04	2.83E-05	٧Z	¥Z	4.04E-07	K !	NA NA
Caroazore	6.005+02	7.54E-01	6.70E-04	3.14E-05	Y.	Š	4.49E-07	3.10E-03	1.39E-09
Curysene Ditangle bloodsrecene		7.00E-02	6.21E-05	2.92E-06	Y.Y	¥	4.17E-08	3.106+00	1.29E-07
Indeped 3 1-relinorene		2.73E-01		1,14E-05	Y'Z	¥	1.63E-07	3.105-01	5.03E-08
Naphthalene		3.83E+00		1.60E-04	٧Z	¥.	2.28E-06	ď.	Š.
							To	Total Cancer Risk:	1.49E-06





Intake (mg/kg-day) = Cs*SA*	AH*ABS*EF	*ED*CF	
	BW*AT		
Cs - Concentration in soil =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm ² /day	5560	calculated
SA, - Total skin surface area =	cm ²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		27.8%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm²	0.1	USEPA 1997, EFH
ABS_0 - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	80	reasonable assumption
ED - Exposure duration =	years	1	reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	8.35E+01	4.36E-06	NA	NA	6.23E-08	1.46E+00	9.10E-08
Benzo(a)pyrene	4.42E+01	2.31E-06	NA	NA	3.30E-08	1.46E+01	4.81E-07
Benzo(b)fluoranthene	7.95E+01	4.15E-06	NA.	NA	5.93E-08	1.46E+00	8.66E-08
Benzo(k)fluoranthene	1.68E+01	8.77E-07	NA	NA	1.25E-08	1.46E-01	1.83E-09
Chrysene	8.25E+01	4.31E-06	NA	NA	6.16E-08	1.46E-02	8.99E-10
Dibenz(a,h)anthracene	1.53E+00	7.99E-08	NA	NA	1.14E-09	1.46E+01	1.67E-08
Indeno(1,2,3-cd)pyrene	1.32E+01	6.89E-07	.NA	NA	9.85E-09	1.46E+00	1.44E-08

Total Cancer Risk = 6.93E-07



Table 69 Oral Exposure to EU5 Soil (0-20') by a Construction Worker Kerr McGee, Hattiesburg, MS



Intake (mg/kg-day) = Cd*In	gR*EF*ED*C	F <u>*ME</u>		
	BW*AT			
Cd - Concentration in sediment =	mg/kg	see below		
lngR _a - Ingestion rate for soil ≈	mg/day	480	USEPA 1997, EFH	
$lngR_b$ - $lngestion rate for soil =$	mg/day	100	USEPA 1997, EFH	
EF _a - Exposure frequency =	days/year	10	reasonable assumption	•
EF _b - Exposure frequency =	days/year	70	reasonable assumption	P.
ED - Exposure duration =	years	1	USEPA 1995, Region IV	
CF - Conversion factor =	kg/mg	1.00E-06		
ME - Matrix effect =		1	Magee, et al., 1996	
BW - Body weight =	kg	70	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM	•
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Exposure Level A

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RM mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		,					
Benzo(a)anthracene	8.35E+01	1.57E-05	NA	NA	2 24E-07	7.30E-01	1.64E-07
Benzo(a)pyrene	4.42E+01	8.30E-06	NA	NA	1.19E-07	7.30E+00	8.66E-07
Benzo(b)fluoranthene	7.95E+01	1.49E-05	NA	NA	2.13E-07	7.30E-01	1.56E-07
Benzo(k)fluoranthene	1.68E+01	3.16E-06	NA	NA	4.51E-08	7.30E-02	3.29E-09
Chrysene	8.25E+01	1.55E-05	NA	NA	2.21E-07	7.30E-03	1.62E-09
Dibenz(a,h)anthracene	1.53E+00	2.87E-07	NA	NA	4.11E-09	7.30E+00	3.00E-08
Indeno(1,2,3-cd)pyrene	1.32E+01	2.48E-06	NA	NA	3.54E-08	7.30E-01	2.59E-08
indeno(1,2,3-cd)pyrene	1.522-01	2.70D-00	1475	М	5.0 12-00		

NA - Not Available

Cancer Risk # 1.25E-06

Exposure Level B

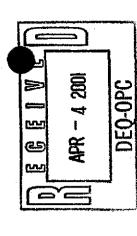
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RM mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles			<u> </u>				
Benzo(a)anthracene	8.35E+01	2.29E-05	NA	NA	3.27E-07	7.30E-01	2.39E-07
Benzo(a)pyrene	4.42E+01	1.21E-05	NA	NA	1.73E-07	7.30E+00	1.26E-06
Benzo(b)fluoranthene	7.95E+01	2.18E-05	NA	NA	3.11E-07	7.30E-01	2.27E-07
Benzo(k)fluoranthene	1.68E+01	4.60E-06	NA	NA	6.58E-08	7.30E-02	4.80E-09
Chrysene	8.25E+01	2.26E-05	NA	NA	3.23E-07	7.30E-03	2.36E-09
Dibenz(a,h)anthracene	1.53E+00	4.19E-07	NA	NA	5.99E-09	7.30E+00	4.37E-08
Indeno(1,2,3-cd)pyrene	1.32E+01	3.62E-06	NA	NA	5.17E-08	7.30E-01	3.77E-08
'							

NA - Not Available

Cancer Risk = 1.82E-06

Total Cancer Risk = 3.06E-06





Exposure to Construction Workers from Inhalation of Fugitive Dust in EUS Kerr McGee, Hattiesburg, MS Table 70

	Intake (mg/kg-day) =		Ca*inhR*EF*ED*RF BW*AT	₹¥	ప్ర	- Concentrati	Ca = Concentration in Air (mg/m³) = Ei / (Hb • W • V)	Ei / (Hb • W • V)	
C. EF E E RF, - Retention AT, - Averaging	Ca - Concentration in air = InhR - Inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = RF ₃ - Retention Factor - semivolatiles = AT _n - Averaging Time noncarcinogenic = AT _e - Averaging Time Carcinogenic = BW - Body Weight =	mg/m² m²shift shifts/year years days days	see below 20 80 1 0.75 365 70	USEPA 1995, Region IV reasonable assumption reasonable assumption ICRP, 1968 USEPA 1991, HHEM USEPA 1995, Region IV	Ei - Em z = 6.25	Hb - I Hb - I V - W rngth (downv r - F - F z - down A + Ln(Hb/r)	Ei - Emission Rate of Component (mg/scc) = see below Hb - Downwind Ht (m) = 4.81 W - Width (m) = 50 V - Wind speed (m/sec) = 4.69 Length (downwind distance) (m) = 50 r - Roughness Ht. (m) = 0.20 z - downwind distance (m) = 50 z - downwind distance (m) = 50	see below 4.81 50 4.69 50 0.20	
Ej1 CS	Ei - Emission Rate (mg/sec) = Cs*(PERv+PERe) Cs - Concentration in soil = mg/kg see be	Cs*(PERv+l mg/kg	PERe) see below						
slesiment	Concentration in Soil	Emission Rate mg/sec	Concentration in Air mg/m³	Average Daily Intake mg/kg-day	Inhalation Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Inhalation Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles				200	7	Ž	\$ 44F-08	3.10E-01	1.69E-08
Benzo(a)anthracene	8.35E+01	9.13E-02	8.10E-05	3.81E-00	4 2	ź Ż	2.88E-08	3.10E+00	8.92E-08
Benzo(a)pyrene	4.42E+01	4.835-02	4.295-05	2.01E-00	¥Z	¥	5.18E-08	3.10E-01	1.60E-08
Benzo(b)fluoranthene	7.95E+01	8.69E-02	7.71E-05	3.04E-00	Y N	Ž	1.09E-08	3.10E-02	3.39E-10
Benzo(k)fluoranthene	1.68E+01	1.845-02	1.035-03	3 76E-06	NA N	¥	5.37E-08	3.10E-03	1.67E-10
Chrysene	8.25E+01	70-970.6	6.01E-03	6.07E-08	Y X	×	9.96E-10	3.10E+00	3.09E-09
Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene	1.53E+00 1.32E+01	1.6/E-03 1.44E-02	1.28E-05	6.02E-07	NA A	X.	8.59E-09	3.10E-01	2.66E-09
									1000

Table 71
Dermal Exposure to EU6 Sediment by a Child Resident (Aged 1 to 6 years)
Kerr McGee, Hattiesburg, MS



$lntake (mg/kg-day) = \underline{Cs*SA*}$	AH*ABS*EF BW*AT	*ED*CF	
Cs - Concentration in sediment =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm²/day	2229	calculated
SA ₄ - Total skin surface area =	cm²	7213	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.33	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	40	reasonable assumption
ED - Exposure duration =	years	6	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	15	USEPA 1995, Region IV
AT _a - Averaging time - noncarcinogenic =	days	2190	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM
			·

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
2-Nitroaniline	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA.
2-Nitrophenol	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
3-Nitroaniline	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
4-Bromophenylphenylether	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
4-Chloro-3-methylphenol	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
4-Chlorophenylphenylether	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA
4-Nitroaniline	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA .	NA
Benzo(a)anthracene	1.00E+02	1.61E-05	NA	NA	1.38E-06	1.46E+00	2.02E-06
Benzo(a)pyrene	4.90E+01	7.90E-06	NA	NA	6.77E-07	1.46E+01	9.89E-06
Benzo(b)fluoranthene	7.80E+01	1.26E-05	NA	NA	1.08E-06	1.46E+00	1.57E-06
Benzo(k)fluroanthene	2.30E+01	3.71E-06	NA	NA	3.18E-07	1.46E-01	4.64E-08
Bis(2-chloroethoxy)methane	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA.
Bis(2-chloroethyl)ether	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA
Carbazole	1.00E+02	5.37E-05	NA	NA	4.61 E-06	NA -	NA
Chrysene	7.60E+01	1.23E-05	NA	NA	1.05E-06	1.46E-02	1.53E-08
Dibenz(a,h)anthracene	9.60E+00	1.55E-06	NA	NA	1.33E-07	1.46E+01	1.94E-06
Hexachlorobenzene	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA
Hexachiorocyclopentadiene	2.00E+00	1.07E-06	NA	NA	9.21E-08	NA	NA
Indeno(1,2,3-cd)pyrene	3.90E+01	6.29E-06	NA	NA	5.39E-07	1.46E+00	7.87E-07
N-nitrosodi-n-propylamine	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA

NA - Not Available

Total Cancer Risk = 1.63E-05

Table 72

Oral Exposure to EU6 Sediment by a Child Resident (Aged 1 to 6 years)

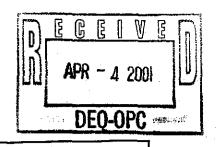
Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) =	<u>Cd*ingR*EF*ED*</u> BW*AT	CF*ME		e.
Cd - Concentration in s IngR - Ingestion rate for s EF - Exposure fr ED - Exposure CF - Conversion	ediment = mg/day equency = days/year duration = years	see below 200 40 6 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV	
ME - Matr BW - Body AT _a - Averaging time - noncard AT _a - Averaging time - card	ix effect = weight = kg nogenic = days	1 15 2190 25550	Magee, et al., 1996 USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Dally Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
2-Nitroaniline	4.00E-01	5.84E-07	NA	ŇA	5.01E-08	NA	NA
2-Nítrophenol	8.00E-01	1.17E-06	NA	NA	1.00E-07	NA	NA
3-Nitroaniline	8.00E-01	1.17E-06	NA	NA	1.00E-07	NA	NA
4-Bromophenylphenylether	8.00E-01	1.17E-06	NA	NA	1.00E-07	NA	NA
4-Chloro-3-methylphenol	8.00E-01	1.17E-06	NA	NA	1.00E-07	NA	· NA
4-Chlorophenylphenylether	4.00E-01	5.84E-07	NA	NA	5.01E-08	NA	NA
4-Nitroaniline	8.00E-01	1.17E-06	NA	NA	1.00E-07	NA	NA
Benzo(a)anthracene	1.00E+02	1.46E-04	NA	NA	1.25E-05	7.30E-01	9.14E-06
Benzo(a)pyrene	4.90E+01	7.16E-05	· NA	NA	6.14E-06	7.30E+00	4.48E-05
Benzo(b)fluoranthene	7.80E+01	1.14E-04	N.A.	NA	9.77E-06	7.30E-01	7.13E-06
Benzo(k)fluroanthene	2.30E+01	3.36E-05	NA	NA	2.88E-06	7.30E-02	2.10E-07
Bis(2-chloroethoxy)methane	8.00E-01	1.17E-06	NA	NA	1.00E-07	NA	NA
Bis(2-chloroethyl)ether	4.00E-01	5.84E-07	NA	NA	5.01E-08	1.10E+00	5.51E-08
Carbazole	1.00E+02	1.46E÷04	NA	NA	1.25E-05	2.00E-02	2.50E-07
Chrysene	7.60E+01	1.11E-04	NA	ŅA	9.52E-06	7.30E-03	6.95E-08
Dibenz(a,h)anthracene	9.60E+00	1.40E-05	NA	NA	1.20E-06	7.30E+00	8.78E-06
Hexachlorobenzene	4.00E-01	5.84E-07	NA	NA	5.01E-08	1.60E+00	8.02E-08
Hexachlorocyclopentadiene	2.00E+00	2.92E-06	NA	NA	2.50E-07	NA	· NA
Indeno(1,2,3-cd)pyrene	3.90E+01	5.70E-05	NA	NA	4.88E-06	7.30E-01	3.57E-06
N-nitrosodi-n-propylamine	4.00E-01	5.84E-07	NA	NA	5.01E-08	7.00E+00	3.51E-07

Total Cancer Risk = 7.44E-05





$Intake (mg/kg-day) = \frac{Cs*SA*A}{}$	H*ABS*EF BW*AT	*ED*CF		
Cs - Concentration in sediment = SA - Surface area available for exposure = SA _t - Total skin surface area = Fs - Fraction of skin surface area available for exposure = AH - Adherence factor = ABS _p - Absorption - cPAHs =	mg/kg cm²/day cm²	chem. spec. 6180 20000 30.9% 0.33 0.03	calculated USEPA 1997, EFH USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III	
ABS _s - Absorption - other SVOCs = EF - Exposure frequency = ED - Exposure duration =	days/year years	0.1 40 24	USEPA 1995, Region III reasonable assumption USEPA 1995, Region IV	
CF - Conversion factor = BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	kg/mg kg days days	1.00E-06 70 8760 25550	USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles			-				
2-Nitroaniline	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA
2-Nitrophenol	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
3-Nitroaniline	8.00E-01	2.55E-07	NA	NA	8.76E-08	· NA	NA
4-Bromophenylphenylether	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
4-Chloro-3-methylphenol	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
4-Chlorophenylphenylether	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA
4-Nitroaniline	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
Benzo(a)anthracene	1.00E+02	9.58E-06	· NA	NA	3.28E-06	1.46E+00	4.79E-06
Benzo(a)pyrene	4.90E+01	4.69E-06	NA	NA	1.61E-06	1.46E+01	2.35E-05
Benzo(b)fluoranthene	7.80E+01	7.47E-06	NA	NA	2.56E-06	1.46E+00	3.74E-06
Benzo(k)fluroanthene	2.30E+01	2.20E-06	NA	NA	7.55E-07	1.46E-01	1.10E-07
Bis(2-chloroethoxy)methane	8,00E-01	2.55E-07	NA	NΑ	8.76E-08	NA	NA
Bis(2-chloroethyl)ether	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA -
Carbazole	1.00E+02	3.19E-05	NA	NA	1.09E-05	NA	NA
Chrysene	7.60E+01	7.28E-06	NA	NA ·	2.50E-06	1.46E-02	3.64E-08
Dibenz(a,h)anthracene	9.60E+00	9.20E-07	NA	NA	3.15E-07	1.46E+01	4.60E-06
Hexachlorobenzene	4.00E-01	1.28E-07	4.00E-04	3.19E-04	4.38E-08	NA	NA
Hexachlorocyclopentadiene	2.00E+00	6.39E-07	3.50E-03	1.82E-04	2.19E-07	NA	NA
Indeno(1,2,3-cd)pyrene	3.90E+01	3.74E-06	NA	NA	1.28E-06	1.46E+00	1.87E-06
N-nitrosodi-n-propylamine	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA

Total Hazard Index = 5.02E-04

Total Cancer Risk = 3.86E-05



Table 74

Oral Exposure to EU6 Sediment by an Adult Resident (Aged 7 to 30 years)

Kerr McGee, Hattiesburg, MS

	Intake (mg/kg-day) = Cd*Ir	gR*EF*ED*C	F*ME		
		BW*AT			
	Cd - Concentration in sediment ≈	mg/kg	see below		
	IngR - Ingestion rate for sediment =	mg/day	100	USEPA 1997, EFH	
	EF - Exposure frequency =	days/year	40	reasonable assumption	
	ED - Exposure duration =	years	24	USEPA 1995, Region IV	
:	CF - Conversion factor =	kg/mg	1.00E-06		
	ME - Matrix effect =		1,	Magee, et al., 1996	
	BW - Body weight =	kg	70	USEPA 1995, Region IV	•
	AT _n - Averaging time - noncarcinogenic =	days	8760	USEPA 1991, HHEM	٠.
	AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Dally Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
2-Nitroaniline	4.00E-01	6.26E-08	NA	NA	2.15E-08	NA	NA
2-Nitrophenol	8.00E-01	1.25E-07	NA	NA	4.29E-08	NA	NA
3-Nitroaniline	8.00E-01	1.25E-07	NA	NA	4.29E-08	NA ·	NA
4-Bromophenylphenylether	8.00E-01	1.25E-07	NA	. NA	4.29E-08	NA	NA
4-Chloro-3-methylphenol	8.00E-01	1.25E-07	NA	NA	4:29E-08	NA	NA
4-Chlorophenylphenylether	4.00E-01	6.26E-08	NA -	NA	2.15E-08	NA .	NA
4-Nitroaniline	8.00E-01	1.25E-07	NA	NA	4.29E-08	NA	NA NA
Benzo(a)anthracene	1.00E+02	1.57E-05	NA .	NA	5.37E-06	7.30E-01	3.92E-06
Benzo(a)pyrene	4.90E+01	7.67E-06	NA	NA	2.63E-06	7.30E+00	1.92E-05
Benzo(b)fluoranthene	7.80E+01	1.22E-05	NA	NA	4.19E-06	7.30E-01	3.06E-06
Benzo(k)fluroanthene	2.30E+01	3.60E-06	NA	NA	1.23E-06	7.30E-02	9.01E-08
Bis(2-chloroethoxy)methane	8.00E-01	1.25E-07	NA	NA	4.29E-08	NA	NA.
Bis(2-chloroethyl)ether	4.00E-01	6.26E-08	NA	NA	2.15E-08	1.10E+00	2.36E-08
Carbazole	1.00E+02	1.57E-05	NA	NA	5.37E-06	2.00E-02	1.07E-07
Chrysene	7.60E+01	1.19E-05	NA	NA	4.08E-06	7.30E-03	2.98E-08
Dibenz(a,h)anthracene	9.60E+00	1.50E-06	NA	NA	5.15E-07	7.30E+00	3.76E-06
Hexachlorobenzene	4.00E-01	6.26E-08	8.00E-04	7.83E-05	2.15E-08	1.60E+00	3.44E-08
Hexachlorocyclopentadiene	2.00E+00	3.13E-07	7.00E-03	4.47E-05	1.07E-07	NA	NA
Indeno(1,2,3-cd)pyrene	3.90E+01	6.11E-06	NA	NA	2.09E-06	7.30E-01	1.53E-00
N-nitrosodi-n-propylamine	4.00E-01	6.26E-08	NA	NA	2.15E-08	7.00E+00	1.50E-0
1	4. *						

Total Hazard Index = 1.23E-04

Total Cancer Risk = 3.19E-05

Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = <u>Cw*SA*KJ</u>	b*ABS*ET*E BW*AT	<u> </u>	
Cw - Concentration in surface water =	mg/L	see below	
SA - Surface area available for exposure =	cm²	2229	calculated
SA ₁ - Total skin surface area =	cm²	7213	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
Kp - Dermal permeability constant =	cm/hr	see below	
ABS _p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessment
EF • Exposure frequency =	days/year	40	reasonable assumption
ED - Exposure duration =	years	6	USEPA 1995, Region IV
CF - Conversion factor =	L/cm³	1.00E-03	
BW - Body weight =	kg	15	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	2190	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Kp em/hr	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
emivolatiles							1.4CE100	2.48E-08
ienzo(a)anthracene	5.00E-04	8.10E-01	1.98E-07	NA	NA	1.70E-08	1.46E+00	•
Senzo(a)pyrene	5.00E-04	1.20E+00	2.93E-07	NA	NA	2.51E-08	1.46E+01	3.67E-07
nzo(b)fluoranthene	9.00E-03	1.20E+00	5.28E-06	NA	NA	4_52E-07	1:46E+00	6.60E-07
	5.00E-04	4.48E+01	1.09E-05	NA	NA	9.38E-07	1.46E-01	1.37E-07
enzo(k)fluoranthene		8.10E-01	1.98E-07	NA	NA.	1.70E-08	1.46E-02	2.48E-10
Chrysene	5.00E-04					5.65E-08	1.46E+01	8.25E-07
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	6.59E-07	NA	NA	•	*****	
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	4.64E-07	NA .	NA	3.98E-08	1.46E+00	5.81E-08

NA - Not Available

Total Cancer Risk = 2.07E-06

Table 76
Oral Exposure to EU6 Surface Water by a Child Resident (Aged 1 to 6 years)
Kerr McGee, Hattiesburg, MS

		BW*AT		
	Csw - Concentration in surface water =	mg/L	see below	
-	IngR - Ingestion rate for surface water =	L/hour	0.05	USEPA 1995, Region IV
	EF - Exposure frequency	days/year	40	reasonable assumption
	ED - Exposure duration =	years	6	USEPA 1995, Region IV
	ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessmen
	BW - Body weight =	kg	15	USEPA 1995, Region IV
	AT _n - Averaging time - noncarcinogenic =	days	2190	USEPA 1991, HHEM
	AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM
		· · · · · · · · · · · · · · · · · · ·		
				Average
	,			Lifetime Daily Oral Cancer

Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
					The second secon	
5.00E-04	1.83E-07	NA	NA	1.57E-08	7.30E-01	1.14E-08
5.00E-04	1.83E-07	NA	NA	1.57E-08	7.30E+00	1.14E-07
9.00E-03	3.29E-06	NA	NA	2.82E-07	7.30E-01	2.06E-07
5.00E-04	1.83E-07	NA	NA	1.57E-08	7.30E-02	1.14E-09
5.00E-04	1.83E-07	NA	NA	1.57E-08	7.30E-03	1.14E-10
	1.83E-07	NA ·	NA	1.57E-08	7.30E+00	1.14E-07
5.00E-04	1.83E-07	NA	NA	1.57E-08	7.30E-01	1.14E-08
	5.00E-04 5.00E-04 5.00E-04 9.00E-03 5.00E-04 5.00E-04	Surface Water mg/L Intake mg/kg-day 5.00E-04 1.83E-07 5.00E-04 1.83E-07 9.00E-03 3.29E-06 5.00E-04 1.83E-07 5.00E-04 1.83E-07 5.00E-04 1.83E-07 5.00E-04 1.83E-07	Surface Water mg/L Intake mg/kg-day RfD mg/kg-day 5.00E-04 1.83E-07 NA 5.00E-04 1.83E-07 NA 9.00E-03 3.29E-06 NA 5.00E-04 1.83E-07 NA 5.00E-04 1.83E-07 NA 5.00E-04 1.83E-07 NA 5.00E-04 1.83E-07 NA	Surface Water mg/L Intake mg/kg-day RfD mg/kg-day Hazard mg/kg-day 5.00E-04 1.83E-07 NA NA 5.00E-04 1.83E-07 NA NA 9.00E-03 3.29E-06 NA NA 5.00E-04 1.83E-07 NA NA 5.00E-04 1.83E-07 NA NA 5.00E-04 1.83E-07 NA NA 5.00E-04 1.83E-07 NA NA	Concentration in Surface Water mg/L Average Daily lntake mg/kg-day Oral Subchronic RfD mg/kg-day Lifetime Daily lntake mg/kg-day 5.00E-04 1.83E-07 NA NA 1.57E-08 5.00E-04 1.83E-07 NA NA 1.57E-08 9.00E-03 3.29E-06 NA NA 2.82E-07 5.00E-04 1.83E-07 NA NA 1.57E-08	Concentration in Surface Water Mg/L Average Daily Intake Mg/kg-day Oral Subchronic RfD Mg/kg-day Lifetime Daily Intake Mg/kg-day Oral Cancer Slope Factor Mg/kg-day 5.00E-04 1.83E-07 NA NA 1.57E-08 7.30E-01 5.00E-04 1.83E-07 NA NA 1.57E-08 7.30E-01 9.00E-03 3.29E-06 NA NA 2.82E-07 7.30E-01 5.00E-04 1.83E-07 NA NA 1.57E-08 7.30E-02 5.00E-04 1.83E-07 NA NA 1.57E-08 7.30E-03 5.00E-04 1.83E-07 NA NA 1.57E-08 7.30E-03 5.00E-04 1.83E-07 NA NA 1.57E-08 7.30E-03 5.00E-04 1.83E-07 NA NA 1.57E-08 7.30E-00

Total Cancer Risk = 4.58E-07

Table 77 Dermal Exposure to EU6 Surface Water by an Adult Resident (Aged 7 to 30 years) Kerr McGee, Hattiesburg, MS

	Intake (mg/kg-day) =		Cw*SA*	Kp*ABS*ET*EF* BW*AT	ED*CF			•
•	Cw - Conc	entration in s	urface water =	mg/L	see below			
	SA - Surface a	rea available :	for exposure =	cm²	6180	calculated		
			surface area =	cm²	20000	USEPA 1997, EFI	H .	
Fc	- Fraction of skin surface a	rea available :	for exposure =		30.9%	USEPA 1997, EFI	H	
			lity constant =	cm/hr	see below	•		
		•	ion - cPAHs =		0.03	USEPA 1995, Region III		
٠,	-		posure time =	hrs/day	1	USEPA 1992, De	rmai Exposure As	sessment
•			re frequency =	days/yeaτ	40	reasonable assump	otion	* .
•	•	-	ure duration =	years	24	USEPA 1995, Rep	gion IV	
		•	ersion factor =	L/cm³	1.00E-03			
		BW-	Body weight =	. kg	70	USEPA 1995, Re	gion IV	•
AT _n - Averaging time - noncarcinogenic =			days	8760	USEPA 1991, HE	IEM		
	AT _c - Averaging time - carcinogenic =			days	25550	USEPA 1991, HE	IEM	1
* *				•				٠.
	<u> </u>		.,			Average		
	Concentration in		Average	Dermal Chronic		Lifetime Daily	Cancer Slope	
	Surface Water	Kp	Daily Intake	RM	Hazard	Intake	Factor	
Constituent	mg/L	cm/hr	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Cancer Ri
Semivolatiles					-			
Benzo(a)anthracene	5.00E-04	8.10E-01	1.18E-07	NA	NA	4.03E-08	1.46E+00	5.88E-08
Benzo(a)pyrene	5.00E-04	1.20E+00	1.74E-07	NA.	NA	5.97E-08	1.46E+01	8.72E-01
Benzo(b)fluoranthene	9.00E-03	1.20E+00	3.13E-06	NA	NA	1.07E-06	1.46E+00	1.57E-00
Benzo(k)fluoranthene	5.00E-04	4.48E+01	6.50E-06	NA	NA	2.23E-06	1.46E-01	3.25E-0
Chrysene	5.00E-04	8.10E-01	1.18E-07	NA	NA	4.03E-08	1.46E-02	5.88E-10
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	3.92E-07	NA	NA	1.34E-07	1.46E+01	1.96E-0
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	2.76E-07	NA	NA	9.45E-08	1.46E+00	1.38E-0

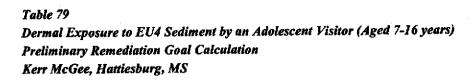
Table 78

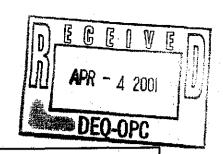
Oral Exposure to EU6 Surface Water by an Adult Resident (Aged 7 to 30 years)

Kerr McGee, Hattiesburg, MS

	Intake (mg/kg-day) =	<u>Csv</u>	<u>v*ingR*EF*ED*</u> BW*AT	<u>ET</u>	e.			
	Csw - Concentration in	surface water =	mg/L	see below	e e e e e e e e e e e e e e e e e e e	•	. •	
	lngR - Ingestion rate for	Surface water =	L/hour	0.01	USEPA 1995, R	egion IV		
	EF - Exposure frequency = ED - Exposure duration =		ency = days/year	40 24	reasonable assun	nption		
,					USEPA 1995, R	-		
	ET - Exposure time = BW - Body weight =			1 70 8760 25550	USEPA 1992, Dermal Exposure Assessment			
					USEPA 1995, Region IV			
AT _n - Averaging time - noncarcinogenic =			days		USEPA 1991, HHEM USEPA 1991, HHEM			
AT _c - Averaging time - carcinogenic =		me - carcinogeníc = days						
			-		Average			
Constituent	Concentration in Surface Water mg/L	n Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Rist	
Constituent Semivolatiles	Surface Water mg/L	Daily Intake mg/kg-day	RfD mg/kg-day	Index	Lifetime Daily Intake mg/kg-day	Slope Factor 1/(mg/kg-day)	1 1 1	
	Surface Water mg/L 5.00E-04	Daily Intake mg/kg-day 7.83E-09	RfD mg/kg-day NA	Index NA	Lifetime Daily Intake mg/kg-day 2.68E-09	Siope Factor 1/(mg/kg-day) 7.30E-01	1.96E-09	
Semivolatiles	Surface Water mg/L	Daily Intake mg/kg-day	RfD mg/kg-day NA NA	NA NA	Lifetime Daily Intake mg/kg-day 2.68E-09 2.68E-09	7.30E-01 7.30E+00	1.96E-09 1.96E-09	
Semivolatiles Benzo(a)anthracene	Surface Water mg/L 5.00E-04 5.00E-04	Daily Intake mg/kg-day 7.83E-09	RfD mg/kg-day NA NA NA	NA NA NA	Lifetime Daily Intake mg/kg-day 2.68E-09 2.68E-09 4.83E-08	7.30E-01 7.30E-01 7.30E-01	1.96E-09 1.96E-09 3.53E-09	
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene	Surface Water mg/L 5.00E-04 5.00E-04 9.00E-03	7.83E-09 7.83E-09 1.41E-07 7.83E-09	RfD mg/kg-day NA NA NA NA	NA NA NA NA	Lifetime Daily Intake mg/kg-day 2.68E-09 2.68E-09 4.83E-08 2.68E-09	7.30E-01 7.30E-01 7.30E-01 7.30E-01 7.30E-02	1.96E-09 1.96E-09 3.53E-09 1.96E-10	
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene	Surface Water mg/L 5.00E-04 5.00E-04 9.00E-03	7.83E-09 7.83E-09 1.41E-07 7.83E-09 7.83E-09	RfD mg/kg-day NA NA NA NA NA	NA NA NA NA NA	Lifetime Daily Intake mg/kg-day 2.68E-09 2.68E-09 4.83E-08 2.68E-09 2.68E-09	7.30E-01 7.30E-01 7.30E-01 7.30E-01 7.30E-02 7.30E-02 7.30E-03	1.96E-09 1.96E-09 3.53E-09 1.96E-10	
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene	5.00E-04 5.00E-04 5.00E-03 5.00E-04 5.00E-04	7.83E-09 7.83E-09 1.41E-07 7.83E-09	RfD mg/kg-day NA NA NA NA	NA NA NA NA	Lifetime Daily Intake mg/kg-day 2.68E-09 2.68E-09 4.83E-08 2.68E-09	7.30E-01 7.30E-01 7.30E-01 7.30E-01 7.30E-02	1.96E-09 1.96E-09 3.53E-09 1.96E-10	

Total Cancer Risk = 7.86E-08





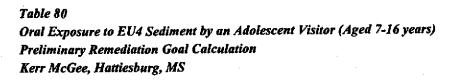
Intake (mg/kg-day) = $\frac{\text{Cs*SA*}A}{\text{Cs*SA*}A}$	4H*ABS*EF	<u>*ED*CF</u>	
•	BW*AT		•
Cs - Concentration in sediment =	mg/kg cm²/day	chem. spec.	calculated
SA - Surface area available for exposure = SA _t - Total skin surface area =	cm ²	3945 12768.3	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure = AH - Adherence factor =	mg/cm²	30.9% 0.33	USEPA 1997, EFH USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _a - Absorption - other SVOCs = EF - Exposure frequency =	days/year	0.1 12	USEPA 1995, Region III reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
CF - Conversion factor ≈ BW - Body weight ≈	kg/mg kg	1.00E-06 45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _e - Averaging time - carcinogenic ≈	days	25550	USEPA 1991, HHEM

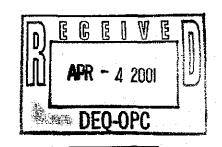
; Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles			•				
Benzo(a)anthracene	2.56E+00	7.31E-08	NA	NA	1.04E-08	1.46E+00	1.52E-08
Benzo(a)pyrene	3.10E+00	8.85E-08	NA	NA	1.26E-08	1.46E+01	1.85E-07
Benzo(b)fluoranthene	4.78E+00	1.36E-07	NA .	NA	1.95E-08	1.46E+00	2.85E-08
Benzo(k)fluoranthene	2.27E+00	6.48E-08	NA	NA ·	9.25E-09	1.46E-01	1.35E-09
Carbazole	•	NA '	NA	NA	NA	NA	NA
Chrysene	*	NA	NA	NA:	. NA	1.46E-02	NA
Dibenz(a,h)anthracene	5.87E-01	1.68E-08	NA	NA	2.39E-09	1.46E+01	3.49E-08
Dibenzofuran	•	NA	2.00E-03	NA.	NA	NA	NA.
indeno(1,2,3-cd)pyrene	2.40E+00	6.85E-08	NA	NA	9.78E-09	1.46E+00	1.43E-08
Naphthalene	•	NA '	1.00E-02	NA	NA	NA	NA
Phenanthrene	*	. NA	NA	NA	NA	NA	NA

NA - Not Available/Not Applicable

*Constituent not present in remaining samples.

Total Cancer Risk = 2.79E-07





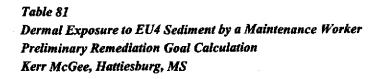
$lntake (mg/kg-day) = \underline{C}$	d*IngR*EF*ED*C	F*ME		
	BW*AT			
Cd - Concentration in sediment	:= mg/kg	see below		
IngR - Ingestion rate for sediment	= mg/day	100	USEPA 1997, EFH	
EF - Exposure frequency		12	reasonable assumption	
ED - Exposure duration		10	USEPA 1995, Region IV	
CF - Conversion factor	r≐ kg/mg	1.00E-06		
ME - Matrix effect	t =	1	Magee, et al., 1996	
BW - Body weight	= kg	45	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic	= days	3650	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic		25550	USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	2.56E+00	1.87E-07	NA	NA	2.67E-08	7.30E-01	1.95E-08
Benzo(a)pyrene	3.10E+00	2.26E-07	NA	NA	3.24E-08	7.30E+00	2.36E-07
Benzo(b)fluoranthene	4.78E+00	3.49E-07	NA	NA .	4.99E-08	7.30E-01	3.64E-08
Benzo(k)fluoranthene	2.27E+00	1.66E-07	NA	NA	2.37E-08	7.30E-02	1.73E-09
Carbazole	*	NA ·	NA	NA	NA	2.00E-02	NA
Chrysene	•	NA	NA	NA	NA	7.30E-03	NA
Dibenz(a,h)anthracene	5.87E-01	4.29E-08	NA '	NA	6.13E-09	7.30E+00	4.47E-08
Dibenzofuran	*	NA ···	4.00E-03	NA	NA -	NA	NA
Indeno(1,2,3-cd)pyrene	2.40E+00	1.75E-07	NA	NA	2.50E-08	7.30E-01	1.83E-08
Naphthalene	*	NA.	2.00E-02	NA	NA	NA	NA
Phenanthrene	*	NA	NA	NA	NA	NA	NA
	•				•	100	

NA - Not Available/Not Applicable

*Constituent not present in remaining samples.

Total Cancer Risk = 3.57E-07





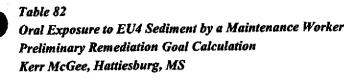
Intake (mg/kg-day) = Cs*SA*/	H*ABS*EI BW*AT	·*ED*CF	
Cs - Concentration in sediment =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm ² /day	3000	calculated
SA ₄ - Total skin surface area =	cm²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15.0%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.038	USEPA 1997, EFH
ABS_{p} - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _a - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

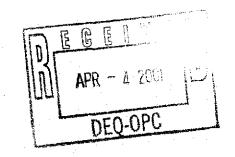
Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk	
Semivolatiles								
Benzo(a)anthracene	2.56E+00	1.03E-08	NA	NA	3.67E-09	1.46E+00	5.36E-09	
Benzo(a)pyrene	3.10E+00	1.24E-08	NA:	NA	4.45E-09	1.46E+01	.6.49E-08	
Benzo(b)fluoranthene	4.78E+00	1.92E-08	NA	NA	6.86E-09	1.46E+00	1.00E-08	
Benzo(k)fluoranthene	2.27E+00	9.12E-09	NA	NA .	3.26E-09	1.46E-01	4.75E-10	
Carbazole	*	NA	NA	NA	NA	NA ·	NA	
Chrysene	*	NA	NA	NA	NA	1.46E-02	NA	
Dibenz(a,h)anthracene	5.87E-01	2.36E-09	NA	NA	8.42E-10	1.46E+01.	1.23E-08	
Dibenzofuran	•	NA	2.00E-03	NA	NA	NA	NA	
Indeno(1,2,3-cd)pyrene	2.40E+00	9.64E-09	NA	NA	3.44E-09	1.46E+00	5.03E-09	
Naphthalene	•	NA	1.00E-02	NA	NA	NA	NA	
Phenanthrene	•	NA	NA	NA	NA -	NA .	NA	

NA - Not Available/Not Applicable

*Constituent not present in remaining samples.

Total Cancer Risk = 9.81E-08





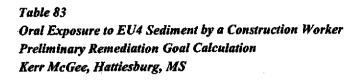
Intake (mg/kg-day) = Cd*In	gR*EF*ED*C	F*ME		
	BW*AT			
Cd - Concentration in sediment =	mg/kg	see below		
IngR - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH	
EF - Exposure frequency =	days/year	30	reasonable assumption	
ED - Exposure duration =	years	25	USEPA 1995, Region IV	
CF - Conversion factor =	kg/mg	1.00E-06		
ME - Matrix effect =		1	Magee, et al., 1996	
BW - Body weight =	kg	70	USEPA 1995, Region IV	•
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							-0.5
Benzo(a)anthracene	2.56E+00	3.01E-07	NA	NA	1.07E-07	7.30E-01	7.84E-08
Benzo(a)pyrene	3.10E+00	3.64E-07	NA	NA	1.30E-07	7.30E+00	9.49E-07
Benzo(b)fluoranthene	4.78E+00	5.61E-07	NA	NA	2.00E-07	7.30E-01	1.46E-07
Benzo(k)fluoranthene	2.27E+00	2.67E-07	NA	NA	9.52E-08	7.30E-02	6.95E-09
Carbazole	*	NA	NA	NA	NA	2.00F-02	NA.
Chrysene	*	NA	NA	NA	NA	7.30E-03	NA
Dibenz(a,h)anthracene	5.87E-01	6.89E-08	NA	NA	2.46E-08	7.30E+00	1.80E-07
Dibenzofuran	*	NA	4.00E-03	NA	NA	NA	NA:
Indeno(1,2,3-cd)pyrene	2.40E+00	2.82E-07	NA	NA	1.01E-07	7.30E-01	7.35E-08
Naphthalene	•	NA	2.00E-02	NA	NA	NA	NA
Phenanthrene	*	NA	NA	NA	NA	NA	NA

NA - Not Available/Not Applicable

Total Cancer Risk = 1.43E-06

^{*}Constituent not present in remaining samples.





$lntake (mg/kg-day) = \underline{Cd*ln}$	gR*EF*ED*C BW*AT	<u>F*ME</u>	
Cd - Concentration in sediment = lngR - Ingestion rate for sediment = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	mg/kg mg/day days/year years kg/mg	see below 480 8 1 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV
ME - Matrix effect =		ì	Magee, et al., 1996
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM
AT_c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Caneer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	2.56E+00	3.85E-07	NA	NA	5.50E-09	7.30E-01	4.01E-09
Benzo(a)pyrene	3.10E+00	4.66E-07	NA	NA	6.66E-09	7.30E+00	4.86E-08
Benzo(b)fluoranthene	4.78E+00	7.18E-07	NA	NA	1.03E-08	7.30E-01	7.49E-09
Benzo(k)fluoranthene	2.27E+00	3.41E-07	NA	NA	4.87E-09	7.30E-02	3.56E-10
Carbazole	*	NA	NA	NA	NA	2.00E-02	NA
Chrysene	•	NA	NA	NA	NA	7.30E-03	NA
Dibenz(a,h)anthracene	5.87E-01	8.82E-08	NA	NA	1.26E-09	7.30E+00	9.20E-09
Dibenzofuran	*	NA	NA	NA	NA	NA ·	NA
Indeno(1,2,3-cd)pyrene	2.40E+00	3.61E-07	NA	NA	5.15E-09	7.30E-01	3.76E-09
Naphthalene	•	NA	NA	NA -	NA	NA	NA
Phenanthrene	•	NA	NA	NA	NA	NA	NA

NA - Not Available/Not Applicable

Total Cancer Risk = 7.34E-08

^{*}Constituent not present in remaining samples.

Table 84

Dermal Exposure to EU4 Surface Soil (0-6') by a Maintenance Worker Preliminary Remediation Goal Calculation

Kerr McGee, Hattlesburg, MS

Intake (mg/kg-day) =



BW*AT			
mg/kg	chem. spec.		
cm ² /day	3000	calculated	
cm²	20000	USEPA 1997, EFH	
	15%	USEPA 1997, EFH	
mg/cm ²	0.038	USEPA 1997, EFH	
	0.03	USEPA 1995, Region III	
-	0.1	USEPA 1995, Region III	
days/year	30	reasonable assumption	
years	25	USEPA 1995, Region IV	
kg/mg	1.00E-06		
kg	70	USEPA 1995, Region IV	
days	9125	USEPA 1991, HHEM	
days	25550	USEPA 1991, HHEM	
	mg/kg cm²/day cm² mg/cm² days/year years kg/mg kg days	mg/kg chem. spec. cm²/day 3000 cm² 20000 15% mg/cm² 0.038 0.03 0.1 days/year 30 years 25 kg/mg 1.00E-06 kg 70 days 9125	mg/kg chem. spec. cm²/day 3000 calculated cm² 20000 USEPA 1997, EFH 15% USEPA 1997, EFH mg/cm² 0.038 USEPA 1997, EFH 0.03 USEPA 1995, Region III 0.1 USEPA 1995, Region III days/year 30 reasonable assumption years 25 USEPA 1995, Region IV kg/mg 1.00E-06 kg 70 USEPA 1995, Region IV days 9125 USEPA 1991, HHEM

Cs*SA*AH*ABS*EF*ED*CF

Constituent	Concentration In Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk	
Semivolatiles								
Benzo(a)anthracene	8.10E-01	3.25E-09	NA	NA	1.16E-09	1.46E+00	1.70E-09	
Benzo(a)pyrene	2.90E-01	1.16E-09	NA	NA	4.16E-10	1.46E+01	6.07E-09	
Benzo(b)fluoranthene	3.70E-01	1.49E-09	NA	NA	5.31E-10	1.46E+00	7.75E-10	
Benzo(k)fluoranthene	1.60E-01	6.43E-10	NA	NA	2.29E-10	1.46E-01	3.35E-11	
Carbazole	4.90E-01	6.56E-09	NA	NA	2.34E-09	NA	NA	
Chrysene	6.10E-01	2.45E-09	NA	NA	8.75E-10	1.46E-02	1.28E-11	
Dibenz(a,h)anthracene	1.10E-02	4.42E-11	NA	NA	1.58E-11	1.46E+01	2.30E-10	
Indeno(1,2,3-cd)pyrene	9.40E-02	3.77E-10	NA	NA	1.35E-10	1.46E+00	- 1.97E-10	
Naphthalene	4.00E-01	5.35E-09	1.00E-02	5.35E-07	1.91E-09	NA	NA	

NA - Not Available

Total Hazard Index = 5.35E-07

Total Cancer Risk = 9.02E-09

Table 85
Oral Exposure to EU4 Surface Soil (0-6') by a Maintenance Worker
Preliminary Remediation Goal Calculation
Kerr McGee, Hattiesburg, MS



Intake (mg/kg-day) = Cd*li	ngR*EF*ED*C	F*ME	
	BW*AT		÷
Cd - Concentration in soil =	mg/kg	see below	LICEDA 1007 EEU
IngR - Ingestion rate for soil = EF - Exposure frequency =	mg/day days/year	100 30	USEPA 1997, EFH reasonable assumption
ED - Exposure duration = CF - Conversion factor =	years kg/mg	25 1.00E-06	USEPA 1995, Region IV
ME - Matrix effect =		1	Magee, et al., 1996
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _a - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Dally Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivol atiles							
Benzo(a)anthracene	8.10E-01	9.51E-08	NA	NA	3.40E-08	7.30E-01	2.48E-08
Benzo(a)pyrene	2.90E-01	3.41E-08	NA	NA	1.22E-08	7.30E+00	8.88E-08
Benzo(b)fluoranthene	3.70E-01	4.34E-08	NA	NA	1.55E-08	7.30E-01	1.13E-08
Benzo(k)fluoranthene	1.60E-01	1.88E-08	NA	NA	6.71E-09	7.30E-02	4.90E-10
Carbazole	4.90E-01	5.75E-08	NA	NA	2.05E-08	2.00E-02	4.11E-10
Chrysene	6.10E-01	7.16E-08	NA	NA	2.56E-08	7.30E-03	1.87E-10
Dibenz(a,h)anthracene	1.10E-02	1.29E-09	NA ·	NA	4.61E-10	7.30E+00	3.37E-09
Indeno(1,2,3-cd)pyrene	9.40E-02	1.10E-08	NA	NA	3.94E-09	7.30E-01	2.88E-09
Naphthalene	4.00E-01	4.70E-08	2.00E-02	2.35E-06	1.68E-08	NA	NA

Total Hazard Index = 2.35E-06

Total Cancer Risk = 1.32E-07

Table 86

Dermal Exposure to EU4 Soil (0-20') by a Construction Worker

Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

m.a.	ke (mg/kg-day) =	<u> </u>	AH*ABS*EF* BW*AT				
	Cs - Concent	ation in soil =	mg/kg	chem. spec.			
SA - Surf	ace area available	for exposure =	cm²/day	5560	calculated		
	SA _t - Total skin surface area =			20000	USEPA 1997, EFI		
s - Fraction of skin surf		27.8%	USEPA 1997, EFI	H .			
	mg/cm²	0.1	USEPA 1997, EFH				
		0.03	USEPA 1995, Reg				
AB	-	0.1	USEPA 1995, Rej				
, ;	days/year	80	reasonable assum				
EF - Exposure frequency = ED - Exposure duration =			m = years [pr = kg/mg 1.00E-		reasonable assum	otion	
	1.00E-06						
	70	USEPA 1995, Re-					
AT - Au	BW - Body weight = AT_n - Averaging time - noncarcinogenic =				365	USEPA 1991, HH	
	- Averaging time -		days days	25550	USEPA 1991, HF	IEM	
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RID mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					. 105.00	1.445400	1 620 0
Benzo(a)anthracene	1.50E+01	7.83E-07	NA	NA	1.12E-08	1.46E+00	
Benzo(a)anthracene Benzo(a)pyrene	5.20E+00	2.72E-07	NA	NA	3.88E-09	1.46E+01	1.63E-0
Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene	5.20E+00 7.80E+00	2.72E-07 4.07E-07	NA NA	NA NA	3.88E-09 5.82E-09	1.46E+01 1.46E+00	5.66E-0 8.50E-0
Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene	5.20E+00 7.80E+00 3.70E+00	2.72E-07 4.07E-07 1.93E-07	NA NA NA	NA NA NA	3.88E-09 5.82E-09 2.76E-09	1.46E+01 1.46E+00 1.46E-01	5.66E-0 8.50E-0 4.03E-1
Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Carbazole	5.20E+00 7.80E+00 3.70E+00 9.50E+00	2.72E-07 4.07E-07 1.93E-07 1.65E-06	NA NA NA NA	NA NA NA NA	3.88E-09 5.82E-09 2.76E-09 2.36E-08	1.46E+01 1.46E+00 1.46E-01 NA	5.66E-0 8.50E-0 4.03E-1 NA
Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene	5.20E+00 7.80E+00 3.70E+00	2.72E-07 4.07E-07 1.93E-07	NA NA NA	NA NA NA	3.88E-09 5.82E-09 2.76E-09	1.46E+01 1.46E+00 1.46E-01	5.66E-0 8.50E-0 4.03E-1

NA

NA

1.04E-07

2.61E-05

NA

NA

1.49E-09

3.73E-07

NA - Not Available

Naphthalene

indeno(1,2,3-cd)pyrene

2.00E+00

1.50E+02

Total Cancer Risk = 8.96E-08

2.18E-09

NA

1.46E+00

NA

Table 87

Oral Exposure to EU4 Soil (0-20') by a Construction Worker

Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = <u>Cd*lr</u>	igR*EF*ED*C	<u>F*ME</u>		
•	BW*AT			
Cd - Concentration in soil =	mg/kg	see below	•	
IngR _a - Ingestion rate for soil =	mg/day	480	USEPA 1997, EFH	
lngR _b - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH	
EF, - Exposure frequency =	days/year	10	reasonable assumption	
EF _b - Exposure frequency =	days/year	70	reasonable assumption	
ED - Exposure duration =	years	1 .	USEPA 1995, Region IV	
CF - Conversion factor = .	kg/mg	1.00E-06		
ME - Matrix effect =		1 .	Magee, et al., 1996	
BW - Body weight =	kg	70	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RID mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	1.50E+01	2.82E-06	NA	NA	4.03E-08	7.30E-01	2.94E-08
Benzo(a)pyrene	5.20E+00	9.77E-07	NA	NA	1.40E-08	7.30E+00	1.02E-07
Benzo(b)fluoranthene	7.80E+00	1.47E-06	NA	NA	2.09E-08	7.30E-01	1.53E-08
Benzo(k)fluoranthene	3.70E+00	6.95E-07	. NA	NA	9.93E-09	7.30E-02	7.25E-10
Carbazole	9.50€+00	1.78E-06	NA	NA	2.55E-08	2.00E-02	.5.10E-10
Chrysene	1.20E+01	2.25E-06	NA ·	NA	3.22E-08	7.30E-03	2.35E-10
Dibenz(a,h)anthracene	5.00E-01	9.39E-08	NA	NA	1.34E-09	7.30E+00	9.80E-09
Indeno(1,2,3-cd)pyrene	2.00E+00	3.76E-07	NA	NA	5.37E-09	7.30E-01	3.92E-09
Naphthalene	1.50E+02	2.82E-05	NA	NA .	4.03E-07	· NA	NA

Cancer Risk = 1.62E-07

Exposure	Level B

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Siope Factor 1/(mg/kg-day)	C≅ncer Risk
Semivolatiles				<u> </u>			
Benzo(a)anthracene	1.50E+01	4.11E-06	NA	NA	5.87E-08	7.30E-01	4.29E-08
Benzo(a)pyrene	5.20E+00	1.42E-06	NA	NA	2.04E-08	7.30E+00	1.49E-07
Benzo(b)fluoranthene	7.80E+00	2.14E-06	· NA	NA	3.05E-08	7.30E-01	2.23E-08
Benzo(k)fluoranthene	3.70E+00	1.01E-06	NA	NA	1.45E-08	7.30E-02	1.06E-09
Carbazole	9.50E+00	2.60E-06	NA	NA	3.72E-08	2.00E-02	7.44E-10
Chrysene	1.20E+01	3.29E-06	NA	NA	4.70E-08	7.30E-03	3.43E-10
Dibenz(a,h)anthracene	5.00E-01	1.37E-07	NA	NA	1.96E-09	7.30E+00	1.43E-08
Indeno(1,2,3-cd)pyrene	2.00E+00	5.48E-07	NA	NA	7.83E-09	7.30E-01	5.71E-09
Naphthalene	1.50E+02	4.11E-05	NA	NΑ	5.87E-07	NA	NA.

NA - Not Available

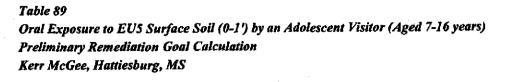
Cancer Risk = 2.36E-07

Total Cancer Risk = 3.98E-07

Table 88

Exposure to Construction Workers from Inhalation of Fugitive Dust in EU4 Preliminary Remediation Goal Calculation Kerr McGee, Hattiesburg, MS

Intak	Intake (mg/kg-day) =		Ca*InhR*EF*ED*RF BW*AT	D*RF	<u> </u>	Concentration	$C_8 = Concentration in Air (mat/m3) = Ei / (Hb * W * V)$	Ei/(HP * W * V)	,
Ca - Concentration in air = thhR - Inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = RF _s - Retention Factor - semivolatiles = AT _c - Averaging Time noncarcinogenic = AT _c - Averaging Time carcinogenic = BW - Body Weight =	Ca - Concentration in air = inhR - inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = ion Factor - semivolatiles = ing Time noncarcinogenic = raging Time carcinogenic = RW - Body Weight =	mg/m² m²/shift shifts/year years days days	see below 20 80 1 0.75 365 25550	USEPA 1995, Region IV reasonable assumption reasonable assumption ICRP, 1968 USEPA 1991, HHEM USEPA 1991, HHEM USEPA 1995, Region IV	Ei - Emi	Rate of Com Hb - Dc V - Wir r - Ro z - downw	Ei - Ernission Rate of Component (mg/sec) = see below Hb - Downwind Ht (m) = 4.81 W - Width (m) = 50 V - Wind speed (m/sec) = 4.69 Length (downwind distance) (m) = 50 r - Roughness Ht. (m) = 0.20 z - downwind distance (m) = 50 z = 6.25r[Hb/r* Ln(Hb/r) - 1.58*Hb/r + 1.58]	see below 4.81 50 4.69 50 0.20 50	
E _i - Emission Cs - Conce	E _i - Emission Rate (mg/scc) = Cs*(PERv+ Cs - Concentration in soil = mg/kg	Cs*(PERv+	PERe) sec below	٠			į		·
	Concentration	Emission Rate	Concentration in Air	Average Daily Intake	Inhalation Subchronic RfD	Hazard	Average Lifetime Daily Intake		Cancer
Chemicals	mg/kg	mg/sec	mg/m³	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Risk
Semivolatiles							00	1 105 01	3.03E.09
Renzo(a)anthracene	1.50E+01	1.64E-02	1.46E-05	6.84E-07	¥Z.	₹ :	9.11E-07	10-201	00 250
ongo(e)mimena	5 20F+00	5.69E-03	5.05E-06	2.37E-07	NA	∢ Z	3.39E-09	3.105+00	1.035-06
Denzo(a)pyrene	7 90E+00	8 53E-03	7 57E-06	3.55E-07	NA	K Z	5.08E-09	3.10E-01	1.57E-09
Senzo(b)iluoranthene	0.000	4 05E-03	3 59E-06	1.69E-07	NA V	Ϋ́	2.41E-09	3.10E-02	7.47E-11
Benzo(K)filuofantneiic	3.705+00	1.04E-02	0.27E-06	4.33E-07	NA	Ϋ́	6.19E-09	¥ Z	¥ Z
Carbazole	9.305.40	1 315 03	1 168-05	\$ 47E-07	¥	٧X	7.81E-09	3.10E-03	2.42E-11
Chrysene	10.202.1	20-31C.1	4 85E-07	2.28E-08	Ϋ́	Ϋ́	3,26E-10	3.10E+00	1.01E-09
Dibenz(a,h)anthracene	-	2.000.0	0.00 ×	0 11E-08	Ϋ́	٧X	1,30E-09	3.10E-01	4.04E-10
indeno(1,2,3-cd)pyrene	1.50F±02	1.64E-01	1.46E-04	6.84E-06	V V	N A	9.77E-08	NA	Ϋ́





Intake (mg/kg-day) = Cd*l	ngR*EF*ED*C	F*ME	
	BW*AT	•	
Cd - Concentration in sediment =	mg/kg	see below	
IngR - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH
EF - Exposure frequency =	days/year	12	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
ME - Matrix effect =		1	Magee, et al., 1996
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT_c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soli mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	2.90E-01	2.12E-08	NA	NA	3.03E-09	7.30E-01	2.21E-09
Веп20(а)ругеле	3.70E-01	2.70E-08	NA	NA	3.86E-09	7.30E+00	2.82E-08
Benzo(b)fluoranthene	7.60E-01	5.55E-08	NA	NA	7.93E-09	7.30E-01	5.79E-09
Benzo(k)fluoranthene	4.60E-01	3.36E-08	NA	NA	4.80E-09	7.30E-02	3.50E-10
Chrysene	3.70E-01	2.70E-08	NA	NA	3.86E-09	7.30E-03	2.82E-11
Dibenz(a,h)anthracene	6.60E-02	4.82E-09	NA	NA	6.89E-10	7.30E+00	5.03E-09
Indeno(1,2,3-cd)pyrene	2.90E-01	2.12E-08	NA	NA	3.03E-09	7.30E-01	2.21E-09

Total Cancer Risk = 4.38E-08

Table 90

Dermal Exposure to EU5 Surface Soil (0-6') by a Maintenance Worker

Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

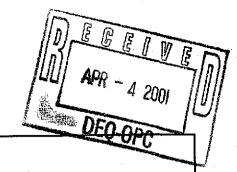


intake (mg/kg-day) = Cs*SA	*AH*ABS*EF	**ED*CF	4
	BW*AT		
Cs - Concentration in soil =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	= cm²/day	3000	calculated
SA _t - Total skin surface area =	= cm²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure		15%	USEPA 1997, EFH
AH - Adherence factor =		0.038	USEPA 1997, EFH
ABS _p - Absorption - cPAHs =	=	0.03	USEPA 1995, Region III
EF - Exposure frequency		150	reasonable assumption
ED - Exposure duration	≈ years	25	USEPA 1995, Region IV
CF - Conversion factor		1.00E-06	
BW - Body weight	≈ kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic	≈ days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic		25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles				-			
Benzo(a)anthracene	9.54E-02	1.91E-09	NA	NA	6.84E-10	1.46E+00	9.98E-10
Benzo(a)pyrene	1.18E-01	2.36E-09	NA	NA	8.43E-10	1.46E+01	1.23E-08
Benzo(b)fluoranthene	2.90E-01	5.82E-09	NA	NA	2.08E-09	1.46E+00	3.03E-09
Benzo(k)fluoranthene	1.55E-01	3.10E-09	NA	NA	1.11E-09	1.46E-01	1.62E-10
Chrysene	1.50E-01	3.01E-09	NA	NA	1.07E-09	1.46E-02	1.57E-11
Dibenz(a,h)anthracene	4.40E-02	8.83E-10	NA	NA	3.15E-10	1.46E+01	4.60E-09
Indeno(1,2,3-cd)pyrene	9.13E-02	1.83E-09	NA	NA	6.54E-10	1.46E+00	9.55E-10

Total Cancer Risk = 2.21E-08

Table 91
Oral Exposure to EU5 Surface Soil (0-6') by a Maintenance Worker
Preliminary Remediation Goal Calculation
Kerr McGee, Hattiesburg, MS



gR*EF*ED*C	F*ME	
BW*AT		•
mg/kg	see below	
mg/day	100	USEPA 1997, EFH
days/year	150	reasonable assumption
years	25	USEPA 1995, Region IV
kg/mg	1.00E-06	
	1	Magee, et al., 1996
kg	70	USEPA 1995, Region IV
days	9125	USEPA 1991, HHEM
days	25550	USEPA 1991, HHEM
	BW*AT mg/kg mg/day days/year years kg/mg kg days	mg/kg see below mg/day 100 days/year 150 years 25 kg/mg 1.00E-06 1 kg 70 days 9125

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.54E-02	5.60E-08	NA	NA	2.00E-08	7.30E-01	1.46E-08
Benzo(a)ругене	1.18E-01	6.91E-08	NA	NA	2.47E-08	7.30E+00	1.80E-07
Benzo(b)fluoranthene	2.90E-01	1.70E-07	NA	NA	6.08E-08	7.30E-01	4.44E-08
Benzo(k)fluoranthene	1.55E-01	9.08E-08	NA	NA	3.24E-08	7.30E-02	2.37E-09
Chrysene	1.50E-01	8.79E-08	NA	NA	3.14E-08	7.30E-03	2.29E-10
Dibenz(a,h)anthracene	4.40E-02	2.58E-08	NA	NA	9.22E-09	7.30E+00	6.73E-08
Indeno(1,2,3-cd)pyrene	9.13E-02	5.36E-08	NA	NA	1.91E-08	7.30E-01	1.40E-08

Total Cancer Risk = 3.23E-07

Table 92 Oral Exposure to EU5 Soil (0-20') by a Construction Worker Preliminary Remediation Goal Calculation Kerr McGee, Hattiesburg, MS

			UNI	<u> </u>	1 100
 Intake (mg/kg-day) = Cd*	ngR*EF*ED*C BW*AT	F*ME		FOPC	1/
Cd - Concentration in sediment = IngR _a - Ingestion rate for soil = IngR _b - Ingestion rate for soil = EF _a - Exposure frequency = EF _b - Exposure frequency = ED - Exposure duration = CF - Conversion factor = ME - Matrix effect = BW - Body weight = AT _a - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	mg/kg mg/day mg/day days/year days/year years kg/mg kg days	see below 480 100 10 70 1 1.00E-06 1 70 365 25550	USEPA 1997, EFH USEPA 1997, EFH reasonable assumption reasonable assumption USEPA 1995, Region IV Magee, et al., 1996 USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM		

Exposure Level A Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatlles						= AAD at	2 707 10
Benzo(a)anthracene	1.93E-01	3.62E-08	NA	NA	5.18E-10	7.30E-01	3.78E-10
Benzo(a)pyrene	1.91E-01	3.59E-08	NA	NA	5.13E-10	7.30E+00	3.74E-09
Benzo(b)fluoranthene	3.89E-01	7.30E-08	NA	NA	1.04E-09	7.30E-01	7.61E-10
Benzo(k)fluoranthene	1.90E-01	3.58E-08	NA	NA	5.11E-10	7.30E-02	3.73E-11
Chrysene	2.64E-01	4.95E-08	NA	NA	7.07E-10	7.30E-03	5.16E-12
Dibenz(a,h)anthracene	5.15E-02	9.68E-09	NA	NA	1.38E-10	7.30E+00	1.01E-09
Indeno(1,2,3-cd)pyrene	1.30E-01	2.45E-08	NA	NA	3.50E-10	7.30E-01	2.56E-10
NA - Not Available			:			Cancer Risk =	6.19E-09

Exposure Level B	Concentration in	Average Daily	Oral Chronic		-	ly Oral Cancer Slope	
Constituent	Soil mg/kg	Intake mg/kg-day	RfD mg/kg-day	Hazard Index	Intake mg/kg-day	Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						·	
Benzo(a)anthracene	1.93E-01	5.28E-08	NA	NA	7.55E-10	7.30E-01	5.51E-10
Benzo(a)pyrene	1.91E-01	5.23E-08	NA	NA	7.47E-10	7.30E+00	5.46E-09
Benzo(b)fluoranthene	3.89E-01	1.06E-07	NA.	NA	1.52E-09	7.30E-01	1.11E-09
Benzo(b)fluoranthene	1.90E-01	5,22E-08	NA	NA	7.45E-10	7.30E-02	5.44E-11
	2.64E-01	7.22E-08	NA	NA	1.03E-09	7.30E-03	7.53E-12
Chrysene	5.15E-02	1.41E-08	NA.	NA	2.02E-10	7.30E+00	1.47E-09
Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene	1.30E-01	3.57E-08	NA	NA	5.11E-10	7.30E-01	3.73E-10
NA - Not Available		<u>, </u>				Cancer Risk =	9.02E-09

Total Cancer Risk = 1.52E-08

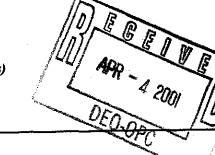
Table 93

Dermal Exposure to EU6 Sediment by an Adult Resident (Aged 7 to 30 years)

Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) =



	BW*AT		
Cs - Concentration in sediment = SA - Surface area available for exposure = SA _t - Total skin surface area = Fs - Fraction of skin surface area available for exposure = AH - Adherence factor = ABS _p - Absorption - cPAHs = ABS _s - Absorption - other SVOCs =	mg/kg cm²/day cm² mg/cm²	chem. spec. 6180 20000 30.9% 0.33 0.03	calculated USEPA 1997, EFH USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor = BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	days/year years kg/mg kg days days	40 24 1.00E-06 70 8760 25550	reasonable assumption USEPA 1995, Region IV USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

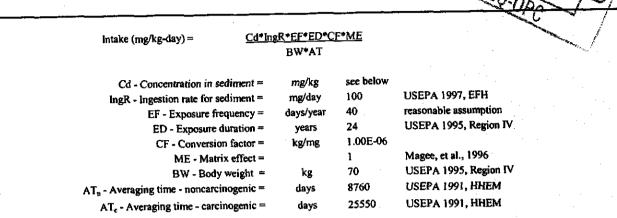
Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		<u> </u>					
2-Nitroaniline	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	. NA
2-Nitrophenol	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
3-Nitroaniline	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA ·	NA .
4-Bromophenylphenylether	8.40E-02	2.68E-08	NA	NA	9.20E - 09	NA	NA
4-Chloro-3-methylphenol	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
4-Chlorophenylphenylether	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	NA
4-Nitroaniline	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
Benzo(a)anthracene	9.30E-01	8.91E-08	NA	NA	3.05E-08	1.46E+00	4.46E-08
Benzo(a)pyrene	9.70E-01	9.29E-08	NA	NA	3.19E-08	1.46E+01	4.65E-07
Benzo(b)fluoranthene	1.40E+00	1.34E-07	NA	NA	4.60E-08	1.46E+00	6.71E-08
Benzo(k)fluroanthene	5.00E-01	4.79E-08	NA	NA	1.64E-08	1.46E-01	2.40E-09
Bis(2-chloroethoxy)methane	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA .	NA
Bis(2-chloroethyl)ether	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	NA
Carbazole	2.20E-01	7.02E-08	NA	NA	2.41E-08	NA	NA
Chrysene	1.30E+00	1.25E-07	NA	NA	4.27E-08	1.46E-02	6.23E-10
Dibenz(a,h)anthracene	1.50E-01	1.44E-08	NA	NA	4.93E-09	1.46E+01	7.19E-08
Hexachlorobenzene	4.20E-02	1.34E-08	4.00E-04	3.35E-05	4.60E-09	NA	·NA
Hexachlorocyclopentadiene	2.10E-01	6.70E-08	3.50E-03	1.92E-05	2.30E-08	NA	NA
Indeno(1,2,3-cd)pyrene	5.40E-01	5.17E-08	NA	NA	1.77E-08	1.46E+00	2.59E-08
N-nitrosodi-n-propylamine	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	NA

NA - Not Available

Total Hazard Index = 5.27E-05

Total Cancer Risk = 6.78E-07

Table 94
Oral Exposure to EU6 Sediment by an Adult Resident (Aged 7 to 30 years)
Preliminary Remediation Goal Calculation
Kerr McGee, Hattiesburg, MS



Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						71.	STA
2-Nitroaniline	4.20E-02	6.58E-09	NA ·	NA	2.25E-09	NA	NA
2-Nitrophenol	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
3-Nitroaniline	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA .	NA
4-Bromophenylphenylether	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
4-Chloro-3-methylphenol	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA.	NA
4-Chlorophenylphenylether	4.20E-02	6.58E-09	NA	NA	2.25E-09	NA NA	NA
4-Nitroaniline	8.40E-02	1.32E-08	NA ·	NA	4.51E-09	NA	NA
Benzo(a)anthracene	9.30E-01	1.46E-07	NA	NA	4.99E-08	7.30E-01	3.64E-08
Benzo(a)pyrene	9.70E-01	1.52E-07	NA	NA	5.21E-08	7.30E+00	3.80E-07
Benzo(b)fluoranthene	1.40E+00	2.19E-07	NA	NA	7.51E-08	7.30E-01	5.49E-08
Benzo(k)fluroanthene	5.00E-01	7.83E-08	NA	NA	2.68E-08	7.30E-02	1.96E-09
Bis(2-chloroethoxy)methane	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
Bis(2-chloroethyl)ether	4.20E-02	6.58E-09	NA	NA	2.25E-09	1.10E+00	2.48E-09
Carbazole	2.20E-01	3.44E-08	NA	NA	1.18E-08	2.00E-02	2.36E-10
Chrysene	1.30E+00	2.04E-07	NA	NA	6.98E-08	7.30E-03	5.09E-10
(-	1.50E-01	2.35E-08	NA	NA	8.05E-09	7.30E+00	5.88E-08
Dibenz(a,h)anthracene Hexachlorobenzene	4.20E-02	6.58E-09	8.00E-04	8.22E-06	2.25E-09	1.60E+00	3.61E-09
	4.20E-02 2.10E-01	3.29E-08	7.00E-03	4.70E-06	1.13E-08	NA	NA
Hexachlorocyclopentadiene	5.40E-01	8.45E-08	NA	NA	2.90E-08	7.30E-01	2.12E-08
Indeno(1,2,3-cd)pyrene N-nitrosodi-n-propylamine	4.20E-02	6.58E-09	NA	NA	2.25E-09	7.00E+00	1.58E-08

Total Hazard Index = 1.29E-05

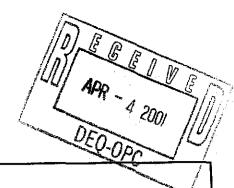
Total Cancer Risk = 5.76E-07

Table 95

Dermal Exposure to EU6 Sediment by a Child Resident (Aged 1 to 6 years)

Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS



Intake (mg/kg-day) = <u>Cs*SA*</u>	AH*ABS*EF	*ED*CF	
	BW*AT		
Cs - Concentration in sediment =	mg/kg	chem, spec.	
SA - Surface area available for exposure =	cm²/day	2229	calculated
SA ₁ - Total skin surface area =	cm ²	7213	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm²	0.33	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	40	reasonable assumption
ED - Exposure duration =	years	6	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	15	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	2190	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
2-Nitroaniline	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA ·	NA
2-Nitrophenol	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA _.	NA
3-Nitroaniline	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
4-Bromophenylphenylether	8.40E-02	4.51E-08	NA	NA	3.87E-09	,NA	NA
4-Chloro-3-methylphenol	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
4-Chlorophenylphenylether	4.20E-02	2.26E-08	.NA	NA	1.93E-09	NA -	NA
4-Nitroaniline	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
Benzo(a)anthracene	9.30E-01	1.50E-07	NA .	NA .	1.29E-08	1.46E+00	1.88E-08
Benzo(a)pyrene	9.70E-01	1.56E-07	NA	NA	1.34E-08	1.46E+01	1.96E-07
Benzo(b)fluoranthene	1.40E+00	2.26E-07	NA	NA	1.93E-08	1.46E+00	2.82E-08
Benzo(k)fluroanthene	5.00E-01	8.06E-08	NA	NA	6.91E-09	1.46E-01	1.01E-09
Bis(2-chloroethoxy)methane	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
Bis(2-chloroethyl)ether	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA	NA
Carbazole	2,20E-01	1.18E-07	NA	NA	1.01E-08	NA	NA
Chrysene	1.30E+00	2.10E-07	NA	NA	1.80E-08	1.46E-02	2.62E-10
Dibenz(a,h)anthracene	1.50E-01	2.42E-08	NA	NA	2.07E-09	1.46E+01	3.03E-08
Hexachlorobenzene	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA	NA
Hexachlorocyclopentadiene	2.10E-01	1.13E-07	NA	NA ·	9.67E-09	NA	NA
Indeno(1,2,3-cd)pyrene	5.40E-01	8.71E-08	NA	NA	7.46E-09	1.46E+00	1.09E-08
N-nitrosodi-n-propylamine	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA	NA

Total Cancer Risk = 2.85E-07

Table 96
Oral Exposure to EU6 Sediment by a Child Resident (Aged 1 to 6 years)
Preliminary Remediation Goal Calculation
Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = Cd*In	gR*EF*ED*C BW*AT	<u>F*ME</u>	
Cd - Concentration in sediment = IngR - Ingestion rate for sediment = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	mg/kg mg/day days/year years kg/mg	see below 200 40 6 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV
ME - Matrix effect = BW - Body weight = AT _n - Averaging time - noncarcinogenic =	kg days	1 15 2190	Magec, et al., 1996 USEPA 1995, Region IV USEPA 1991, HHEM
AT _e - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Orał Subchronic R(D mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						***	N/A
2-Nitroaniline	4.20E-02	6.14E-08	NA	NA	5.26E-09	NA	NA NA
2-Nitrophenol	8.40E-02	1.23E-07	NA NA	NA	1.05E-08	NA	
3-Nitroaniline	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
4-Bromophenylphenylether	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
4-Chloro-3-methylphenol	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
4-Chlorophenylphenylether	4.20E-02	6.14E-08	NA	NA	5.26E-09	NA	NA
4-Nitroaniline	8,40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
Benzo(a)anthracene	9.30E-01	1.36E-06	NA	NA	1.16E-07	7.30E-01	8.50E-08
Benzo(a)pyrene	9.70E-01	1.42E-06	NA	NA	1.21E-07	7.30E+00	8.87E-07
Benzo(b)fluoranthene	1.40E+00	2.05E-06	NA	NA	1.75E-07	7.30E-01	1.28E-07
Benzo(k)fluroanthene	5.00E-01	7.31E-07	NA	NA	6.26E-08	7.30E-02	4.57E-09
Bis(2-chloroethoxy)methane	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
Bis(2-chloroethyl)ether	4.20E-02	6.14E-08	NA	NA	5.26E-09	1.10E+00	5.79E-09
Carbazole	2.20E-01	3.21E-07	NA	NA	2.76E-08	2.00E-02	5.51E-10
1	1.30E+00	1.90E-06	NA	NA	1.63E-07	7.30E-03	1.19E-09
Chrysene	1.50E-01	2.19E-07	NA	NA	1.88E-08	7.30E+00	1.37E-07
Dibenz(a,h)anthracene	4.20E-02	6.14E-08	NA	NA	5.26E-09	1.60E+00	8.42E-09
Hexachlorobenzene	2.10E-01	3.07E-07	NA.	NA	2.63E-08	. NA	NA
Hexachlorocyclopentadiene	5.40E-01	7.89E-07	NA.	NA	6.76E-08	7.30E-01	4.94E-08
Indeno(1,2,3-ed)pyrene N-nitrosodi-n-propylamine	4.20E-02	6.14E-08	NA	NA	5.26E-09	7.00E+00	3.68E-08

Total Cancer Risk = 1.34E-06

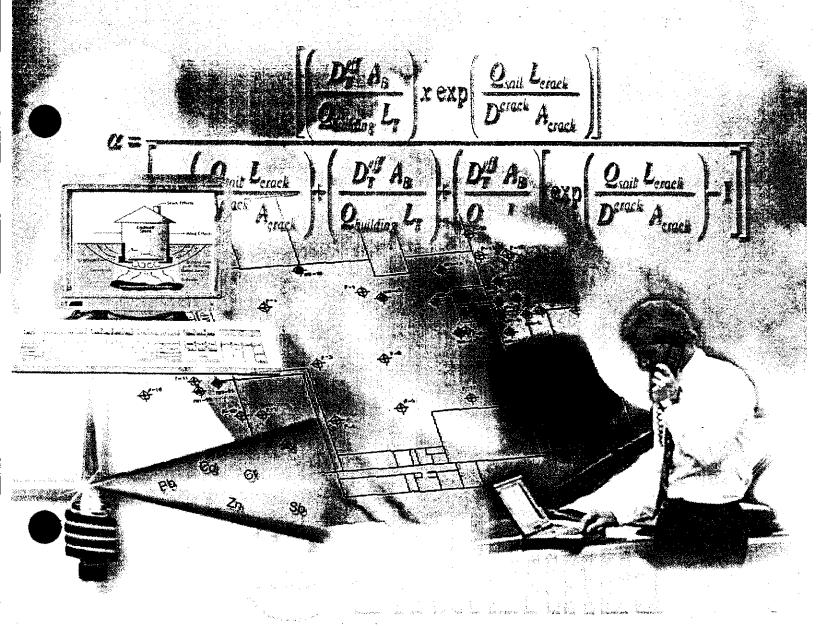


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Setting the Standards for Innovative Environmental Solutions

HUMAN HEALTH RISK ASSESSMENT FOR THE FORMER GULF STATES CREOSOTING FACILITY, HATTIESBURG, MISSISSIPPI

May 2, 2001



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May 2, 2001

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Table of Contents

			_	age
Exe	cutiv	e Sumn	1ary	es-1
1.0	Intr	oductio	n	.1-1
2.0	Haz	ard Ide	ntification and Conceptual Site Model	.2-1
3.0	Data	a Evalua	ation	.3-1
	3.1	Exposu	re Unit Delineation	.3-1
		3.1.1	Exposure Unit 1	.3-1
		3.1.2	Exposure Unit 2	
		3.1.3	Exposure Unit 3	.3-2
		3.1.4	Exposure Unit 4	.3-3
		3.1.5	Exposure Unit 5	.3-4
		3.1.6	Exposure Unit 6	.3-5
	3.2	Statistic	cal Evaluation	.3-6
	3.3	Determ	nination of Exposure-Point Concentrations	.3-8
	3.4	COPC	Selection	.3-9
4.0	Exp		ssessment	
	4.1	Recept	or Identification	.4-1
		4.1.1	Infrequent Site Visitor	.4-2
		4.1.2	Maintenance Worker	.4-3
		4.1.3	Construction Worker	
6-1		4.1.4	Future On-Site Residents	
		4.1.5	Off-Site Residential Exposures	
	4.2		I Intake Equation	
		4.2.1	General Exposure Parameters	
		4.2	2.1.1 Exposure Frequency	
		4.2	2.1.2 Exposure Duration	
			2.1.3 Averaging Time	
		4.2	2.1.4 Body Weight	

Table of Contents (Cont.)

				Page
	4.2.2	Rout	te-Specific Exposure Parameters	4-9
	4.	.2.2.1	Dermal Exposure Parameters	4-10
	4	.2.2.2	Ingestion Exposure Parameters	4-17
	. 4	.2.2.3	Inhalation Exposure Parameters and Paradigms	4-18
5.0	Toxicity As	ssessm	ent	5-1
6.0	Risk Chara	acteriz	ation	6-1
7.0	Uncertaint	y Anal	lysis	7-1
	7.1 Uncer	tainty o	of Data Evaluation Factors	7-1
	7.2 Uncer	tainty o	of Toxicity Values	7-2
	7.3 Uncer	tainties	s in Assessing Potential Exposure	7-3
8.0	Summary	of Find	lings	8-1
Fig	ures			
Tak	مامد			

Executive Summary

A baseline human health risk assessment (HHRA) was conducted for the Former Gulf States Creosoting facility in Hattiesburg, Mississippi. The HHRA was performed in accordance with: Mississippi Commission on Environmental Quality's (MCEQ's) Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999); US EPA's Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (1989); US EPA Region 4 guidance entitled Technical Services Supplemental Guidance to RAGS, Region 4 Bulletins (1995); and other relevant US EPA guidance documents.

Creosoting constituents of potential health concern include polycyclic aromatic hydrocarbons (PAHs), of which benzo(a)pyrene is the predominant contributor to potential risks. Much of the former creosoting process area is currently covered with asphalt or large building structures. Potential future exposure scenarios included a construction worker, a maintenance worker, an infrequent Site visitor, and off-Site residents. Media of concern included soils, sediment, and surface water.

Hazards posed by chemical constituents in soils, sediment, and surface water for health effects other than an increased risk of cancer were well below a threshold of possible concern for each receptor evaluated in this risk assessment. Cancer risks for all exposure scenarios were within or below the US EPA's acceptable target risk range of 1×10^{-6} to 1×10^{-4} (i.e., one in one million to one in ten thousand) with the exception of maintenance worker exposure to soils in EU4 and offsite resident exposure to sediments in EU6. The added lifetime cancer risk conservatively estimated for a maintenance worker was 4×10^{-4} for the entire Site, while that for the off-site resident was 2×10^{-4} for the entire Site. The potential risk for a construction worker was estimated to be 5×10^{-5} for the entire Site. The estimated potential risk for an adolescent Site visitor was 9×10^{-5} for the entire Site. For the Site visitor, maintenance worker, and construction worker scenarios, oral contact with carcinogenic PAHs in sediment and soils drove the cancer risk level. For the off-Site resident scenario, oral contact with carcinogenic PAHs in sediment drove the cancer risk level.

Risk levels are mainly attributable to residual concentrations of carcinogenic polycyclic aromatic hydrocarbons (cPAH) in EUs 4, 5, and 6. Remedial actions currently planned for these areas, including deed restrictions, will result in incomplete exposure pathways thereby resulting in acceptable levels of risks to potential receptors. Proposed remediation activities to address impacted media in EUs 4, 5, and 6 include the following:

- Conduct in-situ biological treatment of impacted soils in the unpaved area between the former Process Area and the Southern railroad tracks (EU4);
- Attempt to recover free product from targeted areas within the former Process Area to address continuing sources (EU5);

- Remove impacted sediments from the northeast drainage ditch and install a culvert to provide for surface drainage (EU6);
- Establish deed restrictions limiting the use of property to non-residential (i.e., "restricted") purposes (EU4 and EU5); and
- Include in the deed restrictions provisions for maintaining pavement to preclude contact with impacted media left in place (EU5).

Constituent concentrations in surface soils at two isolated locations within EU2 also resulted in maintenance worker risk levels slightly greater than 1×10^{-6} . Because these locations are within a densely wooded area where no maintenance activities currently occur and remediation would require significant clearing, no remediation activities are planned to address surface soils at these locations. Deed restrictions limiting the use of properties within EU2 to non-residential purposes will be established.

1.0 Introduction

Environmental Standards, Inc. (Environmental Standards) was retained by Kerr-McGee Chemical Corporation (Kerr-McGee) to perform a human health risk assessment (HHRA) to evaluate hazards and risks potentially posed by residual levels of chemicals present at the Former Gulf States Creosoting facility (Site). The Site, located near the intersection of US Highways 49 and 11 in Hattiesburg, Mississippi, was formerly a wood treating facility that operated between the early 1900s and 1960. In the early 1960s, the Site was redeveloped for commercial and light industrial uses (Michael Pisani & Assoc., 1997). The land on which the Site is located is a portion of the Sixteenth Section land owned by the Hattiesburg Public School District and leased to the current tenants under a 99-year lease, granted on July 7, 1947. At the time of this report, the Site, with the exception of the grassy and wooded areas in the south and southwest, respectively, was primarily used for automobile dealerships. There are no residential or institutional (i.e., schools) uses of the Site (Michael Pisani & Assoc., 1997).

Operations at the Site consisted of a small-scale wood preserving process using creosote. The creosoting process was primarily confined to a 2.5-acre area in the northeast corner of the Site; this is known as the former Process Area and is currently occupied by Courtesy Ford. During the redevelopment of the Site in the early 1960s, construction debris (e.g., broken concrete, asphalt, etc.) appears to have been relocated to the southwestern corner of the Site along Gordon's Creek. This area is known as the Fill Area and currently remains undeveloped.

This assessment has been conducted as a result of an agreement between Kerr-McGee, the Mississippi Department of Environmental Quality (MDEQ), and the Mississippi Commission on Environmental Quality (MCEQ) pursuant to the Uncontrolled Site Voluntary Evaluation Program. The MDEQ Office of Pollution Control, Uncontrolled Sites Section has been providing oversight and review of investigations and reports relating to the former Gulf States Creosoting facility.

This report will address the potential for on-Site exposures to human receptors and off-Site exposures to humans along the northeast drainage ditch.

The primary guidance used to develop this risk assessment was the MCEQ Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999). US EPA Region 4's Technical Services Supplemental Guidance to RAGS: Region 4 Bulletins (1995) were also referred to for guidance. Additional US EPA guidance documents cited herein include:

- Guidance for Remediation of Uncontrolled Hazardous Substance Sites in Mississippi (MDEQ, 1990);
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual/ Part A (RAGS/Part A) (US EPA, 1989);
- Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" (US EPA, 1991);
- Exposure Factors Handbook (US EPA, 1997);
- Guidelines for Exposure Assessment (US EPA 1992);
- Dermal Exposure Assessment: Principles and Applications (US EPA, 1992);

These documents are not listed in a hierarchical manner; other US EPA guidance documents and peer-reviewed technical papers may have also been referenced in this risk assessment report.

2.0 Hazard Identification and Conceptual Site Model

As a result of the historical wood preservation process, residual levels of creosote-related chemicals are present in soils in the former Process Area. Sediment and surface water in a drainage ditch along the southeast border of the former Process Area also contain chemical residuals. These Site-related chemicals, mostly polycyclic aromatic hydrocarbons (PAHs) are also present in the Fill Area. Residual levels of PAHs have been found in soil in the Fill Area and in Gordon's Creek surface water and sediment.

PAH residuals have also been detected in shallow groundwater underlying the Site. Currently, there are no private water wells located on-Site that access this shallow groundwater for potable purposes. The results of a door-to-door survey conducted by Michael Pisani and Associates on October 3, 2000 indicated no private uses of shallow groundwater downgradient of the Site. For these reasons, the groundwater exposure pathway, both on- and off-Site, was considered incomplete and not evaluated in this assessment.

A conceptual site model (CSM) was developed for the Site to aid in determining the potential receptors and exposure units to be evaluated under current and future potential land use (Figure 1). These receptors were identified as infrequent Site visitors, maintenance workers, construction workers, and off-Site residents.

Under current land use assumptions, Site visitors may potentially contact residual chemicals in Gordon's Creek surface water and sediment, and/or surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the drainage ditch along side of the former Process Area. Visitors may also potentially contact surface soil, surface water, and sediment along the former Process Area drainage ditch. The remaining affected areas of the Site are covered with either buildings or pavement precluding casual direct contact with surface soils. As a conservative measure, however, visitor exposure to soils from these paved areas was also assessed.

Under both current and future land use assumptions, a maintenance worker may contact surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the former Process Area and surrounding affected areas, including the drainage ditch located to the southeast of the former Process Area. Although most of the former Process Area and vicinity are paved, maintenance activities may involve some shallow digging; therefore, direct contact with shallow soils in this area was assessed. As a conservative measure, exposure to surface water and sediment in Gordon's Creek was assessed. The remainder of the Site was relatively unaffected by historical creosoting activities.

Although there are currently no major construction activities at the Site, these types of activities may occur at some time in the future. As with the maintenance worker scenario, construction activities could potentially occur in the Fill Area and vicinity, the grassy field southeast of the Fill Area, and the former Process Area and vicinity. Construction workers may be exposed to both surface and subsurface soils (down to the water table). Construction worker exposure to surface water and sediment in Gordon's Creek was assessed as a conservative measure. The remainder of the Site was relatively unaffected by historical creosoting activities.

Areas of the Site affected by historical creosoting activities will be deed restricted prohibiting future residential development. Off-Site areas along the northeast Drainage Ditch, currently a residential neighborhood, were assessed for residential exposures to soil, sediment, and surface water.

3.0 Data Evaluation

To characterize potential exposures to Site-related chemicals, the former Gulf States Creosoting facility was divided into six exposure units (EUs). Each exposure unit outlines potentially affected areas of the Site and adjacent on-Site locales that may be frequented by individuals accessing the Site for recreational or occupational purposes. The use of EUs is encouraged by the US EPA Region 4 (1995), which defines an EU as "an areal extent of a receptor's movements during a single day...." Each of these exposure units is depicted on Figure 2 and is discussed below.

A sixth EU was created for off-Site residential exposures to surface water and sediment along the northeast Drainage Ditch. This EU is delineated on Figure 3.

3.1 Exposure Unit Delineation

The following EUs were delineated based upon the presence of residual chemicals and the potential for receptors to contact those chemicals. Areas of the Site most affected were included in at least one of the five EUs while areas with relatively low or non-detectable concentrations of residuals were not included in an EU. By limiting Site-wide exposures to the EUs most affected by historical activities at the Site, worst-case scenarios were created.

3.1.1 Exposure Unit 1

EU1 outlines the on-Site areas in, adjacent to, and downstream of the Fill Area along Gordon's Creek (Figure 2). EU1 includes exposures to surface water and sediment by an infrequent Site visitor, future maintenance worker, and future construction worker. Although US EPA Region IV guidance indicates that "In most cases it is unnecessary to evaluate human exposures to sediments covered by surface water," (US EPA, 1995) dermal and oral surface water exposures were conservatively assessed herein at the request of the MDEQ (2000). Sediment samples included in EU 1 were SD07 and SD08. Surface water samples included in were SW-07 and SW-08.

Soil samples from this area were considered part of EU2 and exposures were assessed accordingly.

3.1.2 Exposure Unit 2

EU2 delineates the upland areas of the Fill Area and adjacent woody and grassy areas (Figure 2). Surface soils from zero to one foot and zero to six feet below ground surface [bgs] in this area were evaluated for potential visitor and future hypothetical maintenance worker scenarios, respectively. Surface and subsurface soils were also evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table (approximately 10 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU2 are presented in the table below:

Soils (0-1' bgs)	GEO-13/0-1'	SS-1	SS-2	SS-3	SS-4
	SS-5	SS-6	SS-7	SS-8	SS-9
	SS-10	SS-11	SS-12	SS-13	
Soils (0-6' bgs)	GEO-03/2-3'	GEO-03/5-6"	GEO-10/2-3	GEO-10/5-6	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-44/5-6'	SS-1	SS-2
	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
	SS-13				
Soils (0-10' bgs)	GEO-03/2-3'	GEO-03/5-6'	GEO-10/2-3	GEO-10/5-6'	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-43/7-8'	GEO-44/5-6'	GEO-45/7-8'
	SB-03/8-9.3	SB-05/4-9	SB-07/5-7	SS-1	SS-2
	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
	SS-13				

3.1.3 Exposure Unit 3

In the southwest corner of the Site there exists a grassy field east of West Pine Street between Henson Auto Sales and Eagan Cars and Trucks. This grassy area has been defined as EU3 for purposes of this risk assessment (Figure 2). Similar to EU2, surface soil from zero to one foot and zero to six feet bgs were evaluated in EU2 for visitor and hypothetical future maintenance worker scenarios, respectively. Surface and subsurface soils in this EU were evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table(approximately 20 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU3 are presented in the table below:

Soils (0-1' bgs)	SS-15	SS-16	SS-17		
Soils (0-6' and 0-20' bgs)	GEO-16/2-3'	GEO-16/5-6'	GEO-17/2-3'	GEO-17/5-6'	SS-15
	SS-16	SS-17			

3.1.4 Exposure Unit 4

EU 4 encompasses the grassy drainage ditch area along the fenceline behind Courtesy Ford in the northeast corner of the Site and continues parallel to the railroad tracks, and west through EU 3 and EU 2 (Figure 2). EU 4, along the southeast side of the former Process Area, has been widened to include soil data from that area. Receptors associated with EU 4 included Site visitor exposures via casual contact with surface soil, sediment, and surface water. Maintenance worker and construction worker scenarios were also evaluated for exposures to surface water and sediment in EU 4 as well as soils in EU 4 near the former Process Area. Soils down to six feet bgs were evaluated for maintenance workers while soils down to the water table (approximately20 feet bgs) were evaluated for construction workers in this EU as requested by the MDEQ (2000). Sediment, surface water, and soil samples included in EU4 are presented in the following table:

Sediment	SD-02	SD-12	SD-18	SD-19	SD-20
	SD-21	SD-22	SD-23		
Surface Water	SW-02		· · · · · · · · · · · · · · · · · · ·		
Soils (0-1' bgs)	GEO-19/0-1'	GEO-20/0-1'	GEO-21/0-1'	GEO-46/0-1'	GEO-47/0-1'
	GEO-48/0-1'				
Soils (0-6' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6'	GEO-20/0-1	GEO-20/2-3
	GEO-20/5-6'	GEO-21/0-1	GEO-21/2-3'	GEO-21/5-6'	GEO-46/0-1'
	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1'	GEO-47/2-3'	GEO-47/5-6'
	GEO-48/0-1'	GEO-48/2-3'	GEO-48/5-6'		
Soils (0-20' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6'	GEO-20/0-1'	GEO-20/2-3'
	GEO-20/5-6'	GEO-20/9-10'	GEO-21/0-1'	GEO-21/2-3'	GEO-21/5-6'
	GEO-21/9-10'	GEO-46/0-1'	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1'
	GEO-47/2-3°	GEO-47/5-6'	GEO-47/7-8'	GEO-48/0-1'	GEO-48/2-3'
	GEO-48/5-6'				

3.1.5 Exposure Unit 5

EU5 outlines the former Process Area and the historical drip track and treated wood storage areas of the former Gulf States Creosoting facility (Figure 2). Surface soils from zero to six feet bgs were evaluated in EU5 for a hypothetical maintenance worker scenario. Available data for soils down to the water table (approximately 20 feet bgs) were evaluated in EU5 for a hypothetical future construction worker scenario. Soil samples included in EU5 are presented in the table below:

Soils (0-1' bgs)	GEO-28/0-1'	GEO-29/0-1'	GEO-30/0-1 ²	GEO-31/0-1'	GEO-32/0-1'
	GEO-33/0-1'	GEO-59/0-1'	GEO-60/0-1'		
Soils (0-6' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
	GEO-29/5-6'	GEO-30/0-1'	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
	GEO-33/0-1'	GEO-33/2-3	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1'	GEO-60/2-3'	GEO-60/5-6'	
Soils (0-20' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
	GEO-29/5-6'	GEO-30/0-1'	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
	GEO-33/0-1	GEO-33/2-3'	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1'	GEO-60/2-3'	GEO-60/5-6'	GEO-60/7-8'
	SB-01/8-10	SB-02/9-11	SB-05/10.5-12.5	SB-06/6-10	SB-07/14-16

3.1.6 Exposure Unit 6

EU6 outlines a stretch (approximately 2700 feet in length) of the northeast drainage ditch that leads from the Site into the neighboring residential area. EU6 exposures include oral and dermal exposures by off-Site residents to sediment and surface water along the northeast drainage ditch. Soil exposures were not assessed in this area for lack of soil data. Also, it was anticipated that sediment exposures in this area represent a more conservative estimate of exposure in that chemical concentrations in the exposed sediment along the drainage ditch are likely to be greater than concentrations in the surrounding soils. Sediment and surface water samples included in EU6 are presented in the table below:

Sediment	SD-03	SD-04	SD-05	SD- 13
	SD-14	SD-15	SD-16	SD-17
Surface Water	SW-03	SW-04		

3.2 Statistical Evaluation

Environmental samples undergo laboratory analyses that are designed to quantitate the concentrations of constituents in the various environmental media. As a result of the analytical procedures, a constituent may be detected and its concentration measured, detected but not able to be quantitated, or not detected at all in a sample. The data set for the Site contains a number of nondetections for some chemicals of potential concern (COPCs) in various samples. Assuming that the COPC is present in these samples at the achieved detection limit is biased because the chemical may be absent altogether. Assuming a concentration of zero is also flawed because the chemical could be present at a level below laboratory capabilities to detect and quantify the concentration. Consequently, in the event that an analyte identified at least once in a given medium was not detected in a given sample, it was conservatively assumed for the risk assessment purposes to be present at a concentration equivalent to one-half of the sample quantitation limit (SQL). In addition, samples labeled with an "R" (rejected) qualifier were not included in the data analysis because those data were deemed unreliable and, therefore, unusable. Constituents that were not detected in any sample from a particular medium were eliminated from further consideration in accordance with US EPA guidelines (1989).

Site analytical data used in this assessment were collected during the Phase I (1997) and Phase II (1998) remedial investigations as well as the additional investigation conducted in 2000 at the request of the MDEQ. These data were fully validated by qualified technical professionals using standard data validation protocols, as required by the MCEQ (1999).

Previous investigations at the Site have been conducted since 1990. These investigations included the following:

- 1990 soil gas and soil sampling by Roy F. Weston
- 1991 MDEQ Site inspections and Phase II report
- 1994 Phase II Site investigation by Environmental Protection Systems (EPS)
- 1994 Site investigation by Bonner Analytical Testing Company (BATCO)
- 1994 preliminary subsurface investigation by BATCO

- 1995 three-dimension resistivity surveys by American Remediation Technology
- 1996 investigation by McLaren/Hart
- 1996 investigation by Kerr McGee Chemical Corporation

Data acquired from these historical (pre-1997) investigatory activities were not used in this assessment as they were not validated by qualified chemists and sampling locations for some of the data could not be accurately established. These historical data were not considered valid and were, therefore, not appropriate to use in this assessment of risks. Only validated data that were considered to be representative of Site conditions with a reasonable level of confidence were used for this assessment.

The validated laboratory data from 1997, 1998, and 2000 investigations were compiled into data sets representing areas of potential exposure (EUs) for each potential receptor. Each data set was analyzed statistically using SiteStat[®], a commercially available software package, to calculate the minimum, maximum, arithmetic mean, logarithmic mean, standard error of the mean, and the 95% upper confidence limit of the mean concentration (95% UCL) for each constituent based on distributional analysis of the data (*i.e.*, utilizing goodness-of-fit statistical tests to determine whether the data are distributed normally or lognormally). The data qualifier associated with the minimum and maximum detected concentrations as well as the location of the maximum detected concentration for each EU were also determined. Results of the quantitative and statistical analyses for each of the EUs discussed above are presented in Tables 1 through 18.

Standard sampling protocol requires the collection of duplicate field samples used to ensure the quality of a laboratory analysis (i.e., to ensure that analytical results can be replicated). As such, duplicate sample results were provided as part of the database for the Hattiesburg Site. In accordance with US EPA guidance (1989), duplicate sample results were averaged (for any sample containing duplicates) and the average concentration was used as a single concentration for that sample in the calculation of summary statistics as discussed below.

Soils down to one foot deep were assumed to be representative of surface soils at the Site for infrequent visitor exposures. A depth of 0 to 6 feet was used to define surface soils for maintenance worker exposures. These assumptions were recommended by the MDEQ (2000). The groundwater table was considered the extent of subsurface soils as recommended by MDEQ (2000). This value (depth-to-groundwater) varies significantly across the Site and, as such, the extent of subsurface soil was EU-specific as follows:

EU2 - soils down to 10 feet

EU3 - soils down to 20 feet

EU4 – soils down to 20 feet

EU5 - soils down to 20 feet

This risk assessment focuses mainly on environmental data collected from the former Process and Fill Areas and any other portions of the Site that were affected by former creosoting operations. Virtually unaffected areas (e.g., the developed area north of West Pine Street) as delineated using historical data were not considered to contribute significantly to risk levels and, therefore, were excluded from this risk assessment.

3.3 Determination of Exposure-Point Concentrations

Exposure-point concentrations were determined to be the 95% UCL or the maximum concentration of a COPC in an EU, whichever was lower. This methodology is in accordance with US EPA guidance (1989). If the distribution of the concentration data was determined to be lognormal, then the lognormal 95% UCL was compared to the maximum concentration to determine the exposure-point concentration. In the event that the distribution of a chemical in any given medium could not be confidently labeled as normal or lognormal, it is termed either "unknown" or "normal/lognormal." In these cases, the lognormal 95% UCL was compared to maximum concentration when determining the exposure-point concentration. It should be noted, however, that in cases where the distribution is "unknown," the normal and lognormal 95% UCLs could not be reliably predicted. Assuming a lognormal distribution of the data increases

the uncertainty associated with this step of the risk assessment process; however, hazard and risk estimates are likely to be less uncertain than if the maximum concentrations were used.

Exposure-point concentrations are provided on the statistical summary tables, Tables 1 through 18.

3.4 COPC Selection

Soils (both surface and subsurface) were screened according to MCEQ (1999) guidance. The first tier of the screening process compared maximum concentrations of a constituent in an EU with the Restricted Tier 1 target remediation goal (TRG) for maintenance worker and construction worker scenarios. Restricted TRGs were used because the Site is not currently used for residential purposes and the current commercial/industrial land-use is anticipated to remain into the future as a result of the implementation of deed restrictions on the impacted areas of the Site. If a maximum concentration of a constituent was less than the Restricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment.

Surface soil data (zero to one foot bgs) for the visitor scenario was screened using Unrestricted Tier 1 TRGs at the request of MDEQ (2000). If a maximum concentration of a constituent was less than the Unrestricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment. Conversely, if the maximum concentration of a constituent exceeded the Tier 1 TRG, that constituent was retained for quantitative analysis.

If the maximum concentration of a constituent in an EU exceeded the Tier 1 TRG, then the 95% UCL of the constituent was compared to the Tier 1 TRG (Restricted or Unrestricted, depending on the exposure scenarios as described above) as part of the Tier II screening process. In the event that the concentrations of a chemical were distributed lognormally, the lognormal 95% UCL of that constituent was compared to the Tier 1 TRG. If the distribution of data of a chemical could not be positively identified as either normal or lognormal, the lognormal 95% UCL was used in the screening process. In these cases, either the maximum concentration or the lognormal 95% UCL can be conservatively used. The US EPA, however, justifies the use of an

average concentration as the exposure-point concentration by explaining that toxicity criteria for both carcinogenic and non-carcinogenic effects are based on lifetime average exposures and that the "average concentration is most representative of the concentration that would be contacted at a site over time" (Supplemental Guidance to RAGS: Calculating the Concentration Term, 1992). Other US EPA guidance states that "... in most situations, assuming long-term contact with the maximum concentration is not reasonable" (Risk Assessment Guidance for Superfund, Part A, 1989). US EPA Region 4 also states that, generally, it is reasonable to assume that soil data are distributed lognormally (1995). In keeping with these guidances, the lognormal 95% UCL was considered in the screening process where the data distribution for a compound could not be defined as specifically normal or lognormal.

If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent was less than the Tier 1 TRG, then that constituent was eliminated from further quantitative analysis. If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent in soil exceeded the Tier 1 TRG, then that constituent was retained for quantitative analysis in the Site-specific risk assessment (Tier III).

MCEQ guidance (1999) does not specify screening levels for constituents in sediment or surface water; therefore, Region 4 was referred to for guidance (1995). Sediment is only found on the Site in drainage ditches that contain little to no water most of the time. US EPA Region 4 guidance states that sediments in an intermittent stream (or ditch) should be considered as surface soil for the portion of the year the stream is without water. Based on these factors and comments provided by the MDEQ (2000), the maximum detected constituent concentrations in sediment was compared to MCEQ unrestricted Tier 1 TRGs. The screening process then followed the same procedure as mentioned above for other soils.

For surface water, the maximum detected concentration of a constituent in an EU was compared to the US EPA Human Health Water Quality Standard (WQS) for consumption of water and organisms in accordance with US EPA Region 4 guidance (1995). If the maximum

concentration of a constituent in surface water was less than the WQS, then that constituent was eliminated from quantitative analysis. If the maximum concentration of a constituent in surface water exceeded the WQS, then that constituent was retained for quantitative analysis.

At the request of MDEQ (2000), if any single carcinogenic polycyclic aromatic hydrocarbon (cPAH) was retained as a COPC in a medium, then all cPAHs were also retained as COPCs in that medium. This guidance refers to the following chemicals: benzo(a)anthracene, benzo(b)fluoroanthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. To establish an exposure point concentration for undetected cPAHs retained as COPCs in an EU, one-half the maximum detection limit was used.

The results of the screening process are presented on the statistical summary tables, Tables 1 through 18. The screening process eliminated detected constituents from the subsurface soil dataset down to 20 feet bgs and surface soil dataset down to 6 feet bgs in EU3 For this reason, construction worker and maintenance worker exposures to soils in EU3 were not evaluated quantitatively in this assessment.

4.0 Exposure Assessment

Currently, a majority of the Site is used for commercial and light industrial purposes and is paved for roads and parking lots. Unpaved areas are limited to Gordon's Creek (EU 1), the wooded portion in and around the Fill Area (EU2) and the grassy field outlined by EU 3, and the drainage ditches and surrounding area delineated by EU 4 (Figure 2). Since the developed and undeveloped areas of the Site vary considerably with respect to both residual chemical concentrations and land use, the Site was divided into five EUs for the exposure assessment. A sixth EU was created to assess off-Site residential exposures. Chemical data from each EU were combined with EU-specific exposure parameter values and receptor scenarios to determine the chemical intake for each receptor potentially accessing an EU for occupational, recreational, or residential purposes.

4.1 Receptor Identification

The following exposures pathways (indicated with an "X") have been selected for this risk assessment as reasonable and realistic scenarios under current and future land-use assumptions:

EU/Media: Receptor/Route:	EU1		EU2	EU3	EU4			EU5	EU6	
	Sed.	Surf. Water	Soil	Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water
Visitor		:		<u> </u>						
Dermal	X	X	X	x	х	X	X	X		
Orali	X	X	X	X	Х	X	X	X		
Inhalation										******************
Maint. Worker			***************************************	-						
Dermal	X	X	X	X	Х	Х	X	X		
Orai	X	X	X	X	Х	X	Х	X	·	***************************************
Inhalation							**************************************			****
Const. Worker	ra wasaya ya Marabara		administrative programme	*************				rigi yanging lagay kilok kililin kalan	***********	
Dermai	x	Х	X	x	Х	X	Х	×		***************************************
Oral	X	X	X	X	x	X	X	X		~~~~
Inhalation		,	X	X	Х			X		,

EU/Media:	EU1		EU2	EU3	EU4			EU5	EU6		
Receptor/Route:	Sed.	Surf. Water	Soil	Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water	
Off-Site Resident											
Dermal		*****************	, mp, mp, mp, mp, mp, mp, mp, mp, mp, mp	************	100 W 100 100	(*************************************			X	X	
Oral										x	
Inhalation		\$	***************************************								

Surface water present on-Site is either ephemeral or very shallow and is conducive only to wading-type activities. Ingestion of Site surface water was considered an insignificant exposure pathway since on-Site drainage ditches "contain little or no water most of the time" (MDEQ, 2000). In addition, US EPA IV guidance indicates that "In most cases, it is unnecessary to evaluate human exposures to sediments covered by surface water" (1995). At the request of MDEQ (2000), however, dermal and oral exposures to surface water were assessed for visitors, maintenance workers, and construction workers in EUs 1 and 4. Surface water exposures were also assessed for residents in off-Site EU 6.

Each of the potential receptors is discussed below.

4.1.1 Infrequent Site Visitor

Since the Site is not currently fenced or guarded, the general public has access to most areas of the Site at any given time. It is possible, though unlikely, that an individual may use some areas of the Site, such as EU1, EU2, or EU3, for recreational purposes. For this reason, sediment and surface water exposures to visitors in EU1, and surface soil exposures in EU2 and EU3 were assessed for the visitor scenario. The vast majority of the remainder of the Site (EU5) is covered with either buildings or pavement, precluding direct contact with surface soils; however, a small exposed area encompassing a drainage ditch exists along side of the former Process Area (EU4). Although this area is not attractive for recreational purposes, it is possible that an individual traversing the Site may contact surface soils, sediment, or surface water in this EU; therefore, these potential exposures were assessed. Sediment exposures in EU1 and EU4 were addressed in accordance with US EPA Region 4 guidance that recommends evaluating sediment exposures in intermittent streams. At the request of MDEQ (2000), soil exposures were assessed for visitors

in EU5 regardless of the existence of buildings and pavements precluding almost all potential direct contact with soils in this area.

4.1.2 Maintenance Worker

Currently, maintenance activities are most likely limited to the developed portions of the Site. Of these, the former Process Area and adjacent former drip track and treated wood storage areas (EU5) were most affected by historical wood preserving processes. Although these areas are mostly paved or built upon, it is possible that maintenance activities may require some shallow digging in unpaved areas; therefore, exposures to surface soils in EU5 were assessed. As a conservative measure, surface soil data from sample locations located in paved areas were evaluated in conjunction with surface soil data from exposed areas in EU5. If the currently undeveloped portions of the Site (EU2 and EU3) become developed in the future, similar maintenance activities may be required and, therefore, exposures to surface soils in EU2 and EU3 were also assessed. The drainage ditch encompassed by EU4 requires periodic maintenance; therefore, exposures to soil, sediment, and surface water in this area were assessed. At the request of MDEQ (2000), maintenance worker exposures to surface water and sediment in EU1 were also assessed.

4.1.3 Construction Worker

Although there are currently no major construction activities at the Site, such activities may hypothetically occur in the future. Thus, exposures to surface water and sediment in EUs 1 and 4, and exposures to soil in EUs 2 through 5 were assessed herein. Construction workers may be exposed to both surface and subsurface soils during activities such as excavating. Subsurface soils, for purposes of this assessment, were defined as those soils at the water table and shallower. Since the depth to the water varies significantly across the Site, so does the definition of "subsurface" soils. Accordingly, subsurface soils were evaluated down to 10 feet for EU2 and 20 feet for EUs 3, 4, and 5.

4.1.4 Future On-Site Residents

The affected areas of the Property (the Site) are currently zoned for industrial or light-commercial use, and, at the time of this report, there were no plans to develop the Site for residential housing. In fact, deed restrictions preventing residential development are in the process of being implemented for the impacted areas on Site. Because of these deed restrictions, it is reasonable and realistic to assume that the Site will remain commercial/industrial in the future; therefore, on-Site residential exposures were not addressed in this risk assessment.

4.1.5 Off-Site Residential Exposures

The northeast drainage ditch extends from the former Process Area to the northeast into a nearby residential community. Surface water and sediment data from areas along the northeast drainage ditch (EU6, Figure 3) were evaluated for off-Site residential exposures. For purposes of exposure assessment, a child resident between the ages of 1 and 6 years and an adolescent/adult resident between the ages of 7 and 30 years were evaluated. Hazards and risks for these two receptors were then combined (summed) to reflect the exposures incurred by a single individual living off-Site in the vicinity of the northeast drainage ditch for 30 years.

4.2 General Intake Equation

Chemical exposure/intake is expressed as the amount of the agent at the exchange boundaries of an organism (i.e., skin, lungs, gut) that is available for systemic absorption. An applied dose is defined as the amount of a chemical at the absorption barriers such as skin, lung, digestive tract, available for absorption and is (usually expressed in milligrams, or mg) absorbed per unit of body weight of the receptor (usually expressed in units of kilogram, or kg). Absorbed dose can be defined as the amount of chemical that penetrates the exchange boundaries. If the exposure occurs over time, the total exposure can be divided by the time period of interest to obtain an average exposure rate (e.g., mg/kg-day). The general equation, as defined by US EPA, for estimating a time-weighted average intake is:

Intake (mg/kg - day) =
$$\frac{C \times IR \times EF \times ED}{BW \times AT}$$

[Equation 1]

where:

C = chemical concentration at the exposure point (e.g., mg/m^3 air);

IR = intake rate $(e.g., m^3/hr)$;

EF = exposure frequency (days/year);

ED = exposure duration (years);

BW = body weight of exposed individual (kg); and

AT = averaging time (period over which exposure is averaged, usually

measured in days).

Additional parameters (e.g., skin surface area) were incorporated into the above general equation to evaluate the different potential exposure routes (dermal, oral, inhalation).

Table 19 presents the general and pathway-specific exposure parameters utilized for the intake equations in this assessment.

4.2.1 General Exposure Parameters

Although some of the parameters used to calculate potential exposure are pathway- or route-specific, exposure frequency (EF), exposure duration (ED), averaging time (AT; determined separately for carcinogenic and non-carcinogenic exposures), and body weight (BW) are present in each intake model. These general parameters remain consistent throughout the intake calculations for each specific receptor.

4.2.1.1 Exposure Frequency

The exposure frequency (EF) describes the number of times per year an event is likely to occur. It is most often expressed in units of days/year or events/year, depending on the scenario. Variables such as weather, vacations, sick days, and institutional controls often aid in determining reasonable and realistic exposure frequencies.

The EF for an adolescent visitor was extracted from US EPA Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) Interim Final (1989). This EF value of 12 days/year per EU is a reasonable estimate that assumes an adolescent would most likely be engaged in outdoor activity on the unpaved areas of the Site for one day a week during

the three warmest months of the year. This value was used for soil, sediment, and surface water exposures.

Typical construction projects, especially at industrial complexes, generally involve several phases of activity prior to completion. The EF parameter used for oral exposure in construction workers, therefore, was subdivided into two exposure events. The first event hypothetically lasts for 10 days (used in relevant exposure model calculations under "Exposure Level A") and would involve earth-moving activities such as foundation. The second exposure event to the same individual hypothetically lasts for 70 days (for a total of 80 days at the Site for an individual; this value was used in relevant exposure model calculations under "Exposure Level B") and included remaining construction activities such as building framing, plumbing installation, electrical installation, and roofing. Generally, to complete each of these phases, a different team of specialized contractors is employed to perform the tasks for which they are most qualified. As a result, an individual may only remain at the construction site for a few days or weeks until his/her task has been completed and the next phase has begun. This is especially true for those activities involving direct contact with soil such as excavating and foundation pouring. Individuals performing these tasks are not usually qualified or employed to continue with the actual building processes. For dermal and inhalation exposures, however, an 80-day EF was used and accounted for an individual to be involved in construction activities for four entire months of the year (assuming five-day work weeks).

For surface water and sediment exposures to construction workers, an EF value of 8 days/year was used. This value represents 1/10th of the time a worker may be on-Site for construction-type activities and is conservative in that it is unlikely that construction workers would be exposed at all to Site surface water or sediment.

The EF value used for the maintenance worker scenario was 150 days/year for surface soil exposures in EUs 2, 3, and 5. This is also a conservative assumption in that the currently developed areas of the Site are covered with buildings or pavement. Maintenance activities in

these areas would require little contact with the obscured surface soils. The undeveloped areas of the Site currently require little or no maintenance as they are only occasionally mowed or allowed to grow naturally. Should these areas become developed, they will most likely take on the appearance of the remainder of the Site, including industrial/commercial buildings and paved roads or parking lots. Once again, extensive direct contact with surface soils would be minimal for a maintenance worker.

For maintenance worker sediment and surface water exposures in EUs 1 and 4 and surface soil exposures in EU 4, an EF value of 30 days/year was used. Historically, the northeast drainage ditch has been maintained on an as-needed basis (less than annually). Maintenance worker exposures to sediment and surface water in these areas were assessed at the request of the MDEQ (2000). An EF value of 30 days/year is amply conservative in that both Gordon's Creek (EU 1) and the northeast drainage ditch (EU 4) are currently maintained less than annually.

For residential soil exposures, an exposure frequency of 350 days/year was used in accordance with Region IV guidance. This value assumes that 15 days/year are spent away from home (US EPA, 1991).

Sediments along the bank of the northeast drainage ditch are not comparable to surface soils comprising a yard with respect to exposure. Typically, yard soils include relatively large areas where children frequently play and where surface soils are tracked into the home to become part of the household dust that can be ingested, particularly by crawling infants, on a daily basis. These are the assumptions that underlie the standard residential soil exposure algorithm and parameter values. However, it is not realistic to assume that infants, children, or adults will directly contact a relatively small area of sediments on the banks of a drainage ditch on a daily basis. A more realistic exposure scenario for this unique area under an assumption of residential land use is for a resident child to play on occasion in the drainage ditch that traverses the residential property. An exposure frequency of 40 days/year, two hours per exploring event, is conservatively plausible.

4.2.1.2 Exposure Duration

The ED parameter represents the number of years during which an event is likely to occur. Factors affecting this parameter include variables such as age of receptor, population mobility, and occupational mobility. Exposure durations of less than seven years typically correspond to subchronic exposures while those greater than seven years are typically considered chronic exposures (US EPA, 1989). Toxicity indices are selected based on subchronic or chronic exposure durations.

The future construction worker scenario used an ED of one year because it is highly unlikely that a future construction worker would remain on one site for more than a year. Often, two months is considered the maximum amount of time a construction worker may reasonably remain at the same site.

The future maintenance worker ED, on the other hand, is based on occupational mobility studies. The ED of 25 years was obtained from US EPA (1991) which recommends a 95th percentile value of 25 years based on a study by the Bureau of Labor Statistics as of 1987. US EPA Region 4 also recommends a default value of 25 years for worker scenarios (1995).

The adolescent visitor scenario used an ED of 10 years. An adolescent was defined in this assessment as an individual aged seven to 16 years in accordance with US EPA Region 4 (1995); therefore, an exposure duration of 10 years was most appropriate.

An ED of 30 years (US EPA Region 4, 1995) was used for off-Site residents. This value assumes an individual spends 6 years as a child and 24 years as an adolescent/adult in the same location.

4.2.1.3 Averaging Time

The averaging time (AT) parameter is the time period over which exposure is averaged. For human health cancer risk calculations, the AT_c value prorates a total cumulative dose over a

lifetime. As a conservative approach, the AT_c value for each receptor is the product of a 365-day year and a 70-year life span, equaling 25,550 days.

The AT_n used for non-carcinogenic effects is the product of a 365-day year and the exposure duration (i.e., $AT_n = 365$ days × ED). Because the ED parameter changes for each receptor, the AT_n changes as well. The AT_n values used for each receptor are summarized below:

Future Construction Worker - 365 days

Maintenance Worker - 9125 days

Adolescent Visitor - 3650 days

Off-Site Child Resident - 2,190 days

Off-Site Adult Resident - 8,760 days

4.2.1.4 Body Weight

The body weight used for the adult exposures (future construction worker and maintenance worker) analyzed in this assessment was the current US EPA default value of 70 kg (US EPA, 1989, US EPA Region 4, 1995). This value was also used for the adolescent/adult off-Site resident scenario. The adolescent body weight used for the visitor scenarios was 45 kg. This value was extracted from US EPA Region 4 guidance (1995). For the child resident scenario, a body weight of 15 kg was used as recommended by US EPA (1991).

4.2.2 Route-Specific Exposure Parameters

The general intake equation discussed above (Equation 1) was modified by including route-specific exposure parameters in order to calculate route-specific intake values. For dermal exposures, skin surface area, adherence factor, exposure time (surface water exposures only), and absorption factor parameters were included in the intake equation. For ingestion exposures, an ingestion rate and a matrix effect were included in the intake calculation. For inhalation exposures, an inhalation rate and a retention factor for fugitive dusts were included in the intake equation. Also, for inhalation exposures, an additional paradigm was necessary to convert soil concentrations to concentrations in air available for intake.

4.2.2.1 Dermal Exposure Parameters

Skin Surface Area

The total skin surface area used for adult receptors in this assessment was 20,000 cm². This is a US EPA default value extracted from the *Exposure Factors Handbook* (1997). For adolescent exposures, a value of 12,768.3 cm² was used for total skin surface area. This was a mean value calculated based on the distributions of total skin surface areas for males and females between the ages of 7 and 16 as presented in *Exposure Factors Handbook* (1997). For the off-Site child resident scenario, a skin surface area of 7,213 cm² was used. This value was based on skin surface area data for male and female children provided in *Exposure Factors Handbook* (1997).

For purposes of exposure, it was assumed that only portions of the body would be exposed to the affected media on the Site. For the construction worker scenario, it was assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. These body parts comprise 27.8% of the total skin surface area, or 5560 cm².

For maintenance worker exposures to Site soils, it was assumed that the hands, forearms, and face would be exposed. These body parts comprise 15 percent of the total skin surface area, or 3000 cm².

For surface water and sediment exposures, exposed body parts for construction and maintenance workers included hands, forearms, and face or 3000 cm² (15% of the total skin surface area).

The visitor and off-Site resident scenarios assumed that the hands, forearms, and lower legs would be exposed for contact with Site soils. These body parts comprise 23.9% of the total skin surface area, or 3052 cm² for adolescent visitors, 1724 cm² for child residents, and 4780 cm² for adult residents. For exposures to surface water and sediment, hands, forearms, lower legs, and feet were assumed exposed for adolescent visitor and off-Site resident scenarios. These body parts comprise 30.9 % of the total skin surface area or 3945 cm² for adolescent visitors, 2229 cm² for child residents, and 6180 cm² for adult residents.

Soil Adherence Factor

Until recently, the US EPA-recommended default for soil adherence on skin ranged from 0.2 to 1.0 mg/cm² for the entire exposed surface area, without consideration of the type of activity (US EPA, 1992). However, the data from which that range was derived were primarily the result of indirect measurements, artificial activities, and sampling of hands only. A more recent study has presented the results of direct measurement of soil loading on skin surfaces before and after normal occupational and recreational activities that might result in soil contact (Kissel et al., 1996). A fiveorder of magnitude range (roughly 10^{-3} to 10^{+2} mg/cm²) was reported for observed activity-related hand loadings. That report indicated that hand loadings within the range of 0.2 to 1.0 mg/cm² were produced by activities in which there was vigorous soil contact (e.g., rugby, farming); but for activities in which there was less soil contact (e.g., soccer, professional grounds maintenance), loadings substantially less than 0.2 mg/cm² were found on hands and other body parts. Kissel et al. (1996) concluded that, because non-hand loadings attributable to higher contact activities exceeded hand loadings resulting from lower contact activities, hand data from limited activities cannot be used as a conservative predictor of loadings that might occur on other body surfaces without regard to activity. Furthermore, because exposures are activity-dependent, dermal exposure to soil should be quantified using data describing human behavior (e.g., type of activity, frequency, duration, including interval before bathing, clothing worn, etc.).

The most recent version of the Exposure Factors Handbook (1997) states:

In consideration, of these general observations and the recent data from Kissel et al. (1996, 1997), this document recommends a new approach for estimating soil adherence to skin. First use Table 6-12 [Summary of Field Studies, Kissel et al., 1996a] to select the activity which best approximates the exposure scenario of concern. Next, use Table 6-13 [Mean Soil Adherence by Activity and Body Region, Kissel et al., 1996a] to select soil loadings on exposed skin surfaces which correspond to the activity of interest. This table contains soil loading estimates for various body parts. The estimates were derived from soil adherence measurements of body parts of individuals engaged in specific activities described in Table 6-12. These results provide the best estimate of central loadings, but are

based on limited data. Therefore, they have a high degree of uncertainty such that considerable judgment must be used when selecting them for an assessment.

In another study that assessed the percentage of skin coverage in several soil contact trials in a greenhouse and an irrigation pipe laying trial, Kissel et al. (1996) concluded that adjusted loadings may be two to three orders of magnitude larger than average loadings if average loadings are small.

The activity-specific soil adherence factor for exposures to a maintenance worker was calculated based on data presented by Kissel *et al.* (1996) for grounds keepers, as presented below:

Re Receptor		Soil Adherence Factor by Body Part (mg/cm²)					
	Representative Activity	Hands	Arms	Lower Legs	Face		
Maintenance Worker	Grounds Keepers	0.030 - 0.15	0.0021 - 0.023	0.0008 - 0.0012	0.0021 - 0.01		

Data for the grounds keepers were used for the maintenance worker estimates because the activities of a grounds keeper best mimic those of a maintenance worker.

Soil adherence factors were calculated by normalizing each body part-specific soil adherence value (using the mid-points of the ranges tabulated above) with regard to the percentage of total body surface area represented by the respective body part (extracted from the US EPA Dermal Exposure Assessment: Principles and Applications [US EPA, 1992]). The maintenance worker adherence factor for soil was calculated based upon exposure to the hands, forearms and face. Surface area percentages for the hands, forearms, and face are 5.2, 5.9, and 3.9 percent, respectively (US EPA, 1997). Those body parts comprise 15 percent of the total body surface area. The normalized values for all body parts of interest were added, and the sum was divided by the total percentage of body surface area occupied by the parts. For example, the soil and sediment adherence factors for maintenance worker soil exposures (0.038 mg/cm²) were calculated as follows:

AF (mg/cm²) =
$$\frac{(0.09 \times 0.052) + (0.0126 \times 0.059) + (0.006 \times 0.039)}{0.15}$$
 = 0.038

The construction worker adherence factor was also calculated in this fashion. This exposure scenario assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. Soil loadings for the upper torso (chest and back) were not measured by Kissel *et al.* (1996) for construction workers because this body area is generally covered. However, to account for exposure to the upper torso during the very hot months of the year, the total area of the forearms, legs, hands, and face were assumed to be completely exposed. The hands, forearms, legs, and face comprise 5.2%, 5.9%, 12.8%, and 3.9% of the total skin surface area, respectively (with the face comprising one-third the surface area of the head), for a total of 27.8% exposed surface area. The construction worker soil adherence factor was based on data from Kissel *et al.* (1996) for construction workers as follows:

Receptor		Soil Adherence Factor by Body Part (mg/cm²)					
	Representative Activity	Hands	Arms	Lower Legs	Face		
Construction Worker	Construction Worker	0.24	0.098	0.066	0.029		

The soil adherence factor for the construction worker scenario was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.066 \times 0.128) + (0.029 \times 0.039)}{0.278} = 0.1$$

For sediment exposures, the soil adherence factor was calculated for the construction worker scenario using adherence data from Kissel et al. (1996) for construction workers (as tabulated above) for the hands, forearms, and face. The hands, forearms, and face comprise 5.2, 5.9, and

3.9 percent of the total skin surface area, respectively (totaling 15 percent). Thus, the adherence factor for construction workers exposed to sediment (0.13 mg/cm²) was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.029 \times 0.039)}{0.15}$$
 = 0.13

The adherence factor for visitor and off-Site resident exposures to soil assumed that the forearms, hands, and lower legs would be exposed to soil or sediment. The data used in these calculation were based on data by Kissel et al. (1996) for soccer players (exposed to a playing field of roughly one-half grass and one-half bare earth in a light mist) as presented below:

		Soil Adherence Factor by Body Part (mg/cm²)					
Receptor	Representative Activity	Arms	Hands	Lower Legs			
Visitor and Off- Site Resident	Soccer Players	0.0029 - 0.011	0.019 - 0.11	0.0081 - 0.031			

The forearms, hands, and lower legs comprise 5.9%, 5.2%, and 12.8% of the total skin surface area, respectively, for a total of 23.9% (US EPA *Exposure Factors Handbook*, 1997). The adherence factor was then calculated for visitor and off-Site resident dermal exposures to soil as follows:

AF (mg/cm²) =
$$\frac{(0.00695 \times 0.059) + (0.0645 \times 0.052) + (0.0196 \times 0.128)}{0.239} = 0.026$$

A value of 0.026 mg/cm² was used as the soil adherence factor for visitors to the Site and off-Site residents.

Soil adherence factors for sediment exposures to Site visitors and off-Site residents were calculated using adherence data for the hands, forearms, lower legs, and feet. Adherence data for

reed gatherers were used for these exposures to best mimic activities that may incur sediment exposures. The reed gatherers studied by Kissel et al. (1996) periodically visited tidal flats to collect raw materials for basket weaving. The data from Kissel et al. (1996) presented in Exposure Factors Handbook (US EPA, 1997) were as follows:

		Soil Adherence Factor by Body Part (mg/cm					
Receptor	Representative Activity	Hands	Arms	Lower Legs	Feet		
Visitors and Off-Site Residents	Reed Gatherers	0.66	0.036	0.128	0.63		

The hands, forearms, lower legs, and feet comprises 5.2, 5.9, 12.8 and 7.0 percent of the total skin surface area, respectively (totaling 30.9 percent). Thus, the adherence factor for visitors and off-Site residents exposed to sediment (0.33 mg/cm²) was calculated as follows:

AF
$$(mg/cm^2) = \frac{(0.66 \times 0.052) + (0.036 \times 0.059) + (0.16 \times 0.128) + (0.63 \times 0.07)}{0.309} = 0.33$$

Exposure Time

To estimate intakes as a result of dermal exposure to surface water, an exposure time (ET) parameter was included in the intake formula for Site visitors and off-Site residents. The parameter value of 1.0 hour/day was estimated using best professional judgement. This value represents the amount of time a Site visitor or off-Site resident may spend exposed to surface water in any one EU.

Dermal Permeability Constant

The permeability constant, Kp, accounts for the movement of a constituent dissolved in water through the skin, across the stratum corneum, and into the blood stream. Kp values for the constituents examined in this assessment for surface water exposures were obtained from US EPA Dermal Exposure Assessment: Principles and Applications (1992). For values not available in

US EPA Dermal Exposure Assessment (1992), the Kp value were calculated using the equations provided by the US EPA in the same document.

Dermal Absorption Factor

The final parameter included in the dermal intake paradigm was a dermal absorption factor. In general, the skin provides an effective barrier to environmental toxins. For example, certain hair-coloring formulations which are vigorously rubbed onto the scalp on a daily basis contain lead acetate at concentrations up to 200,000 ppm, yet lead toxicity does not appear to result. Moore et al. (1980) determined that the rate of lead absorption from 203^{Pb} labeled lead acetate in cosmetic preparations containing six mmol Pb acetate/L in male volunteers over 12 hours was 0.06% during normal use of such preparations. For most inorganic salts, percutaneous (skin) absorption is considered insignificant relative to incidental ingestion (for example, US EPA, 1986). On the other hand, some drugs (e.g., nicotine) are effectively administered and absorbed into the blood stream from dermal "patches."

Most dermal bioavailability data for impacted soil have been obtained in laboratory animals or in vitro test systems. This introduces a significant source of uncertainty for predicting the human response. Safety factors have sometimes been applied to dermal absorption data obtained in animals to conservatively estimate the upper-bound of likely human percutaneous uptake of a certain constituent from skin exposure. This is usually unnecessary because human skin has generally been shown, for a diverse group of constituents, to be about 10-fold less permeable than the skin of typical animal species, such as rabbits and rats (Bartek and LaBudde, 1975; Shu et al., 1988).

US EPA Region III evaluated available data concerning the dermal absorption of specific constituents and classes of constituents and provided several recommendations (US EPA Region 3, 1995). For semivolatile compounds, such as bis(2-ethylhexyl)phthalate, the US EPA recommends a range of 1% to 10% (US EPA, 1995). Kao et al. (1985) reported 2.7 percent for absorption of topically applied pure benzo(a)pyrene by human skin in vitro. The US EPA

Region 3 recommends using 10% as a conservative assumption based on the Ryan et al. study (1987). In addition, US EPA Region 4 guidance (1995) states that a soil dermal absorption factor "of 1.0% for organics and 0.1% for inorganics should be used as defaults in determining the uptake associated with dermal exposure" (see the Dermal Contact subsection of Exposure Assessment section of the 1995 guidance). For the purpose of this risk assessment, an ABS of 3% for cPAHs and of 10% for other SVOCs were conservatively assumed for dermal absorption, in keeping with US EPA Region 3's and MDEQ's recommendations.

4.2.2.2 Ingestion Exposure Parameters

Ingestion Rate

US EPA's Exposure Factors Handbook (1997) discusses three adult soil ingestion studies with results ranging from 10 mg/day to 480 mg/day. Hawley's (1985) value of 480 mg/day (as recommended by the MDEQ) was "derived from assumptions about soil/dust levels on hands and mouthing behavior" (US EPA, 1997). Since no supporting measurements were made for Hawley's study, the US EPA states that Hawley's estimate "must be considered conjectural" (1997). As such, the US EPA goes on to suggest adult soil ingestion rates of 50 mg/day for industrial settings and 100 mg/day for residential and agricultural settings, although "50 mg/day still represents a reasonable central estimate of adult soil ingestion and is the recommended value..." (1997). Accordingly, a value of 100 mg/day for the maintenance worker and adult off-Site resident is amply conservative and was used in this assessment. In conjunction with the use of a two-tiered EF to reflect the different stages of potential future construction activities (see Section 4.2.1.1), the soil ingestion s for the construction worker scenario was also divided into two exposure levels for a single individual. A highly conservative ingestion rate of 480 mg/day (used in relevant exposure model calculations under "Exposure Level A") was used for construction workers for the first 10 days of exposure to address direct contact with soil during earth-moving activities such as foundation excavating. A soil ingestion rate of 100 mg/day (used in relevant exposure model calculations under "Exposure Level B") was used for the remainder of the construction worker exposure (70 days). Risks were then summed for both exposure levels to estimate the total potential risk posed to an individual construction worker

The ingestion rate used for the adolescent visitor scenario was 100 mg/day. The US EPA Region IV (1995) recommends a value of 200 mg/day as a mean ingestion rate for children under six years of age. This value was conservatively used in this assessment to estimate soil and sediment ingestion exposures for an off-Site resident child aged one to six years.

Gastrointestinal Matrix Effects of Soil

Incidental ingestion incorporates the matrix effect (ME; sometimes called the absorption adjustment factor [AAF]) into the general intake equation. When constituents are administered in solid vehicles such as food and soil, only a fraction of the ingested dose is extracted from the vehicle and subsequently absorbed through the gastrointestinal tract (US EPA Estimated Exposure to Dioxin-like Compounds, 1992). Gastrointestinal absorption of constituents sorbed onto such a medium is inhibited by physical-constituent bonding to the matrix (Hawley, 1985). This phenomenon is referred to as the gastrointestinal matrix effect of soil. Several studies referenced in the US EPA's Estimated Exposure to Dioxin-like Compounds (1992) have been performed to estimate the oral absorption factors of constituents from soil. At the request of MDEQ (2001), however, a gastrointestinal matrix effect of 1.0 was used in accordance with US EPA Region IV guidance (1995), although this approach is highly conservative and does not account for scientific studies that indicate the absorption of chemical constituents through the gastrointestinal tract is less than 100%.

4.2.2.3 Inhalation Exposure Parameters and Paradigms

Inhalation Rate

The inhalation rate used for the construction worker scenario was 20 m³/day. This is a common US EPA default value and was recommended by US EPA Region 4 (1995).

Retention Factor

According to the International Commission on Radiological Protection (ICRP), 75 percent of respirable dust particles (PM₁₀, or particles less than 10 microns in aerodynamic diameter) are retained when inhaled, the vast majority of which is potentially subsequently swallowed (ICRP,

1968). This 75% was included in the inhalation intake equation as the retention factor parameter (RF). This parameter applies only to non-VOC constituents entrained onto dust particles.

Concentration in Air

To estimate airborne dust levels during hypothetical construction activities, an emission rate of suspendible particles of less than 15 microns in aerodynamic diameter (PM₁₅) was calculated (grams/second); particles less than 10 microns were considered to be respirable. Considering particles of 15 microns or less in diameter in the emission rate calculation is a conservative assumption, inasmuch as only particles with an aerodynamic diameter of less than five to seven microns are inhaled into the lung.

The two types of construction activities at the Site that have the potential to emit fugitive dusts are vehicular movement over bare (unpaved or unvegetated) surfaces and the excavation of soil. Estimation of fugitive dust emissions caused by each activity were examined separately, as follows, and were derived from existing estimates of general construction exposure. The sum of the emissions from these two activities was multiplied by the concentration of constituent in the soil (Cs) in order to derive the total emission rate (Ei) for non-VOCs as follows:

$$Ei = C_s \times (PERv + PERe)$$
 [Equation 2]

where:

Ei = Emission rate (mg/sec);

 C_s = Concentration in soil (mg/kg);

PERv = Particulate emission rate for vehicular movement (lb/vehicle mile);

and

PERe = Particulate emission rate for excavation (lb/vehicle mile).

The following empirical expression (US EPA, 1988) was used to estimate the fugitive dust generated by vehicles during construction activities:

PERv (lbs/vehicle mile) =
$$k \times 5.9 \times (s/12)(S/30) \times (mvw/3)^{0.7} \times (ww/4)^{0.5} \times ((365 - p)/365)$$
[Equation 3]

where:

PERv = Vehicle particle emission rate (lb/vehicle mile traveled); s = Percent silt content (unitless);

k = Particle size multiplier (unitless);

S = Mean vehicle speed (mph); mvw = Mean vehicle weight (ton);

ww = Mean number of wheels per vehicle (unitless); and

p = Mean number of days with ≥ 0.01 inches of precipitation per year (unitless).

It was assumed that the vehicle travels during 40% of the 80-day exposure duration and 0.5 miles per day. The result is a value of 16 miles per construction event. Percent silt content was estimated to have a mean value of 50%, based on geotechnical data provided in the *Remedial Investigation Report* (Pisani & Assoc., 1997). US EPA default values were utilized and referenced for all other parameters. The particle size multiplier was assumed to be 0.50, corresponding to particles less than 15 microns (US EPA, 1996). Vehicle characteristics consist of the following: mean vehicle speed was assumed to be 15 mph, with mean vehicle weight assumed to be approximately 12.5 tons, for 8-wheeled vehicles (US EPA, 1988). The estimated mean number of days with precipitation equal to or greater than 0.01 inches per year is 110 (US EPA, 1988). Total resultant dust emissions for constituents during vehicular movement activities were estimated to be approximately 16.5 lbs/vehicle mile traveled, or 0.0001 kg/sec. Calculations are summarized in Table 20.

Future excavation may be performed by bulldozers, a backhoe, or other heavy construction equipment. The following estimate of particulate emissions, less than 15 µm in diameter resulting from bulldozing activity, was based on the approach described in the US EPA Compilation of Air Pollution Emission Factors (1996), as developed from studies of emissions from uncontrolled open dust sources resulting from bulldozing at western surface coal mines.

PERe (lb/hour) =
$$\frac{1.0 \times s^{1.5}}{M^{1.4}}$$
 [Equation 4]

where:

PERe = Excavation particle emission rate (lb/hr);

s = Percent silt content (unitless); and

M = Soil moisture content (unitless).

Percent soil moisture content was assumed to be 15.1%, an average of Site-specific soil moisture data and percent silt content 50%, as described above.

The resultant fugitive dust emission rate during excavation activities was 7.9 lbs/hr or 0.001 kg/sec. Table 20 summarizes these calculations.

Once the emission rate (Ei in Equation 2) was calculated, it was converted to a concentration in ambient air. Gaussian models are conventionally used to determine downwind ambient air concentrations, Ca, from the emission rate, Ei, estimated. However, in this scenario, such models have limited applicability when the receptor(s) is at or very near the source of emission. In this case, a bulldozer operator, for example, is situated directly within the area of ground emissions of vapors and dusts. Average ambient air concentrations in this circumstance are best estimated by use of a near-field box model (US EPA, 1988).

The near-field box model assumes uniform wind speed and uniform mixing throughout the box. The release and mixing of VOCs or respirable dusts in ambient air is estimated as follows:

Ca (mg/m³) =
$$\frac{E_i}{W_b \times H_b \times V}$$
 [Equation 5]

where:

Ca = Concentration of constituent in ambient air (mg/m^3) ;

Ei = Emission rate of constituent (mg/sec);

W_b = Width of box in crosswind dimension within the area of residual

constituent in soil (m);

 H_b = Downwind height of box (m); and

V = Average wind speed through the box (m/sec).

The value of H_b in this calculation is determined by the downwind distance and the atmospheric turbulence at ground level, which determines the trajectory of a release from the upwind edge of the source of vapor or dust emissions. For neutral atmospheric conditions, the height at the downwind boundary (H_b) may be expressed by the following function (Pasquill 1975, Horst 1979):

$$z = 6.25 \text{ r} [H_b/r \times \ln (H_b/r) - 1.58 H_b/r + 1.58]$$
 [Equation 6]

where:

 $H_b = Downwind height of box (m);$

z = Downwind distance to boundary (m); and

r = A terrain-dependent roughness height (m)

H_b (defined in Equation 5) is adjusted until the z parameter is equal to W_b (defined in Equation 5). The resulting H_b value is the height of the box. On any given workday, it is estimated that grading or excavation activities occur over the entire "workable" Site area (exposure unit) from which dusts are generated. This area is estimated to be 2,500 m², with length of the box estimated to be 50 meters (downwind distance) and the width of the box (W) estimated to be 50 meters. The greater the roughness height, the greater the wind turbulence and constituent dilution (i.e., the height of the box increases). For the purposes of this risk assessment, it is conservatively assumed that the roughness height is 0.20 meters, which corresponds to a terrain with grass, some small bushes, and occasional trees (US EPA Rapid Assessment of Exposure to Particulate Emission from Surface Contamination Sites, 1985). This

assumption is appropriate for the actual Site conditions. An annual average wind speed (4.69 m/sec) is obtained from the STAR data set, accessed through the Personal Computer Graphical Exposure Modeling System (PCGEMS), for STAR station 03940, Jackson/Thompson, MS for the period 1974-1978 (Table 21).

5.0 Toxicity Assessment

The toxicity assessment involves the evaluation of available toxicity information to be utilized in the risk assessment process. Toxicity values derived from a dose-response relationship can be used to estimate the potential for the occurrence of adverse effects in individuals exposed to various constituent levels.

Exposure to a constituent does not necessarily result in adverse effects. The relationship between dose and response defines the quantitative indices of toxicity required to evaluate the potential health risks associated with a given level of exposure. If the nature of the dose-response relationship is such that no effects can be demonstrated below a certain level of exposure, a threshold can be defined and an acceptable exposure level derived. Humans are routinely exposed to naturally-occurring constituents and man-made constituents through the typical diet, air, and water, with no apparent adverse effects. However, the potential for adverse effects may occur if the exposure level exceeds the threshold in a variably sensitive population. This threshold applies primarily to constituents which produce non-carcinogenic (systemic) effects, although there is a growing body of scientific evidence which suggests that exposure thresholds may exist for certain carcinogenic constituents as well.

Adverse effects can be caused by acute exposure, which is a single or short-term exposure to a toxic substance, or by chronic exposure on a continuous or repeated basis over an extended period of time. "Acceptable" acute or chronic levels of exposure are considered to be without any anticipated adverse effects. Such exposure levels are commonly expressed as reference doses (RfDs), health advisories, etc. An acceptable exposure level is calculated to provide an "adequate margin of safety."

Chronic RfDs, which have been derived by the US EPA for a large number of constituents, were utilized to evaluate exposures lasting seven to 70 years (US EPA, 1989). Activities involving exposures of shorter duration to COPCs at the Site are anticipated to result in hazard and risk estimates that are lower than those associated with the long-term exposures. Identification of

subchronic toxicity values corresponding to shorter-term exposure scenarios (i.e., less than seven years) are included in the risk assessment to ensure that both short-term and long-term risks can be addressed.

Currently, the US EPA has not developed toxicity values to be utilized in dermal exposure scenarios; however, the US EPA does provide the following guidance for dermal exposure:

No RfDs or slope factors are available for the dermal route of exposure. In some cases, however, non-carcinogenic or carcinogenic risks associated with dermal exposure can be evaluated using an oral RfD or oral slope factor, respectively. (US EPA, 1989).

Provisional dermal toxicity values were developed and utilized in the dermal exposure pathways considered in the human health risk assessment to provide a more accurate Site-specific risk assessment. These dermal RfD values were developed by multiplying the published oral RfD for a given constituent by the fraction of that constituent that can be absorbed through the gastrointestinal tract (stomach/intestine lining). The absorption fraction utilized was 50% for semivolatiles as extracted from US EPA Region 4 guidance (1995).

A number of sources of toxicity information exists, and these sources vary with regard to the availability and strength of supporting evidence. The following protocol has been established for the determination of toxicity indices; it defines a hierarchy of sources to be consulted and the methodology for the determination of toxicity values. This protocol has been developed in accordance with current US EPA methodology. Toxicity values for the COPCs at the Site were obtained with reference to the following hierarchy of sources developed in accordance with MCEQ guidance (1999):

1) Toxicity values were obtained from the *Integrated Risk Information System* (IRIS, 1999) database. This database contains the RfDs and Cancer Slope Factors (CSFs), which have been verified by the US EPA's RfD and Carcinogen Risk Assessment Verification Endeavor (CRAVE) workgroups, and is, thus, the

agency's preferred source for toxicity values. IRIS supersedes all other information sources.

- For toxicity values which are unavailable on IRIS, the most current source of information is the Health Effects Assessment Summary Tables (HEAST, US EPA, 1997), published by the US EPA. HEAST contains interim, as well as verified RfDs and CSFs. Supporting toxicity information for verified values is provided in an extensive reference section of HEAST.
- In cases where IRIS or HEAST could not provide toxicity values, US EPA Region III's Risk-Based Concentration (RBC) Tables were visited. These tables often provide toxicity values generated by reliable sources other than IRIS or HEAST. For example, in response to specific requests from risk assessors, the US EPA National Center for Environmental Assessment (NCEA) develops provisional RfDs or CSFs for chemicals not listed in IRIS or HEAST. Region III's RBC tables will list such provisional values. Also, RfDs or CSFs that have since been withdrawn from IRIS or HEAST may still be listed on the Region III RBC tables, although they are flagged with a "W." These toxicity values were no longer agreed upon by US EPA scientists; however, the Region III RBC tables continue to publish such values because risk assessors still need to quantify exposures to these chemicals. Lastly, the Region III RBC tables will list toxicity indices found in "other" US EPA documents. These values are flagged with an "O" on the tables.

The US EPA has derived carcinogenic slope factors for both oral and inhalation pathways, and these are utilized to quantitatively estimate risks. In the first step of the US EPA's evaluation, the available data are analyzed to determine the likelihood that the agent is a human carcinogen. The evidence is characterized separately for human studies and animal studies as sufficient, limited, inadequate, no data, or evidence of no effect. The characterizations of these two types of data are combined, and based on the extent to which the agent has been shown to be a carcinogen in experimental animals or humans, or both, the agent is given a provisional weight-of-evidence classification. The US EPA scientists then adjust the provisional classification upward or downward, based on other supporting evidence of carcinogenicity (see Section 7.1.3, US EPA, 1989). For a further description of the role of supporting evidence, see the US EPA guidelines (US EPA, 1986).

The US EPA classification system for weight of evidence is shown in the table below. This system is adapted from the approach taken by the International Agency for Research on Cancer.

·	US EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY
Group	Description
Α	Human carcinogen
B1 or B2	Probable human carcinogen
	B1 indicates that limited human data are available
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
С	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
Е	Evidence of non-carcinogenicity for humans

(US EPA, 1989)

Table 22 summarizes the available toxicity values for the identified COPCs. COPCs lacking published toxicity values were not able to be quantitatively evaluated in this assessment in accordance with MCEQ guidance (1999). The MCEQ limits the use of toxicity values to those that have been published in IRIS, HEAST, ATSDR toxicity profiles, or other peer-reviewed reference sources or literature approved by the MCEQ (1999). The MDEQ (2001), however, requested that risks from dermal exposure to cPAHs be estimated using the oral cancer slope factor for benzo(a)pyrene, applying benzo(a)pyrene relative potency factors, and accounting for an absorption efficiency of 50%. This methodology was used accordingly.

6.0 Risk Characterization

The objective of the risk characterization is to determine potential risk to receptors by combining the results of the exposure and toxicity assessments. Non-carcinogenic effects and carcinogenic risks are summarized in Table 23. Tables 24 through 78 provide algorithms and parameters for each pathway.

The estimated intakes calculated for each exposure pathway considered and each COPC were compared to RfDs for non-carcinogenic effects. The following formula was used to estimate the potential for non-carcinogenic health effects for each COPC.

HQ = ADI/RfD

[Equation 7]

where:

HQ = Hazard quotient - potential for noncancer health effects (unitless);

ADI = Average daily intake of COPC (mg/kg-day); and

RfD = Reference dose (mg/kg-day).

RfDs have been developed by the US EPA for chronic (e.g., lifetime) and/or subchronic exposure to constituents based on the most sensitive non-carcinogenic effects. The chronic RfD for a constituent is an estimate of a lifetime daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. The potential for noncancer health effects was evaluated by comparing the Site-specific exposure level with the RfD derived by the US EPA for a similar exposure period. This ratio of exposure to toxicity is called the hazard quotient (HQ). If the Site-specific exposure level exceeds the threshold (i.e., the HQ exceeds a value greater than 1.0), there may be concern for potential noncancer effects.

To assess the overall potential for noncancer effects posed by multiple constituents, a hazard index (HI) is derived by summing the individual HQs. This approach assumes additivity of critical effects of multiple constituents. This is appropriate only for compounds that induce the

same effect by the same mechanism of action. This conservative approach significantly overestimates the actual potential for adverse health impacts.

In cancer risk assessment, the US EPA has required the use of the upper limit which produces an estimate of potential risk that has a 95% probability of exceeding the actual risk, which may, in fact, be zero. The following formula was utilized to estimate the upper bound excess cancer risk for each carcinogen (note that not all COPCs are carcinogens):

$$TR = CLDI \times SF$$
 [Equation 8]

where:

TR = Target risk - excess probability of an individual developing cancer (unitless):

CLDI = Calculated lifetime average daily intake of carcinogenic COPC (mg/kg-day), and

 $SF = Cancer slope factor (mg/kg-day)^{-1}$.

For exposures to multiple carcinogens, the upper limits of cancer risks are summed to derive a total cancer risk. The US EPA recognizes that it is not technically appropriate to sum upper confidence limits of the risk to produce a realistic total probability, but requires this approach be used.

Carcinogenic risk refers to the probability of developing cancer as a result of exposure to known or suspected carcinogens. The National Contingency Plan (NCP) endorses an acceptable risk range of 10^{-4} to 10^{-6} for exposure to multiple carcinogens. This range represents an incremental increase of 1 in 10,000 to 1 in 1,000,000 in the chance of developing cancer over a lifetime. The MCEQ (1999) indicates that the target risk level is 1×10^{-6} per individual carcinogen and an acceptable cumulative risk level is 1×10^{-4} . As such, risk levels totaled across oral, dermal, and inhalation pathways may exceed 1×10^{-6} and still be in compliance with MCEQ requirements (1999) as long as no single carcinogen exceeds 1×10^{-6} and the cumulative risk for a single receptor does not exceed 1×10^{-4} .

Table 23 provides a summary of the non-carcinogenic effects and carcinogenic risks associated with each of the pathways evaluated in this assessment.

The overall hazard index across the assessed pathways and EUs was 0.1 for the Site visitor scenario. This value is below the acceptable benchmark of 1.0. The highest hazard index associated with the Site visitor scenario was 0.07 corresponding to dermal exposure to sediment in EU4. The overall cancer risk for exposures to Site visitors was estimated to be 9 × 10⁻⁵ and is primarily attributable to oral and dermal exposure to benzo(a)pyrene and associated cPAHs in EU4 soil and sediments. Oral exposure to the same constituents in EU4 and EU5 surface soils also contributed to the cancer risk estimate for the site visitor. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the maintenance worker scenarios was 0.08 and is below the acceptable benchmark of 1.0. The highest hazard index associated with the maintenance worker scenario was 0.05 corresponding to oral exposure to sediment in EU4. The overall cancer risk for the maintenance worker scenario was 4×10^{-4} and was primarily attributable to dermal and oral exposure to benzo(a)pyrene and other cPAHs in surface soils in EUs 2, 4, and 5. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the hypothetical future construction worker was 0.000001 and is well below the acceptable benchmark of 1.0. The highest hazard index associated with the construction worker scenario was 9×10^{-7} corresponding to dermal exposure to surface water in EU 4. The overall cancer risk for the hypothetical future construction worker scenario was 5×10^{-5} and is attributable to benzo(a)pyrene and associated cPAH oral exposure in EU4 sediment and oral and dermal exposure to EU4 and EU5 soils. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The off-Site resident scenario revealed a hazard index of 6×10^{-4} . This value is considerably below the acceptable benchmark of 1.0. The overall cancer risk for the resident exposure

scenario was estimated to be 2×10^{-4} and is attributable to oral and dermal exposure to benzo(a)pyrene and associated cPAHs in EU6.

7.0 Uncertainty Analysis

Risk assessment uses a wide array of information sources and techniques. Even in those rare circumstances where constituent intake for an exposed individual may be measured relatively precisely, assumptions will still be required to evaluate the associated risk. Generally, data are not available for critical aspects of the risk assessment, and the use of professional judgment, inferences based on analogy, the use of default values, model estimation techniques, etc., result in uncertainty of varying degrees.

The expressions of risk in this assessment are not probabilistic; the expressions of risk are conditional, based on the conditions represented by the single-point values selected for the analysis. This section is intended to identify and qualitatively evaluate the more salient Site-specific uncertainties and their potential influence on the credibility of the estimated Site risks.

7.1 Uncertainty of Data Evaluation Factors

Uncertainties in data analysis include analytical error, selection of COPCs, adequacy of sampling design, etc. Generally, there is far less uncertainty in this phase of the risk assessment process than other aspects contribute.

Laboratory analysis is extremely accurate relative to the potential error of "professional judgment" in exposure assessments. The uncertainty of analytical data is likely to be less than 25 percent, most of the time.

The adequacy of the sampling strategies to characterize Site conditions is a potentially large source of uncertainty. Because of the limited availability of resources, sample collection is generally limited. However, sampling (especially in multiple surveys) is not random, but is designed to locate the areas with the highest levels of constituents. Thus, test data are biased toward overestimation of average constituent levels. In addition, in most instances, the upper 95-percent confidence limit of the average concentration is utilized as an exposure-point

concentration in the risk assessment. The use of this value likely will result in an overestimation of risk, as the 95% UCL represents a value that will be greater than the true average 95% of the time.

Oftentimes, only a portion of detected constituents are carried through the risk assessment process because constituents are eliminated through COPC screening procedures (US EPA, 1989). This could result in an underestimation of risk, although the COPC selection process is intended to identify those constituents that account for the vast majority of potential risk. COPCs lacking published RfD values were not quantitatively evaluated and this may result in an underestimation of potential hazards (non-carcinogenic effects).

7.2 Uncertainty of Toxicity Values

The US EPA's IRIS states that the uncertainty associated with RfD values for non-carcinogenic endpoints of toxicity "span perhaps an order of magnitude." In fact, the uncertainty of extrapolating dose-response data from animals to humans with the application of multiple safety factors (100 to 10,000 or more) is likely to be several orders of magnitude. Current policies for deriving RfD values will often result in an overestimation of risk.

The uncertainty associated with the estimation of cancer risk contributes, by far, the major source of potential error and uncertainty. It is beyond the scope of this analysis to explore this toxicity assessment factor in any detail. However, a few salient points are noted below.

Some constituents classified as carcinogens have been shown to produce an increased incidence of cancer in mice but not rats, for example. If the mouse is not an adequate model for the rat, it may be wondered how reliable a model it is for human beings. The assumption of linearity and a non-threshold phenomenon in the dose versus risk relationship may not be valid and could result in a very large overestimation of actual cancer risk, if any even exist at low doses in humans.

The US EPA evaluated the uncertainty of cancer risk estimates from exposures to trichloroethene and several other related VOCs in public drinking water supplies (Cothern et al., 1984). These US EPA scientists concluded the following:

- The largest uncertainty in the calculations is due to the choice of the model [Multistage, Weiball, Logit, Probit, etc.] used in extrapolating risk to low doses in humans, and is 5 to 6 orders of magnitude;
- If a single model were chosen [assumed to be valid], the overall uncertainty in risk estimates would be 2 to 3 orders of magnitude;
- The exposure estimates contribute, at most, an order of magnitude to the uncertainty;
 and
- It would appear that until a particular compound's mechanisms of cancer are better known, it is likely that the uncertainty in the toxicity will not be improved.

7.3 Uncertainties in Assessing Potential Exposure

Ideally, Site-specific exposure values should be used when assessing potential intakes of chemicals at a Site. Oftentimes, however, Site-specific data are not available; therefore, the risk assessor must estimate values that most accurately reflect Site conditions. In doing so, US EPA or other regulatory default values were utilized in place of Site-specific data. These values may over- or under-estimate risks, depending on Site conditions and the percentile range in which the default values fall (e.g., 50th, 95th).

Although a considerable amount of published data is available on the most common exposure parameters (e.g., body weight, skin surface area), even these data contain uncertainties. Studies conducted by different scientists often provide differing levels of detail, statistics, and accuracy based on sample size, study design, geographic area, etc. Such discrepancies can increase uncertainty when the data are combined to derive a single-point default value. These data may be the best available; however, the reflection of reality may still be imprecise.

Where published exposure parameters were not available, best professional judgment had to be used, thereby increasing uncertainty. The default or estimated exposure parameters used in this assessment likely resulted in a moderate over-estimation of risk.

The intakes estimated for dermal absorption of PAHs adsorbed into soils adhering to skin may overestimate risks for a host of reasons. Early studies conducted by Falk and coworkers indicated that the carcinogenic effect of B(a)P on subcutaneous injection in mice could be markedly inhibited by the simultaneous administration of various non-carcinogenic PAHs (Falk et al., 1964, as cited in ATSDR, 1988. In other subcutaneous injection and skin-painting studies with mice, it was shown that a combination of several non-carcinogenic PAH compounds, mixed according to the proportion occurring in auto exhaust, did not enhance or inhibit the action of two potent PAH carcinogens, B(a)P and dibenz(a,h)anthracene- (ATSDR, 1988).

The carcinogenic potency of B(a)P and other carcinogenic PAHs is generally determined by injecting solutions under the skin, painting the skin with the carcinogenic PAH dissolved in a solvent, or dissolved in corn oil in feeding studies. This vehicle or matrix affords a high level of bioavailability of the carcinogenic PAH compound. Recently, Krueger et al. (1999) conducted in vitro percutaneous absorption studies with contaminated soils and organic solvent extracts of contaminated soils collected at former manufactured gas plant (MGP) sites. The MGP tarcontaminated soils contained PAHs at levels ranging from 10 to 2400 mg/kg. The dermal penetration rates of PAH from the MGP tar-contaminated soils and soil solvent extracts were determined experimentally through human skin using tritrum-labelled B(a)P as a surrogate. Results showed reductions of two to three orders of magnitude in PAH absorption through human skin from the most contaminated soils in comparison to the soil extracts. Reduction in PAH penetration was attributed to soil matrix properties. That is, PAH compounds adsorbed to organic carbon in a soil matrix are far less bioavailable for dermal flux than PAH compounds dissolved in a solvent. [No correction for such a profound soil matrix effect was applied in quantitatively estimating cancer risks due to dermal absorption of B(a)P and other carcinogenic PAHs in this assessment.

8.0 Summary of Findings

The results of the baseline human health risk assessment indicate potentially unacceptable risk levels for the following exposure scenarios:

Potentially Exposed Population	Media	EU
Site Visitor	Sediment	4
	Surface Soil	4, 5
Maintenance Worker	Sediment	4
	Surface Soil	2, 4, 5
Construction Worker	Sediment	. 4
	Subsurface Soil	4, 5
Off-Site Resident	Sediment	6

The risk levels associated with the above scenarios were driven by cPAHs, particularly benzo(a)pyrene. To determine the extent of remediation necessary to reduce these risks to acceptable levels, sediment and soil data for cPAHs in EUs 2, 4, 5, and 6 were closely examined.

The benzo(a)pyrene exposure-point concentration used to evaluate maintenance worker exposures to surface soil in EU2 was 5.2 mg/kg (sample location GEO-13/0-1'). This was the maximum benzo(a)pyrene concentration found in surface soil in EU2. The next highest concentration of benzo(a)pyrene in surface soil was found at SS-10 (2.4 mg/kg). However, as previously noted, these samples were collected at locations within a densely wooded area. No remediation is planned to address surface soils at these locations for the following reasons:

- No maintenance activities are currently conducted in this area;
- Any remediation would require significant clearing; and
- Cancer risks associated with surface soils at these locations only slightly exceed 1 × 10⁻⁶ for two individual constituents, and the total cancer risk level is still less than 1 × 10⁻⁵.

In EU4, the maximum concentration of benzo(a)pyrene was used as the exposure-point concentration for site visitor, maintenance worker, and construction worker exposure to sediment. The benzo(a)pyrene exposure-point concentration used to evaluate these in EU4 was 130 mg/kg (sample location SD-02, see Figure 2). The next two highest concentrations of benzo(a)pyrene in sediment were found at SD-12 (71 mg/kg) and SD-23 (5.57 mg/kg), respectively. Implementing a remedy to remove, treat, or preclude contact with sediment at sample locations SD-02, SD-12, and SD-23 would leave a concentration of 3.1 mg/kg (sample location SD-18) as the maximum concentration in sediment that could be potentially contacted by site visitors, maintenance workers, and/or construction workers in EU 4. Excluding samples SD-02, SD-12, and SD-23 and using 3.1 mg/kg as the exposure-point concentration drops the risk level for dermal and oral contact with sediment by a visitor and oral contact with sediment by a maintenance worker or construction worker to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 79 - 83).

In EU4, the maximum concentration of benzo(a)pyrene was also used as the exposure-point concentration for site visitor, maintenance worker, and construction worker soil exposures. Each of these receptors could potentially be exposed to soils at different depth ranges: visitor 0-1' bgs, maintenance worker 0-6' bgs, and construction worker 0-20' bgs. The sample locations and corresponding concentrations of benzo(a)pyrene that contributed to elevated risk estimates in the three exposure scenarios are presented in the table below:

Sample Location	Benzo(a)pyrene Concentration
	(mg/kg)
GEO-48/0-1'	500
GEO-21/0-1'	230
GEO-21/2-3'	190
GEO-19/0-1 ²	56
GEO-46/0-1'	16

Sample Location	Benzo(a)pyrene Concentration (mg/kg)
GEO-20/5-6	11
GEO-47/5-6°	9.6
GEO-48/2-3'	6.1
GEO-20/0-1'	3.2
GEO-47/0-1'	3
GEO-19/2-3'	2.4

Implementing a remedy to remove, treat, or preclude contact with the surface (0-1' bgs) soil sample locations tabulated above would result in eliminating exposures for the site visitor scenario (i.e., the 0-1' bgs samples listed above comprise the entire data set for visitor exposures to surface soils in EU4). In addition, implementation of a remedy addressing the sample locations tabulated above would leave a maximum benzo(a)pyrene soil concentration in the 0-6' horizon of 0.29 mg/kg (sample location GEO-19/5-6'). Using the concentration of 0.29 mg/kg as the exposure-point concentration for estimating risk to maintenance workers drops the risk levels to within acceptable levels (Tables 84 - 85). Implementation of this remedy would also reduce the benzo(a)pyrene exposure-point concentration in soils in the 0-20' horizon for construction workers to 5.2 mg/kg resulting in estimated risk values well below acceptable levels (Tables 86-88). In situ biological treatment is proposed to address impacted soils within EU4. This will include clearing, tilling, application of inorganic nutrients, and, once soils are remediated to the extent practicable, placement of concrete cover. The area to be remediated will extend at least from Courtesy Ford to the edge of the railroad right-of-way, and may extend onto the railroad right-of-way with the permission of the Southern railway.

In EU5, the surface soil sample locations contributing most to elevated risk levels for the maintenance worker, construction worker, and site visitor scenarios were GEO-33/0-1', GEO-33/2-3', GEO-30/0-1', GEO-59/0-1, GEO-29/0-1', and GEO-28/0-1' (see Figure 2). All sample locations, with the exception of GEO-59/0-1', are located underneath paved areas in a

parcel of land extending from Courtesy Ford to the southeast (Figure 2). Pavement in this area precludes direct contact with surface and subsurface soils; therefore, it is not anticipated that current or future maintenance workers or site visitors will have access to soils in or around these sample locations. In addition, a deed restriction will be implemented requiring the maintenance of the paved areas to ensure protection of human health in the future. Sample location GEO-59/0-1', with a benzo(a)pyrene exposure point concentration is 6.1 mg/kg, however, is adjacent to West Pine Street in an unpaved area. Implementing a remedy to remove, treat, or preclude contact with surface soil at this location would leave a concentration of 0.37 mg/kg (GEO-60/0-1') as the maximum concentration in surface soil not covered by pavement that could potentially be contacted by any of the three receptors in this EU. Excluding sample GEO-59/0-1' and using 0.37 mg/kg as the exposure-point concentration drops the estimated exposures in EU5 to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 89 - 92).

The benzo(a)pyrene exposure-point concentration used to evaluate adult and child resident exposures to sediment in EU6 was 49 mg/kg (sample location SD-03, see Figure 3). This was the maximum benzo(a)pyrene concentration found in sediments in EU6. Sample locations SD-04, SD-14, SD-13, SD-16, SD-15, and SD-17 (33, 12.2, 3.27, 2.8, 2.42, and 2.26 mg/kg, respectively) also contributed to elevated cancer risk estimates for both receptors. Implementing a remedy to remove, treat, or preclude contact with sediment at these sample locations would leave a concentration of 0.97 mg/kg (sample location SD-05). Using the benzo(a)pyrene concentration of 0.97 mg/kg as the exposure-point concentration for sediment exposure to adult and child residents reduces the risk estimate to within acceptable limits (i.e., no risk level associated with a single carcinogen exceeds 1×10^{-6} ; Tables 93 - 96). Remediation activities are proposed to remove impacted sediment and preclude contact with residuals in the northeast drainage ditch. These activities include removal and off-Site treatment and/or disposal of impacted sediments, installation of a storm water collection and conveyance pipe, backfilling around the culvert, and planting with native grass.

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

Source/Pathway	Potentially Exposed Population	Total Hazard Index	Total Cancer Risk	Driving Constituent	Table Referenced
Dermal Exposure to Sediment in EU1	Visitor	NA	4E-08		24
Oral Exposure to Sediment in EU1	Visitor	NA	5E-08		25
	Sub-Total	NA	8E-08		
Dermal Exposure to Surface Water in EU1	Visitor	NA	4E-07		26
Oral Exposure to Surface Water in EU1	Visitor	NA	9E-09		27
Cial Exposure to Surface Water in Eco	Sub-Total	NA	4E-07		
Dermal Exposure to Surface Soil in EU2	Visitor	NA	3E-08		28
Oral Exposure to Surface Soil in EU2	Visitor	· NA	6E-07		29
	Sub-Total	NA	6E-07		
Dermal Exposure to Surface Soil in EU3	Visitor	NA	4E-09		30
Oral Exposure to Surface Soil in EU3	Visitor	NA	9E-08		31
Contract Con	Sub-Total	NA	9E-08		
Dermal Exposure to Sediment in EU4	Visitor	7E-02	1E-05	cPAHs	32
Oral Exposure to Sediment in EU4	Visitor	3E-02	2E-05	cPAHs	33
	Sub-Total	1E-01	3E-05		
Dermal Exposure to Surface Water in EU4	Visitor	2E-04	9E-07		34
Oral Exposure to Surface Water in EU4	Visitor	2E-05	2E-08		35
	Sub-Total	3E-04	9E-07		
Dermal Exposure to Surface Soil in EU4	Visitor	4E-03	3E-06	*	36
Oral Exposure to Surface Soil in EU4	Visitor	3E-02	6E-05	cPAHs	37
	Sub-Total	3E-02	6E-05		
Dermal Exposure to Surface Soil in EU5	Visitor	NA	3E-07		38
Oral Exposure to Surface Soil in EU5	Visitor	NA	6E-06	Benzo(a)pyrene	39
	Sub-Total	NA	6E-06	V /F-	

Visitor Total: 1E-01 9E-05

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

Source/Pathway	Potentially Exposed Population	Total Hazard Index	Total Cancer Risk	Driving Constituent	Table Referenced
Dermal Exposure to Sediment in EU1	Maintenance Worker	NA	1E-08		40
Oral Exposure to Sediment in EU1	Maintenance Worker	NA	2E-07		41
	Sub-Total	NA	2E-07		
Dermal Exposure to Surface Water in EU1	Maintenance Worker	NA	1E-06	*	42
Oral Expposure to Surface Water in EU1	Maintenance Worker	NA	4E-08		43
	Sub-Total	NA	1E-06		
Dermal Exposure to Surface Soil in EU2	Maintenance Worker	NA	5E-07	,	44
Oral Exposure to Surface Soil in EU2	Maintenance Worker	NA	7E-06	cPAHs	45
	Sub-Total	NA	7E-06		
Dermal Exposure to Sediment in EU4	Maintenance Worker	1E-02	4E-06	Benzo(a)pyrene	46
Oral Exposure to Sediment in EU4	Maintenance Worker	5E-02	6E-05	cPAHs	47
	Sub-Total	6E-02	7E-05		
Dermal Exposure to Surface Water in EU4	Maintenance Worker	3E-04	3E-06	*	48
Oral Exposure to Surface Water in EU4	Maintenance Worker	3E-05	9E-08	•	49
	Sub-Total	3E-04	3E-06		
Dermal Exposure to Surface Soil in EU4	Maintenance Worker	5E-03	2E-05	cPAHs	50
Oral Exposure to Surface Soil in EU4	Maintenance Worker	2E-02	2E-04	cPAHs	51
	Sub-Total	3E-02	2E-04		
Dermal Exposure to Surface Soil in EU5	Maintenance Worker	NA	6E-06	Benzo(a)pyrene	52·
Oral Exposure to Surface Soil in EU5	Maintenance Worker	NA	9E-05	cPAHs	53
·	Sub-Total	NA	1 E-04		

Maintenance Worker Total: 8E-02 4E-04

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

Source/Pathway	Potentially Exposed Population	Total Hazard Index	Total Cancer Risk	Driving Constituent	Table Referenced
Demost Formand a Codiment in E111	Construction Western	NIA	5E-10		54
Dermal Exposure to Sediment in EU1	Construction Worker	NA			* -
Oral Exposure to Sediment in EU1	Construction Worker Sub-Total	NA NA	9E-09 1E-08		55
	Suo-Total	11/2	115-00		
Dermal Exposure to Surface Water in EU1	Construction Worker	NA	1E-08		56
Oral Exposure to Surface Water in EU1	Construction Worker	NA	4E-10		57
	Sub-Total	NA	1 E-08		
Dermal Exposure to Soil in EU2	Construction Worker	NA	4E-07		58
Oral Exposure to Soil in EU2 Inhalation of Fugitive Dust in EU2	Construction Worker	NA	2E-06	*	59
	Construction Worker	NA	7E-08		60
	Sub-Total	NA	2E-06		
Dermal Exposure to Sediment in EU4	Construction Worker	NA	2E-07		61
Oral Exposure to Sediment in EU4	Construction Worker	NA	3E-06	Benzo(a)pyrene	62
	Sub-Total	NA	3E-06		
Dermal Exposure to Surface Water in EU4	Construction Worker	9E-07	3E-08		63
Oral Exposure to Surface Water in EU4	Construction Worker	5E-07	9E-10		64
	Sub-Total	1E-06	3E-08		
Demost Forces as to Coll in EIII	Construction Worker	NA	0E 06	Benzo(a)pyrene	65
Dermal Exposure to Soil in EU4	Construction Worker	NA NA	8E-06 4E-05	cPAHs	66
Oral Exposure to Soil in EU4					67
Inhalation of Fugitive Dust in EU4	Construction Worker Sub-Total	NA NA	1E-06 5E-05	Benzo(a)pyrene	. 07
	Duo Total				
Dermal Exposure to Soil in EU5	Construction Worker	· NA	7E-07	•	68
Oral Exposure to Soil in EU5	Construction Worker	NA	3E-06	Benzo(a)pyrene	69
Inhalation of Fugitive Dust in EU5	Construction Worker	NA	1E-07		70
Ţ,	Sub-Total	NA	4E-06		

Construction Worker Total: 1E-06 5E-05

		,			
Dermal Exposure to Sediment in EU6	Child Off-Site Resident	NA	2E-05	cPAHs	71
Oral Exposure to Sediment in EU6	Child Off-Site Resident	NA	7E-05	cPAHs	72
	Sub-Total	NA	9E-05		
Dermal Exposure to Sediment in EU6	Adult Off-Site Resident	5E-04	4E-05	cPAHs	73
Oral Exposure to Sediment in EU6	Adult Off-Site Resident	1E-04	3E-05	cPAHs	74
	Sub-Total	6E-04	7E-05		
Dermal Exposure to Surface Water in EU6	Child Off-Site Resident	NA	2E-06	*	75
Oral Exposure to Surface Water in EU6	Child Off-Site Resident	NA	5E-07		76
	Sub-Total	NA	3E-06		
Dermal Exposure to Surface Water in EU6	Adult Off-Site Resident	NA	5E-06	*	77
Oral Exposure to Surface Water in EU6	Adult Off-Site Resident	NA	8E-08	·	78
	Sub-Total	NA	5E-06		
	Off Site Desident Totals	4F 04	2F-04		

Off-Site Resident Total: 6E-04 2E-04

^{*}Estimated carcinogenic risk level is below *de minimis* level as no single constituent exceeded 1x10⁻⁶ and the cumulative site carcinogenic risk is below 1x10⁻⁴ (Section 501, MCEQ, 1999).

Table 60

Exposure to Construction Workers from Inhalation of Fugitive Dust in EU2 Kerr McGee, Hattiesburg, MS

	Intake (mg/kg-day) = CarinhKrerreurkr	a mnk cr	*EU*K						
		BW*AT							
<u>ల</u>	Ca - Concentration in air =	mg/m³	chem.spec.				Ca = Concentrat	Ca = Concentration in Air $(mg/m^3) = E_i / (Hb * W * V)$	/(HP * M * V)
	InhR · Inhalation Rate =	m³/shift	20	USEPA 1995, Region IV	gion IV	Ei · En	nission Rate of Co	Ei - Emission Rate of Component (mg/sec) = see below	e below
E E	EF - Exposure Frequency =	shifts/year	80	reasonable assumption	ption		Hb.	$Hb \cdot Downwind Ht (m) = 4.81$	18
ui)	ED - Exposure Duration =	years	_	reasonable assumption	ption		٠	W - Width (m) = 50	
RF, - Retention	RF, - Retention Factor - semivolatites =		0.75	ICRP, 1968			N - N	V - Wind speed (m/sec) = 4.69	69
AT _n - Averaging	ATn - Averaging Time noncarcinogenic =	days	365	USEPA 1991, HHEM	1EM		Length (down	Length (downwind distance) $(m) = 50$	
AT _c - Averag	ATc - Averaging Time carcinogenic =	days	25550	USEPA 1991, HHEM	IEM		-1	r - Roughness Ht . (m) = 0.20	50
	BW - Body Weight =	× 80	70	USEPA 1995, Region IV	gion IV	•	z - down	z - downwind distance (m) = 50	
						z = 6.25	r[Hb/r * Ln(Hb/r)	z = 6.25r[Hb/r * Ln(Hb/r) - 1.58*Hb/r + 1.58]	
H H	$E_i \cdot Emission Rate (mg/sec) = Cs*(PERv+PERe)$	3s*(PERv+P	'ERe)					•	
S)	Cs - Concentration in soil =	mg/kg	chem.spec.						
	Concentration in	Emission Rate	Concentration Average Daily in Air		Inhalation Substrants R.D.	7.00	Average Lifetime Daily	Inhalation Cancer	
Chemicals	mg/kg	mg/sec	mg/m³	· 	mg/kg-day	Index	mg/kg-day	I/(mg/kg-day)	Cancer Risk
Semivolatiles)		
Benzo(a)anthracene	6.10E+01	6.67E-02	5.92E-05	2.78E-06	Ϋ́	Ϋ́	3.97E-08	3.10E-01	1.23E-08
Benzo(a)pyrene	2.17E+0)	2.37E-02	2.10E-05	9.88E-07	A'N	Ŋ	1,41E-08	3.10E+00	4.37E-08
Benzo(b)fluoranthene	3.30E+01	3.61E-02	3.20F-05	1.50E-06	NA	NA	2.15E-08	3.10E-01	6.66E-09
Benzo(k)fluoranthene	1.10E+01	1.20E-02	1.07E-05	5.01E-07	Ϋ́	NA	7.16E-09	3.10E-02	2.22E-10
Chrysene	5.20E+01	5.69E-02	5.05E-05	2.37E-06	Y Y	NA	3.39E-08	3.10E-03	1.05E-10
Dibenz(a,h)anthracene	1.69E+00	1.85E-03	1.64E-06	7.70E-08	ΝΑ	NA	1.10E-09	3.10E+00	3.41E-09
Indeno(1,2,3-cd)pyrene	8.70E+00	9.51E-03	8.44E-06	3.96E-07	ΝA	Ν	5.66E-09	3.10E-01	1.76E-09

NA - Not Available

6.82E-08

Total Cancer Risk:

Table 86

Dermal Exposure to EU4 Soil (0-20') by a Construction Worker Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

Inta	ake (mg/kg-day) ≈	Cs*SA	*AH*ABS*EF	*ED*CF			
			BW*AT				
	Cs - Concen	tration in soil =	mg/kg	chem, spec.			
SA - Sur	face area available	for exposure =	cm²/day	5560	calculated		
	SA _t - Total skir	ı surface area =	cm²	20000	USEPA 1997, EF	Ή	
Fs - Fraction of skin sur	face area available	for exposure =		27.8%	USEPA 1997, EF	H	
,	AH - Adi	erence factor =	mg/cm²	0.1	USEPA 1997, EF	H	
	ABS _p - Absorp	tion - cPAHs =		0.03	USEPA 1995, Re	gion III	
AI	BS _s - Absorption -	other SVOCs =		0.1	USEPA 1995, Re	gion III	
	EF - Exposi	re frequency =	days/year	80	reasonable assum	ption	
	ED - Expo	sure duration =	years	1	reasonable assum	ption	
	CF - Con	version factor =	kg/mg	1.00E-06			
	BW -	Body weight =	kg	70	USEPA 1995, Re	gion IV	
AT _n • Av	eraging time - non	carcinogenic =	days	365	USEPA 1991, HI	IEM	
AT _c	- Averaging time -	carcinogenic =	days	25550	USEPA 1991, HF	IEM	
			Dermai		Average		
	Concentration	Average	Subchronic		Lifetime Daily	Cancer Slope	
1_	in Soil	Daily Intake	RM	Hazard	Intake	Factor	Cancer
Constituent	mg/kg	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Risk
Semivolatiles							
Benzo(a)anthracene	1.50E+01	7.83E-07	NA	NA	1.12E-08	1.46E+00	1.63E-08
Benzo(a)pyrene	5.20E+00	2.72E-07	NA	NA	3.88E-09	1.46E+01	5.66E-08
Benzo(b)fluoranthene	7.80E+00	4.07E-07	NA	NA	5.82E-09	1.46E+00	8.50E-09
Benzo(k)fluoranthene	3.70E+00	1.93E-07	NA	NA	2.76E-09	1.46E-01	4.03E-10
Carbazole	9.50E+00	1.65E-06	NA	NA	2.36E-08	NA	NA
Chrysene	1.20E+01	6.27E-07	NA	NA	8.95E-09	1.46E-02	1.31E-10
Dibenz(a,h)anthracene	5.00E-01	2.61E-08	NA	NA	3.73E-10	1.46E+01	5.45E-09
Indeno(1,2,3-cd)pyrene	2.00E+00	1.04E-07	NA	NA	1.49E-09	1.46E+00	2.18E-09
Naphthalene	1.50E+02	2.61E-05	NA	NΑ	3.73E-07	NA	NA

NA - Not Available Total Cancer Risk = 8.96E-08

Table 87

Oral Exposure to EU4 Soil (0-20') by a Construction Worker Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = <u>Cd*fn</u>	gR*EF*ED*C	F*M <u>E</u>	
	BW*AT		
Cd - Concentration in soil =	mg/kg	see below	
$lngR_a$ - $lngestion$ rate for soil =	mg/day	480	USEPA 1997, EFH
lngR _b - lngestion rate for soil =	mg/day	100	USEPA 1997, EFH
EF_a - Exposure frequency =	days/year	10	reasonable assumption
EF _b - Exposure frequency =	days/year	70	reasonable assumption
ED - Exposure duration =	years	1	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	· -
ME - Matrix effect =	•	1	Magee, et al., 1996
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Exposure	Level A
----------	---------

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles	711g/ Rg	mg ng unj	mg/kg-day	Tittex	mg/mg/may	n(mg/kg-day)	Misk
Benzo(a)anthracene	1.50E+01	2.82E-06	· NA	NA	4.03E-08	7.30E-01	2.94E-08
Benzo(a)pyrene	5.20E+00	9.77E-07	NA	NA	1.40E-08	7.30E+00	1.02E-07
Benzo(b)fluoranthene	7.80E+00	1.47E-06	NA	NA	2.09E-08	7.30E-01	1.53E-08
Benzo(k)fluoranthene	3.70E+00	6.95E-07	NA	NA	9.93E-09	7.30E-02	7.25E-10
Carbazole	9.50E+00	1.78E-06	NA:	NA	2.55E-08	2.00E-02	5.10E-10
Chrysene	1.20E+01	2.25E-06	NA	NA	3.22E-08	7.30E-03	2.35E-10
Dibenz(a,h)anthracene	5.00E-01	9.39E-08	NA	NA	1.34E-09	7.30E+00	9.80E-09
Indeno(1,2,3-cd)pyrene	2.00E+00	3.76E-07	NA	NA	5.37E-09	7.30E-01	3.92E-09
Naphthalene	1.50E+02	2.82E-05	NA	NA	4.03E-07	. NA	NA

NA - Not Available

Cancer Risk = 1.62E-07

Exposure Level B

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RID mg/kg-day	Hazard Index	Average Lifetime Daily latake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					M		,
Benzo(a)anthracene	1.50E+01	4.11E-06	NA	NA	5.87E-08	7.30E-01	4.29E-08
Вепzo(a)рутепе	5.20E+00	1.42E-06	NA ·	NA	2.04E-08	7.30E+00	1.49E-07
Benzo(b)fluoranthene	7.80E+00	2.14E-06	NA	NA	3.05E-08	7.30E-01	2.23E-08
Benzo(k)fluoranthene	3.70E+00	1.01E-06	NA	NA	1.45E-08	7.30E-02	1.06E-09
Carbazole	9.50E+00	2.60E-06	NA	NA	3.72E-08	2.00E-02	7.44E-10
Chrysene	1.20E+01	3.29E-06	NA	NA	4.70E-08	7.30E-03	3.43E-10
Dibenz(a,h)anthracene	5.00E-01	1.37E-07	NA	NA	1.96E-09	7.30E+00	1.43E-08
Indeno(1,2,3-cd)pyrene	2.00E+00	5.48E-07	NA	NA	7.83E-09	7.30E-01	5.71E-09
Naphthalene	1.50E+02	4.11E-05	NA	NA	5.87E-07	NA	NA ·

NA - Not Available

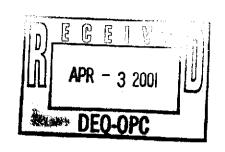
Cancer Risk = 2.36E-07

Total Cancer Risk = 3.98E-07

Table 88

Exposure to Construction Workers from Inhalation of Fugitive Dust in EU4 Preliminary Remediation Goal Calculation Kerr McGee, Hattiesburg, MS

Inta	Intake (mg/kg-day) =		Ca*InhR*EF*ED*RF BW*AT	D*RF					
Ca - Concentration in air = InhR - Inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = RF _s - Retention Factor - semivolatiles = AT _n - Averaging Time noncarcinogenic = AT _c - Averaging Time Carcinogenic = BW - Body Weight =	Ca - Concentration in air = InhR - Inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = ion Factor - semivolatiles = ag Time noncarcinogenic = aging Time carcinogenic = BW - Body Weight =	mg/m³ m³/shift shifts/year years days days	see below 20 80 1 0.75 25550	USEPA 1995, Region IV reasonable assumption reasonable assumption ICRP, 1968 USEPA 1991, HHEM USEPA 1991, HHEM USEPA 1995, Region IV	Ei - Em	Concentration Rate of Coo Hb - I V - W ygth (downw r - R Z - downw	Ca = Concentration in Air (mg/m²) = Ei / (Hb * W * V) Ei - Emission Rate of Component (mg/sec) = see below Hb - Downwind Ht (m) = 4.81 W - Width (m) = 50 V - Wind speed (m/sec) = 4.69 Length (downwind distance) (m) = 50 r - Roughness Ht. (m) = 5.0 z - downwind distance (m) = 50 z - downwind distance (m) = 50	Ei / (Hb * W * V, see below 4.81 50 4.69 50 0.20	
E _i - Emissior Cs - Conce	E _i - Emission Rate (mg/sec) = Cs*(PERv+PERe) Cs - Concentration in soil = mg/kg see b	Cs*(PERv+F mg/kg	PERe) see below						
·	Concentration in Soil	Emission Rate	Concentration in Air	Average Daily Intake	Inhalation Subchronic RM	Hazard	Average Lifetime Dally Intake	Inhalation Cancer Slope Feator	Conrar
Chemicals	mg/kg	mg/sec	mg/m³	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Risk
Semivolatiles									
Benzo(a)anthracene	1.50E+01	1.64E-02	1.46E-05	6.84E-07	NA	Ϋ́	9.77E-09	3.10E-01	3.03E-09
Benzo(a)pyrene	5.20E+00	5.69E-03	5.05E-06	2.37E-07	NA	ΑN	3.39E-09	3.10E+00	1.05E-08
Benzo(b)fluoranthene	7.80E+00	8.53E-03	7.57E-06	3.55E-07	NA	Ν	5.08E-09	3.10E-01	1.57E-09
Benzo(k)fluoranthene	3.70E+00	4.05E-03	3.59E-06	1.69E-07	NA	Ν	2.41E-09	3.10E-02	7.47E-11
Carbazole	9.50E+00	1.04E-02	9.22E-06	4.33E-07	NA AN	NA	6.19E-09	Ϋ́	AN
Chrysene	1.20E+01	1.31E-02	1.16E-05	5.47E-07	NA	Y V	7.81E-09	3.10E-03	2.42E-11
Dibenz(a,h)anthracene	5.00E-01	5.47E-04	4.85E-07	2.28E-08	NA	NA	3.26E-10	3.10E+00	1.01E-09
Indeno(1,2,3-cd)pyrene	2.00E+00	2.19E-03	1.94E-06	9.11E-08	Ϋ́Z	NA	1.30E-09	3.10E-01	4.04E-10
Naphthalene	1.50E+02	1.64E-01	1.46E-04	6.84E-06	NA	NA	9.77E-08	NA	NA
NA - Not Available							Tc	Total Cancer Risk: 1.66E-08	1.66E-08



HUMAN HEALTH RISK ASSESSMENT FOR THE FORMER GULF STATES CREOSOTING FACILITY, HATTIESBURG, MISSISSIPPI

FILE COPY

April 3, 2001

Prepared for:

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Table of Contents

					Page
Exe	cutiv	e Summ	ary		es-1
1.0	Intr	oductio	n		1-1
2.0	Haz	ard Ide	ntifica	tion and Conceptual Site Model	2-1
3.0	Data	a Evalua	ation	***************************************	3-1
	3.1	Exposu	ıre Uni	it Delineation	3-1
		3.1.1	Expo	sure Unit 1	3-1
		3.1.2	Expo	osure Unit 2	3-2
		3.1.3	Expo	osure Unit 3	3-2
		3.1.4	Expo	sure Unit 4	3-3
		3.1.5	Expo	sure Unit 5	3-4
		3.1.6	Expo	sure Unit 6	3-5
	3.2	Statisti	cal Eva	aluation	3-6
	3.3	Determ	ination	n of Exposure-Point Concentrations	3-8
	3.4	ion	3-9		
4.0	Exp	osure A	ssessm	nent	4-1
	4.1	Recepto	or Iden	ntification	4-1
		4.1.1	Infred	quent Site Visitor	4-2
		4.1.2	Main	tenance Worker	4-3
		4.1.3	Cons	truction Worker	4-3
		4.1.4	Futur	re On-Site Residents	4-4
		4.1.5	Off-S	Site Residential Exposures	4-4
	4.2	Genera	l Intak	e Equation	4-4
		4.2.1	Gene	ral Exposure Parameters	4-5
		4.2	2.1.1	Exposure Frequency	4-5
		4.2	2.1.2	Exposure Duration	4-8
		4.2	2.1.3	Averaging Time	4-8
		4.2	2.1.4	Body Weight	4-9

Table of Contents (Cont.)

				<u>Page</u>
		4.2.2 Rout	te-Specific Exposure Parameters	4-9
		4.2.2.1	Dermal Exposure Parameters	4-10
		4.2.2.2	Ingestion Exposure Parameters	4-17
		4.2.2.3	Inhalation Exposure Parameters and Paradigms	4-18
5.0	Tox	icity Assessm	ent	5-1
6.0	Ris	k Characteriz	ation	6-1
7.0	Uno	ertainty Anal	lysis	7-1
	7.1	Uncertainty of	of Data Evaluation Factors	7-1
	7.2	Uncertainty of	of Toxicity Values	7-2
	7.3	Uncertainties	s in Assessing Potential Exposure	7-3
8.0	Sun	amary of Find	lings	8-1

Bibliography

Figures

Tables

Executive Summary

A baseline human health risk assessment (HHRA) was conducted for the Former Gulf States Creosoting facility in Hattiesburg, Mississippi. The HHRA was performed in accordance with: Mississippi Commission on Environmental Quality's (MCEQ's) Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999); US EPA's Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (1989); US EPA Region 4 guidance entitled Technical Services Supplemental Guidance to RAGS, Region 4 Bulletins (1995); and other relevant US EPA guidance documents.

Creosoting constituents of potential health concern include polycyclic aromatic hydrocarbons (PAHs), of which benzo(a)pyrene is the predominant contributor to potential risks. Much of the former creosoting process area is currently covered with asphalt or large building structures. Potential future exposure scenarios included a construction worker, a maintenance worker, an infrequent Site visitor, and off-Site residents. Media of concern included soils, sediment, and surface water.

Hazards posed by chemical constituents in soils, sediment, and surface water for health effects other than an increased risk of cancer were well below a threshold of possible concern for each receptor evaluated in this risk assessment. Cancer risks for all exposure scenarios were within or below the US EPA's acceptable target risk range of 1×10^{-6} to 1×10^{-4} (*i.e.*, one in one million to one in ten thousand) with the exception of maintenance worker exposure to soils in EU4 and off-site resident exposure to sediments in EU6. The added lifetime cancer risk conservatively estimated for a maintenance worker was 4×10^{-4} for the entire Site, while that for the off-site resident was 2×10^{-4} for the entire Site. The potential risk for a construction worker was estimated to be 5×10^{-5} for the entire Site. The estimated potential risk for an adolescent Site visitor was 7×10^{-5} for the entire Site. For the Site visitor, maintenance worker, and construction worker scenarios, oral contact with carcinogenic PAHs in sediment and soils drove the cancer risk level. For the off-Site resident scenario, oral contact with carcinogenic PAHs in sediment drove the cancer risk level.

Risk levels are mainly attributable to residual concentrations of carcinogenic polycyclic aromatic hydrocarbons (cPAH) in EUs 4, 5, and 6. Remedial actions currently planned for these areas, including deed restrictions, will result in incomplete exposure pathways thereby resulting in acceptable levels of risks to potential receptors. Proposed remediation activities to address impacted media in EUs 4, 5, and 6 include the following:

- Conduct in-situ biological treatment of impacted soils in the unpaved area between the former Process Area and the Southern railroad tracks (EU4);
- Attempt to recover free product from targeted areas within the former Process Area to address continuing sources (EU5);

- Remove impacted sediments from the northeast drainage ditch and install a culvert to provide for surface drainage (EU6);
- Establish deed restrictions limiting the use of property to non-residential (i.e., "restricted") purposes (EU4 and EU5); and
- Include in the deed restrictions provisions for maintaining pavement to preclude contact with impacted media left in place (EU5).

Constituent concentrations in surface soils at two isolated locations within EU2 also resulted in maintenance worker risk levels slightly greater than 1×10^{-6} . Because these locations are within a densely wooded area where no maintenance activities currently occur and remediation would require significant clearing, no remediation activities are planned to address surface soils at these locations. Deed restrictions limiting the use of properties within EU2 to non-residential purposes will be established.

1.0 Introduction

Environmental Standards, Inc. (Environmental Standards) was retained by Kerr-McGee Chemical Corporation (Kerr-McGee) to perform a human health risk assessment (HHRA) to evaluate hazards and risks potentially posed by residual levels of chemicals present at the Former Gulf States Creosoting facility (Site). The Site, located near the intersection of US Highways 49 and 11 in Hattiesburg, Mississippi, was formerly a wood treating facility that operated between the early 1900s and 1960. In the early 1960s, the Site was redeveloped for commercial and light industrial uses (Michael Pisani & Assoc., 1997). The land on which the Site is located is a portion of the Sixteenth Section land owned by the Hattiesburg Public School District and leased to the current tenants under a 99-year lease, granted on July 7, 1947. At the time of this report, the Site, with the exception of the grassy and wooded areas in the south and southwest, respectively, was primarily used for automobile dealerships. There are no residential or institutional (*i.e.*, schools) uses of the Site (Michael Pisani & Assoc., 1997).

Operations at the Site consisted of a small-scale wood preserving process using creosote. The creosoting process was primarily confined to a 2.5-acre area in the northeast corner of the Site; this is known as the former Process Area and is currently occupied by Courtesy Ford. During the redevelopment of the Site in the early 1960s, construction debris (e.g., broken concrete, asphalt, etc.) appears to have been relocated to the southwestern corner of the Site along Gordon's Creek. This area is known as the Fill Area and currently remains undeveloped.

This assessment has been conducted as a result of an agreement between Kerr-McGee, the Mississippi Department of Environmental Quality (MDEQ), and the Mississippi Commission on Environmental Quality (MCEQ) pursuant to the Uncontrolled Site Voluntary Evaluation Program. The MDEQ Office of Pollution Control, Uncontrolled Sites Section has been providing oversight and review of investigations and reports relating to the former Gulf States Creosoting facility.

This report will address the potential for on-Site exposures to human receptors and off-Site exposures to humans along the northeast drainage ditch.

The primary guidance used to develop this risk assessment was the MCEQ Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999). US EPA Region 4's Technical Services Supplemental Guidance to RAGS: Region 4 Bulletins (1995) were also referred to for guidance. Additional US EPA guidance documents cited herein include:

- Guidance for Remediation of Uncontrolled Hazardous Substance Sites in Mississippi (MDEQ, 1990);
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual/ Part A (RAGS/Part A) (US EPA, 1989);
- Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" (US EPA, 1991);
- Exposure Factors Handbook (US EPA, 1997);
- Guidelines for Exposure Assessment (US EPA 1992);
- Dermal Exposure Assessment: Principles and Applications (US EPA, 1992);

These documents are not listed in a hierarchical manner; other US EPA guidance documents and peer-reviewed technical papers may have also been referenced in this risk assessment report.

2.0 Hazard Identification and Conceptual Site Model

As a result of the historical wood preservation process, residual levels of creosote-related chemicals are present in soils in the former Process Area. Sediment and surface water in a drainage ditch along the southeast border of the former Process Area also contain chemical residuals. These Site-related chemicals, mostly polycyclic aromatic hydrocarbons (PAHs) are also present in the Fill Area. Residual levels of PAHs have been found in soil in the Fill Area and in Gordon's Creek surface water and sediment.

PAH residuals have also been detected in shallow groundwater underlying the Site. Currently, there are no private water wells located on-Site that access this shallow groundwater for potable purposes. The results of a door-to-door survey conducted by Michael Pisani and Associates on October 3, 2000 indicated no private uses of shallow groundwater downgradient of the Site. For these reasons, the groundwater exposure pathway, both on- and off-Site, was considered incomplete and not evaluated in this assessment.

A conceptual site model (CSM) was developed for the Site to aid in determining the potential receptors and exposure units to be evaluated under current and future potential land use (Figure 1). These receptors were identified as infrequent Site visitors, maintenance workers, construction workers, and off-Site residents.

Under current land use assumptions, Site visitors may potentially contact residual chemicals in Gordon's Creek surface water and sediment, and/or surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the drainage ditch along side of the former Process Area. Visitors may also potentially contact surface soil, surface water, and sediment along the former Process Area drainage ditch. The remaining affected areas of the Site are covered with either buildings or pavement precluding casual direct contact with surface soils. As a conservative measure, however, visitor exposure to soils from these paved areas was also assessed.

Under both current and future land use assumptions, a maintenance worker may contact surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the former Process Area and surrounding affected areas, including the drainage ditch located to the southeast of the former Process Area. Although most of the former Process Area and vicinity are paved, maintenance activities may involve some shallow digging; therefore, direct contact with shallow soils in this area was assessed. As a conservative measure, exposure to surface water and sediment in Gordon's Creek was assessed. The remainder of the Site was relatively unaffected by historical creosoting activities.

Although there are currently no major construction activities at the Site, these types of activities may occur at some time in the future. As with the maintenance worker scenario, construction activities could potentially occur in the Fill Area and vicinity, the grassy field southeast of the Fill Area, and the former Process Area and vicinity. Construction workers may be exposed to both surface and subsurface soils (down to the water table). Construction worker exposure to surface water and sediment in Gordon's Creek was assessed as a conservative measure. The remainder of the Site was relatively unaffected by historical creosoting activities.

Areas of the Site affected by historical creosoting activities will be deed restricted prohibiting future residential development. Off-Site areas along the northeast Drainage Ditch, currently a residential neighborhood, were assessed for residential exposures to soil, sediment, and surface water.

3.0 Data Evaluation

To characterize potential exposures to Site-related chemicals, the former Gulf States Creosoting facility was divided into six exposure units (EUs). Each exposure unit outlines potentially affected areas of the Site and adjacent on-Site locales that may be frequented by individuals accessing the Site for recreational or occupational purposes. The use of EUs is encouraged by the US EPA Region 4 (1995), which defines an EU as "an areal extent of a receptor's movements during a single day...." Each of these exposure units is depicted on Figure 2 and is discussed below.

A sixth EU was created for off-Site residential exposures to surface water and sediment along the northeast Drainage Ditch. This EU is delineated on Figure 3.

3.1 Exposure Unit Delineation

The following EUs were delineated based upon the presence of residual chemicals and the potential for receptors to contact those chemicals. Areas of the Site most affected were included in at least one of the five EUs while areas with relatively low or non-detectable concentrations of residuals were not included in an EU. By limiting Site-wide exposures to the EUs most affected by historical activities at the Site, worst-case scenarios were created.

3.1.1 Exposure Unit 1

EU1 outlines the on-Site areas in, adjacent to, and downstream of the Fill Area along Gordon's Creek (Figure 2). EU1 includes exposures to surface water and sediment by an infrequent Site visitor, future maintenance worker, and future construction worker. Although US EPA Region IV guidance indicates that "In most cases it is unnecessary to evaluate human exposures to sediments covered by surface water," (US EPA, 1995) dermal and oral surface water exposures were conservatively assessed herein at the request of the MDEQ (2000). Sediment samples included in EU 1 were SD07 and SD08. Surface water samples included in were SW-07 and SW-08.

Soil samples from this area were considered part of EU2 and exposures were assessed accordingly.

3.1.2 Exposure Unit 2

EU2 delineates the upland areas of the Fill Area and adjacent woody and grassy areas (Figure 2). Surface soils from zero to one foot and zero to six feet below ground surface [bgs] in this area were evaluated for potential visitor and future hypothetical maintenance worker scenarios, respectively. Surface and subsurface soils were also evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table (approximately 10 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU2 are presented in the table below:

Soils (0-1' bgs)	GEO-13/0-1'	SS-1	SS-2	SS-3	SS-4
	SS-5	SS-6	SS-7	SS-8	SS-9
	SS-10	SS-11	SS-12	SS-13	
Soils (0-6' bgs)	GEO-03/2-3'	GEO-03/5-6"	GEO-10/2-3	GEO-10/5-6	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-44/5-6'	SS-1	SS-2
	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
	SS-13				
Soils (0-10' bgs)	GEO-03/2-3'	GEO-03/5-6'	GEO-10/2-3	GEO-10/5-6'	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-43/7-8°	GEO-44/5-6'	GEO-45/7-8'
	SB-03/8-9.3	SB-05/4-9	SB-07/5-7	SS-1	SS-2
	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
	SS-13				

3.1.3 Exposure Unit 3

In the southwest corner of the Site there exists a grassy field east of West Pine Street between Henson Auto Sales and Eagan Cars and Trucks. This grassy area has been defined as EU3 for purposes of this risk assessment (Figure 2). Similar to EU2, surface soil from zero to one foot and zero to six feet bgs were evaluated in EU2 for visitor and hypothetical future maintenance worker scenarios, respectively. Surface and subsurface soils in this EU were evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table(approximately 20 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU3 are presented in the table below:

Soils (0-1' bgs)	SS-15	SS-16	SS-17		
Soils (0-6' and	GEO-16/2-3'	GEO-16/5-6'	GEO-17/2-3'	GEO-17/5-6'	SS-15
0-20' bgs)			l		
	SS-16	SS-17			
			_		

3.1.4 Exposure Unit 4

EU 4 encompasses the grassy drainage ditch area along the fenceline behind Courtesy Ford in the northeast corner of the Site and continues parallel to the railroad tracks, and west through EU 3 and EU 2 (Figure 2). EU 4, along the southeast side of the former Process Area, has been widened to include soil data from that area. Receptors associated with EU 4 included Site visitor exposures via casual contact with surface soil, sediment, and surface water. Maintenance worker and construction worker scenarios were also evaluated for exposures to surface water and sediment in EU 4 as well as soils in EU 4 near the former Process Area. Soils down to six feet bgs were evaluated for maintenance workers while soils down to the water table (approximately20 feet bgs) were evaluated for construction workers in this EU as requested by the MDEQ (2000). Sediment, surface water, and soil samples included in EU4 are presented in the following table:

Sediment	SD-02	SD-12	SD-18	SD-19	SD-20
	SD-21	'SD-22	SD-23		
Surface Water	SW-02				
Soils (0-1' bgs)	GEO-19/0-1'	GEO-20/0-1'	GEO-21/0-1'	GEO-46/0-1'	GEO-47/0-1
	GEO-48/0-1'				
Soils (0-6' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6°	GEO-20/0-1'	GEO-20/2-3'
	GEO-20/5-6'	GEO-21/0-1'	GEO-21/2-3'	GEO-21/5-6'	GEO-46/0-1'
	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1'	GEO-47/2-3'	GEO-47/5-6'
	GEO-48/0-1'	GEO-48/2-3'	GEO-48/5-6'		
Soils (0-20' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6'	GEO-20/0-1'	GEO-20/2-3'
	GEO-20/5-6'	GEO-20/9-10'	GEO-21/0-1'	GEO-21/2-3'	GEO-21/5-6'
	GEO-21/9-10'	GEO-46/0-1'	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1'
	GEO-47/2-3'	GEO-47/5-6'	GEO-47/7-8'	GEO-48/0-1'	GEO-48/2-3'
	GEO-48/5-6'				

3.1.5 Exposure Unit 5

EU5 outlines the former Process Area and the historical drip track and treated wood storage areas of the former Gulf States Creosoting facility (Figure 2). Surface soils from zero to six feet bgs were evaluated in EU5 for a hypothetical maintenance worker scenario. Available data for soils down to the water table (approximately 20 feet bgs) were evaluated in EU5 for a hypothetical future construction worker scenario. Soil samples included in EU5 are presented in the table below:

Soils (0-1' bgs)	GEO-28/0-1'	GEO-29/0-1'	GEO-30/0-1'	GEO-31/0-1'	GEO-32/0-1'
	GEO-33/0-1'	GEO-59/0-1'	GEO-60/0-1'		
Soils (0-6' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
1	GEO-29/5-6'	GEO-30/0-1'	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
	GEO-33/0-1'	GEO-33/2-3'	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1'	GEO-60/2-3'	GEO-60/5-6'	
Soils (0-20' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
	GEO-29/5-6'	GEO-30/0-1	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
	GEO-33/0-1'	GEO-33/2-3'	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1'	GEO-60/2-3'	GEO-60/5-6'	GEO-60/7-8'
	SB-01/8-10	SB-02/9-11	SB-05/10.5-12.5	SB-06/6-10	SB-07/14-16

3.1.6 Exposure Unit 6

EU6 outlines a stretch (approximately 2700 feet in length) of the northeast drainage ditch that leads from the Site into the neighboring residential area. EU6 exposures include oral and dermal exposures by off-Site residents to sediment and surface water along the northeast drainage ditch. Soil exposures were not assessed in this area for lack of soil data. Also, it was anticipated that sediment exposures in this area represent a more conservative estimate of exposure in that chemical concentrations in the exposed sediment along the drainage ditch are likely to be greater than concentrations in the surrounding soils. Sediment and surface water samples included in EU6 are presented in the table below:

Sediment	SD-03	SD-04	SD-05	SD-13	
	SD-14	SD-15	SD-16	SD-17	
Surface Water	SW-03	SW-04			

3.2 Statistical Evaluation

Environmental samples undergo laboratory analyses that are designed to quantitate the concentrations of constituents in the various environmental media. As a result of the analytical procedures, a constituent may be detected and its concentration measured, detected but not able to be quantitated, or not detected at all in a sample. The data set for the Site contains a number of nondetections for some chemicals of potential concern (COPCs) in various samples. Assuming that the COPC is present in these samples at the achieved detection limit is biased because the chemical may be absent altogether. Assuming a concentration of zero is also flawed because the chemical could be present at a level below laboratory capabilities to detect and quantify the concentration. Consequently, in the event that an analyte identified at least once in a given medium was not detected in a given sample, it was conservatively assumed for the risk assessment purposes to be present at a concentration equivalent to one-half of the sample quantitation limit (SQL). In addition, samples labeled with an "R" (rejected) qualifier were not included in the data analysis because those data were deemed unreliable and, therefore, unusable. Constituents that were not detected in any sample from a particular medium were eliminated from further consideration in accordance with US EPA guidelines (1989).

Site analytical data used in this assessment were collected during the Phase I (1997) and Phase II (1998) remedial investigations as well as the additional investigation conducted in 2000 at the request of the MDEQ. These data were fully validated by qualified technical professionals using standard data validation protocols, as required by the MCEQ (1999).

Previous investigations at the Site have been conducted since 1990. These investigations included the following:

- 1990 soil gas and soil sampling by Roy F. Weston
- 1991 MDEQ Site inspections and Phase II report
- 1994 Phase II Site investigation by Environmental Protection Systems (EPS)
- 1994 Site investigation by Bonner Analytical Testing Company (BATCO)
- 1994 preliminary subsurface investigation by BATCO

- 1995 three-dimension resistivity surveys by American Remediation Technology
- 1996 investigation by McLaren/Hart
- 1996 investigation by Kerr McGee Chemical Corporation

Data acquired from these historical (pre-1997) investigatory activities were not used in this assessment as they were not validated by qualified chemists and sampling locations for some of the data could not be accurately established. These historical data were not considered valid and were, therefore, not appropriate to use in this assessment of risks. Only validated data that were considered to be representative of Site conditions with a reasonable level of confidence were used for this assessment.

The validated laboratory data from 1997, 1998, and 2000 investigations were compiled into data sets representing areas of potential exposure (EUs) for each potential receptor. Each data set was analyzed statistically using SiteStat[®], a commercially available software package, to calculate the minimum, maximum, arithmetic mean, logarithmic mean, standard error of the mean, and the 95% upper confidence limit of the mean concentration (95% UCL) for each constituent based on distributional analysis of the data (*i.e.*, utilizing goodness-of-fit statistical tests to determine whether the data are distributed normally or lognormally). The data qualifier associated with the minimum and maximum detected concentrations as well as the location of the maximum detected concentration for each EU were also determined. Results of the quantitative and statistical analyses for each of the EUs discussed above are presented in Tables 1 through 18.

Standard sampling protocol requires the collection of duplicate field samples used to ensure the quality of a laboratory analysis (i.e., to ensure that analytical results can be replicated). As such, duplicate sample results were provided as part of the database for the Hattiesburg Site. In accordance with US EPA guidance (1989), duplicate sample results were averaged (for any sample containing duplicates) and the average concentration was used as a single concentration for that sample in the calculation of summary statistics as discussed below.

Soils down to one foot deep were assumed to be representative of surface soils at the Site for infrequent visitor exposures. A depth of 0 to 6 feet was used to define surface soils for maintenance worker exposures. These assumptions were recommended by the MDEQ (2000). The groundwater table was considered the extent of subsurface soils as recommended by MDEQ (2000). This value (depth-to-groundwater) varies significantly across the Site and, as such, the extent of subsurface soil was EU-specific as follows:

EU2 – soils down to 10 feet

EU3 – soils down to 20 feet

EU4 - soils down to 20 feet

EU5 – soils down to 20 feet

This risk assessment focuses mainly on environmental data collected from the former Process and Fill Areas and any other portions of the Site that were affected by former creosoting operations. Virtually unaffected areas (e.g., the developed area north of West Pine Street) as delineated using historical data were not considered to contribute significantly to risk levels and, therefore, were excluded from this risk assessment.

3.3 Determination of Exposure-Point Concentrations

Exposure-point concentrations were determined to be the 95% UCL or the maximum concentration of a COPC in an EU, whichever was lower. This methodology is in accordance with US EPA guidance (1989). If the distribution of the concentration data was determined to be lognormal, then the lognormal 95% UCL was compared to the maximum concentration to determine the exposure-point concentration. In the event that the distribution of a chemical in any given medium could not be confidently labeled as normal or lognormal, it is termed either "unknown" or "normal/lognormal." In these cases, the lognormal 95% UCL was compared to maximum concentration when determining the exposure-point concentration. It should be noted, however, that in cases where the distribution is "unknown," the normal and lognormal 95% UCLs could not be reliably predicted. Assuming a lognormal distribution of the data increases

the uncertainty associated with this step of the risk assessment process; however, hazard and risk estimates are likely to be less uncertain than if the maximum concentrations were used.

Exposure-point concentrations are provided on the statistical summary tables, Tables 1 through 18.

3.4 COPC Selection

Soils (both surface and subsurface) were screened according to MCEQ (1999) guidance. The first tier of the screening process compared maximum concentrations of a constituent in an EU with the Restricted Tier 1 target remediation goal (TRG) for maintenance worker and construction worker scenarios. Restricted TRGs were used because the Site is not currently used for residential purposes and the current commercial/industrial land-use is anticipated to remain into the future as a result of the implementation of deed restrictions on the impacted areas of the Site. If a maximum concentration of a constituent was less than the Restricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment.

Surface soil data (zero to one foot bgs) for the visitor scenario were screened using Unrestricted Tier 1 TRGs at the request of MDEQ (2000). If a maximum concentration of a constituent was less than the Unrestricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment. Conversely, if the maximum concentration of a constituent exceeded the Tier 1 TRG, that constituent was retained for quantitative analysis.

If the maximum concentration of a constituent in an EU exceeded the Tier 1 TRG, then the 95% UCL of the constituent was compared to the Tier 1 TRG (Restricted or Unrestricted, depending on the exposure scenarios as described above) as part of the Tier II screening process. In the event that the concentrations of a chemical were distributed lognormally, the lognormal 95% UCL of that constituent was compared to the Tier 1 TRG. If the distribution of data of a chemical could not be positively identified as either normal or lognormal, the lognormal 95% UCL was used in the screening process. In these cases, either the maximum concentration or the lognormal 95% UCL can be conservatively used. The US EPA, however, justifies the use of an

average concentration as the exposure-point concentration by explaining that toxicity criteria for both carcinogenic and non-carcinogenic effects are based on lifetime average exposures and that the "average concentration is most representative of the concentration that would be contacted at a site over time" (Supplemental Guidance to RAGS: Calculating the Concentration Term, 1992). Other US EPA guidance states that "...in most situations, assuming long-term contact with the maximum concentration is not reasonable" (Risk Assessment Guidance for Superfund, Part A, 1989). US EPA Region 4 also states that, generally, it is reasonable to assume that soil data are distributed lognormally (1995). In keeping with these guidances, the lognormal 95% UCL was considered in the screening process where the data distribution for a compound could not be defined as specifically normal or lognormal.

If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent was less than the Tier 1 TRG, then that constituent was eliminated from further quantitative analysis. If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent in soil exceeded the Tier 1 TRG, then that constituent was retained for quantitative analysis in the Site-specific risk assessment (Tier III).

MCEQ guidance (1999) does not specify screening levels for constituents in sediment or surface water; therefore, Region 4 was referred to for guidance (1995). Sediment is only found on the Site in drainage ditches that contain little to no water most of the time. US EPA Region 4 guidance states that sediments in an intermittent stream (or ditch) should be considered as surface soil for the portion of the year the stream is without water. Based on these factors and comments provided by the MDEQ (2000), the maximum detected constituent concentrations in sediment was compared to MCEQ unrestricted Tier 1 TRGs. The screening process then followed the same procedure as mentioned above for other soils.

For surface water, the maximum detected concentration of a constituent in an EU was compared to the US EPA Human Health Water Quality Standard (WQS) for consumption of water and organisms in accordance with US EPA Region 4 guidance (1995). If the maximum

concentration of a constituent in surface water was less than the WQS, then that constituent was eliminated from quantitative analysis. If the maximum concentration of a constituent in surface water exceeded the WQS, then that constituent was retained for quantitative analysis.

At the request of MDEQ (2000), if any single carcinogenic polycyclic aromatic hydrocarbon (cPAH) was retained as a COPC in a medium, then all cPAHs were also retained as COPCs in that medium. This guidance refers to the following chemicals: benzo(a)anthracene, benzo(b)fluoroanthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. To establish an exposure point concentration for undetected cPAHs retained as COPCs in an EU, one-half the maximum detection limit was used.

The results of the screening process are presented on the statistical summary tables, Tables 1 through 18. The screening process eliminated detected constituents from the subsurface soil dataset down to 20 feet bgs and surface soil dataset down to 6 feet bgs in EU3 For this reason, construction worker and maintenance worker exposures to soils in EU3 were not evaluated quantitatively in this assessment.

4.0 Exposure Assessment

Currently, a majority of the Site is used for commercial and light industrial purposes and is paved for roads and parking lots. Unpaved areas are limited to Gordon's Creek (EU 1), the wooded portion in and around the Fill Area (EU2) and the grassy field outlined by EU 3, and the drainage ditches and surrounding area delineated by EU 4 (Figure 2). Since the developed and undeveloped areas of the Site vary considerably with respect to both residual chemical concentrations and land use, the Site was divided into five EUs for the exposure assessment. A sixth EU was created to assess off-Site residential exposures. Chemical data from each EU were combined with EU-specific exposure parameter values and receptor scenarios to determine the chemical intake for each receptor potentially accessing an EU for occupational, recreational, or residential purposes.

4.1 Receptor Identification

The following exposures pathways (indicated with an "X") have been selected for this risk assessment as reasonable and realistic scenarios under current and future land-use assumptions:

EU/Media:	EU1		EU2	EU3	EU4			EU5	EU6	
Receptor/Route:	Sed.	Surf. Water	Soil	l Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water
Visitor										•
Dermal	X	X	X	X	X	X	X	X	1	
Oral	X	X	X	Х	Х	X	X	X		
Inhalation		Committee on the committee of the commit	PH-144 (PH-2014K)(A01		(a-2) - (a-2) - (a-2) - (a-2)					
Maint. Worker						EAT ************************************		MANUSTINISMOSTA MO CITOR ACA		
Dermal	X	x	X	X	X	X	X	X		
Oral	X	X	X	Х	Х	Х	X	Х		
Inhalation	Nachara Production Administration			e de la companya de l		note outside the source of a side		direka sasakda ash sakas mus		
Const. Worker	wee-to-coorse-accocsaese		WANTER AND SOME SPOKE From	O BOLISTON AND AND AND AND AND AND AND AND AND AN						normalistic de la companie de la companie de la companie de la companie de la companie de la companie de la co
Dermal	Х	X	Х	Х	Х	Х	X	X		
Oral	Х	X	X	X	x	X	X	X		
Inhalation			X	Х	х			X		
Off-Site Resident	may ay arang makadda ba	en (Parigurium as specialised a salabati su estamat un associ	**************************************			and a decide delication of the second of the				go ya yangiri wasakana ka katika ta ta taka ta taka ta ta taka ta ta taka ta
Dermal	8 0.77507.40 t - 10.7750.100 t - 40.00			DECEMBER OF THE STREET					х	Х

EU/Media:	EU1		EU2	EU3	EU4			EU5	EU6	
Receptor/Route:	Sed.	Surf. Water	Soil	Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water
Oral										X
Inhalation		granus program on a money or many or many		e symtosoy miletos I i		President of the Property of Company of the		economission de la filia e paga cara de		AND THE PERSON AS A PROPERTY WAS ASSESSED.
66/54 - 344 (2009/P) 5 26/5 (1 1 22) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Berne de anti-ser i e son Pa					habitalit vord omstader eleme n vorder 4	hardwaren (dans M) M (Spider System (da	den entre en		

Surface water present on-Site is either ephemeral or very shallow and is conducive only to wading-type activities. Ingestion of Site surface water was considered an insignificant exposure pathway since on-Site drainage ditches "contain little or no water most of the time" (MDEQ, 2000). In addition, US EPA IV guidance indicates that "In most cases, it is unnecessary to evaluate human exposures to sediments covered by surface water" (1995). At the request of MDEQ (2000), however, dermal and oral exposures to surface water were assessed for visitors, maintenance workers, and construction workers in EUs 1 and 4. Surface water exposures were also assessed for residents in off-Site EU 6.

Each of the potential receptors is discussed below.

4.1.1 Infrequent Site Visitor

Since the Site is not currently fenced or guarded, the general public has access to most areas of the Site at any given time. It is possible, though unlikely, that an individual may use some areas of the Site, such as EU1, EU2, or EU3, for recreational purposes. For this reason, sediment and surface water exposures to visitors in EU1, and surface soil exposures in EU2 and EU3 were assessed for the visitor scenario. The vast majority of the remainder of the Site (EU5) is covered with either buildings or pavement, precluding direct contact with surface soils; however, a small exposed area encompassing a drainage ditch exists along side of the former Process Area (EU4). Although this area is not attractive for recreational purposes, it is possible that an individual traversing the Site may contact surface soils, sediment, or surface water in this EU; therefore, these potential exposures were assessed. Sediment exposures in EU1 and EU4 were addressed in accordance with US EPA Region 4 guidance that recommends evaluating sediment exposures in intermittent streams. At the request of MDEQ (2000), soil exposures were assessed for visitors

in EU5 regardless of the existence of buildings and pavements precluding almost all potential direct contact with soils in this area.

4.1.2 Maintenance Worker

Currently, maintenance activities are most likely limited to the developed portions of the Site. Of these, the former Process Area and adjacent former drip track and treated wood storage areas (EU5) were most affected by historical wood preserving processes. Although these areas are mostly paved or built upon, it is possible that maintenance activities may require some shallow digging in unpaved areas; therefore, exposures to surface soils in EU5 were assessed. As a conservative measure, surface soil data from sample locations located in paved areas were evaluated in conjunction with surface soil data from exposed areas in EU5. If the currently undeveloped portions of the Site (EU2 and EU3) become developed in the future, similar maintenance activities may be required and, therefore, exposures to surface soils in EU2 and EU3 were also assessed. The drainage ditch encompassed by EU4 requires periodic maintenance; therefore, exposures to soil, sediment, and surface water in this area were assessed. At the request of MDEQ (2000), maintenance worker exposures to surface water and sediment in EU1 were also assessed.

4.1.3 Construction Worker

Although there are currently no major construction activities at the Site, such activities may hypothetically occur in the future. Thus, exposures to surface water and sediment in EUs 1 and 4, and exposures to soil in EUs 2 through 5 were assessed herein. Construction workers may be exposed to both surface and subsurface soils during activities such as excavating. Subsurface soils, for purposes of this assessment, were defined as those soils at the water table and shallower. Since the depth to the water varies significantly across the Site, so does the definition of "subsurface" soils. Accordingly, subsurface soils were evaluated down to 10 feet for EU2 and 20 feet for EUs 3, 4, and 5.

4.1.4 Future On-Site Residents

The affected areas of the Property (the Site) are currently zoned for industrial or light-commercial use, and, at the time of this report, there were no plans to develop the Site for residential housing. In fact, deed restrictions preventing residential development are in the process of being implemented for the impacted areas on Site. Because of these deed restrictions, it is reasonable and realistic to assume that the Site will remain commercial/industrial in the future; therefore, on-Site residential exposures were not addressed in this risk assessment.

4.1.5 Off-Site Residential Exposures

The northeast drainage ditch extends from the former Process Area to the northeast into a nearby residential community. Surface water and sediment data from areas along the northeast drainage ditch (EU6, Figure 3) were evaluated for off-Site residential exposures. For purposes of exposure assessment, a child resident between the ages of 1 and 6 years and an adolescent/adult resident between the ages of 7 and 30 years were evaluated. Hazards and risks for these two receptors were then combined (summed) to reflect the exposures incurred by a single individual living off-Site in the vicinity of the northeast drainage ditch for 30 years.

4.2 General Intake Equation

Chemical exposure/intake is expressed as the amount of the agent at the exchange boundaries of an organism (i.e., skin, lungs, gut) that is available for systemic absorption. An applied dose is defined as the amount of a chemical at the absorption barriers such as skin, lung, digestive tract, available for absorption and is (usually expressed in milligrams, or mg) absorbed per unit of body weight of the receptor (usually expressed in units of kilogram, or kg). Absorbed dose can be defined as the amount of chemical that penetrates the exchange boundaries. If the exposure occurs over time, the total exposure can be divided by the time period of interest to obtain an average exposure rate (e.g., mg/kg-day). The general equation, as defined by US EPA, for estimating a time-weighted average intake is:

Intake (mg/kg - day) =
$$\frac{C \times IR \times EF \times ED}{BW \times AT}$$

[Equation 1]

where:

C = chemical concentration at the exposure point $(e.g., mg/m^3 air)$;

IR = intake rate $(e.g., m^3/hr)$;

EF = exposure frequency (days/year);

ED = exposure duration (years);

BW = body weight of exposed individual (kg); and

AT = averaging time (period over which exposure is averaged, usually

measured in days).

Additional parameters (e.g., skin surface area) were incorporated into the above general equation to evaluate the different potential exposure routes (dermal, oral, inhalation).

Table 19 presents the general and pathway-specific exposure parameters utilized for the intake equations in this assessment.

4.2.1 General Exposure Parameters

Although some of the parameters used to calculate potential exposure are pathway- or route-specific, exposure frequency (EF), exposure duration (ED), averaging time (AT; determined separately for carcinogenic and non-carcinogenic exposures), and body weight (BW) are present in each intake model. These general parameters remain consistent throughout the intake calculations for each specific receptor.

4.2.1.1 Exposure Frequency

The exposure frequency (EF) describes the number of times per year an event is likely to occur. It is most often expressed in units of days/year or events/year, depending on the scenario. Variables such as weather, vacations, sick days, and institutional controls often aid in determining reasonable and realistic exposure frequencies.

The EF for an adolescent visitor was extracted from US EPA Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) Interim Final (1989). This EF value of 12 days/year per EU is a reasonable estimate that assumes an adolescent would most likely be engaged in outdoor activity on the unpaved areas of the Site for one day a week during

the three warmest months of the year. This value was used for soil, sediment, and surface water exposures.

Typical construction projects, especially at industrial complexes, generally involve several phases of activity prior to completion. The EF parameter used for oral exposure in construction workers, therefore, was subdivided into two exposure events. The first event hypothetically lasts for 10 days (used in relevant exposure model calculations under "Exposure Level A") and would involve earth-moving activities such as foundation. The second exposure event to the same individual hypothetically lasts for 70 days (for a total of 80 days at the Site for an individual; this value was used in relevant exposure model calculations under "Exposure Level B") and included remaining construction activities such as building framing, plumbing installation, electrical installation, and roofing. Generally, to complete each of these phases, a different team of specialized contractors is employed to perform the tasks for which they are most qualified. As a result, an individual may only remain at the construction site for a few days or weeks until his/her task has been completed and the next phase has begun. This is especially true for those activities involving direct contact with soil such as excavating and foundation pouring. Individuals performing these tasks are not usually qualified or employed to continue with the actual building processes. For dermal and inhalation exposures, however, an 80-day EF was used and accounted for an individual to be involved in construction activities for four entire months of the year (assuming five-day work weeks).

For surface water and sediment exposures to construction workers, an EF value of 8 days/year was used. This value represents $1/10^{th}$ of the time a worker may be on-Site for construction-type activities and is conservative in that it is unlikely that construction workers would be exposed at all to Site surface water or sediment.

The EF value used for the maintenance worker scenario was 150 days/year for surface soil exposures in EUs 2, 3, and 5. This is also a conservative assumption in that the currently developed areas of the Site are covered with buildings or pavement. Maintenance activities in

these areas would require little contact with the obscured surface soils. The undeveloped areas of the Site currently require little or no maintenance as they are only occasionally mowed or allowed to grow naturally. Should these areas become developed, they will most likely take on the appearance of the remainder of the Site, including industrial/commercial buildings and paved roads or parking lots. Once again, extensive direct contact with surface soils would be minimal for a maintenance worker.

For maintenance worker sediment and surface water exposures in EUs 1 and 4 and surface soil exposures in EU 4, an EF value of 30 days/year was used. Historically, the northeast drainage ditch has been maintained on an as-needed basis (less than annually). Maintenance worker exposures to sediment and surface water in these areas were assessed at the request of the MDEQ (2000). An EF value of 30 days/year is amply conservative in that both Gordon's Creek (EU 1) and the northeast drainage ditch (EU 4) are currently maintained less than annually.

For residential soil exposures, an exposure frequency of 350 days/year was used in accordance with Region IV guidance. This value assumes that 15 days/year are spent away from home (US EPA, 1991).

Sediments along the bank of the northeast drainage ditch are not comparable to surface soils comprising a yard with respect to exposure. Typically, yard soils include relatively large areas where children frequently play and where surface soils are tracked into the home to become part of the household dust that can be ingested, particularly by crawling infants, on a daily basis. These are the assumptions that underlie the standard residential soil exposure algorithm and parameter values. However, it is not realistic to assume that infants, children, or adults will directly contact a relatively small area of sediments on the banks of a drainage ditch on a daily basis. A more realistic exposure scenario for this unique area under an assumption of residential land use is for a resident child to play on occasion in the drainage ditch that traverses the residential property. An exposure frequency of 40 days/year, two hours per exploring event, is conservatively plausible.

4.2.1.2 Exposure Duration

The ED parameter represents the number of years during which an event is likely to occur. Factors affecting this parameter include variables such as age of receptor, population mobility, and occupational mobility. Exposure durations of less than seven years typically correspond to subchronic exposures while those greater than seven years are typically considered chronic exposures (US EPA, 1989). Toxicity indices are selected based on subchronic or chronic exposure durations.

The future construction worker scenario used an ED of one year because it is highly unlikely that a future construction worker would remain on one site for more than a year. Often, two months is considered the maximum amount of time a construction worker may reasonably remain at the same site.

The future maintenance worker ED, on the other hand, is based on occupational mobility studies. The ED of 25 years was obtained from US EPA (1991) which recommends a 95th percentile value of 25 years based on a study by the Bureau of Labor Statistics as of 1987. US EPA Region 4 also recommends a default value of 25 years for worker scenarios (1995).

The adolescent visitor scenario used an ED of 10 years. An adolescent was defined in this assessment as an individual aged seven to 16 years in accordance with US EPA Region 4 (1995); therefore, an exposure duration of 10 years was most appropriate.

An ED of 30 years (US EPA Region 4, 1995) was used for off-Site residents. This value assumes an individual spends 6 years as a child and 24 years as an adolescent/adult in the same location.

4.2.1.3 Averaging Time

The averaging time (AT) parameter is the time period over which exposure is averaged. For human health cancer risk calculations, the AT_c value prorates a total cumulative dose over a

lifetime. As a conservative approach, the AT_c value for each receptor is the product of a 365-day year and a 70-year life span, equaling 25,550 days.

The AT_n used for non-carcinogenic effects is the product of a 365-day year and the exposure duration (i.e., $AT_n = 365$ days × ED). Because the ED parameter changes for each receptor, the AT_n changes as well. The AT_n values used for each receptor are summarized below:

Future Construction Worker - 365 days

Maintenance Worker - 9125 days

Adolescent Visitor - 3650 days

Off-Site Child Resident - 2,190 days

Off-Site Adult Resident - 8,760 days

4.2.1.4 Body Weight

The body weight used for the adult exposures (future construction worker and maintenance worker) analyzed in this assessment was the current US EPA default value of 70 kg (US EPA, 1989; US EPA Region 4, 1995). This value was also used for the adolescent/adult off-Site resident scenario. The adolescent body weight used for the visitor scenarios was 45 kg. This value was extracted from US EPA Region 4 guidance (1995). For the child resident scenario, a body weight of 15 kg was used as recommended by US EPA (1991).

4.2.2 Route-Specific Exposure Parameters

The general intake equation discussed above (Equation 1) was modified by including route-specific exposure parameters in order to calculate route-specific intake values. For dermal exposures, skin surface area, adherence factor, exposure time (surface water exposures only), and absorption factor parameters were included in the intake equation. For ingestion exposures, an ingestion rate and a matrix effect were included in the intake calculation. For inhalation exposures, an inhalation rate and a retention factor for fugitive dusts were included in the intake equation. Also, for inhalation exposures, an additional paradigm was necessary to convert soil concentrations to concentrations in air available for intake.

4.2.2.1 Dermal Exposure Parameters

Skin Surface Area

The total skin surface area used for adult receptors in this assessment was 20,000 cm². This is a US EPA default value extracted from the *Exposure Factors Handbook* (1997). For adolescent exposures, a value of 12,768.3 cm² was used for total skin surface area. This was a mean value calculated based on the distributions of total skin surface areas for males and females between the ages of 7 and 16 as presented in *Exposure Factors Handbook* (1997). For the off-Site child resident scenario, a skin surface area of 7,213 cm² was used. This value was based on skin surface area data for male and female children provided in *Exposure Factors Handbook* (1997).

For purposes of exposure, it was assumed that only portions of the body would be exposed to the affected media on the Site. For the construction worker scenario, it was assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. These body parts comprise 27.8% of the total skin surface area, or 5560 cm².

For maintenance worker exposures to Site soils, it was assumed that the hands, forearms, and face would be exposed. These body parts comprise 15 percent of the total skin surface area, or 3000 cm².

For surface water and sediment exposures, exposed body parts for construction and maintenance workers included hands, forearms, and face or 3000 cm² (15% of the total skin surface area).

The visitor and off-Site resident scenarios assumed that the hands, forearms, and lower legs would be exposed for contact with Site soils. These body parts comprise 23.9% of the total skin surface area, or 3052 cm² for adolescent visitors, 1724 cm² for child residents, and 4780 cm² for adult residents. For exposures to surface water and sediment, hands, forearms, lower legs, and feet were assumed exposed for adolescent visitor and off-Site resident scenarios. These body parts comprise 30.9 % of the total skin surface area or 3945 cm² for adolescent visitors, 2229 cm² for child residents, and 6180 cm² for adult residents.

Soil Adherence Factor

Until recently, the US EPA-recommended default for soil adherence on skin ranged from 0.2 to 1.0 mg/cm² for the entire exposed surface area, without consideration of the type of activity (US EPA, 1992). However, the data from which that range was derived were primarily the result of indirect measurements, artificial activities, and sampling of hands only. A more recent study has presented the results of direct measurement of soil loading on skin surfaces before and after normal occupational and recreational activities that might result in soil contact (Kissel et al., 1996). A fiveorder of magnitude range (roughly 10^{-3} to 10^{+2} mg/cm²) was reported for observed activity-related hand loadings. That report indicated that hand loadings within the range of 0.2 to 1.0 mg/cm² were produced by activities in which there was vigorous soil contact (e.g., rugby, farming); but for activities in which there was less soil contact (e.g., soccer, professional grounds maintenance), loadings substantially less than 0.2 mg/cm² were found on hands and other body parts. Kissel et al. (1996) concluded that, because non-hand loadings attributable to higher contact activities exceeded hand loadings resulting from lower contact activities, hand data from limited activities cannot be used as a conservative predictor of loadings that might occur on other body surfaces without regard to activity. Furthermore, because exposures are activity-dependent, dermal exposure to soil should be quantified using data describing human behavior (e.g., type of activity, frequency, duration, including interval before bathing, clothing worn, etc.).

The most recent version of the Exposure Factors Handbook (1997) states:

In consideration, of these general observations and the recent data from Kissel et al. (1996, 1997), this document recommends a new approach for estimating soil adherence to skin. First use Table 6-12 [Summary of Field Studies, Kissel et al., 1996a] to select the activity which best approximates the exposure scenario of concern. Next, use Table 6-13 [Mean Soil Adherence by Activity and Body Region, Kissel et al., 1996a] to select soil loadings on exposed skin surfaces which correspond to the activity of interest. This table contains soil loading estimates for various body parts. The estimates were derived from soil adherence measurements of body parts of individuals engaged in specific activities described in Table 6-12. These results provide the best estimate of central loadings, but are

based on limited data. Therefore, they have a high degree of uncertainty such that considerable judgment must be used when selecting them for an assessment.

In another study that assessed the percentage of skin coverage in several soil contact trials in a greenhouse and an irrigation pipe laying trial, Kissel *et al.* (1996) concluded that adjusted loadings may be two to three orders of magnitude larger than average loadings if average loadings are small.

The activity-specific soil adherence factor for exposures to a maintenance worker was calculated based on data presented by Kissel *et al.* (1996) for grounds keepers, as presented below:

		Soil Adherence Factor by Body Part (mg/cm²)							
Receptor	Representative Activity	Hands	Arms	Lower Legs	Face				
Maintenance Worker	Grounds Keepers	0.030 - 0.15	0.0021 - 0.023	0.0008 - 0.0012	0.0021 - 0.01				

Data for the grounds keepers were used for the maintenance worker estimates because the activities of a grounds keeper best mimic those of a maintenance worker.

Soil adherence factors were calculated by normalizing each body part-specific soil adherence value (using the mid-points of the ranges tabulated above) with regard to the percentage of total body surface area represented by the respective body part (extracted from the US EPA Dermal Exposure Assessment: Principles and Applications [US EPA, 1992]). The maintenance worker adherence factor for soil was calculated based upon exposure to the hands, forearms and face. Surface area percentages for the hands, forearms, and face are 5.2, 5.9, and 3.9 percent, respectively (US EPA, 1997). Those body parts comprise 15 percent of the total body surface area. The normalized values for all body parts of interest were added, and the sum was divided by the total percentage of body surface area occupied by the parts. For example, the soil and sediment adherence factors for maintenance worker soil exposures (0.038 mg/cm²) were calculated as follows:

AF (mg/cm²) =
$$\frac{(0.09 \times 0.052) + (0.0126 \times 0.059) + (0.006 \times 0.039)}{0.15}$$
 = 0.038

The construction worker adherence factor was also calculated in this fashion. This exposure scenario assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. Soil loadings for the upper torso (chest and back) were not measured by Kissel *et al.* (1996) for construction workers because this body area is generally covered. However, to account for exposure to the upper torso during the very hot months of the year, the total area of the forearms, legs, hands, and face were assumed to be completely exposed. The hands, forearms, legs, and face comprise 5.2%, 5.9%, 12.8%, and 3.9% of the total skin surface area, respectively (with the face comprising one-third the surface area of the head), for a total of 27.8% exposed surface area. The construction worker soil adherence factor was based on data from Kissel *et al.* (1996) for construction workers as follows:

		Soil Adh	erence Fact	or by Body Part (mg/cm ²)
Receptor	Representative Activity	Hands	Arms	Lower Legs	Face
Construction Worker	Construction Worker	0.24	0.098	0.066	0.029

The soil adherence factor for the construction worker scenario was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.066 \times 0.128) + (0.029 \times 0.039)}{0.278} = 0.1$$

For sediment exposures, the soil adherence factor was calculated for the construction worker scenario using adherence data from Kissel et al. (1996) for construction workers (as tabulated above) for the hands, forearms, and face. The hands, forearms, and face comprise 5.2, 5.9, and

3.9 percent of the total skin surface area, respectively (totaling 15 percent). Thus, the adherence factor for construction workers exposed to sediment (0.13 mg/cm²) was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.029 \times 0.039)}{0.15}$$
 = 0.13

The adherence factor for visitor and off-Site resident exposures to soil assumed that the forearms, hands, and lower legs would be exposed to soil or sediment. The data used in these calculation were based on data by Kissel *et al.* (1996) for soccer players (exposed to a playing field of roughly one-half grass and one-half bare earth in a light mist) as presented below:

		Soil Adherence	Factor by Body	Part (mg/cm²)
Receptor	Representative Activity	Arms	Hands	Lower Legs
Visitor and Off- Site Resident	Soccer Players	0.0029 - 0.011	0.019 - 0.11	0.0081 - 0.031

The forearms, hands, and lower legs comprise 5.9%, 5.2%, and 12.8% of the total skin surface area, respectively, for a total of 23.9% (US EPA *Exposure Factors Handbook*, 1997). The adherence factor was then calculated for visitor and off-Site resident dermal exposures to soil as follows:

$$AF (mg/cm^2) = \frac{(0.00695 \times 0.059) + (0.0645 \times 0.052) + (0.0196 \times 0.128)}{0.239} = 0.026$$

A value of 0.026 mg/cm² was used as the soil adherence factor for visitors to the Site and off-Site residents.

Soil adherence factors for sediment exposures to Site visitors and off-Site residents were calculated using adherence data for the hands, forearms, lower legs, and feet. Adherence data for

reed gatherers were used for these exposures to best mimic activities that may incur sediment exposures. The reed gatherers studied by Kissel *et al.* (1996) periodically visited tidal flats to collect raw materials for basket weaving. The data from Kissel *et al.* (1996) presented in *Exposure Factors Handbook* (US EPA, 1997) were as follows:

	-	Soil Adhei	ence Factor	· by Body Part (n	ng/cm²)
Receptor	Representative Activity	Hands	Arms	Lower Legs	Feet
Visitors and Off-Site Residents	Reed Gatherers	0.66	0.036	0.128	0.63

The hands, forearms, lower legs, and feet comprises 5.2, 5.9, 12.8 and 7.0 percent of the total skin surface area, respectively (totaling 30.9 percent). Thus, the adherence factor for visitors and off-Site residents exposed to sediment (0.33 mg/cm²) was calculated as follows:

$$AF (mg/cm^2) = \frac{(0.66 \times 0.052) + (0.036 \times 0.059) + (0.16 \times 0.128) + (0.63 \times 0.07)}{0.309} = 0.33$$

Exposure Time

To estimate intakes as a result of dermal exposure to surface water, an exposure time (ET) parameter was included in the intake formula for Site visitors and off-Site residents. The parameter value of 1.0 hour/day was estimated using best professional judgement. This value represents the amount of time a Site visitor or off-Site resident may spend exposed to surface water in any one EU.

Dermal Permeability Constant

The permeability constant, Kp, accounts for the movement of a constituent dissolved in water through the skin, across the stratum corneum, and into the blood stream. Kp values for the constituents examined in this assessment for surface water exposures were obtained from US EPA Dermal Exposure Assessment: Principles and Applications (1992). For values not available in

US EPA *Dermal Exposure Assessment* (1992), the Kp value were calculated using the equations provided by the US EPA in the same document.

Dermal Absorption Factor

The final parameter included in the dermal intake paradigm was a dermal absorption factor. In general, the skin provides an effective barrier to environmental toxins. For example, certain hair-coloring formulations which are vigorously rubbed onto the scalp on a daily basis contain lead acetate at concentrations up to 200,000 ppm, yet lead toxicity does not appear to result. Moore *et al.* (1980) determined that the rate of lead absorption from 203^{Pb} labeled lead acetate in cosmetic preparations containing six mmol Pb acetate/L in male volunteers over 12 hours was 0.06% during normal use of such preparations. For most inorganic salts, percutaneous (skin) absorption is considered insignificant relative to incidental ingestion (for example, US EPA, 1986). On the other hand, some drugs (*e.g.*, nicotine) are effectively administered and absorbed into the blood stream from dermal "patches."

Most dermal bioavailability data for impacted soil have been obtained in laboratory animals or in vitro test systems. This introduces a significant source of uncertainty for predicting the human response. Safety factors have sometimes been applied to dermal absorption data obtained in animals to conservatively estimate the upper-bound of likely human percutaneous uptake of a certain constituent from skin exposure. This is usually unnecessary because human skin has generally been shown, for a diverse group of constituents, to be about 10-fold less permeable than the skin of typical animal species, such as rabbits and rats (Bartek and LaBudde, 1975; Shu et al., 1988).

US EPA Region III evaluated available data concerning the dermal absorption of specific constituents and classes of constituents and provided several recommendations (US EPA Region 3, 1995). For semivolatile compounds, such as *bis*(2-ethylhexyl)phthalate, the US EPA recommends a range of 1% to 10% (US EPA, 1995). Kao *et al.* (1985) reported 2.7 percent for absorption of topically applied pure benzo(a)pyrene by human skin *in vitro*. The US EPA

Region 3 recommends using 10% as a conservative assumption based on the Ryan *et al.* study (1987). In addition, US EPA Region 4 guidance (1995) states that a soil dermal absorption factor "of 1.0% for organics and 0.1% for inorganics should be used as defaults in determining the uptake associated with dermal exposure" (see the Dermal Contact subsection of Exposure Assessment section of the 1995 guidance). For the purpose of this risk assessment, an ABS of 3% for cPAHs and of 10% for other SVOCs were conservatively assumed for dermal absorption, in keeping with US EPA Region 3's and MDEQ's recommendations.

4.2.2.2 Ingestion Exposure Parameters

Ingestion Rate

US EPA's Exposure Factors Handbook (1997) discusses three adult soil ingestion studies with results ranging from 10 mg/day to 480 mg/day. Hawley's (1985) value of 480 mg/day (as recommended by the MDEQ) was "derived from assumptions about soil/dust levels on hands and mouthing behavior" (US EPA, 1997). Since no supporting measurements were made for Hawley's study, the US EPA states that Hawley's estimate "must be considered conjectural" (1997). As such, the US EPA goes on to suggest adult soil ingestion rates of 50 mg/day for industrial settings and 100 mg/day for residential and agricultural settings, although "50 mg/day still represents a reasonable central estimate of adult soil ingestion and is the recommended value..." (1997). Accordingly, a value of 100 mg/day for the maintenance worker and adult off-Site resident is amply conservative and was used in this assessment. In conjunction with the use of a two-tiered EF to reflect the different stages of potential future construction activities (see Section 4.2.1.1), the soil ingestion s for the construction worker scenario was also divided into two exposure levels for a single individual. A highly conservative ingestion rate of 480 mg/day (used in relevant exposure model calculations under "Exposure Level A") was used for construction workers for the first 10 days of exposure to address direct contact with soil during earth-moving activities such as foundation excavating. A soil ingestion rate of 100 mg/day (used in relevant exposure model calculations under "Exposure Level B") was used for the remainder of the construction worker exposure (70 days). Risks were then summed for both exposure levels to estimate the total potential risk posed to an individual construction worker

The ingestion rate used for the adolescent visitor scenario was 100 mg/day. The US EPA Region IV (1995) recommends a value of 200 mg/day as a mean ingestion rate for children under six years of age. This value was conservatively used in this assessment to estimate soil and sediment ingestion exposures for an off-Site resident child aged one to six years.

Gastrointestinal Matrix Effects of Soil

Incidental ingestion incorporates the matrix effect (ME; sometimes called the absorption adjustment factor [AAF]) into the general intake equation. When constituents are administered in solid vehicles such as food and soil, only a fraction of the ingested dose is extracted from the vehicle and subsequently absorbed through the gastrointestinal tract (US EPA Estimated Exposure to Dioxin-like Compounds, 1992). Gastrointestinal absorption of constituents sorbed onto such a medium is inhibited by physical-constituent bonding to the matrix (Hawley, 1985). This phenomenon is referred to as the gastrointestinal matrix effect of soil. Several studies referenced in the US EPA's Estimated Exposure to Dioxin-like Compounds (1992) have been performed to estimate the oral absorption factors of constituents from soil. At the request of MDEQ (2001), however, a gastrointestinal matrix effect of 1.0 was used in accordance with US EPA Region IV guidance (1995), although this approach is highly conservative and does not account for scientific studies that indicate the absorption of chemical constituents through the gastrointestinal tract is less than 100%.

4.2.2.3 Inhalation Exposure Parameters and Paradigms

Inhalation Rate

The inhalation rate used for the construction worker scenario was 20 m³/day. This is a common US EPA default value and was recommended by US EPA Region 4 (1995).

Retention Factor

According to the International Commission on Radiological Protection (ICRP), 75 percent of respirable dust particles (PM₁₀, or particles less than 10 microns in aerodynamic diameter) are retained when inhaled, the vast majority of which is potentially subsequently swallowed (ICRP,

1968). This 75% was included in the inhalation intake equation as the retention factor parameter

(RF). This parameter applies only to non-VOC constituents entrained onto dust particles.

Concentration in Air

To estimate airborne dust levels during hypothetical construction activities, an emission rate of suspendible particles of less than 15 microns in aerodynamic diameter (PM₁₅) was calculated (grams/second); particles less than 10 microns were considered to be respirable. Considering particles of 15 microns or less in diameter in the emission rate calculation is a conservative assumption, inasmuch as only particles with an aerodynamic diameter of less than five to seven

microns are inhaled into the lung.

The two types of construction activities at the Site that have the potential to emit fugitive dusts are vehicular movement over bare (unpaved or unvegetated) surfaces and the excavation of soil. Estimation of fugitive dust emissions caused by each activity were examined separately, as follows, and were derived from existing estimates of general construction exposure. The sum of the emissions from these two activities was multiplied by the concentration of constituent in the soil (Cs) in order to derive the total emission rate (Ei) for non-VOCs as follows:

$$Ei = C_s \times (PERv + PERe)$$
 [Equation 2]

where:

Ei = Emission rate (mg/sec);

 $C_s = Concentration in soil (mg/kg);$

PERv = Particulate emission rate for vehicular movement (lb/vehicle mile);

and

PERe = Particulate emission rate for excavation (lb/vehicle mile).

The following empirical expression (US EPA, 1988) was used to estimate the fugitive dust generated by vehicles during construction activities:

PERv (lbs/vehicle mile) =
$$k \times 5.9 \times (s/12)(S/30) \times (mvw/3)^{0.7} \times (ww/4)^{0.5} \times ((365 - p)/365)$$
[Equation 3]

where:

PERv = Vehicle particle emission rate (lb/vehicle mile traveled);

s = Percent silt content (unitless); k = Particle size multiplier (unitless);

S = Mean vehicle speed (mph); mvw = Mean vehicle weight (ton);

ww = Mean number of wheels per vehicle (unitless); and

p = Mean number of days with ≥ 0.01 inches of precipitation per year

(unitless).

It was assumed that the vehicle travels during 40% of the 80-day exposure duration and 0.5 miles per day. The result is a value of 16 miles per construction event. Percent silt content was estimated to have a mean value of 50%, based on geotechnical data provided in the *Remedial Investigation Report* (Pisani & Assoc., 1997). US EPA default values were utilized and referenced for all other parameters. The particle size multiplier was assumed to be 0.50, corresponding to particles less than 15 microns (US EPA, 1996). Vehicle characteristics consist of the following: mean vehicle speed was assumed to be 15 mph, with mean vehicle weight assumed to be approximately 12.5 tons, for 8-wheeled vehicles (US EPA, 1988). The estimated mean number of days with precipitation equal to or greater than 0.01 inches per year is 110 (US EPA, 1988). Total resultant dust emissions for constituents during vehicular movement activities were estimated to be approximately 16.5 lbs/vehicle mile traveled, or 0.0001 kg/sec. Calculations are summarized in Table 20.

Future excavation may be performed by bulldozers, a backhoe, or other heavy construction equipment. The following estimate of particulate emissions, less than 15 μm in diameter resulting from bulldozing activity, was based on the approach described in the US EPA Compilation of Air Pollution Emission Factors (1996), as developed from studies of emissions from uncontrolled open dust sources resulting from bulldozing at western surface coal mines.

PERe (lb/hour) =
$$\frac{1.0 \times s^{1.5}}{M^{1.4}}$$
 [Equation 4]

where:

PERe = Excavation particle emission rate (lb/hr);

s = Percent silt content (unitless); and

M = Soil moisture content (unitless).

Percent soil moisture content was assumed to be 15.1%, an average of Site-specific soil moisture data and percent silt content 50%, as described above.

The resultant fugitive dust emission rate during excavation activities was 7.9 lbs/hr or 0.001 kg/sec. Table 20 summarizes these calculations.

Once the emission rate (Ei in Equation 2) was calculated, it was converted to a concentration in ambient air. Gaussian models are conventionally used to determine downwind ambient air concentrations, Ca, from the emission rate, Ei, estimated. However, in this scenario, such models have limited applicability when the receptor(s) is at or very near the source of emission. In this case, a bulldozer operator, for example, is situated directly within the area of ground emissions of vapors and dusts. Average ambient air concentrations in this circumstance are best estimated by use of a near-field box model (US EPA, 1988).

The near-field box model assumes uniform wind speed and uniform mixing throughout the box. The release and mixing of VOCs or respirable dusts in ambient air is estimated as follows:

Ca (mg/m³) =
$$\frac{\text{Ei}}{\text{W}_{b} \times \text{H}_{b} \times \text{V}}$$
 [Equation 5]

where:

Ca = Concentration of constituent in ambient air (mg/m³);

Ei = Emission rate of constituent (mg/sec);

W_b = Width of box in crosswind dimension within the area of residual

constituent in soil (m);

 H_b = Downwind height of box (m); and

V = Average wind speed through the box (m/sec).

The value of H_b in this calculation is determined by the downwind distance and the atmospheric turbulence at ground level, which determines the trajectory of a release from the upwind edge of the source of vapor or dust emissions. For neutral atmospheric conditions, the height at the downwind boundary (H_b) may be expressed by the following function (Pasquill 1975, Horst 1979):

$$z = 6.25 \text{ r} [H_b/r \times \ln (H_b/r) - 1.58 H_b/r + 1.58]$$
 [Equation 6]

where:

 $H_b = Downwind height of box (m);$

z = Downwind distance to boundary (m); and r = A terrain-dependent roughness height (m)

H_b (defined in Equation 5) is adjusted until the z parameter is equal to W_b (defined in Equation 5). The resulting H_b value is the height of the box. On any given workday, it is estimated that grading or excavation activities occur over the entire "workable" Site area (exposure unit) from which dusts are generated. This area is estimated to be 2,500 m², with length of the box estimated to be 50 meters (downwind distance) and the width of the box (W) estimated to be 50 meters. The greater the roughness height, the greater the wind turbulence and constituent dilution (i.e., the height of the box increases). For the purposes of this risk assessment, it is conservatively assumed that the roughness height is 0.20 meters, which corresponds to a terrain with grass, some small bushes, and occasional trees (US EPA Rapid Assessment of Exposure to Particulate Emission from Surface Contamination Sites, 1985). This

assumption is appropriate for the actual Site conditions. An annual average wind speed (4.69 m/sec) is obtained from the STAR data set, accessed through the Personal Computer Graphical Exposure Modeling System (PCGEMS), for STAR station 03940, Jackson/Thompson, MS for the period 1974-1978 (Table 21).

5.0 Toxicity Assessment

The toxicity assessment involves the evaluation of available toxicity information to be utilized in the risk assessment process. Toxicity values derived from a dose-response relationship can be used to estimate the potential for the occurrence of adverse effects in individuals exposed to various constituent levels.

Exposure to a constituent does not necessarily result in adverse effects. The relationship between dose and response defines the quantitative indices of toxicity required to evaluate the potential health risks associated with a given level of exposure. If the nature of the dose-response relationship is such that no effects can be demonstrated below a certain level of exposure, a threshold can be defined and an acceptable exposure level derived. Humans are routinely exposed to naturally-occurring constituents and man-made constituents through the typical diet, air, and water, with no apparent adverse effects. However, the potential for adverse effects may occur if the exposure level exceeds the threshold in a variably sensitive population. This threshold applies primarily to constituents which produce non-carcinogenic (systemic) effects, although there is a growing body of scientific evidence which suggests that exposure thresholds may exist for certain carcinogenic constituents as well.

Adverse effects can be caused by acute exposure, which is a single or short-term exposure to a toxic substance, or by chronic exposure on a continuous or repeated basis over an extended period of time. "Acceptable" acute or chronic levels of exposure are considered to be without any anticipated adverse effects. Such exposure levels are commonly expressed as reference doses (RfDs), health advisories, etc. An acceptable exposure level is calculated to provide an "adequate margin of safety."

Chronic RfDs, which have been derived by the US EPA for a large number of constituents, were utilized to evaluate exposures lasting seven to 70 years (US EPA, 1989). Activities involving exposures of shorter duration to COPCs at the Site are anticipated to result in hazard and risk estimates that are lower than those associated with the long-term exposures. Identification of

subchronic toxicity values corresponding to shorter-term exposure scenarios (*i.e.*, less than seven years) are included in the risk assessment to ensure that both short-term and long-term risks can be addressed.

Currently, the US EPA has not developed toxicity values to be utilized in dermal exposure scenarios; however, the US EPA does provide the following guidance for dermal exposure:

No RfDs or slope factors are available for the dermal route of exposure. In some cases, however, non-carcinogenic or carcinogenic risks associated with dermal exposure can be evaluated using an oral RfD or oral slope factor, respectively. (US EPA, 1989).

Provisional dermal toxicity values were developed and utilized in the dermal exposure pathways considered in the human health risk assessment to provide a more accurate Site-specific risk assessment. These dermal RfD values were developed by multiplying the published oral RfD for a given constituent by the fraction of that constituent that can be absorbed through the gastrointestinal tract (stomach/intestine lining). The absorption fraction utilized was 50% for semivolatiles as extracted from US EPA Region 4 guidance (1995).

A number of sources of toxicity information exists, and these sources vary with regard to the availability and strength of supporting evidence. The following protocol has been established for the determination of toxicity indices; it defines a hierarchy of sources to be consulted and the methodology for the determination of toxicity values. This protocol has been developed in accordance with current US EPA methodology. Toxicity values for the COPCs at the Site were obtained with reference to the following hierarchy of sources developed in accordance with MCEQ guidance (1999):

Toxicity values were obtained from the *Integrated Risk Information System* (IRIS, 1999) database. This database contains the RfDs and Cancer Slope Factors (CSFs), which have been verified by the US EPA's RfD and Carcinogen Risk Assessment Verification Endeavor (CRAVE) workgroups, and is, thus, the

- agency's preferred source for toxicity values. IRIS supersedes all other information sources.
- 2) For toxicity values which are unavailable on IRIS, the most current source of information is the Health Effects Assessment Summary Tables (HEAST, US EPA, 1997), published by the US EPA. HEAST contains interim, as well as verified RfDs and CSFs. Supporting toxicity information for verified values is provided in an extensive reference section of HEAST.
- Region III's Risk-Based Concentration (RBC) Tables were visited. These tables often provide toxicity values generated by reliable sources other than IRIS or HEAST. For example, in response to specific requests from risk assessors, the US EPA National Center for Environmental Assessment (NCEA) develops provisional RfDs or CSFs for chemicals not listed in IRIS or HEAST. Region III's RBC tables will list such provisional values. Also, RfDs or CSFs that have since been withdrawn from IRIS or HEAST may still be listed on the Region III RBC tables, although they are flagged with a "W." These toxicity values were no longer agreed upon by US EPA scientists; however, the Region III RBC tables continue to publish such values because risk assessors still need to quantify exposures to these chemicals. Lastly, the Region III RBC tables will list toxicity indices found in "other" US EPA documents. These values are flagged with an "O" on the tables.

The US EPA has derived carcinogenic slope factors for both oral and inhalation pathways, and these are utilized to quantitatively estimate risks. In the first step of the US EPA's evaluation, the available data are analyzed to determine the likelihood that the agent is a human carcinogen. The evidence is characterized separately for human studies and animal studies as sufficient, limited, inadequate, no data, or evidence of no effect. The characterizations of these two types of data are combined, and based on the extent to which the agent has been shown to be a carcinogen in experimental animals or humans, or both, the agent is given a provisional weight-of-evidence classification. The US EPA scientists then adjust the provisional classification upward or downward, based on other supporting evidence of carcinogenicity (see Section 7.1.3, US EPA, 1989). For a further description of the role of supporting evidence, see the US EPA guidelines (US EPA, 1986).

The US EPA classification system for weight of evidence is shown in the table below. This system is adapted from the approach taken by the International Agency for Research on Cancer.

	US EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY
Group	Description
Α	Human carcinogen
B1 or B2	Probable human carcinogen
DZ	B1 indicates that limited human data are available
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
Е	Evidence of non-carcinogenicity for humans

(US EPA, 1989)

Table 22 summarizes the available toxicity values for the identified COPCs. COPCs lacking published toxicity values were not able to be quantitatively evaluated in this assessment in accordance with MCEQ guidance (1999). The MCEQ limits the use of toxicity values to those that have been published in IRIS, HEAST, ATSDR toxicity profiles, or other peer-reviewed reference sources or literature approved by the MCEQ (1999). The MDEQ (2001), however, requested that risks from dermal exposure to cPAHs be estimated using the oral cancer slope factor for benzo(a)pyrene, applying benzo(a)pyrene relative potency factors, and accounting for an absorption efficiency of 50%. This methodology was used accordingly.

6.0 Risk Characterization

The objective of the risk characterization is to determine potential risk to receptors by combining the results of the exposure and toxicity assessments. Non-carcinogenic effects and carcinogenic risks are summarized in Table 23. Tables 24 through 78 provide algorithms and parameters for each pathway.

The estimated intakes calculated for each exposure pathway considered and each COPC were compared to RfDs for non-carcinogenic effects. The following formula was used to estimate the potential for non-carcinogenic health effects for each COPC.

HQ = ADI/RfD

[Equation 7]

where:

HQ = Hazard quotient - potential for noncancer health effects (unitless);

ADI = Average daily intake of COPC (mg/kg-day); and

RfD = Reference dose (mg/kg-day).

RfDs have been developed by the US EPA for chronic (e.g., lifetime) and/or subchronic exposure to constituents based on the most sensitive non-carcinogenic effects. The chronic RfD for a constituent is an estimate of a lifetime daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. The potential for noncancer health effects was evaluated by comparing the Site-specific exposure level with the RfD derived by the US EPA for a similar exposure period. This ratio of exposure to toxicity is called the hazard quotient (HQ). If the Site-specific exposure level exceeds the threshold (i.e., the HQ exceeds a value greater than 1.0), there may be concern for potential noncancer effects.

To assess the overall potential for noncancer effects posed by multiple constituents, a hazard index (HI) is derived by summing the individual HQs. This approach assumes additivity of critical effects of multiple constituents. This is appropriate only for compounds that induce the

same effect by the same mechanism of action. This conservative approach significantly overestimates the actual potential for adverse health impacts.

In cancer risk assessment, the US EPA has required the use of the upper limit which produces an estimate of potential risk that has a 95% probability of exceeding the actual risk, which may, in fact, be zero. The following formula was utilized to estimate the upper bound excess cancer risk for each carcinogen (note that not all COPCs are carcinogens):

 $TR = CLDI \times SF$ [Equation 8]

where:

TR = Target risk - excess probability of an individual developing cancer (unitless):

CLDI = Calculated lifetime average daily intake of carcinogenic COPC

(mg/kg-day); and

 $SF = Cancer slope factor (mg/kg-day)^{-1}$.

For exposures to multiple carcinogens, the upper limits of cancer risks are summed to derive a total cancer risk. The US EPA recognizes that it is not technically appropriate to sum upper confidence limits of the risk to produce a realistic total probability, but requires this approach be used.

Carcinogenic risk refers to the probability of developing cancer as a result of exposure to known or suspected carcinogens. The National Contingency Plan (NCP) endorses an acceptable risk range of 10^{-4} to 10^{-6} for exposure to multiple carcinogens. This range represents an incremental increase of 1 in 10,000 to 1 in 1,000,000 in the chance of developing cancer over a lifetime. The MCEQ (1999) indicates that the target risk level is 1×10^{-6} per individual carcinogen and an acceptable cumulative risk level is 1×10^{-4} . As such, risk levels totaled across oral, dermal, and inhalation pathways may exceed 1×10^{-6} and still be in compliance with MCEQ requirements (1999) as long as no single carcinogen exceeds 1×10^{-6} and the cumulative risk for a single receptor does not exceed 1×10^{-4} .

Table 23 provides a summary of the non-carcinogenic effects and carcinogenic risks associated with each of the pathways evaluated in this assessment.

The overall hazard index across the assessed pathways and EUs was 0.1 for the Site visitor scenario. This value is below the acceptable benchmark of 1.0. The highest hazard index associated with the Site visitor scenario was 0.07 corresponding to dermal exposure to sediment in EU4. The overall cancer risk for exposures to Site visitors was estimated to be 7×10^{-5} and is primarily attributable to oral and dermal exposure to benzo(a)pyrene and associated cPAHs in EU4 soil and sediments. Oral exposure to the same constituents in EU4 and EU5 surface soils also contributed to the cancer risk estimate for the site visitor. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the maintenance worker scenarios was 0.08 and is below the acceptable benchmark of 1.0. The highest hazard index associated with the maintenance worker scenario was 0.05 corresponding to oral exposure to sediment in EU4. The overall cancer risk for the maintenance worker scenario was 4×10^{-4} and was primarily attributable to dermal and oral exposure to benzo(a)pyrene and other cPAHs in surface soils in EUs 2, 4, and 5. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the hypothetical future construction worker was 0.000006 and is well below the acceptable benchmark of 1.0. The highest hazard index associated with the construction worker scenario was 9×10^{-7} corresponding to dermal exposure to surface water in EU 4. The overall cancer risk for the hypothetical future construction worker scenario was 5×10^{-5} and is attributable to benzo(a)pyrene and associated cPAH oral exposure in EU4 sediment and oral and dermal exposure to EU4 and EU5 soils. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The off-Site resident scenario revealed a hazard index of 6×10^{-4} . This value is considerably below the acceptable benchmark of 1.0. The overall cancer risk for the resident exposure

scenario was estimated to be 2×10^{-4} and benzo(a)pyrene and associated cPAHs in EU6.	to oral a	nd dermal	exposure	to
			•	

7.0 Uncertainty Analysis

Risk assessment uses a wide array of information sources and techniques. Even in those rare circumstances where constituent intake for an exposed individual may be measured relatively precisely, assumptions will still be required to evaluate the associated risk. Generally, data are not available for critical aspects of the risk assessment, and the use of professional judgment, inferences based on analogy, the use of default values, model estimation techniques, etc., result in uncertainty of varying degrees.

The expressions of risk in this assessment are not probabilistic; the expressions of risk are conditional, based on the conditions represented by the single-point values selected for the analysis. This section is intended to identify and qualitatively evaluate the more salient Site-specific uncertainties and their potential influence on the credibility of the estimated Site risks.

7.1 Uncertainty of Data Evaluation Factors

Uncertainties in data analysis include analytical error, selection of COPCs, adequacy of sampling design, etc. Generally, there is far less uncertainty in this phase of the risk assessment process than other aspects contribute.

Laboratory analysis is extremely accurate relative to the potential error of "professional judgment" in exposure assessments. The uncertainty of analytical data is likely to be less than 25 percent, most of the time.

The adequacy of the sampling strategies to characterize Site conditions is a potentially large source of uncertainty. Because of the limited availability of resources, sample collection is generally limited. However, sampling (especially in multiple surveys) is not random, but is designed to locate the areas with the highest levels of constituents. Thus, test data are biased toward overestimation of average constituent levels. In addition, in most instances, the upper 95-percent confidence limit of the average concentration is utilized as an exposure-point

concentration in the risk assessment. The use of this value likely will result in an overestimation of risk, as the 95% UCL represents a value that will be greater than the true average 95% of the time.

Oftentimes, only a portion of detected constituents are carried through the risk assessment process because constituents are eliminated through COPC screening procedures (US EPA, 1989). This could result in an underestimation of risk, although the COPC selection process is intended to identify those constituents that account for the vast majority of potential risk. COPCs lacking published RfD values were not quantitatively evaluated and this may result in an underestimation of potential hazards (non-carcinogenic effects).

7.2 Uncertainty of Toxicity Values

The US EPA's IRIS states that the uncertainty associated with RfD values for non-carcinogenic endpoints of toxicity "span perhaps an order of magnitude." In fact, the uncertainty of extrapolating dose-response data from animals to humans with the application of multiple safety factors (100 to 10,000 or more) is likely to be several orders of magnitude. Current policies for deriving RfD values will often result in an overestimation of risk.

The uncertainty associated with the estimation of cancer risk contributes, by far, the major source of potential error and uncertainty. It is beyond the scope of this analysis to explore this toxicity assessment factor in any detail. However, a few salient points are noted below.

Some constituents classified as carcinogens have been shown to produce an increased incidence of cancer in mice but not rats, for example. If the mouse is not an adequate model for the rat, it may be wondered how reliable a model it is for human beings. The assumption of linearity and a non-threshold phenomenon in the dose versus risk relationship may not be valid and could result in a very large overestimation of actual cancer risk, if any even exist at low doses in humans.

The US EPA evaluated the uncertainty of cancer risk estimates from exposures to trichloroethene and several other related VOCs in public drinking water supplies (Cothern *et al.*, 1984). These US EPA scientists concluded the following:

- The largest uncertainty in the calculations is due to the choice of the model [Multistage, Weiball, Logit, Probit, etc.] used in extrapolating risk to low doses in humans, and is 5 to 6 orders of magnitude;
- If a single model were chosen [assumed to be valid], the overall uncertainty in risk estimates would be 2 to 3 orders of magnitude;
- The exposure estimates contribute, at most, an order of magnitude to the uncertainty; and
- It would appear that until a particular compound's mechanisms of cancer are better known, it is likely that the uncertainty in the toxicity will not be improved.

7.3 Uncertainties in Assessing Potential Exposure

Ideally, Site-specific exposure values should be used when assessing potential intakes of chemicals at a Site. Oftentimes, however, Site-specific data are not available; therefore, the risk assessor must estimate values that most accurately reflect Site conditions. In doing so, US EPA or other regulatory default values were utilized in place of Site-specific data. These values may over- or under-estimate risks, depending on Site conditions and the percentile range in which the default values fall (e.g., 50th, 95th).

Although a considerable amount of published data is available on the most common exposure parameters (e.g., body weight, skin surface area), even these data contain uncertainties. Studies conducted by different scientists often provide differing levels of detail, statistics, and accuracy based on sample size, study design, geographic area, etc. Such discrepancies can increase uncertainty when the data are combined to derive a single-point default value. These data may be the best available; however, the reflection of reality may still be imprecise.

Where published exposure parameters were not available, best professional judgment had to be used, thereby increasing uncertainty. The default or estimated exposure parameters used in this assessment likely resulted in a moderate over-estimation of risk.

The intakes estimated for dermal absorption of PAHs adsorbed into soils adhering to skin may overestimate risks for a host of reasons. Early studies conducted by Falk and coworkers indicated that the carcinogenic effect of B(a)P on subcutaneous injection in mice could be markedly inhibited by the simultaneous administration of various non-carcinogenic PAHs (Falk et al., 1964, as cited in ATSDR, 1988. In other subcutaneous injection and skin-painting studies with mice, it was shown that a combination of several non-carcinogenic PAH compounds, mixed according to the proportion occurring in auto exhaust, did not enhance or inhibit the action of two potent PAH carcinogens, B(a)P and dibenz(a,h)anthracene- (ATSDR, 1988).

The carcinogenic potency of B(a)P and other carcinogenic PAHs is generally determined by injecting solutions under the skin, painting the skin with the carcinogenic PAH dissolved in a solvent, or dissolved in corn oil in feeding studies. This vehicle or matrix affords a high level of bioavailability of the carcinogenic PAH compound. Recently, Krueger et al. (1999) conducted in vitro percutaneous absorption studies with contaminated soils and organic solvent extracts of contaminated soils collected at former manufactured gas plant (MGP) sites. The MGP tarcontaminated soils contained PAHs at levels ranging from 10 to 2400 mg/kg. The dermal penetration rates of PAH from the MGP tar-contaminated soils and soil solvent extracts were determined experimentally through human skin using tritrum-labelled B(a)P as a surrogate. Results showed reductions of two to three orders of magnitude in PAH absorption through human skin from the most contaminated soils in comparison to the soil extracts. Reduction in PAH penetration was attributed to soil matrix properties. That is, PAH compounds adsorbed to organic carbon in a soil matrix are far less bioavailable for dermal flux than PAH compounds dissolved in a solvent. [No correction for such a profound soil matrix effect was applied in quantitatively estimating cancer risks due to dermal absorption of B(a)P and other carcinogenic PAHs in this assessment.]

8.0 Summary of Findings

The results of the baseline human health risk assessment indicate potentially unacceptable risk levels for the following exposure scenarios:

Potentially Exposed Population	Media	EU
Site Visitor	Sediment	4
	Surface Soil	4, 5
Maintenance Worker	Sediment	4
	Surface Soil	2, 4, 5
Construction Worker	Sediment	4
	Subsurface Soil	4, 5
Off-Site Resident	Sediment	6

The risk levels associated with the above scenarios were driven by cPAHs, particularly benzo(a)pyrene. To determine the extent of remediation necessary to reduce these risks to acceptable levels, sediment and soil data for cPAHs in EUs 2, 4, 5, and 6 were closely examined.

The benzo(a)pyrene exposure-point concentration used to evaluate maintenance worker exposures to surface soil in EU2 was 5.2 mg/kg (sample location GEO-13/0-1'). This was the maximum benzo(a)pyrene concentration found in surface soil in EU2. The next highest concentration of benzo(a)pyrene in sediment was found at SS-10 (2.4 mg/kg). However, as previously noted, these samples were collected at locations within a densely wooded area. No remediation is planned to address surface soils at these locations for the following reasons:

- No maintenance activities are currently conducted in this area;
- Any remediation would require significant clearing; and
- Cancer risks associated with surface soils at these locations only slightly exceed 1×10^{-6} for two individual constituents, and the total cancer risk level is still less than 1×10^{-5} .

In EU4, the maximum concentration of benzo(a)pyrene was used as the exposure-point concentration for site visitor, maintenance worker, and construction worker exposure to sediment. The benzo(a)pyrene exposure-point concentration used to evaluate these in EU4 was 130 mg/kg (sample location SD-02, see Figure 2). The next two highest concentrations of benzo(a)pyrene in sediment were found at SD-12 (71 mg/kg) and SD-23 (5.57 mg/kg), respectively. Implementing a remedy to remove, treat, or preclude contact with sediment at sample locations SD-02, SD-12, and SD-23 would leave a concentration of 3.1 mg/kg (sample location SD-18) as the maximum concentration in sediment that could be potentially contacted by site visitors, maintenance workers, and/or construction workers in EU 4. Excluding samples SD-02, SD-12, and SD-23 and using 3.1 mg/kg as the exposure-point concentration drops the risk level for dermal and oral contact with sediment by a visitor and oral contact with sediment by a maintenance worker or construction worker to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 79 - 83).

In EU4, the maximum concentration of benzo(a)pyrene was also used as the exposure-point concentration for site visitor, maintenance worker, and construction worker soil exposures. Each of these receptors could potentially be exposed to soils at different depth ranges: visitor 0-1' bgs, maintenance worker 0-6' bgs, and construction worker 0-20' bgs. The sample locations and corresponding concentrations of benzo(a)pyrene that contributed to elevated risk estimates in the three exposure scenarios are presented in the table below:

Sample Location	Benzo(a)pyrene Concentration
	(mg/kg)
GEO-48/0-1'	500
GEO-21/0-1'	230
GEO-21/2-3'	190
GEO-19/0-1'	56
GEO-46/0-1'	16

Sample Location	Benzo(a)pyrene Concentration (mg/kg)
GEO-20/5-6'	11
GEO-47/5-6'	9.6
GEO-48/2-3°	6.1
GEO-20/0-1'	3.2
GEO-47/0-1'	3
GEO-19/2-3'	2.4

Implementing a remedy to remove, treat, or preclude contact with the surface (0-1' bgs) soil sample locations tabulated above would result in eliminating exposures for the site visitor scenario (i.e., the 0-1' bgs samples listed above comprise the entire data set for visitor exposures to surface soils in EU4). In addition, implementation of a remedy addressing the sample locations tabulated above would leave a maximum subsurface soil benzo(a)pyrene concentration of 0.29 mg/kg (sample location GEO-19/5-6'). Using the concentration of 0.29 mg/kg as the exposure-point concentration for estimating risk to maintenance workers and construction workers drops the risk levels to within acceptable levels (Tables 84 - 88). In situ biological treatment is proposed to address impacted soils within EU4. This will include clearing, tilling, application of inorganic nutrients, and, once soils are remediated to the extent practicable, placement of concrete cover. The area to be remediated will extend at least from Courtesy Ford to the edge of the railroad right-of-way, and may extend onto the railroad right-of-way with the permission of the Southern railway.

In EU5, the surface soil sample locations contributing most to elevated risk levels for the maintenance worker, construction worker, and site visitor scenarios were GEO-33/0-1', GEO-33/2-3', GEO-30/0-1', GEO-59/0-1, GEO-29/0-1', and GEO-28/0-1' (see Figure 2). All sample locations, with the exception of GEO-59/0-1', are located underneath paved areas in a parcel of land extending from Courtesy Ford to the southeast (Figure 2). Pavement in this area precludes direct contact with surface and subsurface soils; therefore, it is not anticipated that current or

future maintenance workers or site visitors will have access to soils in or around these sample locations. In addition, a deed restriction will be implemented requiring the maintenance of the paved areas to ensure protection of human health in the future. Sample location GEO-59/0-1', with a benzo(a)pyrene exposure point concentration is 6.1 mg/kg, however, is adjacent to West Pine Street in an unpaved area. Implementing a remedy to remove, treat, or preclude contact with surface soil at this location would leave a concentration of 0.37 mg/kg (GEO-60/0-1') as the maximum concentration in surface soil not covered by pavement that could potentially be contacted by any of the three receptors in this EU. Excluding sample GEO-59/0-1' and using 0.37 mg/kg as the exposure-point concentration drops the estimated exposures in EU5 to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 89 - 92).

The benzo(a)pyrene exposure-point concentration used to evaluate adult and child resident exposures to sediment in EU6 was 49 mg/kg (sample location SD-03, see Figure 3). This was the maximum benzo(a)pyrene concentration found in sediments in EU6. Sample locations SD-04, SD-14, SD-13, SD-16, SD-15, and SD-17 (33, 12.2, 3.27, 2.8, 2.42, and 2.26 mg/kg, respectively) also contributed to elevated cancer risk estimates for both receptors. Implementing a remedy to remove, treat, or preclude contact with sediment at these sample locations would leave a concentration of 0.97 mg/kg (sample location SD-05). Using the benzo(a)pyrene concentration of 0.97 mg/kg as the exposure-point concentration for sediment exposure to adult and child residents reduces the risk estimate to within acceptable limits (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 93 - 96). Remediation activities are proposed to remove impacted sediment and preclude contact with residuals in the northeast drainage ditch. These activities include removal and off-Site treatment and/or disposal of impacted sediments, installation of a storm water collection and conveyance pipe, backfilling around the culvert, and planting with native grass.

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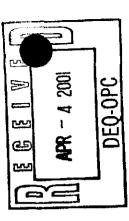
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Statistical Summary and Selection of COPCs in EU2 Soil (0-10' bgs) Kerr McGee, Hattiesburg, MS Table 5

			<u> </u>		Minimum	Махіти								
		Total		Ħ	Detection	Detection	Minimum	Minimum		Logarithmic Maximum		Maximum	Location of	Standard
	CAS	Number of		Frequency	Limit	Limit	Detected	Detected	Mean	Mean		Detected	Maximum	Deviation
Constituent	Number	Samples	Hits	%	mg/kg	mg/kg	mg/kg	Qualifier	mg/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Pesticides														
Endosulfan 1	8-86-656	_	-	100	0.00E+00	0.00E+00	4.00E-03		4.00E-03	4.00E-03	4.00E-03	ſ	SB-05	1
Heptachlor	76-44-8	_	-	100	0.00E+00	0.00E+00	1.00E-02		1.00E-02	1.00E-02	1.00E-02		SB-05	1
Semivolatiles														
2,4-dimethylphenol	105-67-9	23	_	4.35	6.70E-02	3.30E-01	1.10E+00	-	8.68E-02	4.33E-02	1.10E+00	-	SB-05	2.23E-01
2-methylnaphthalene	91-57-6	23	4	17.39	3.30E-02	3.90E-02	7.00E-02	-	1.87E+01	4.58E-02	2.30E+02		SB-07	6.21E+01
Acenaphthene	83-32-9	56	m	11.54	2.80E-02	3.10E-01	4.90E-02	-	1.14E+01	4.20E-02	2.00E+02		SB-07	4.29E+01
Acenaphthylene	208-96-8	56	œ	30.77	2.80E-02	3.10E-01	3.70E-02	-	6.65E-01	5.37E-02	7.70E+00		SB-07	1.97E+00
Anthracene	120-12-7	56	10	38.46	7.90E-04	3.90E-02	4.10E-02	r	8.11E+00	5.28E-02	1.20E+02		SB-07	2.86E+01
Benzo(a)anthracene	56-55-3	26	16	61.54	8.60E-04	3.80E-02	4.10E-02	-	4.69E+00	1.16E-01	6.10E+01		SB-07	1.48E+01
Benzo(a)pyrene	50-32-8	56	16	61.54	3.70E-02	6.70E-02	1.69E-03	-	2.09E+00	1.33E-01	2.20E+01		SB-07	5.75E+00
Benzo(b)fluoranthene	205-99-2	56	20	76.92	3.70E-02	6.70E-02	7.60E-04	٦.	3.49E+00	2.74E-01	3.30E+01	ſ	SB-07	8.58E+00
Benzo(ghi)perylene	191-24-2	56	14	53.85	1.70E-02	6.70E-02	1.80E-03	L	7.49E-01	1.06E-01	6.40E+00		SB-07	1.65E+00
Benzo(k)fluoranthene	207-08-9	56	17	65.38	3.70E-02	1.30E-01	5.10E-04	٠,	1.18E+00	1.62E-01	1.10E+01		SB-07	2.70E+00
Bis(2-ethylhexyl)phthalate	117-81-7	23	-	4.35	6.70E-02	5.00E-01	3.70E-01	-,	6.43E-02	4.48E-02	3.70E-01	-	GEO-13	8.41E-02
Carbazole	86-74-8	23	9	56.09	3.30E-02	3.90E-02	4.30E-02	ь.	3.39E+00	4.75E-02	5.00E+01		SB-05	1.16E+01
Chrysene	218-01-9	56	15	57.69	2.50E-03	7.40E-02	5.10E-02	۳.	4.36E+00	1.44E-01	5.20E+01		SB-07	1.31E+01
Dibenz(a,h)anthracene	53-70-3	56	10	38.46	5.30E-04	6.70E-02	1.88E-02		3.23E-01	5.14E-02	3.40E+00		SB-07	7.82E-01
Dibenzofuran	132-64-9	23	4	17.39	3.30E-02	3.90E-02	7.20E-02	·	1.33E+01	4.35E-02	1.80E+02		SB-07	4.47E+01
Di-n-butylphthalate	84-74-2	23	6	39.13	3.30E-02	2.50E-01	3.60E-02	•	4.59E-02	3.91E-02	1.10E-01	ſ	SS-10	2.80E-02
Fluoranthene	206-44-0	26	16	61.54	2.00E-03	3.80E-02	5.00E-02	⊷,	1.73E+01	1.63E-01	2.50E+02		SB-07	5.91E+01
Fluorene	86-73-7	56	9	23.08	2.60E-03	3.80E-02	2.90E-02	٠,	1.48E+01	4.19E-02	2.50E+02		SB-07	5.48E+01
Indeno(1,2,3-cd)pyrene	193-39-5	56	7	53.85	1.10E-02	6.70E-02	1.40E-03	₩,	1.01E+00	1.11E-01	8.70E+00		SB-07	2.30E+00
Naphthalene	91-20-3	56	5	19.23	2.80E-02	3.10E-01	8.80E-02	 -3	2.31E+01	5.46E-02	3.90E+02		SB-05	8.54E+01
Phenanthrene	8-10-8	26	Ξ	42.31	2.10E-03	3.90E-02	3.70E-02	 -,	3.34E+01	6.64E-02	5.10E+02		SB-07	1.20E+02
Phenol	108-95-2	23	7	8.7	3.30E-02	2.50E-01	1.10E-01	-,	4.04E-02	2.79E-02	1.90E-01	-	GEO-03	4,49E-02
Pyrene	129-00-0	56	16	61.54	4.50E-03	6.70E-02	6.80E-02	٠,	1.59E+01	2.33E-01	2.30E+02		SB-07	5.37E+01
Volatiles														
Acetone	67-64-1	æ	-	33.33	7.00E-03	3.50E-02	6.30E-02	 3	2.80E-02	1.57E-02	6.30E-02	-	SB-05	3.11E-02
Ethylbenzene	100-41-4	m	7	29.99	1.00E-03	1.00E-03	6.80E-02		9.62E-02	1.96E-02	2.20E-01		SB-05	1.12E-01
Toluene	108-88-3	m	7	19.99	1.00E-03	1.00E-03	1.40E-02	۳-,	2.07E-02	6.93E-03	4.75E-02		SB-05	2.42E-02
Xylene (total)	1330-20-7	3	7	66.67	1.00E-03	1.00E-03	4,90E-01		5.64E-01	6.65E-02	1.20E+00		SB-05	6,03E-01



Table 5
Statistical Summary and Selection of COPCs in EU2 Soil (0-10' bgs)
Kerr McGee, Hattiesburg, MS

APR - 4 2001

(F)

_	95% UCL	Logarithmic 95% UCL	Distribution 99%	Exposure Point Concentration	Tier I Restricted	Is the Maximum	Is the Maximum Is the 95% UCL >
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	Detected > TRG?	TRG?
Pesticides							
Endosulfan I	ı	1	Unknown	4.00E-03	1.23E+03	оп	
Heptachlor	ı	ı	Unknown	1.00E-02	1.95E-01	no no	
Semivolatiles							
2,4-dimethylphenol	1.66E-01	8.51E-02	Unknown	8.51E-02	4.08E+04	ou	
2-methylnaphthalene	4.10E+01	3.97E+01	Unknown	3.97E+01	8.18E+04	uo	
Acenaphthene	2.58E+01	8.98E+00	Unknown	8.98E+00	1.23E+05	ou	
Acenaphthylene	1.33E+00	1.26E+00	Unknown	1.26E+00	1.23E+05	92	
Anthracene	1.77E+01	3.27E+01	Unknown	3.27E+01	6.13E+05	01	
Benzo(a)anthracene	9.66E+00	9.96E+01	Lognormal	6.10E+01	7.84E+00	YES	YES-COPC
Benzo(a)pyrene	4.02E+00	2.17E+01	Lognormal	2.17E+01	7.84E-01	YES	YES-COPC
Benzo(b)fluoranthene	6.36E+00	1.42E+02	Lognormal	3.30E+01	7.84E+00	YES	YES-COPC
Benzo(ghi)perylene	1.30E+00	5.31E+00	Lognormal	5.31E+00	6.13E+04	υu	
Benzo(k)fluoranthene	2.08E+00	1.71E+01	Lognormal	1.10E+01	7.84E+01	ОП	COPC*
Bis(2-ethylhexyl)phthalate	9.44E-02	7.81E-02	Unknown	7.81E-02	4.09E+02	υu	
Carbazole	7.55E+00	5.44E+00	Unknown	5.44E+00	2.86E+02	no	
Chrysene	8.74E+00	7.90E+01	Lognormal	5.20E+01	7.84E+02	ОП	COPC*
Dibenz(a,h)anthracene	5.85E-01	1.69E+00	Lognormal	1.69E+00	7.84E-01	YES	YES-COPC
Dibenzofuran	2.93E+01	2.24E+01	Unknown	2.24E+01	8.18E+03	OL	
Di-n-butylphthalate	5.59E-02	5.95E-02	Lognormal	5.95E-02	2.28E+03	ОП	
Fluoranthene	3.71E+01	4.36E+02	Lognormal	2.50E+02	8.17E+04	ОĽ	
Fluorene	3.32E+01	2.15E+01	Unknown	2.15E+01	8.17E+04	ou	
Indeno(1,2,3-cd)pyrene	1.78E+00	9.60E+00	Lognormal	8.70E+00	7.84E+00	YES	YES-COPC
Naphthalene	5.17E+01	2.83E+01	Unknown	2.83E+01	8.24E+02	оц	
Phenanthrene	7.34E+01	1.11E+02	Unknown	1.11E+02	6.13E+04	ou	
Phenol	5.65E-02	5.50E-02	Unknown	5.50E-02	1.23E+05	Ou	
Pyrene	3.39E+01	2.55E+02	Lognormal	2.30E+02	6.13E+04	no Di	
Volatiles							
Acetone	8.04E-02	1.17E+07	Normal/Lognormal	6.30E-02	1.04E+05	OU.	
Ethylbenzene	2.86E-01	2.68E+42	Normal/Lognormal	2.20E-01	3.95E+02	ОП	
Toluene	6.15E-02	2.26E+21	Normal/Lognormal	4.75E-02	3.80E+01	01	
Xylene (total)	1.58E+00	3.97E+75	Normal/Lognormal	1.20E+00	3.18E+02	110	

^{*}Retained as a COPC, as per MDEQ Comments (8/2/2000): constituent is a member of a carcinogenic PAH family one of which has been retained as a COPC.



Statistical Summary and Selection of COPCs in EU5 Soil (0-20' bgs) Kerr McGee, Hattiesburg, MS Table 16

					Мінітип	Maximum								
		Total		Ħ	Detection	Detection	Minimum	Minimum		Logarithmic	Maximum	Maximum	Location of	Standard
;	CAS	Number of	į	Frequency	Limit	Limit	Detected	Detected	Mean	Mean	Detected	Detected	Maximum	Deviation
Constituent	Number	Samples	Hits	%	mg/kg	mg/kg	mg/kg	Qualifier	тв/kg	mg/kg	mg/kg	Qualifier	Concentration	mg/kg
Semivolatiles		,												
2,4-dimethylphenol	105-67-9	23		4.35	6.70E-02	1.30E+00	1.10E-01	-	8.81E-02	5.57E-02	1.10E-01	-	GEO-30	1.34E-01
2-methylnaphthalene	91-57-6	23	0 ¢	34.78	3.30E-02	4.10E-02	5.10E-02	7	2.37E+01	1.19E-01	4.40E+02		SB-05	9.23E+01
2-methylphenol	95-48-7	23	_	4.35	3.80E-02	1.30E+00	4.20E-02	-	6.29E-02	3.18E-02	4.20E-02	5	GEO-30	1.33E-01
3- and 4-methylphenol	106-44-5	23	_	4.35	7.50E-02	2.00E+00	1.40E-01	ŗ	1.10E-01	6.12E-02	1.40E-01	-	GEO-30	2.04E-01
Acenaphthene	83-32-9	30	7	23.33	2.90E-02	2.40E+00	1.10E-01	-	1.29E+01	1.15E-01	2.90E+02		SB-05	5.34E+01
Acenaphthylene	208-96-8	30	6	30	3.30E-02	2.40E+00	4.80E-02	 -3	1.15E+00	9.90E-02	1.60E+01		GEO-33	3.36E+00
Anthracene	120-12-7	30	6	30	5.40E-04	6.00E-02	1.30E-01	-	7.18E+00	6.99E-02	9.80E+01		SB-05	2.26E+01
Benzo(a)anthracene	56-55-3	30	17	26.67	3.30E-02	4.10E-02	6.80E-03	Z	6.52E+00	1.56E-01	8.35E+01		GEO-33	1.93E+01
Benzo(a)pyrene	50-32-8	30	17	56.67	3.80E-02	6.70E-02	8.30E-03	2	3.56E+00	1.55E-01	5.25E+01	-,	GEO-33	1.05E+01
Benzo(b)fluoranthene	205-99-2	30	18	99	3.80E-02	6.70E-02	9.00E-03	2	5.47E+00	2.09E-01	7.95E+01		GEO-33	1.59E+01
Benzo(ghi)perylene	191-24-2	30	16	53.33	3.80E-02	6.70E-02	6.70E-03	7	1.51E+00	9.66E-02	2.55E+01		GEO-33	4.77E+00
Benzo(k)fluoranthene	207-08-9	30	18	09	3.80E-02	1.30E-01	4.70E-03	7	1.99E+00	1.32E-01	2.85E+01		GEO-33	5.64E+00
Bis(2-ethylhexyl)phthalate 117-81-7	117-81-7	23	7	8.7	6.70E-02	1.30E+00	1.40E-01	_	9.40E-02	6.04E-02	1.50E-01	-	GEO-32	1.34E-01
Carbazole	86-74-8	23	7	30.43	3.30E-02	4.10E-02	5.30E-01	_	4.29E+00	9.66E-02	6.90E+01		SB-05	1.45E+01
Chrysene	218-01-9	30	<u>82</u>	99	3.30E-02	4.10E-02	2.40E-03	-	6.33E+00	1.59E-01	8.25E+01		GEO-33	1.85E+01
Dibenz(a,h)anthracene	53-70-3	30	15	50	3.80E-02	3.30E-01	1.70E-03	<u>.</u>	4.87E-01	5.48E-02	7.45E+00		GEO-33	1.42E+00
Dibenzofuran	132-64-9	23	6	39.13	3.30E-02	4.10E-02	3.90E-02	-	1.47E+01	1.23E-01	2.70E+02		SB-05	5.62E+01
Fluoranthene	206-44-0	30	<u>œ</u>	09	3.30E-02	4.10E-02	1.30E-02	Z	3.13E+01	2.82E-01	4.30E+02		SB-05	9.95E+01
Fluorene	86-73-7	30		36.67	2.90E-03	5.20E-02	3.60E-03	7	1.52E+01	8.67E-02	3.30E+02		SB-05	6.11E+01
Indeno(1,2,3-cd)pyrene	193-39-5	30	13	56.67	3.80E-02	6.70E-02	7.80E-03	-	1.92E+00	1.22E-01	3.10E+01		GEO-33	5.84E+00
Naphthalene	91-20-3	30	ó	30	2.90E-02	5.60E-01	7.50E-02	-	3.80E+01	1.33E-01	9.10E+02		SB-05	1.68E+02
Phenanthrene	85-01-8	30	17	26.67	3.30E-02	4.10E-02	6.80E-03	_	3.77E+01	2.06E-01	7.10E+02		SB-05	1.36E+02
Phenol	108-95-2	23	13	56.52	3.30E-02	6.70E-01	1.00E-01	-	1.36E-01	9.66E-02	3.80E-01		GEO-29	9.90E-02
Рутеле	129-00-0	30	<u>∞</u>	8	3.80E-02	6.70E-02	1.60E-02	-	2.04E+01	2.85E-01	2.60E+02		GEO-33	6.43E+01
Volatiles														•
Acetone	67-64-1	'n	ς.	100	0.00E+00	0.00E+00	9.00E-03	~	4.40E-02	2.95E-02	1.00E-01	٠,	SB-05	3.79E-02
Benzene	71-43-2	'n	7	40	1.00E-03	1.00E-03	5.00E-03	-,	2.70E-03	1.34E-03	7.00E-03	-	SB-05	3.09E-03
Ethylbenzene	100-41-4	νn	m	8	1.00E-03	1.00E-03	2.40E-02		3.82E-02	8.02E-03	1.20E-01		SB-05	4.95E-02
Styrene	100-42-5	'n	_	20	1.00E-03	1.00E-03	1.00E-01		2.04E-02	1.44E-03	1.00E-01		SB-05	4.45E-02
Toluene	108-88-3	ς.	ю	9	1.00E-03	1.00E-03	1.30E-02		3.38E-02	5.85E-03	1.40E-01		SB-05	5.98E-02
Xylene (total)	1330-20-7	2	3	09	1.00E-03	1.00E-03	7.50E-02		2.27E-01	2.10E-02	7.80E-01		SB-05	3.30E-01



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APR - 4 2001

		Logarithmic	Dietribution	Exposure Point	Exposure Point Tier I Restricted		
	95% UCL	95% UCL	%66	Concentration	Soil TRG	Is the Maximum Is the 95% UCL	Is the 95% UCI
Constituent	mg/kg	mg/kg	Confidence	mg/kg	mg/kg	Detected > TRG?	> TRG?
Semivolatiles							
2,4-dimethylphenol	1.36E-01	1.12E-01	Unknown	1.10E-01	4.08E+04	00	
2-methylnaphthalene	5.67E+01	6.89E+02	Unknown	4.40E+02	8.18E+04	ou	
2-methylphenol	1.11E-01	7.64E-02	Unknown	4.20E-02	1.02E+05	0U	
3- and 4-methylphenol	1.83E-01	1.37E-01	Unknown	1.37E-01	1.02E+04	00	
Acenaphthene	2.95E+01	8.04E+01	Unknown	8.04E+01	1.23E+05	ou	
Acenaphthylene	2.19E+00	3.82E+00	Unknown	3.82E+00	1.23E+05	00	
Anthracene	1.42E+01	4.31E+02	Unknown	9.80E+01	6.13E+05	ОП	
Benzo(a)anthracene	1.25E+01	1.52E+02	Unknown	8.35E+01	7.84E+00	Yes	YES-COPC
Benzo(a)pyrene	6.82E+00	4.42E+01	Unknown	4.42E+01	7.84E-01	Yes	YES-COPC
Benzo(b)fluoranthene	1.04E+01	1.19E+02	Unknown	7.95E+01	7.84E+00	Yes	YES-COPC
Benzo(ghi)perylene	2.99E+00	7.40E+00	Unknown	7.40E+00	6.13E+04	110	
Benzo(k)fluoranthene	3.74E+00	1.68E+01	Unknown	1.68E+01	7.84E+01	110	COPC*
Bis(2-ethylhexyl)phthalate	1.42E-01	1.24E-01	Unknown	1.24E-01	4.09E+02	010	
Carbazole	9.49E+00	6.44E+01	Unknown	6.44E+01	2.86E+02	00	
Chrysene	1.21E+01	2.00E+02	Unknown	8.25E+01	7.84E+02	Yes	YES-COPC
Dibenz(a,h)anthracene	9.29E-01	1.53E+00	Unknown	1.53E+00	7.84E-01	ou 0	COPC*
Dibenzofuran	3.48E+01	4.46E+02	Unknown	2.70E+02	8.18E+03	υo	
Fluoranthene	6.22E+01	3.34E+03	Unknown	4.30E+02	8.17E+04	ou	
Fluorene	3.42E+01	2.24E+02	Unknown	2.24E+02	8.17E+04	01	
Indeno(1,2,3-cd)pyrene	3.73E+00	1.32E+01	Unknown	1.32E+01	7.84E+00	οu	COPC*
Naphthalene	9.01E+01	2.69E+02	Unknown	2.69E+02	8.24E+02	ou	
Phenanthrene	7.98E+01	2.37E+03	Unknown	7.10E+02	6.13E+04	011	
Phenol	1.72E-01	2.53E-01	Normal/Lognormal	2.53E-01	1.23E+05	ou	
Pyrene	4.03E+01	1.08E + 03	Unknown	2.60E+02	6.13E+04	DO .	
Volatiles							
Acetone	8.01E-02	9.07E-01	Normal/Lognormal	1.00E-01	1.04E+05	00	
Benzene	5.65E-03	2.77E-01	Normal/Lognormai	7.00E-03	1.36E+00	00	
Ethylbenzene	8.54E-02	1.58E+06	Normal/Lognormal	1.20E-01	3.95E+02	00	
Styrene	6.28E-02	1.19E+04	Unknown	1.00E-01	3.84E+02	Ou	
Toluene	9.08E-02	1.16E+05	Lognormal	1.40E-01	3.80E+01	ou .	
Xylene (total)	5.41E-01	2.82E+13	Normal/Lognormal	7.80E-01	3.18E+02	2	

*Logarithmic 95% UCL is less than benchmark but retained as a COPC, as per MDEQ Comments (8/2/2000): constituent is a member of carcinogenic PAH family, one of which has been retained as a COPC.

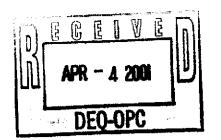


Table 19 Summary of Human Health Exposure Parameters Kerr McGee, Hattiesburg, MS

Receptors:		Adolescent		Maintenance Worker		Construction Worker	-	Off-Site Resident		Off-Site Resident	
		Visitor		worker		worker		Child		Adult	
Parameter	Units					~				:::::::	
Surface area available for exposure - soil	cm²/day	3052	1	3000	1	5560	ì	1724	1	4780	1
Surface area available for exposure - sed. & sw	cm ² /day	3945	1	3000	1	3000	1	2229	1	6180	1
Total skin surface area	cm ²	12768.3	2	20000	2	20000	2	7213	2	20000	2
Skin surface area available for exposure - soil	%	23.9%	2	15%	2	27.8%	2	23.9%	2	23.9%	2
Skin surface area available for exposure - sed. & sw	%	30.9%	2	15.0%	2	15.0%	. 2	30.9%	2	30.9%	2
Adherence factor - soil	mg/cm ²	0.026	2	0.038	2	0.1	. 2	0.026	2	0.026	2
Adherence factor - sed.	mg/cm ³	0.33	2	0.038	2	0.13	2	0.33	2	0.33	2
Dermal absorption factor - cPAHs		0.03	3	0.03	3	0.03	3	0.03	3	0.03	3
Dermal absorption factor - other SVOCs		0.1	3	0.1	3	0.1	.3	0.1	3	0.1	3
Exposure time	hours/day	1	5	1	5	1	5	1	5	1	5
Exposure frequency - soils	days/year	12	5	150	5	10/70*	. 5	NA		NA	
Exposure frequency - soils (EU4)	days/year	12	5	30	5	10/70*	5	NA .		NA:	
Exposure frequency - sed. & sw	days/year	12	5	30	5	. 8	-5	40	. 5	40	5
Exposure duration	years	10	. 6	25	6	· 1	5	6	6	24	6
Body weight	kg	45	6	70	6	70	6	15	7	70	6
Averaging time - noncarcinogenic	days	3650	.7	9125	7	365	7	2190	7	8760	7
Averaging time - carcinogenic	days	25550	7	25550	. 7	25550	7	25550	7	25550	7
Ingestion rate - soil	mg/day	100	2	100	2.	480/100*	2	200	2	100	2
Ingestion rate - surface water	L/hour	0.01	6	0.01	- 6	0.01	5	0.05	6	0.04	6
Matrix effect - PAHs		. 1	5	1.1	5	. 1	. 5 .	:. 1	5	. 1.	5
Inhalation rate	m³/day	NA		NA		20	6	NA ·		NA	
etention factor - semivolatiles		NA		NA		0.75	8	NA		NA	

NA - Not Applicable

- 1 Calculated
- 2 USEPA 1997, Exposure Factors Handbook
- 3 USEPA 1995, Region III Technical Guidance Manual: Assessing Dermal Exposure to Soil
- 4 USEPA 1992, Dermal Exposure Assessment
- 5 Reasonable Maximum
- 6 USEPA 1995, Region IV
- 7 USEPA 1991, HHEM Supplemental Guidances
- 8 International Commission on Radiological Protection, 1968

^{*}Exposure Scenario A/Exposure Scenario B

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	Oral Chronic RM		Inhalation Chronic RM		Kange of Absorption hv G.L		Dermal Chronic RM	Oral Subchronic RM		Inhalation Subchronic RfD	Dermal Subchronic Ren		Oral CSF	- <u>`</u>	Dermal CSF	Inhalation CSF	
Chemical	mg/kg-day		Source mg/kg-day Source	Source	Tract	Source	mg/kg-day	mg/kg-day	Source	mg/kg-day	mg/kg-day Source mg/kg-day Source mg/kg-day			zource	(mg/kg- day) Source		Source
Semivolatiles				j									l	ı	ſ		
2-Methylnaphthalene	2.00E-02	щ			0.5	Region IV	1.00E-02										
2-Nitroaniline			5.70E-05	I	6.5	Region IV				5.70E-04	HE						
2-Nitrophenol					0.5	Region IV											
3-Nitroaniline					0.5	Region IV											
4-Bromophenylphenylether	5.80E-02	0			0.5	Region IV	2.90E-02										
4-Chloro-3-methylphenol					6.0	Region IV											
4-Chlorophenylphenylether					0.5	Region IV											
4-Nitroaniline					0.5	Region IV											
Acenaphthylene					0.5	Region IV											
Benzo(a)anthracene					0.5	Region IV						7.	7.30E-01	EI L	1.46E+00 MDEQ	3.10E-01	(T)
Benzo(a)pyrene					6.5	Region IV						7	7.30E+00 I	IRIS 1.	1.46E+01 MDEQ	3.10E+00	щ
Benzo(b)fluoranthene					6.5	Region IV						7	7.30E-01	ы 	1.46E+00 MDEQ	3.10E-01	ш
Benzo(g,h,i)perylene					0.5	Region IV											
Benzo(k)fluoranthene					0.5	Region IV						7	7.30E-02	Э	1.46E-01 MDEQ	3.10E-02	Œ
Bis(2-chłoroethoxy)methane					0.5	Region IV											
Bis(2-chloroethyl)ether					0.5	Region IV							.10E+00 I	IRIS		1.10E+00	IRIS
Bis(2-ethylhexyl) phthalate	2.00E-02	IRIS			0.5	Region IV	1.00E-02	2.00E-02	A		1.00	1.00E-02 1.	1.40E-02	IRIS		1.40E-02	ш
Carbazole					0.5	Region IV						2.	2.00E-02	Ξ		٠	
Chrysene					6.5	Region IV						7.	7.30E-03	<u>п</u>	1.46E-02 MDEQ	3.10E-03	щ
Dibenz(a,h)anthracene					0.5	Region IV						7	7.30E+00		1.46E+01 MDEQ	3.10E+00	ш
Dibenzofuran	4.00E-03	ப			0.5	Region IV	2.00E-03										
Fluoranthene	4.00E-02	IRIS			6.5	Region IV	2.00E-02	4.00E-01	Η		2.00E-01	E-01					
Fluorene	4.00E-02	IRIS			0.5	Region IV	2.00E-02	4.00E-01	Ξ		2.00E-01	E-01					
Hexachlorobenzene	8.00E-04	IRIS			6.5	Region IV	4.00E-04					ĭ	1.60E+00 I	IRIS		1.60E+00	IRIS
Hexachlorocyclopentadiene	7.00E-03	IRIS	2.00E-05	I	6.5	Region IV	3.50E-03										
Indeno(1,2,3-cd)pyrene					0.5	Region IV						7.	7.30E-01	Ε 1.	1.46E+00 MDEQ 3.10E-01	3.10E-01	Ľ
N-nitrosodi-n-propylamine			•		0.5	Region IV						7.5	7.00E+00 I	IRIS	•		
Naphthalene	2.00E-02	IRIS	9.00E-04	IRIS	0.5	Region IV	1.00E-02										
Phenanthrene					0.5	Region IV											
Pyrene	3 OOF 02	2			50	Demon IV	1 SAE 03	2 OOE 01	7		1 505 01	5					

E - EPA-NCEA Regional Support provisional value from Region III RBC Tables, April 2000 H - Values are published in HEAST, 1997

IRIS - Values are available in IRIS, 2000

MDEQ - Based on MDEQ's recommendation of using the Oral CSF with an absorption efficiency of 50%. O - Values are withdrawn from other EPA documents as presented in the Region III RBC Tables, April 1999

Region IV - Region IV default value, 1995 W - Withdrawn from IRIS or HEAST 7toxvals.xls \tox-fnl

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

		Total	Total		DFO-C
Source/Pathway	Potentially Exposed Population	Hazard Index	Cancer Risk	Driving Constituent	Table Referenced
Dermal Exposure to Sediment in EU1	Visitor	NA	4E-08		24
Oral Exposure to Sediment in EU1	Visitor	NA			
Oral Exposure to Seament III EOT	Sub-Total	NA NA	5E-08 8E-08		25
	340-10(2)		0L-00		
Dermal Exposure to Surface Water in EU1	Visitor	NA	4E-07		26
Oral Exposure to Surface Water in EU1	Visitor	NA	9E-09		27
<u> </u>	Sub-Total	NA	4E-07		
Dermal Exposure to Surface Soil in EU2	Visitor	NA	3E-08		28
Oral Exposure to Surface Soil in EU2	Visitor	NA	6E-07		29
	Sub-Total	NA	6E-07		
D	Train.	NIA.	4E 00		70
Dermal Exposure to Surface Soil in EU3	Visitor Visitor	NA NA	4E-09 9E-08		30
Oral Exposure to Surface Soil in EU3	Sub-Total	NA NA	4E-09		31
	Gub-Tolai		76-07	······································	
Dermal Exposure to Sediment in EU4	Visitor	7E-02	1E-05	cPAHs	32
Oral Exposure to Sediment in EU4	Visitor	3E-02	2E-05	· cPAHs	33
	Sub-Total	1E-01	1E-05		
	,				
Dermal Exposure to Surface Water in EU4 :	Visitor	2E-04	9E-07		34
Oral Exposure to Surface Water in EU4	Visitor	2E-05	2E-08		35
	Sub-Total	3E-04	9E-07		
		#			
Dermal Exposure to Surface Soil in EU4	Visitor	4E-03	3E-06	*	36
Oral Exposure to Surface Soil in EU4	Visitor	3E-02	6E-05	cPAHs	37
	Sub-Total	₹ 3E-02	6E-05	<u> </u>	
Donnal European to Sunface Sail in Ellis	Violen	NA.	3E-07		38
Dermal Exposure to Surface Soil in EU5 Oral Exposure to Surface Soil in EU5	Visitor Visitor	NA NA	6E-06	Benzo(a)pyrene	
Oral Exposure to Surface Soil in EU3	Visitor Sub-Total	NA NA	3E-07	Бенго(а)ругене	39
	340-10(a)	INA	JE-U/		

Visitor Total: 1E-01

7summary.XLS\summary Page 1 of 3 APR - 4 2001

Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

					<u> </u>
Source/Pathway	Potentially Exposed Population	Total Hazard Index	Total Cancer Risk	Driving Constituent	DE Tame Referenced
Sources activaly	1 opniation	HIGEA	Mak	Consudent	Referenced
Dermal Exposure to Sediment in EU1	Maintenance Worker	NA	1E-08		40
Oral Exposure to Sediment in EU1	Maintenance Worker	NA	2E-07		41
	Sub-Total	NA	2E-07		
Dermal Exposure to Surface Water in EU1	Maintenance Worker	NA	1E-06	*	42
Oral Expposure to Surface Water in EU1	Maintenance Worker	NA	4E-08		43
	Sub-Total	NA	1E-06		
Dermal Exposure to Surface Soil in EU2	Maintenance Worker	· NA	5E-07		44
Oral Exposure to Surface Soil in EU2	Maintenance Worker	NA	7E-06	сРАНs	45
· · · · · · · · · · · · · · · · · · ·	Sub-Total	NA	7E-06		
Dermal Exposure to Sediment in EU4	Maintenance Worker	1E-02	4E-06	Benzo(a)pyrene	46
Oral Exposure to Sediment in EU4	Maintenance Worker	5E-02	6E-05	cPAHs	47
	Sub-Total	6E-02	7E-05		
Dermal Exposure to Surface Water in EU4	Maintenance Worker	3E-04	3E-06	*	48
Oral Exposure to Surface Water in EU4	Maintenance Worker	3E-05	9E-08		49
	Sub-Total	3E-04	3E-06		
Dermal Exposure to Surface Soil in EU4	Maintenance Worker	5E-03	2E-05	cPAHs ·	50
Oral Exposure to Surface Soil in EU4	Maintenance Worker	2E-02	2E-04	cPAHs	51
	Sub-Total	3E-02	2E-04		
Dermal Exposure to Surface Soil in EU5	Maintenance Worker	. NA	6E-06	Benzo(a)pyrene	52
Oral Exposure to Surface Soil in EU5	Maintenance Worker	. NA	9E-05	cPAHs	53
· · · · · · · · · · · · · · · · · · ·	O. J. T. 4-1	374	15.04		

Maintenance Worker Total: 8E-02 4E-04

ENVIRONMENTAL STANDARDS

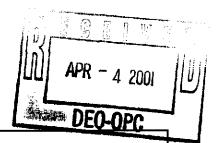
Table 23
Summary of Hazard and Risk Calculations
Kerr McGee, Hattiesburg, MS

		Total	Total	183	PEN DEC
Source/Pathway	Potentially Exposed Population		Cancer Risk	Driving Constituent	Table Referenced
Dermal Exposure to Sediment in EU1	Construction Worker	NA	5E-10		54
Oral Exposure to Sediment in EU1	Construction Worker	NA	9E-09		55
	Sub-Total	NA	1E-08		
Dermal Exposure to Surface Water in EU1	Construction Worker	NA	1E-08		56
Oral Exposure to Surface Water in EU1	Construction Worker	NA	4E-10		57
	Sub-Total	NA	1E-08		
Dermal Exposure to Soil in EU2	Construction Worker	ΝA	4E-07		58
Oral Exposure to Soil in EU2	Construction Worker	NA	2E-06		59
Inhalation of Fugitive Dust in EU2	Construction Worker	NA	6E-08		60
· · · · · · · · · · · · · · · · · · ·	Sub-Total	NA	2E-06		
Dermal Exposure to Sediment in EU4	Construction Worker	NA	2E-07		61
Oral Exposure to Sediment in EU4	Construction Worker	NA	3E-06	Benzo(a)pyrene	62
	Sub-Total	NA	3E-06		
Dermal Exposure to Surface Water in EU4	Construction Worker	9E-07	3E-08		63
Oral Exposure to Surface Water in EU4	Construction Worker	5E-07	9E-10	1	64
	Sub-Total	1E-06	9E-10		
Dermal Exposure to Soil in EU4	Construction Worker	NA	8E-06	Benzo(a)pyrene	65
Oral Exposure to Soil in EU4	Construction Worker	NA	4E-05	cPAHs	66
Inhalation of Fugitive Dust in EU4	Construction Worker	NA	1E-06	Benzo(a)pyrene	67
	Sub-Total	NA	5E-05		
Dermal Exposure to Soil in EUS	Construction Worker	NA	7E-07		68
Oral Exposure to Soil in EU5	Construction Worker	NA	3E-06	Benzo(a)pyrene	69
Inhalation of Fugitive Dust in EU5	Construction Worker	NA	1E-07		70
·	Sub-Total	NA	4E-06		
	Construction Worker Total:	1E-06	5E-05	<u> </u>	

Dermal Exposure to Sediment in EU6	Child Off-Site Resident	NA	2E-05	cPAHs	71
Oral Exposure to Sediment in EU6	Child Off-Site Resident	NA_	7E-05	cPAHs	72
	Sub-Total	NA	9E-05		
Dermal Exposure to Sediment in EU6	Adult Off-Site Resident	5E-04	4E-05	cPAHs	73
Oral Exposure to Sediment in EU6	Adult Off-Site Resident	1E-04	3E-05	cPAHs	74
	Sub-Total	6E-04	7E-05	-	
Daniel Companyon to Confere Water in File	Charles and the product	214	20.00		75
Dermal Exposure to Surface Water in EU6	Child Off-Site Resident	NA	2E-06	•	75
Oral Exposure to Surface Water in EU6	Child Off-Site Resident	NA	5E-07		76
i	Sub-Total	NA	2E-06		
Dermal Exposure to Surface Water in EU6	Adult Off-Site Resident	NA	5E-06	*	77
Oral Exposure to Surface Water in EU6	Adult Off-Site Resident	NA	8E-08		78
	Sub-Total	NA	5E-06		

^{*}Estimated carcinogenic risk level is below *de minimis* level as no single constituent exceeded 1x10⁻⁶ and the cumulative site carcinogenic risk is below 1x10⁻⁴ (Section 501, MCEQ, 1999).

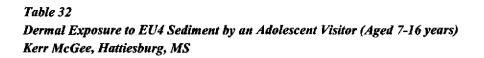


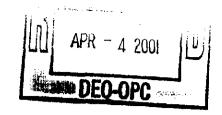


Intake (mg/kg-day) = \underline{Csw}	*IngR*EF*EI BW*AT	<u>)*ET</u>	
Csw - Concentration in surface water =	mg/L	see below	
IngR - Ingestion rate for surface water =	L/hour	0.01	USEPA 1995, Region IV
EF - Exposure frequency =	days/year	12	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessment
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles					"		
Benzo(a)anthracene	1.00E-03	7.31E-09	NA	NA	1.04E-09	7.30E-01	7.62E-10
Benzo(a)pyrene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E+00	3.81E-09
Benzo(b)fluoranthene	5.00E-04	3.65E-09	" NA	NA	5.22E-10	7.30E-01	3.81E-10
Benzo(k)fluoranthene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E-02	3.81F-11
Chrysene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E-03	3.81E-12
Dibenz(a,h)anthracene	5.00E-04	3.65E-09	NΛ	NA	5.22E-10	7.30E+00	3.81E-09
Indeno(1,2,3 cd)pyrene	5.00E-04	3.65E-09	NA	NA	5.22E-10	7.30E-01	3.81E-10

NA - Not Available Total Cancer Risk = 9.18E-09



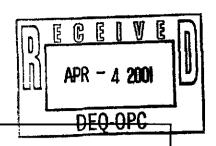


Intake (mg/kg-day) = $\frac{\text{Cs*SA*}}{\text{Cs*SA*}}$	AH*ABS*EF	*ED*CF	
, , , , , , , , , , , , , , , , , , ,	BW*AT		
Cs - Concentration in sediment =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm ² /day	3945	calculated
SA ₁ - Total skin surface area =	cm²	12768.3	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm²	0.33	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	12.	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	3.30E+02	9.42E-06	NA	NA	1.35E-06	1.46E+00	1.96E-06
Benzo(a)pyrene	1.30E+02	3.71E-06	NA	NA	5.30E-07	1.46E+01	7.74E-06
Benzo(b)fluoranthene	1.80E+02	5.14E-06	NA .	NA:	7.34E-07	· 1.46E+00	1.07E-06
Benzo(k)fluoranthene	6.40E+01	1.83E-06	NA.	NA	2.61E-07	1.46E-01	3.81E-08.
Carbazole	5.90E+02	5.61E-05	NA	NA	8.02E-06	NA	NA
Chrysene	2.90E+02	8.28E-06	NA	NA	1.18E-06	1.46E-02	1.73E-08
Dibenz(a,h)anthracene	1.20E+01	3.42E-07	NA'	NA	4.89E-08	1.46E+01	7.14E-07
Dibenzofuran	9.40E+02	8.94E-05	2.00E-03	4.47E-02	1.28E-05	· NA	NA
Indeno(1,2,3-cd)pyrene	4.70E+01	1.34E-06	NA	NA	1.92E-07	1.46E+00	2.80E-07
Naphthalene	3.00E+03	2.85E-04	1.00E-02	2.85E-02	4.08E-05	NA	NA
Phenanthrene	3.20E+03	3.04E-04	NA	NA	4.35E-05	NA	NA

NA - Not Available Total Hazard Index = 7.32E-02 Total Cancer Risk = 1.18E-05





Intake (mj	$g/kg-day$) = $Cw*SA*K_1$	*ABS*ET	EF*ED*CF	•
		BW*AT		
	Cw - Concentration in surface water =	mg/L	see below	
SA	- Surface area available for exposure =	cm²	3945	calculated
	SA ₁ - Total skin surface area =	cm²	12768.3	USEPA 1997, EFH
Fs - Fraction of sk	in surface area available for exposure =		30.9%	USEPA 1997, EFH
	Kp - Dermal permeability constant =	cm/hr	see below	
•	ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
	ABS_s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
	ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessment
	EF - Exposure frequency =	days/year	12	reasonable assumption
	ED - Exposure duration =	years	10	USEPS 1995, Region IV
	CF - Conversion factor =	L/cm³	1.00E-03	
	BW - Body weight =	kg	45	USEPA 1995, Region IV
AT	n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
	AT_c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

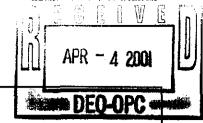
Constituent	Concentration in Surface Water mg/L	Kp cm/hr	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles								
Benzo(a)anthracene	5.00E-03	8.10E-01	3.50E-07	NA	NA	5.00E-08	1.46E+00	7.30E-08
Benzo(a)pyrene	5.00E-04	1.20E+00	5.19E-08	NA	NA	7.41E-09	1.46E+01	1.08E-07
Benzo(b)fluoranthene	1.20E-02	1.20E+00	1.25E-06	NA-	NA	1.78E-07	1.46E+00	2.60E-07
Benzo(k)fluoranthene	2.00E-03	4.48E+01	7.74E-06	NA	NA	1.11E-06	1.46E-01	1.62E-07
Bis(2-ethylhexyl)phthalate	3.00E-03	3.30E-02	2.85E-08	1.00E-02	2.85E-06	4.08E-09	NA ·	NA
Carbazole	1.00E-02	3.57E-02	1.03E-07	NA	NA	1.47E-08	NA ·	NA
Chrysene	6.00E-03	8.10E-01	4.20E-07	NA	NA	6.00E-08	1.46E-02	8.77E-10
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	1.17E-07	NA	NA	1.67E-08	1.46E+01	2.43E-07
Dibenzofuran	1.10E-02	1.51E-01	4.79E-07	2.00E-03	2.40E-04	6.84E-08	NA ·	NA .
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	8.22E-08	NA	NA	1.17E-08	1.46E+00	1.71E-08
Phenanthrene	1.70E-02	2.30E-01	1.13E-06	NA	NA	1.61E-07	NA ·	NA

NA - Not Available Total Hazard Index = 2.42E-04 Total Cancer Risk = 8.64E-07

Table 36

Dermal Exposure to EU4 Surface Soil (0-1') by an Adolescent Visitor (Aged 7-16 years)

Kerr McGee, Hattiesburg, MS

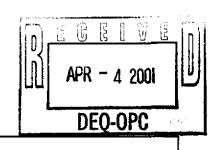


Intake (mg/kg-day) =	Cs*SA*A	H*ABS*EF*	ED*CF		
		BW*AT			
Cs - Concentration in	soil =	mg/kg	chem. spec.		
SA - Surface area available for expo	sure =	cm ² /day	3052	calculated	
SA _t - Total skin surface	агеа =	cm ²	12768.3	USEPA 1997, EFH	
Fs - Fraction of skin surface area available for expo	sure =		23.9%	USEPA 1997, EFH	
AH - Adherence fa	ctor =	mg/cm²	0.026	USEPA 1997, EFH	
ABS _p - Absorption - cP.	AHs =		0.03	USEPA 1995, Regio	m III
ABS _s - Absorption - other SV	OCs =		0.1	USEPA 1995, Regio	n III ax
EF - Exposure freque	ency =	days/year	12	reasonable assumption	on
ED - Exposure dura	ition =	years	10	USEPA 1995, Regio	n IV
CF - Conversion fa	ctor =	kg/mg	1.00E-06		
BW - Body we	ight =	kg	45	USEPA 1995, Regio	n IV
AT _n - Averaging time - noncarcinog	enic =	days	3650	USEPA 1991, HHEN	М
ATc - Averaging time - carcinog	enic =	days	25550	USEPA 1991, HHE	M

	Concentration	Average Daily	Dermal Chronic	Cancer Slope			
	in Soil	Intake	RfD	Hazard	Intake	Factor	
Constituent	mg/kg	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Cancer Risk
Semivolatiles			·				
Benzo(a)anthracene	9.30E+02	1.62E-06	NA	NA	2.31E-07	1.46E+00	3.37E-07
Benzo(a)pyrene	5.00E+02	8.70E-07	NA	NA	1.24E-07	1.46E+01	1.81E-06
Benzo(b)fluoranthene	5.30E+02	9.22E-07	NA	NA	1.32E-07	1.46E+00	1.92E-07
Benzo(k)fluoranthene	2.90E+02	5.04E-07	NA ·	NA	7.20E-08	1.46E-01	1.05E-08
Carbazole	2.30E+02	1.33E-06	NA .	NA	1.90E-07	NA	ŅA
Chrysene	6.90E+02	1.20E-06	NA	NA	1.71E-07	1.46E-02	2.50E-09
Dibenz(a,h)anthracene	6.40E+01	1.11E-07	NA	NA	1.59E-08	1.46E+01	2.32E-07
Fluoranthene	4.60E+03	2.67E-05	2.00E-02	1.33E-03	3.81E-06	NA ·	NA
Indeno(1,2,3-cd)pyrene	2.50E+02	4.35E-07	NA	NA	6.21E-08	1.46E+00	9.07E-08
Naphthalene	2.20E+03	1.28E-05	1.00E-02	1.28E-03	1.82E-06	NA	NA
Phenanthrene	6.40E+03	3.71E-05	NA	NA	5.30E-06	NA	NA .
Рутепе	4.40E+03	2.55E-05	1.50E-02	1.70E-03	3.64E-06	NA ·	NA

NA - Not Available Total Hazard Index = 4.31E-03 Total Cancer Risk = 2.68E-06

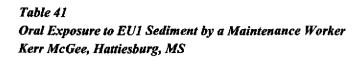


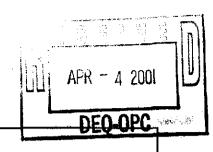


Intake (mg/kg-day) = <u>Cs*SA*</u>	AH*AB\$*EF	**ED*CF	
	BW*AT		
Cs - Concentration in soil =	mg/kg	chem. spec.	•
SA - Surface area available for exposure =	cm ² /day	3000	calculated
SA ₁ - Total skin surface area =	cm ²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15.0%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.038	USEPA 1997, EFH
ABSp - Absorption - cPAHs =		0.03	USEPA 1995, Region III
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	5.90E-01	2.37E-09	NA	NA	8.46E-10	1.46E+00	1.24E-09
Benzo(a)pyrene	3.90E-01	1.57E-09	NA	NA	5.59E-10	1.46E+01	8.17E-09
Benzo(b)fluoranthene	5.80E-01	2.33E-09	NA	NA	8.32E-10	1.46E+00	1.21E-09
Benzo(k)fluoranthene	1.90E-01	7.63E-10	NA	NA	2.72E-10	1.46E-01	3.98E-11
Chrysene	5.30E-01	2.13E-09	NA	NA	7.60E-10	1.46E-02	1.11E-11
Dibenz(a,h)anthracene	6.20E-02	2.49E-10	NA	NA	8.89E-11	1.46E+01	1.30E-09
Indeno(1,2,3-cd)pyrene	2.20E-01	8.83E-10	NA	NA	3.16E-10	1.46E+00	4.61E-10

NA - Not Available Total Cancer Risk = 1.24E-08



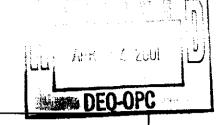


make (mg/kg-day) = <u>Cd*m</u>	SK.EL.ED.C	rivic	
	BW*AT		
Cd - Concentration in sediment =	mg/kg	see below	
lngR - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
ME - Matrix effect =		1	Magee, et al., 1996
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _e - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	5.90E-01	6.93E-08	NA	ΝA	2.47E-08	7.30E-01	1.81E-08
Benzo(a)pyrene	3.90E-01	4.58E-08	NA	NA	1.64E-08	7.30E+00	1.19E-07
Benzo(b)fluoranthene	5.80E-01	6.81E-08	NA	NA	2.43E-08	7.30E-01	1.78E-08
Benzo(k)fluoranthene	1.90E-01	2.23E-08	NA	NA	7.97E-09	7.30E-02	5.82E-10
Chrysene	5.30E-01	6.22E-08	NA NA	NA	2.22E-08	7.30E-03	1.62E-10
Dibenz(a,h)anthracene	6.20E-02	7.28E-09	NA	NA	2.60E-09	7.30E+00	1.90E-08
Indeno(1,2,3-cd)pyrene	2.20E-01	2.58E-08	NA	NA	9.23E-09	7.30E-01	6.73E-09

NA - Not Available Total Cancer Risk = 1.82E-07



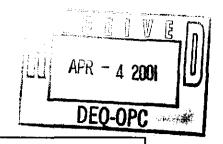


Intake (mg/kg-day) =	Cw*SA*Kp	*ABS*ET*	EF*ED*CF	
		BW*AT		
Cw - Concentration in s SA - Surface area available SA _t - Total skin Fs - Fraction of skin surface area available	for exposure = surface area =	mg/L cm² cm²	see below 3000 20000 15.0%	calculated USEPA 1997, EFH USEPA 1997, EFH
Kp - Dermal permeab: ABSp - Absorpi	ility constant =	em/hr	see below	USEPA 1995, Region III
ET - Ex	posure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessment
EF - Exposu	re frequency =	days/year	30	reasonable assumption
ED - Expos	sure duration =	years	25	USEPA 1995, Region IV
CF - Conv	ersion factor =	L/cm³	1.00E-03	
BW -	Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - non	carcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time -	carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	: Kp cm/hr	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Dally Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles								
Benzo(a)anthracene	1.00E-03	8.10E-01	8.56E-08	NA	NA	3.06E-08	1.46E+00	4.46E-08
Benzo(a)pyrene	5.00E-04	1.20E+00	6.34E-08	NA	NA	2.26E-08	1.46E+01	3.31E-07
Benzo(b)fluoranthene	5.00E-04	1.20E+00	6.34E-08	NA	NA	2.26E-08	1.46E+00	3.31E-08
Benzo(k)fluoranthene	5.00E-04	4.48E+01	2.37E-06	NA	NA	8.45E-07	1.46E-01	1.23E-07
Chrysene	5.00E-04	8.10E-01	4.28E-08	NA	NA	1.53E-08	1.46E-02	2.23E-10
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	1.43E-07	NA	NA	5.10E-08	1.46E+01	7.44E-07
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	1.00E-07	NA	NA	3.59E-08	1.46E+00	5.23E-08

NA - Not Available Total Cancer Risk = 1.33E-06

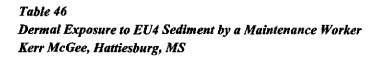


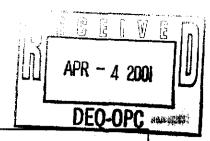


Intake (mg/kg-day) = \underline{Cs}	<u>w*IngR*EF*EI</u> BW*AT)*ET	
Csw - Concentration in surface water =	mg/L	see below	
IngR - Ingestion rate for surface water =	L/hour	0.01	USEPA 1995, Region IV
EF - Exposure frequency ≠	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessment
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT_n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT_c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	1.00E-03	1.17E-08	NA	NA	4.19E-09	7.30E-01	3.06E-09
Benzo(a)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Benzo(b)fluoranthene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-01	1.53E-09
Benzo(k)fluoranthene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-02	1.53E-10
Chrysene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-03	1.53E-11
Dibenz(a,h)anthracene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Indeno(1,2,3-cd)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-01	1.53E-09

NA - Not Available Total Cancer Risk = 3.69E-08



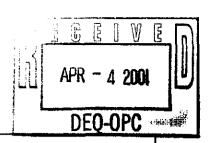


$Intake (mg/kg-day) = \underline{Cs*SA*}$	AH*ABS*E	F*ED*CF	
	BW*AT		
Cs - Concentration in sediment =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm²/day	3000	calculated
SA _t - Total skin surface area =	cm ²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15.0%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.038	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS_s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Sediment mg/kg	Average Daily Intake mg/kg-day	Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
3.30E+02	1.33E-06	NA	NA	4.73E-07	1.46E+00	6.91E-07
1.30E+02	5.22E-07	NA	NA	1.86E-07	1.46E+01	2.72E-06
1.80E+02	7.23E-07	NA	NA	2.58E-07	1.46E+00	3.77E-07
6.40E+01	2.57E-07	NA	NA	9.18E-08	1.46E-01	1.34E-08
5.90E+02	7.90E-06	NA	NA	2.82E-06	NA	NA
2.90E+02	1.16E-06	NA	NA	4.16E-07	1.46E-02	6.07E-09
1.20E+01	4.82E-08	NA	NA .	1.72E-08	1.46E+01	2.51E-07
9.40E+02	1.26E-05	2.00E-03	6.29E-03	4.49E-06	NA	· NA
4.70E+01	1.89E-07	NA	NA .	6.74E-08	1.46E+00	9.84E-08
3.00E+03	4.02E-05	1.00E-02	4.02E-03	1.43E-05	NA	NA
3.20E+03	4.28E-05	NA	NA ·	1.53E-05	NA	NA
	mg/kg 3.30E+02 1.30E+02 1.80E+02 6.40E+01 5.90E+02 2.90E+02 1.20E+01 9.40E+02 4.70E+01 3.00E+03	mg/kg mg/kg-day 3.30E+02 1.33E-06 1.30E+02 5.22E-07 1.80E+02 7.23E-07 6.40E+01 2.57E-07 5.90E+02 7.90E-06 2.90E+02 1.16E-06 1.20E+01 4.82E-08 9.40E+02 1.26E-05 4.70E+01 1.89E-07 3.00E+03 4.02E-05	mg/kg mg/kg-day mg/kg-day 3.30E+02 1.33E-06 NA 1.30E+02 5.22E-07 NA 1.80E+02 7.23E-07 NA 6.40E+01 2.57E-07 NA 5.90E+02 7.90E-06 NA 2.90E+02 1.16E-06 NA 1.20E+01 4.82E-08 NA 9.40E+02 1.26E-05 2.00E-03 4.70E+01 1.89E-07 NA 3.00E+03 4.02E-05 1.00E-02	mg/kg mg/kg-day mg/kg-day Index 3.30E+02 1.33E-06 NA NA 1.30E+02 5.22E-07 NA NA 1.80E+02 7.23E-07 NA NA 6.40E+01 2.57E-07 NA NA 5.90E+02 7.90E-06 NA NA 2.90E+02 1.16E-06 NA NA 1.20E+01 4.82E-08 NA NA 9.40E+02 1.26E-05 2.00E-03 6.29E-03 4.70E+01 1.89E-07 NA NA 3.00E+03 4.02E-05 1.00E-02 4.02E-03	mg/kg mg/kg-day mg/kg-day index mg/kg-day 3.30E+02 1.33E-06 NA NA 4.73E-07 1.30E+02 5.22E-07 NA NA 1.86E-07 1.80E+02 7.23E-07 NA NA 2.58E-07 6.40E+01 2.57E-07 NA NA 9.18E-08 5.90E+02 7.90E-06 NA NA 2.82E-06 2.90E+02 1.16E-06 NA NA 4.16E-07 1.20E+01 4.82E-08 NA NA 1.72E-08 9.40E+02 1.26E-05 2.00E-03 6.29E-03 4.49E-06 4.70E+01 1.89E-07 NA NA 6.74E-08 3.00E+03 4.02E-05 1.00E-02 4.02E-03 1.43E-05	mg/kg mg/kg-day mg/kg-day index mg/kg-day 1/(mg/kg-day) 3.30E+02 1.33E-06 NA NA 4.73E-07 1.46E+00 1.30E+02 5.22E-07 NA NA 1.86E-07 1.46E+01 1.80E+02 7.23E-07 NA NA 2.58E-07 1.46E+00 6.40E+01 2.57E-07 NA NA 9.18E-08 1.46E-01 5.90E+02 7.90E-06 NA NA 2.82E-06 NA 2.90E+02 1.16E-06 NA NA 4.16E-07 1.46E-02 1.20E+01 4.82E-08 NA NA 1.72E-08 1.46E+01 9.40E+02 1.26E-05 2.00E-03 6.29E-03 4.49E-06 NA 4.70E+01 1.89E-07 NA NA 6.74E-08 1.46E+00 3.00E+03 4.02E-05 1.00E-02 4.02E-03 1.43E-05 NA

NA - Not Available Total Hazard Index = 1.03E-02 Total Cancer Risk = 4.16E-06



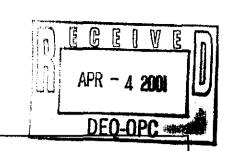


Intake (mg/kg-day) = $Cd*ln$	gR*EF*ED*C BW*AT	F*ME	
Cd - Concentration in sediment = lngR - Ingestion rate for soil = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	mg/kg mg/day days/year years kg/mg	see below 100 30 25 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV
ME - Matrix effect = BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	kg days days	1 70 9125 25550	Magee, et al., 1996 USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	3.30E+02	3.87E-05	NA	NA	1.38E-05	7.30E-01	1.01E-05
Benzo(a)pyrene	1.30E+02	1.53E-05	NA	NA	5.45E-06	7.30E+00	3.98E-05
Benzo(b)fluoranthene	1.80E+02	2.11E-05	NA	NA	7.55E-06	7.30E-01	5.51E-06
Benzo(k)fluoranthenė	6.40E+01	7.51E-06	NA	NA	2.68E-06	7.30E-02	1.96E-07
Carbazole	5.90E+02	6.93E-05	NA T	NA	2.47E-05	2.00E-02	4.95E-07
Chrysene	2.90E+02	3.41E-05	NA	NA	1.22E-05	7.30E-03	8.88E-08
Dibenz(a,h)anthracene	1.20E+01	1.41E-06	NA	NA	5.03E-07	7.30E+00	3.67E-06
Dibenzofuran	9.40E+02	1.10E-04	4.00E-03	2.76E-02	3.94E-05	NA	NA
Indeno(1,2,3-cd)pyrene	4.70E+01	5.52E-06	NA 1	NA	1.97E-06	7.30E-01.	1.44E-06
Naphthalene	3.00E+03	3.52E-04	2.00E-02	1.76E-02	1.26E-04	NA	NA
Phenanthrene	3.20E+03	3.76E-04	NA	NA	1.34E-04	NA	NA

NA - Not Available Total Hazard Index = 4.52E-02 Total Cancer Risk = 6.13E-05

Table 48 Dermal Exposure to EU4 Surface Water by a Maintenance Worker Kerr McGee, Hattiesburg, MS

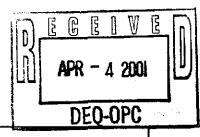


intake (mg/kg-day) =	CW*SA*Kp*ABS	<u>*ET*EF*ED*CI</u>	<u>2</u>	*
	BW ³	'AT		
Cw - Concentration in su SA - Surface area available f SA _t - Total skin s	or exposure = cn	1 ² 3000 1 ² 20000	calculated USEPA 1997, EFH	1 × 1
Fs - Fraction of skin surface area available f Kp - Dermal permeabil ABS _p - Absorpti	ity constant = cm	15.0% for see below 0.03	USEPA 1997, EFH USEPA 1995, Region III	
ABS _s - Absorption - ot	her SVOCs =	0.1	USEPA 1995, Region III	
EF - Exposur ED - Exposu	osure time = hrs/d e frequency = days/ are duration = yearsion factor = L/c	year 30 rs 25	USEPA 1992, Dermal Expressionable assumption USEPA 1995, Region IV	oosure Assessment
BW - B	ody weight = k	g 70 =	USEPA 1995, Region IV	
AT _n - Averaging time - nonc	arcinogenic = day	ys 9125	USEPA 1991, HHEM	and the second
AT _c - Averaging time - c	arcinogenic = day	ys 25550	USEPA 1991, HHEM	

Constituent	Concentration in Surface Water mg/L	Kp em/hr	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles								
Benzo(a)anthracene	5.00E-03	8.10E-01	4.28E-07	NA	NA	1.53E-07	1.46E+00	2.23E-07
Benzo(a)pyrene	5.00E-04	1.20E+00	6.34E-08	NA	NA	2.26E-08	1.46E+01	3.31E-07
Benzo(b)fluoranthene	1.20E-02	1.20E+00	1.52E-06	NA	NA	5,43E-07	1.46E+00	7.93E-07
Benzo(k)fluoranthene	2.00E-03	4.48E+01	9.46E-06	NA	NA	3.38E-06	1.46E-01	4.93E-07
Bis(2-ethylhexyl)phthalate	3.00E-03	3.30E-02	3.49E-08	1.00E-02	3.49E-06	1.25E-08	NA ·	NA
Carbazole	1.00E-02	3.57E-02	1.26E-07	NA	NA	4.50E-08	NA	NA
Chrysene	6.00E-03	8.10E-01	5.14E-07	NA	NA	1.83E-07	1.46E-02	2.68E-09
Dibenz(a,h)anthracene	5.00E-04	2.70E+00	1.43E-07	NA	NA	5.10E-08	1.46E+01	7.44E-07
Dibenzofuran	1.10E-02	1.51E-01	5.85E-07	2.00E-03	2.93E-04	2.09E-07	NA	. NA
Indeno(1,2,3-cd)pyrene	5.00E-04	1.90E+00	1.00E-07	NA	NA.	3.59E-08	1.46E+00	5.23E-08
Phenanthrene	1.70E-02	2.30E-01	1.38E-06	NA	NA.	4.92E-07	NA :	NA 1

NA - Not: Available Total Hazard Index = 2.96E-04 Total Cancer Risk = 2.64E-06





Intake (mg/kg-day) = <u>Csw</u>	*IngR*EF*EI BW*AT	<u>)*ET</u>	
Csw - Concentration in surface water =	mg/L	see below	
IngR - Ingestion rate for surface water =	L/hour	0.01	USEPA 1995, Region IV
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
ET - Exposure time =	hrs/day	1	USEPA 1992, Dermal Exposure Assessmen
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

	Concentration			_	Average		
Constituent	in Surface Water mg/L	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	5.00E-03	5.87E-08	NA	NA	2.10E-08	7.30E-01	1.53E-08
Benzo(a)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Benzo(b)fluoranthene	1.20E-02	1.41E-07	NA .	NA	5.03E-08	7.30E-01	3.67E-08
Benzo(k)fluoranthene	2.00E-03	2.35E-08	NA	NA	8.39E-09	7.30E-02	6.12E-10
Bis(2-ethylhexyl)phthalate	3.00E-03	3.52E-08	2.00E-02	1.76E-06	1.26E-08	1.40E-02	1.76E-10
Carbazole	1.00E-02	1.17E-07	NA	NA	4.19E-08	2.00E-02	8.39E-10
Chrysene	6.00E-03	7.05E-08	NA	NA	2.52E-08	7.30E-03	1.84E-10
Dibenz(a,h)anthracene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E+00	1.53E-08
Dibenzofuran	1.10E-02	1.29E-07	4.00E-03	3.23E-05	4.61E-08	NA	NA
Indeno(1,2,3-cd)pyrene	5.00E-04	5.87E-09	NA	NA	2.10E-09	7.30E-01	1.53E-09
Phenanthrene	1. 70E-02	2.00E-07	NA	NA	7.13E-08	NA	NA

NA - Not Available

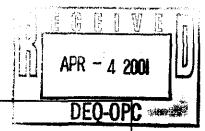
Total Hazard Index = 3.41E-05

Total Cancer Risk = 8.60E-08

Table 50

Dermal Exposure to EU4 Surface Soil (0-6') by a Maintenance Worker Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) =



	BW*AT		
Cs - Concentration in soil =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm ² /day	3000	calculated
SA_{ϵ} - Total skin surface area =	cm²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.038	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Cs*SA*AH*ABS*EF*ED*CF

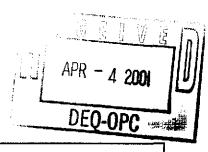
Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.30E+02	3.73E-06	NA	NA	1.33E-06	1.46E+00	1.95E-06
Benzo(a)pyrene	5.00E+02	2.01E-06	NA	NA	7.17E-07	1.46E+01	1.05E-05
Benzo(b)fluoranthene	5.30E+02	2.13E-06	NA	NA	7.60E-07	1.46E+00	1.11E-06
Benzo(k)fluoranthene	2.90E+02	1.16E-06	NA	NA	4.16E-07	1.46E-01	6.07E-08
Carbazole	6.20E+02	8.30E-06	NA	NA	2.96E-06	NA	NA
Chrysene	6.90E+02	2.77E-06	NA	NA	9.90E-07	1.46E-02	1.44E-08
Dibenz(a,h)anthracene	6.40E+01	2.57E-07	NA	NA	9.18E-08	1.46E+01	1.34E-06
Indeno(1,2,3-cd)pyrene	2.50E+02	1.00E-06	NA	NA	3.59E-07	1.46E+00	5.23E-07
Naphthalene	3.50E+03	4.68E-05	1.00E-02	4.68E-03	1.67E-05	NA	NA

NA - Not Available

Total Hazard Index = 4.68E-03

Total Cancer Risk = 1.55E-05



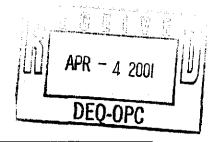


Intake (mg/kg-day) = \underline{Cd}^*	IngR*EF*ED*C BW*AT	F*ME	
Cd - Concentration in soil = lngR - Ingestion rate for soil = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	mg/kg mg/day days/year years kg/mg	see below 100 30 25 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV
ME - Matrix effect =	kg	1	Magee, et al., 1996
BW - Body weight =		70	USEPA 1995, Region IV
AT_n - Averaging time - noncarcinogenic = AT_c - Averaging time - carcinogenic =	days	9125	USEPA 1991, HHEM
	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.30E+02	1.09E-04	NA	NA	3.90E-05	7.30E-01	2.85E-05
Benzo(a)pyrene	5.00E+02	5.87E-05	NA	NA	2.10E-05	7.30E+00	1.53E-04
Benzo(b)fluoranthene	5.30E+02	6.22E-05	NA	NA	2.22E-05	7.30E-01	1.62E-05
Benzo(k)fluoranthene	2.90E+02	3.41E-05	NA	NA	1.22E-05	7.30E-02	8.88E-07
Carbazole	6.20E+02	7.28E-05	NA	NA	2.60E-05	2.00E-02	5.20E-07
Chrysene	6.90E+02	8.10E-05	NA	NA	2.89E-05	7.30E-03	2.11E-07
Dibenz(a,h)anthracene	6.40E+01	7.51E-06	NA	NA	2.68E-06	7.30E+00	1.96E-05
Indeno(1,2,3-cd)pyrene	2.50E+02	2.94E-05	NA	NA	1.05E-05	7.30E-01	7.65E-06
Naphthalene	3.50E+03	4.11E-04	2.00E-02	2.05E-02	1.47E-04	NA	NA

NA - Not Available Total Hazard Index = 2.05E-02 Total Cancer Risk = 2.27E-04



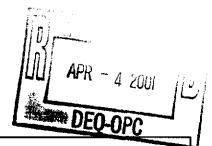


Intake (mg/kg-day) = $\frac{\text{Cs*SA*}}{\text{Cs*SA*}}$	AH*ABS*EF BW*AT	<u> </u>		
Cs - Concentration in soil = SA - Surface area available for exposure =	mg/kg cm²/day cm²	chem. spec.	calculated	
SA _t - Total skin surface area = Fs - Fraction of skin surface area available for exposure =		20000 27.8%	USEPA 1997, EFH USEPA 1997, EFH	
AH - Adherence factor = ABS _p - Absorption - cPAHs =	mg/cm²	0.1 0.03	USEPA 1997, EFH USEPA 1995, Region III	
EF - Exposure frequency = ED - Exposure duration =	days/year years	80 1	reasonable assumption reasonable assumption	
CF - Conversion factor = BW - Body weight =	kg/mg kg	1.00E-06 70	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM	;
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermat Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	6.10E+01	3.19E-06	NA	NA	4.55E-08	1.46E+00	6.64E-08
Benzo(a)pyrene	2.17E+01	1.13E-06	NA	NA	1.62E-08	1.46E+01	2.36E-07
Benzo(b)fluoranthene	3.30E+01	1.72E-06	NA	NA	2.46E-08	1.46E+00	3.59E-08
Benzo(k)fluoranthene	1.10E+01	5.74E-07	NA	NA	8.21E-09	1.46E-01	1.20E-09
Chrysene	5.20E+01	2.72E-06	NA	NA	3.88E-08	1.46E-02	5.66E-10
Dibenz(a,h)anthracene	1.69E+00	8.82E-08	NA	NA	1.26E-09	1.46E+01	1.84E-08
Indeno(1,2,3-cd)pyrene	8.70E+00	4.54E-07	NA	NA	6.49E-09	1.46E+00	9.48E-09

NA - Not Available Total Cancer Risk = 3.68E-07

Table 59 ral Exposure to EU2 Soil (0-10') by a Construction Worker Kerr McGee, Hattiesburg, MS



Intake (mg/kg-day) =	Cd*lngR*EF*ED*Cl	F*ME		
	BW*AT			
Cd - Concentration in so	il = mg/kg	see below		
IngRa - Ingestion rate for so		480	USEPA 1997, EFH	
IngR _b - Ingestion rate for so	il = mg/day	100	USEPA 1997, EFH	
EF _a - Exposure frequenc	y = days/year	10	reasonable assumption	
EF _b - Exposure frequenc	y = days/year	70	reasonable assumption	
ED - Exposure duratio	n = years	1	IJSEPA 1995, Region IV	
CF - Conversion factor	or = kg/mg	1.00E-06		
ME - Matrix effec	et =	1	Magee, et al., 1996	
BW - Body weigh	t= kg	70	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogeni	c = days	365	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogeni	c = days	25550	USEPA 1991, HHEM	

	Exposur	e	Le	vel	A
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Constituent	Concentration in Soil mg/kg	Average Daity Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						10.0	
Benzo(a)anthracene	6.10E+01	1.15E-05	NA	NA	1.64E-07	7.30E-01	1.20E-07
nzo(a)pyrene	2.17E+01	4.07E-06	NA	NA	5.82E-08	7.30E+00	4.25E-07
enzo(b)fluoranthene	3.30E+01	6.20E-06	NA	NA	8.86E-08	7.30E-01	6.47E-08
Benzo(k)fluoranthene	1.10E+01	2.07E-06	NA	NA	2.95E-08	7.30E-02	2.16E-09
Chrysene	5.20E+01	9.77E-06	NA	NA	1.40E-07	7.30E-03	1.02E-09
Dibenz(a,h)anthracene.	1.69E+00	3.17E-07	NA.	NA ·	4.53E-09	7.30E+00	3.31E-08
ndeno(1,2,3-cd)pyrene	8.70E+00	1.63E-06	NA ·	NA	2.33E-08	7.30E-01	1.70E-08

NA - Not Available Cancer Risk = 6.62E-07

Exposure Level B

· •	Concentration in Soil	Average Daily Intake	Oral Chronic RfD	Hazard	Average Lifetime Daily Intake	Factor	
Constituent	mg/kg	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	6.10E+01	1.67E-05	NA	NA	2.39E-07	7.30E-01	1.74E-07
Benzo(a)pyrene	2.17E+01	5.94E-06	NA	NA	8.48E-08	7.30E+00	6.19E-07
Benzo(b)fluoranthene	. 3.30E+01	9.04E-06	NA	NA	1.29E-07	7.30E-01	9.43E-08
Benzo(k)fluoranthene	1.10E+01	3.01E-06	NA	NA	4.31E-08	7.30E-02	3.14E-09
Chrysene	5.20E+01	1.42E-05	NA	NA ·	2.04E-07	7.30E-03	1.49E-09
Dibenz(a,h)anthracene	1.69E+00	4.63E-07	NA	NA	6.61E-09	7.30E+00	4.83E-08
Indeno(1,2,3-cd)pyrene	8.70E+00	2.38E-06	NA	NA	3.41E-08	7.30E-01	2.49E-08

NA - Not Available Cancer Risk = 9.65E-07

Total Cancer Risk = 1.63E-06

Table 60

Exposure to Construction Workers from Inhalation of Fugitive Dust in EU2 Kerr McGee, Hattiesburg, MS

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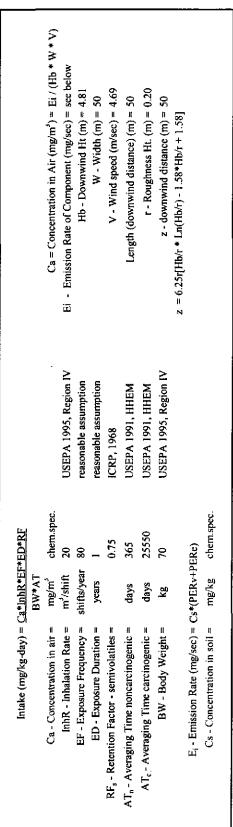
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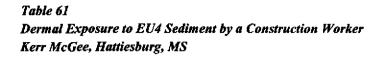
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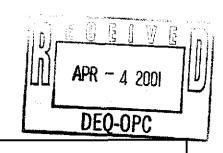


							Average		
	Concentration in Soil	Emission Rate	Concentration in Air	Average Daily Intake	Inhalation Subchronic RfD	Hazard	Lifetime Daily Intake	Inhalation Cancer Slone Factor	
Chemicals	mg/kg	mg/sec	mg/m³	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Cancer Risk
Semivolatiles			!						
Benzo(a)anthracene	6.10E+01	6.67E-02	5.92E-05	2.78E-06	NA	NA	3.97E-08	3.10E-01	1.23E-08
Benzo(a)pyrene	2.17E+01	2.37E-02	2.10E-05	9.88E-07	NA VA	NA	1.41E-08	3.10E+00	4.37E-08
Benzo(b)fluoranthene	3.30E+01	3.61E-02	3.20E-05	1.50E-06	A'N	NA	2.15E-08	3.10E-01	6.66E-09
Benzo(k)fluoranthene	1.10E+01	1.20E-02	1.07E-05	5.01E-07	NA	NA	7.16E-09	3.10E-02	2.22E-10
Chrysene	5.20E+01	5.69E-02	5.05E-05	2.37E-06	NA	NA	3.39E-08	3.10E-03	1.05E-10
Dibenz(a,h)anthracene	1.69E+00	1.85E-03	1.64E-06	7.70E-08	A'A	NA	1.10E-09	3.10E+00	3.41E-09
Indeno(1,2,3-cd)pyrene	8.70E+00	9.51E-03	8.44E-06	3.96E-07	NA	NA	5.66E-09	3.10E-01	1.76E-09

NA - Not Available

Total Cancer Risk:



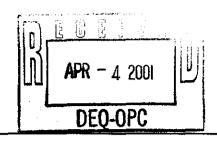


Intake (mg/kg-day) =	Cs*SA*	AH*ABS*EF	*ED*CF	
		BW*AT		
Cs - Concentration in s	ediment =	mg/kg	chem. spec.	
SA - Surface area available for e	xposure =	cm²/day	3000	calculated
SA _t - Total skin surfa	ace area =	cm²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for e	xposure =		15.0%	USEPA 1997, EFH
AH - Adherenc	e factor =	mg/cm ²	0.13	USEPA 1997, EFH
ABS _p - Absorption -	cPAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other	SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure fre	equency =	days/year	8	reasonable assumption
ED - Exposure of	luration =	years	1	reasonable assumption
CF - Conversio	n factor =	kg/mg	1.00E-06	
BW - Body	weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarci	nogenic =	days	365	USEPA 1991, HHEM
AT _c - Averaging time - carci	nogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	, Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	3.30E+02	1.21E-06	NA "	NA	1.73E-08	1.46E+00	2.52E-08
Benzo(a)pyrene	1.30E+02	4.76E-07	NA	NA	6.80E-09	1.46E+01	9.93E-08
Benzo(b)fluoranthene	1.80E+02	6.59E-07	NA	NA	9.42E-09	1.46E+00	1.38E-08
Benzo(k)fluoranthene	6.40E+01	2.34E-07	NA	NA	3.35E-09	.1.46E-01	4.89E-10
Carbazole	5.90E+02	7.20E-06	NA	NA	1.03E-07	NA	NA
Chrysene	2.90E+02	1.06E-06	NA	NA	1.52E-08	1.46E-02	2.22E-10
Dibenz(a,h)anthracene	1.20E+01	4.40E-08	NA	NA	6.28E-10	1.46E+01	9.17E-09
Dibenzofuran	9.40E+02	1.15E-05	NA	NA	1.64E-07	NA	NA
Indeno(1,2,3-cd)pyrene	4.70E+01	1.72E-07	NA	NA	2.46E-09	1.46E+00	3.59E-09
Naphthalene	3.00E+03	3.66E-05	NA	NA	5.23E-07	NA	NA
Phenanthrene	3.20E+03	3.91E-05	NA	NA	5.58E-07	NA	NA

NA - Not Available Total Cancer Risk = 1.52E-07

Table 63 ermal Exposure to EU4 Surface Water by a Construction Worker Kerr McGee, Hattiesburg, MS

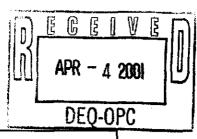


Intake (mg/kg-day) = $\underline{Cw^*SA^*k}$	BW*AT	EF*ED*CF		
Cw - Concentration in surface water =	mg/L	see below		
SA - Surface area available for exposure =	cm ²	3000	calculated	
SA _t - Total skin surface area =	cm ²	20000	USEPA 1997, EFH	
raction of skin surface area available for exposure =		15.0%	USEPA 1997, EFH	
Kp - Dermal permeability constant =	cm/hr	see below		
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III	
ABS _s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III	
ET - Exposure time =	hrs/day	1 -	USEPA 1992, Dermal Exposure Assessment	
EF - Exposure frequency =	days/year	8	reasonable assumption	
ED - Exposure duration =	years	1	reasonable assumption	
CF - Conversion factor =	L/cm³	1.00E-03	•	
BW - Body weight =	kg -	70	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent		ncentration in urface Water mg/L	Kp cm/br	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
nivolatiles									
enzo(a)anthracene		5.00E-03	8.10E-01	1.14E-07	NA	NA	1.63E-09	1.46E+00	2.38E-09
Benzo(a)pyrene		5.00E-04	1.20E+00	1.69E-08	NA	NA	2.42E-10	1.46E+01	3.53E-09
Benzo(b)fluoranthene		1.20E-02	1.20E+00	4.06E-07	NA	NA	5.80E-09	1.46E+00	8.46E-09
Benzo(k)fluoranthene	7	2.00E-03	4.48E+01	2.52E-06	NA	NA	3.60E-08	1.46E-01	5.26E-09
Bis(2-ethylhexyl)phthalate		3.00E-03	3.30E-02	9.30E-09	1.00E-02	9.30E-07	1.33E-10	NA ·	NA
Carbazole		1.00E-02	3.57E-02	3.36E-08	NA	NA ···	4.80E-10	NA	NA
Chrysene		6.00E-03	8.10E-01	1.37E-07	NA	NA	1.96E-09	1.46E-02	2.86E-11
Dibenz(a,h)anthracene		5.00E-04	2.70E+00	3.80E-08	NA	NA	5.43E-10	1.46E+01	7.93E-09
Dibenzofuran		1.10E-02	1.51E-01	1.56E-07	NA	NA ·	2.23E-09	NA	NA NA
Indeno(1,2,3-cd)pyrene	1,000	5.00E-04	1.90E+00	2.68E-08	NA	NA ·	3.82E-10	1.46E+00	5,58E-10
Phenanthrene		1.70E-02	2.30E-01	3.67E-07	NA	NA	5.25E-09	NA	NA

NA - Not Available Total Hazard Index = 9.30E-07 Total Cancer Risk = 2.82E-08





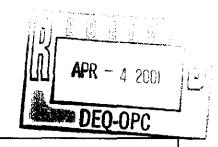
intake (mg/kg-day) = <u>Cs*SA*</u>	AH*ABS*EF BW*AT	* <u>ED*CF</u>	
Cs - Concentration in soil = SA - Surface area available for exposure = SA _t - Total skin surface area =	mg/kg cm²/day cm²	chem. spec. 5560 20000 27.8%	calculated USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure = AH - Adherence factor = ABS _p - Absorption - cPAHs = ABS _s - Absorption - other SVOCs =	mg/cm²	0.1 0.03 0.1	USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	days/year years kg/mg	80 1 1.00E-06	reasonable assumption
BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	kg days days	70 365 25550	USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							:
Benzo(a)anthracene	9.30E+02	4.86E-05	NA	NA	6.94E-07	1.46E+00	1.01E-06
Benzo(a)pyrene	5.00E+02	2.61E-05	NA	NA	3.73E-07	1.46E+01	5.45E-06
Benzo(b)fluoranthene	5.30E+02	2.77E-05	NA	NA	3.95E-07	1.46E+00	5.77E-07
Benzo(k)fluoranthene	2.90E+02	1.51E-05	NA	NA	2.16E-07	1.46E-01	3.16E-08
Carbazole	6.20E+02	1.08E-04	NA	NA	1.54E-06	NA	NA
Chrysene	6.90E+02	3.60E-05	NA	NA	5.15E-07	1.46E-02	7.52E-09
Dibenz(a,h)anthracene	6.40E+01	3.34E-06	NA	NA	4.78E-08	1.46E+01	6.97E-07
Indeno(1,2,3-cd)pyrene	2.50E+02	1.31E-05	NA	NA	1.87E-07	1.46E+00	2.72E-07
Naphthalene	3.50E+03	6.09E-04	NA	NA	8.70E-06	NA	NA

NA - Not Available

Total Cancer Risk = 8.05E-06

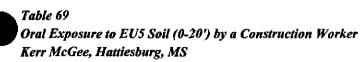


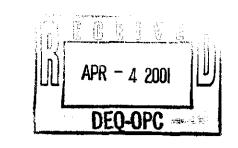


$Intake (mg/kg-day) = \underline{Cs*SA*}$	<u>'AH*ABS*EF</u> BW*AT	*ED*CF	
	DW AI		
Cs - Concentration in soil =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm²/day	5560	calculated
SA _t - Total skin surface area =	cm⁴	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		27.8%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.1	USEPA 1997, EFH
ABS _p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS_s - Absorption - other SVOCs =		0.1	USEPA 1995, Region II
EF - Exposure frequency =	days/year	80 .	reasonable assumption
ED - Exposure duration =	years	1 .	reasonable assumption
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles			<u>_</u>				
Benzo(a)anthracene	8.35E+01	4.36E-06	NA	NA	6.23E-08	1.46E+00	9.10E-08
Benzo(a)pyrene	4.42E+01	2.31E-06	NA.	NA	3.30E-08	1.46E+01	4.81E-07
Benzo(b)fluoranthene	7.95E+01	4.15E-06	NA	NA	5.93E-08	1.46E+00	8.66E-08
Benzo(k)fluoranthene	1.68E+01	8.77E-07	NA	NA	1.25E-08	1.46E-01	1.83E-09
Chrysene	8.25E+01	4.31E-06	NA	NA	6.16E-08	1.46E-02	8.99E-10
Dibenz(a,h)anthracene	1.53E+00	7.99E-08	NA	NA	1.14E-09	1.46E+01	1.67E-08
Indeno(1,2,3-cd)pyrene	1.32E+01	6.89E-07	NA	NA	9.85E-09	1.46E+00	1.44E-08

NA - Not Available Total Cancer Risk = 6.93E-07





Intake (mg/kg-day) = Cd*Ir	ngR*EF*ED*C	<u>F*ME</u>	
	BW*AT		
Cd - Concentration in sediment =	mg/kg	see below	
$IngR_s$ - $Ingestion rate for soil =$	mg/day	480	USEPA 1997, EFH
$IngR_b$ - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH
EF_a - Exposure frequency =	days/year	10	reasonable assumption
EF_b - Exposure frequency =	days/year	70	reasonable assumption
ED - Exposure duration =	years	1	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1. 00E-06	
ME - Matrix effect =		1	Magee, et al., 1996
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	365	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Exposure Level A

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	8.35E+01	1.57E-05	NA	NA	2 24E-07	7.30E-01	1.64E-07
Benzo(a)pyrene	4.42E+01	8.30E-06	NA	NA	1.19E-07	7.30E+00	8.66E-07
Benzo(b)fluoranthene	7.95E+01	1.49E-05	NA	NA	2.13E-07	7.30E-01	1.56E-07
Benzo(k)fluoranthene	1.68E+01	3.16E-06	NA	NA	4.51E-08	7.30E-02	3.29E-09
Chrysene	8.25E+01	1.55E-05	NA	NA	2.21E-07	7.30E-03	1.62E-09
Dibenz(a,h)anthracene	1.53E+00	2.87E-07	NA	NA	4.11E-09	7.30E+00	3.00E-08
Indeno(1,2,3-cd)pyrene	1.32E+01	2.48E-06	NA	NA	3.54E-08	7.30E-01	2.59E-08

NA - Not Available Cancer Risk = 1.25E-06

Exposure Level B

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	8.35E+01	2.29E-05	NA	NA	3.27E-07	7.30E-01	2.39E-07
Benzo(a)pyrene	4.42E+01	1.21E-05	NA	NA	1.73E-07	7.30E+00	1.26E-06
Benzo(b)fluoranthene	7.95E+01	2.18E-05	NA	NA	3.11E-07	7.30E-01	2.27E-07
Benzo(k)fluoranthene	1.68E+01	4.60E-06	NA.	NA	6.58E-08	7.30E-02	4.80E-09
Chrysene	8.25E+01	2.26E-05	NA	NA	3.23E-07	7.30E-03	2.36E-09
Dibenz(a,h)anthracene	1.53E+00	4.19E-07	NA	NA	5.99E-09	7.30E+00	4.37E-08
Indeno(1,2,3-cd)pyrene	1.32E+01	3.62E-06	NA	NA	5.17E-08	7.30E-01	3.77E-08

NA - Not Available Cancer Risk = 1.82E-06

Total Cancer Risk = 3.06E-06





Exposure to Construction Workers from Inhalation of Fugitive Dust in EUS Kerr McGee, Hattiesburg, MS Table 70

-	Intake (mg/kg-day) ≂		Ca*InhR*EF*ED*RF BW*AT	RF.					
Ca - Concentration in air = InhR - Inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = RF _s - Retention Factor - semivolatiles = AT _n - Averaging Time noncarcinogenic = AT _c - Averaging Time carcinogenic = BW - Body Weight = E _i - Emission Rate (mg/sec) = Cs - Concentration in soil =	Ca - Concentration in air = mg/m ³ see bh InhR - Inhalation Rate = m ³ /shift 20 EF - Exposure Frequency = shifts/year 80 ED - Exposure Duration = years 1 Ta - Averaging Time noncarcinogenic = days 365 AT _c - Averaging Time carcinogenic = days 2555 BW - Body Weight = kg 70 E _i - Emission Rate (mg/sec) = Cs*(PERv+PERe) Cs - Concentration in soil = mg/kg see bh	mg/m² m²/shift shifts/year years days kg kg kg mg/kg	see below 20 80 1 0.75 365 25550 70 rene	USEPA 1995, Region IV reasonable assumption reasonable assumption ICRP, 1968 USEPA 1991, HHEM USEPA 1991, HHEM USEPA 1995, Region IV	Ei - Emi	= Concentration Rate of Co Hb - Lo V - W rngth (downv r - R z - down r * Ln(Hb/r)	Ca = Concentration in Air (mg/m³) = Ei / (Hb * W * V) Ei - Emission Rate of Component (mg/scc) = see below Hb - Downwind Ht (m) = 4.81 W - Width (m) = 50 V - Wind speed (m/sec) = 4.69 Length (downwind distance) (m) = 50 r - Rougtness Ht. (m) = 0.20 z - downwind distance (m) = 50 z - downwind distance (m) = 50 z - downwind distance (m) = 50	Ei / (Hb * W * V) see below 4.81 50 4.69 50 0.20 50	
	Concentration in Soil	Emission Rate	Concentration in	ž:	Inhalation Subchronic RfD	Hazard	Average Lifetime Daily Intake	Inhalation Cancer Slope Factor	
Chemicals Semivolatiles	mg/kg	mg/sec	ту/ш	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Cancer Risk
Benzo(a)anthracene	8.35E+01	9.13E-02	8.10E-05	3.81E-06	NA	NA	5.44E-08	3.10E-01	1.69E-08
Benzo(a)pyrene	4.42E+01	4.83E-02	4.29E-05	2.01E-06	NA	NA	2.88E-08	3.10E+00	8.92E-08
Benzo(b)fluoranthene	7.95E+01	8.69E-02	7.71E-05	3.62E-06	NA	NA	5.18E-08	3.10E-01	1.60E-08
Benzo(k)fluoranthene	1.68E+01	1.84E-02	1.63E-05	7.66E-07	NA	NA A	1.09E-08	3.10E-02	3.39E-10
Chrysene	8.25E+01	9.02E-02	8.01E-05	3.76E-06	NA A	A'N	5.37E-08	3.10E-03	1.67E-10
Dibenz(a,h)anthracene	1.53E+00	1.67E-03	1.48E-06	6.97E-08	NA	NA	9.96E-10	3,10E+00	3.09E-09
Indeno(1,2,3-cd)pyrene	1.32E+01	1.44E-02	1.28E-05	6.02E-07	NA	NA	8.59E-09	3.10E-01	2.66E-09
NA - Not Available									

Dermal Exposure to EU6 Sediment by a Child Resident (Aged 1 to 6 years) Kerr McGee, Hattiesburg, MS

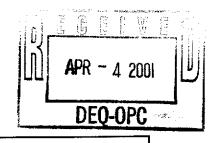


Intake (mg/kg-day) = $Cs*SA$	*AH*ABS*EF	*ED*CF	
	BW*AT		
Cs - Concentration in sediment = SA - Surface area available for exposure = SA ₁ - Total skin surface area = Fs - Fraction of skin surface area available for exposure =	mg/kg cm²/day cm²	chem. spec. 2229 7213 30.9%	calculated USEPA 1997, EFH USEPA 1997, EFH
AH - Adherence factor = ABS_p - Absorption - cPAHs = ABS_s - Absorption - other SVOCs =	mg/cm²	0.33 0.03 0.1	USEPA 1997, EFH USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	days/year years kg/mg	40 6 1.00E-06	reasonable assumption USEPA 1995, Region IV
BW - Body weight = AT_n - Averaging time - noncarcinogenic =	kg days	15 2190	USEPA 1995, Region IV USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
2-Nitroaniline	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA
2-Nitrophenol	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
3-Nitroaniline	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
4-Bromophenylphenylether	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
4-Chloro-3-methylphenol	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
4-Chlorophenylphenylether	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA
4-Nitroaniline	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
Benzo(a)anthracene	1.00E+02	1.61E-05	NA	NA	1.38E-06	1.46E+00	2.02E-06
Benzo(a)pyrene	4.90E+01	7.90E-06	NA	NA	6.77E-07	1.46E+01	9.89E-06
Benzo(b)fluoranthene	7.80E+01	1.26E-05	NA	NA	1.08E-06	1.46E+00	1.57E-06
Benzo(k)fluroanthene	2.30E+01	3.71E-06	NA	NA	3.18E-07	1.46E-01	4.64E-08
Bis(2-chloroethoxy)methane	8.00E-01	4.30E-07	NA	NA	3.68E-08	NA	NA
Bis(2-chloroethyl)ether	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA
Carbazole	1.00E+02	5.37E-05	NA	NA	4.61E-06	NA	NA
Chrysene	7.60E+01	1.23E-05	NA	NA	1.05E-06	1.46E-02	1.53E-08
Dibenz(a,h)anthracene	9.60E+00	1.55E-06	NA	NA	1.33E-07	1.46E+01	1.94E-06
Hexachlorobenzene	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA
Hexachlorocyclopentadiene	2.00E+00	1.07E-06	NA	NA	9.21E-08	NA	NA
Indeno(1,2,3-cd)pyrene	3.90E+01	6.29E-06	NA	NA	5.39E-07	1.46E+00	7.87E-07
N-nitrosodi-n-propylamine	4.00E-01	2.15E-07	NA	NA	1.84E-08	NA	NA

NA - Not Available Total Cancer Risk = 1.63E-05





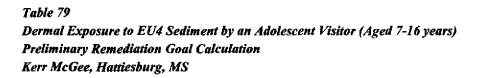
Intake (mg/kg-day) = $\underline{C}s*SA*A$	AH*ABS*EF	*ED*CF	
	BW*AT		
Cs - Concentration in sediment =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm²/day	6180	calculated
SA ₁ - Total skin surface area =	cm ²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.33	USEPA 1997, EFH
ABS_{p} - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS_s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	40	reasonable assumption
ED - Exposure duration =	years	24	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	8760	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

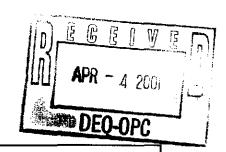
Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
2-Nitroaniline	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA
2-Nitrophenol	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
3-Nitroaniline	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
4-Bromophenylphenylether	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
4-Chloro-3-methylphenol	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
4-Chlorophenylphenylether	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA
4-Nitroaniline	8.00E-01	2.55E-07	NA	NA	8.76E-08	NA	NA
Benzo(a)anthracene	1.00E+02	9.58E-06	NA	NA	3.28E-06	1.46E+00	4.79E-06
Benzo(a)pyrene	4.90E+01	4.69E-06	NA	NA	1.61E-06	1.46E+01	2.35E-05
Benzo(b)fluoranthene	7.80E+01	7.47E-06	NA	NA	2.56E-06	1.46E+00	3.74E-06
Benzo(k)fluroanthene	2.30E+01	2.20E-06	NA	NA	7.55E-07	1.46E-01	1.10E-07
Bis(2-chloroethoxy)methane	8.00E-01	2.55E-07	NA	NA .	8.76E-08	NA	NA:
Bis(2-chloroethyl)ether	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA
Carbazole	1.00E+02	3.19E-05	NA	NA	1.09E-05	NA	NA.
Chrysene	7.60E+01	7.28E-06	NA	NA	2.50E-06	1.46E-02	3.64E-08
Dibenz(a,h)anthracene	9.60E+00	9.20E-07	NA	NA	3.15E-07	1.46E+01	4.60E-06
Hexachlorobenzene	4.00E-01	1.28E-07	4.00E-04	3.19E-04	4.38E-08	NA	NA
Hexachlorocyclopentadiene	2.00E+00	6.39E-07	3.50E-03	1.82E-04	2.19E-07	NA	NA
Indeno(1,2,3-cd)pyrene	3.90E+01	3.74E-06	NA	NA	1.28E-06	1.46E+00	1.87E-06
N-nitrosodi-n-propylamine	4.00E-01	1.28E-07	NA	NA	4.38E-08	NA	NA

NA - Not Available

Total Hazard Index = 5.02E-04

Total Cancer Risk = 3.86E-05





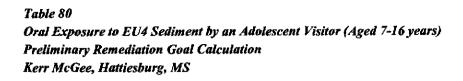
	Cs*SA*A	H*ABS*EF	*ED*CF	
·	I	BW*AT		
Cs - Concentration in sed	iment =	mg/kg	chem. spec.	
SA - Surface area available for exp	osure =	cm ² /day	3945	calculated
SA ₄ - Total skin surfac	e area =	cm ²	12768.3	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exp	osure =		30.9%	USEPA 1997, EFH
AH - Adherence	factor =	mg/cm ²	0.33	USEPA 1997, EFH
ABS _p - Absorption - c	PAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other S	VOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequ	uency =	days/year	12	reasonable assumption
ED - Exposure du	ration =	years	10	USEPA 1995, Region IV
CF - Conversion	factor =	kg/mg	1.00E-06	
BW - Body v	veight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcino	genic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcino	genic =	days	25550	USEPA 1991, HHEM

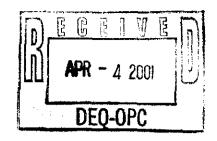
Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						·	
Benzo(a)anthracene	2.56E+00	7.31E-08	NA	NA	1.04E-08	1.46E+00	1.52E-08
Benzo(a)pyrene	3.10E+00	8.85E-08	NA	NA ·	1.26E-08	1.46E+01	1.85E-07
Benzo(b)fluoranthene	4.78E+00	1.36E-07	NA :	NA	1.95E-08	1.46E+00	2.85E-08
Benzo(k)fluoranthene	2.27E+00	6.48E-08	NA	NA	9.25E-09	1.46E-01	1.35E-09
Carbazole	•	NA	NA	NA	NA	NA	NA
Chrysene	*	NA	NA	NA	NA.	1.46E-02	NA
Dibenz(a,h)anthracene	5.87E-01	1.68E-08	NA	NA	2.39E-09	1.46E+01	3.49E-08
Dibenzofuran	* .	NA	2.00E-03	NA	NA	NA ·	NA
Indeno(1,2,3-cd)pyrene	2.40E+00	6.85E-08	NA	NA:	9.78E-09	1.46E+00	1.43E-08
Naphthalene	*	NA	1.00E-02	NA :	NA	NA	NA
Phenanthrene	•	NA	NA	NA	NA	NA	NA

NA - Not Available/Not Applicable

*Constituent not present in remaining samples.

Total Cancer Risk = 2.79E-07



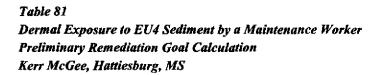


	Intake (mg/kg-day) =	: <u>Cd*</u> 1	ngR*EF*ED*CI BW*AT	<u>F*ME</u>			
	Cd - Concentration	on in sediment =	mg/kg	see below			
·	IngR - Ingestion rat	e for sediment =	mg/day	100	USEPA 1997, EF	TH .	
	EF - Expos	sure frequency =	days/year	12	reasonable assum	ption	
	ED - Exp	osure duration =	years	10	USEPA 1995, Re	gion IV	
	CF - Cor	version factor =	kg/mg	1.00E-06			
	ME ·	- Matrix effect =		1	Magee, et al., 199	96	
	BW -	Body weight =	kg	45	USEPA 1995, Re	gion IV	
A	T _n - Averaging time - no	ncarcinogenic =	days	3650	USEPA 1991, HI	НЕМ	100
:	AT _e - Averaging time	- carcinogenic =	days	25550	USEPA 1991, HI	НЕМ	·
	Concentration in Sediment	Average Daily Intake	Oral Chronic RfD	Hazard	Average Lifetime Daily	Oral Cancer	
Constituent	mg/kg	mg/kg-day	mg/kg-day	nazaro Index	Intake mg/kg-day	Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles	mg/kg	•				•	
	mg/kg 2.56E+00	•				•	
Semivolatiles		mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Risk
Semivolatiles Benzo(a)anthracene	2.56E+00 3.10E+00	mg/kg-day	mg/kg-day NA	Index NA	mg/kg-day 2.67E-08	1/(mg/kg-day) 7.30E-01	Risk 1.95E-08
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene	2.56E+00 3.10E+00 4.78E+00	mg/kg-day 1.87E-07 2.26E-07	mg/kg-day NA NA	NA NA	mg/kg-day 2.67E-08 3.24E-08	7.30E-01 7.30E+00	Risk 1.95E-08 2.36E-07
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene	2.56E+00 3.10E+00 4.78E+00	mg/kg-day 1.87E-07 2.26E-07 3.49E-07	mg/kg-day NA NA NA	NA NA NA	mg/kg-day 2.67E-08 3.24E-08 4.99E-08	7.30E-01 7.30E-00 7.30E-00 7.30E-01	Risk 1.95E-08 2.36E-07 3.64E-08
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene	2.56E+00 3.10E+00 4.78E+00 2.27E+00	mg/kg-day 1.87E-07 2.26E-07 3.49E-07 1.66E-07	mg/kg-day NA NA NA NA NA	NA NA NA NA	2.67E-08 3.24E-08 4.99E-08 2.37E-08	7.30E-01 7.30E-00 7.30E-00 7.30E-01 7.30E-02	Risk 1.95E-08 2.36E-07 3.64E-08 1.73E-09
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Carbazole	2.56E+00 3.10E+00 4.78E+00 2.27E+00	mg/kg-day 1.87E-07 2.26E-07 3.49E-07 1.66E-07 NA	mg/kg-day NA NA NA NA NA NA NA	NA NA NA NA NA	2.67E-08 3.24E-08 4.99E-08 2.37E-08 NA	7.30E-01 7.30E-00 7.30E-00 7.30E-01 7.30E-02 2.00E-02	Risk 1.95E-08 2.36E-07 3.64E-08 1.73E-09 NA
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Carbazole Chrysene	2.56E+00 3.10E+00 4.78E+00 2.27E+00	mg/kg-day 1.87E-07 2.26E-07 3.49E-07 1.66E-07 NA NA	mg/kg-day NA NA NA NA NA NA NA NA	NA NA NA NA NA NA	2.67E-08 3.24E-08 4.99E-08 2.37E-08 NA NA	7.30E-01 7.30E-01 7.30E-00 7.30E-01 7.30E-02 2.00E-02 7.30E-03	Risk 1.95E-08 2.36E-07 3.64E-08 1.73E-09 NA NA
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Carbazole Chrysene Dibenz(a,h)anthracene	2.56E+00 3.10E+00 4.78E+00 2.27E+00 * * \$ 5.87E-01	mg/kg-day 1.87E-07 2.26E-07 3.49E-07 1.66E-07 NA NA 4.29E-08	mg/kg-day NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA	mg/kg-day 2.67E-08 3.24E-08 4.99E-08 2.37E-08 NA NA NA 6.13E-09	7.30E-01 7.30E-01 7.30E-00 7.30E-01 7.30E-02 2.00E-02 7.30E-03 7.30E+00	Risk 1.95E-08 2.36E-07 3.64E-08 1.73E-09 NA NA 4.47E-08
Semivolatiles Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Carbazole Chrysene Dibenz(a,h)anthracene	2.56E+00 3.10E+00 4.78E+00 2.27E+00 * * \$ 5.87E-01	mg/kg-day 1.87E-07 2.26E-07 3.49E-07 1.66E-07 NA NA 4.29E-08 NA	Mg/kg-day NA NA NA NA NA NA NA NA NA NA NA 4.00E-03	NA NA NA NA NA NA NA NA NA NA NA	mg/kg-day 2.67E-08 3.24E-08 4.99E-08 2.37E-08 NA NA 6.13E-09 NA	7.30E-01 7.30E-01 7.30E-00 7.30E-01 7.30E-02 2.00E-02 7.30E-03 7.30E+00 NA	Risk 1.95E-08 2.36E-07 3.64E-08 1.73E-09 NA NA 4.47E-08 NA

NA - Not Available/Not Applicable

*Constituent not present in remaining samples.

Total Cancer Risk ≈ 3.57E-07





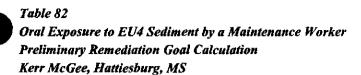
Intake (mg/kg-day) = $\frac{\text{Cs*SA*}}{\text{Cs*SA*}}$	<u>AH*ABS*EI</u> BW*AT	F*ED*CF	
Cs - Concentration in sediment =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm ² /day	3000	calculated
SA ₁ - Total skin surface area =	cm ²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15.0%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm²	0.038	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS_s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	2.56E+00	1.03E-08	NA	NA	3.67E-09	1.46E+00	5.36E-09
Benzo(a)pyrene	3.10E+00	1.24E-08	NA:	NA	4.45E-09	1.46E+01	6.49E-08
Benzo(b)fluoranthene	4.78E+00	1.92E-08	NA	NA	6.86E-09	1.46E+00	1.00E-08
Benzo(k)fluoranthene	2.27E+00	9.12E-09	NA	NA	3.26E-09	1.46E-01	4.75E-10
Carbazole	*	NA	NA	NA	NA ·	NA	NA
Chrysene	*	NA	NA	NA	NA	1.46E-02	NA
Dibenz(a,h)anthracene	5.87E-01	2.36E-09	NA	NA	8.42E-10	1.46E+01	1.23E-08
Dibenzofuran	*	NA	2.00E-03	NA	NA .	NA	NA
Indeno(1,2,3-cd)pyrene	2.40E+00	9.64E-09	NA	NA ·	3.44E-09	1.46E+00	5.03E-09
Naphthalene	*	NA	1.00E-02	NA	. NA	NA	NA
Phenanthrene	•	NA	NA	NA	NA	NA	NA

NA - Not Available/Not Applicable

*Constituent not present in remaining samples.

Total Cancer Risk = 9.81E-08





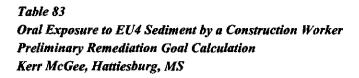
$Intake (mg/kg-day) = \underline{Cd*In}$	gR*EF*ED*C	F*ME		
	BW*AT			
Cd - Concentration in sediment =	mg/kg	see below		
IngR - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH	
EF - Exposure frequency =	days/year	30	reasonable assumption	
ED - Exposure duration =	years	25	USEPA 1995, Region IV	
CF - Conversion factor =	kg/mg	1.00E-06		
ME - Matrix effect =		1	Magee, et al., 1996	
BW - Body weight =	kg	70	USEPA 1995, Region IV	
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM	
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM	

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	2.56E+00	3.01E-07	NA	NA	1.07E-07	7.30E-01	7.84E-08
Benzo(a)pyrene	3.10E+00	3.64E-07	NA	NA	1.30E-07	7.30E+00	9.49E-07
Benzo(b)fluoranthene	4.78E+00	5.61E-07	NA.	NA	2.00E-07	7.30E-01	1.46E-07
Benzo(k)fluoranthene	2.27E+00	2.67E-07	NA	NA	9.52E-08	7.30E-02	6.95E-09
Carbazole	*	NA	NA	NA	NA	2.00E-02	NA
Chrysene	*	NA	NA	NA	NA	7.30E-03	NA
Dibenz(a,h)anthracene	5.87E-01	6.89E-08	NA	NA	2.46E-08	7.30E+00	1.80E-07
Dibenzofuran	. •	NA	4.00E-03	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	2.40E+00	2.82E-07	NA	NA	1.01E-07	7.30E-01	7.35E-08
Naphthalene	*	NA	2.00E-02	NA	NA	NA	NA
Phenanthrene	*	NA	NA	NA	NA ·	NA	NA

NA - Not Available/Not Applicable

Total Cancer Risk = 1.43E-06

^{*}Constituent not present in remaining samples.





Intake (mg/kg-day) = $\underline{Cd*In}$	gR*EF*ED*C BW*AT	F*ME	
Cd - Concentration in sediment = IngR - Ingestion rate for sediment = EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor =	mg/kg mg/day days/year years kg/mg	see below 480 8 1 1.00E-06	USEPA 1997, EFH reasonable assumption USEPA 1995, Region IV
ME - Matrix effect =	kg	1	Magee, et al., 1996
BW - Body weight =		70 .	USEPA 1995, Region IV
AT_{α} - Averaging time - noncarcinogenic = AT_{c} - Averaging time - carcinogenic =	days	365	USEPA 1991, HHEM
	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	2.56E+00	3.85E-07	NA	NA	5.50E-09	7.30E-01	4.01E-09
Benzo(a)pyrene	3.10E+00	4.66E-07	NA	NA	6.66E-09	7.30E+00	4.86E-08
Benzo(b)fluoranthene	4.78E+00	7.18E-07	NA	NA	1.03E-08	7.30E-01	7.49E-09
Benzo(k)fluoranthene	2.27E+00	3.41E-07	NA	NA	4.87E-09	7.30E-02	3.56E-10
Carbazole	*	NA	NA	NA	NA	2.00E-02	NA
Chrysene	•	NA	NA	NA	NA	7.30E-03	NA
Dibenz(a,h)anthracene	5.87E-01	8.82E-08	NA	NA	1.26E-09	7.30E+00	9.20E-09
Dibenzofuran	*	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	2.40E+00	3.61E-07	NA	NA	5.15E-09	7.30E-01	3.76E-09
Naphthalene	*	NA	NA	NA	NA	NA	NA
Phenanthrene	*	NA	NA	NA	NA	NA	NA

NA - Not Available/Not Applicable

Total Cancer Risk = 7.34E-08

^{*}Constituent not present in remaining samples.

Table 84

Dermal Exposure to EU4 Surface Soil (0-6') by a Maintenance Worker

Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

1	(5)	<u> </u>
	APR -4	2001
	-	

$Intake (mg/kg-day) = \underbrace{Cs*SA*}_{}$	<u>AH*ABS*E</u>	F*ED*CF	7.0
	BW*AT		•
Cs - Concentration in soil =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm²/day	3000	calculated
SA_t - Total skin surface area =	cm²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm²	0.038	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS_s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	30	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk	
Semivolatiles								
Benzo(a)anthracene	8.10E-01	3.25E-09	NA	NA	1.16E-09	1.46E+00	Cancer Risk +00 1.70E-09 +01 6.07E-09 +00 7.75E-10 -01 3.35E-11 NA -02 1.28E-11 +01 2.30E-10	
Benzo(a)pyrene	2.90E-01	1.16E-09	NA	NA	4.16E-10	1.46E+01	6.07E-09	
Benzo(b)fluoranthene	3.70E-01	1.49E-09	NA	NA	5.31E-10	1.46E+00	7.75E-10	
Benzo(k)fluoranthene	1.60E-01	6.43E-10	NA	NA	2.29E-10	1.46E-01	3.35E-11	
Carbazole	4.90E-01	6.56E-09	NA	NA	2.34E-09	NA	NA	
Chrysene	6.10E-01	2.45E-09	NA	NA	8.75E-10	1.46E-02	1.28E-11	
Dibenz(a,h)anthracene	1.10E-02	4.42E-11	NA	NA	1.58E-11	1.46E+01	2.30E-10	
Indeno(1,2,3-cd)pyrene	9.40E-02	3.77E-10	NA	NA	1.35E-10	1.46E+00	1.97E-10	
Naphthalene	4.00E-01	5.35E-09	1.00E-02	5.35E-07	1.91E-09	NA	NA	

NA - Not Available

Total Hazard Index = 5.35E-07

Total Cancer Risk = 9.02E-09

Table 85
Oral Exposure to EU4 Surface Soil (0-6') by a Maintenance Worker
Preliminary Remediation Goal Calculation
Kerr McGee, Hattiesburg, MS

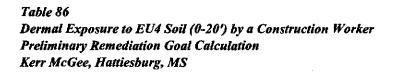
-	Intake (mg/kg-day) = <u>Cd*</u>	IngR*EF*ED*C	F*ME	
		BW*AT		
	Cd - Concentration in soil =	mg/kg	see below	
	lngR - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH
	EF - Exposure frequency =	days/year	30	reasonable assumption
	ED - Exposure duration =	years	25	USEPA 1995, Region IV
	CF - Conversion factor =	kg/mg	1.00E-06	
	ME - Matrix effect =		1	Magee, et al., 1996
	BW - Body weight =	kg	70	USEPA 1995, Region IV
	AT _n - Averaging time - noncarcinogenic =	days.	9125	USEPA 1991, HHEM
	AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	8.10E-01	9.51E-08	NA	NA	3.40E-08	7.30E-01	2.48E-08
Benzo(a)pyrene	2.90E-01	3.41E-08	NA	NA	1.22E-08	7.30E+00	8.88E-08
Benzo(b)fluoranthene	3.70E-01	4.34E-08	NA	NA	1.55E-08	7.30E-01	1.13E-08
Benzo(k)fluoranthene	1.60E-01	1.88E-08	NA	NA	6.71E-09	7.30E-02	4.90E-10
Carbazole	4.90E-01	5.75E-08	NA	NA	2.05E-08	2.00E-02	4.11E-10
Chrysene	6.10E-01	7.16E-08	NA	NA	2.56E-08	7.30E-03	1.87E-10
Dibenz(a,h)anthracene	1.10E-02	1.29E-09	NA	NA	4.61E-10	7.30E+00	3.37E-09
Indeno(1,2,3-cd)pyrene	9.40E-02	1.10E-08	NA .	NA	3.94E-09	7.30E-01	2.88E-09
Naphthalene	4.00E-01	4.70E-08	2.00E-02	2.35E-06	1.68E-08	NA	NA

NA - Not Applicable

Total Hazard Index = 2.35E-06

Total Cancer Risk = 1.32E-07





Intake (mg/kg-day) = Cs*SA*	AH*ABS*EF BW*AT	*ED*CF	
Cs - Concentration in soil = SA - Surface area available for exposure = SA ₁ - Total skin surface area = Fs - Fraction of skin surface area available for exposure = AH - Adherence factor = ABS _p - Absorption - cPAHs = ABS _c - Absorption - other SVOCs =	mg/kg cm²/day cm² mg/cm²	chem. spec 5560 20000 27.8% 0.1 0.03	calculated USEPA 1997, EFH USEPA 1997, EFH USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor = BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	days/year years kg/mg kg days days	80 1 1.00E-06 70 365 25550	reasonable assumption reasonable assumption USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	3.00E+01	1.57E-06	NA	NA.	2.24E-08	1.46E+00	3.27E-08
Benzo(a)pyrene	1.10E+01	5.74E-07	NA	NA	8.21E-09	1.46E+01	1.20E-07
Benzo(b)fluoranthene	1.70E+01	8.88E-07	NA	NA	1.27E-08	1.46E+00	1.85E-08
Benzo(k)fluoranthene	6.00E+00	3.13E-07	NA	NA	4.48E-09	1.46E-01	6.54E-10
Carbazole	2.40E+01	4.18E-06	NA	NA	5.97E-08	NA	NA
Chrysene	2.30E+01	1.20E-06	NA	NA	1.72E-08	1.46E-02	2.51E-10
Dibenz(a,h)anthracene	1.40E+00	7.31E-08	NA	NA	1.04E-09	1.46E+01	1.53E-08
Indeno(1,2,3-cd)pyrene	4.90E+00	2.56E-07	NA	NA	3.66E-09	1.46E+00	5.34E-09
Naphthalene	2.40E+02	4.18E-05	NA	NA	5.97E-07	NA	NA

NA - Not Available

Total Cancer Risk = 1.93E-07

Table 87

Oral Exposure to EU4 Soil (0-20') by a Construction Worker Preliminary Remediation Goal Calculation

Kerr McGee, Hattiesburg, MS

 			The state of the s
Intake (mg/kg-day) = <u>Cd</u>	*IngR*EF*ED*C BW*AT	F*ME	DEO-OPC
Cd - Concentration in soil =	mg/kg	see below	
lngR _a - lngestion rate for soil =	= mg/day	480	USEPA 1997, EFH
IngR _b - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH
EF _a - Exposure frequency =	days/yeaт	10	reasonable assumption
EF _b - Exposure frequency =	days/year	70	reasonable assumption
ED - Exposure duration *	= years	1	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	·
ME - Matrix effect =	•	1	Magee, et al., 1996
BW - Body weight =	kg -	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	- days	365	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	= days	25550	USEPA 1991, HHEM

Exposure Level A

Constituent	Concentration in Soil mg/kg_	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	3.00E+01	5.64E-06	NA	NA	8.05E-08	7.30E-01	5.88E-08
Benzo(a)pyrene	1.10E+01	2.07E-06	NA	NA	2.95E-08	7.30E+00	2.16E-07
Benzo(b)fluoranthene	1.70E+01	3.19E-06	NA	NA	4.56E-08	7.30E-01	3.33E-08
Benzo(k)fluoranthene	6.00E+00	1.13E-06	NA	NA	1.61E-08	7.30E-02	1.18E-09
Carbazole	2.40E+01	4.51E-06	NA	NA:	6.44E-08	2.00E-02	1.29E-09
Chrysene	2.30E+01	4.32E-06	NA	NA	6.17E-08	7.30E-03	4.51E-10
Dibenz(a,h)anthracene	1.40E+00	2.63E-07	NA	NA	3.76E-09	7.30E+00	2.74E-08
Indeno(1,2,3-cd)pyrene	4.90E+00	9.21E-07	NA	NA	1.32E-08	7.30E-01	9.60E-09
Naphthalene	2.40E+02	4.51E-05	NA	NA	6.44E-07	NA	NA

NA - Not Available

Cancer Risk = 3.48E-07

Exposure Level B

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles				. <u></u>			
Benzo(a)anthracene	3.00E+01	8.22E-06	NA	NA	1.17E-07	7.30E-01	8.57E-08
Benzo(a)pyrene	1.10E+01	3.01E-06	NA	NA	4.31E-08	7.30E+00	3.14E-07
Benzo(b)fluoranthene	1.70E+01	4.66E-06	NA	NA	6.65E-08	7.30E-01	4.86E-08
Benzo(k)fluoranthene	6.00E+00	1.64E-06	NA	NA	2.35E-08	7.30E-02	1.71E-09
Carbazole	2.40E+01	6.58E-06	NA	NA	9.39E-08	2.00E-02	1.88E-09
Chrysene	2.30E+01	6.30E-06	NA	NA	9.00E-08	7.30E-03	6.57E-10
Dibenz(a,h)anthracene	1.40E+00	3.84E-07	NA	NA	5.48E-09	7.30E+00	4.00E-08
Indeno(1,2,3-cd)pyrene	4.90E+00	1.34E-06	NA	NA	1.92E-08	7.30E-01	1.40E-08
Naphthalene	2.40E+02	6.58E-05	NA	NA	9.39E-07	NA	NA

NA - Not Available

Cancer Risk = 5.07E-07

Total Cancer Risk = 8.54E-07

Table 88

Exposure to Construction Workers from Inhalation of Fugitive Dust in EU4 Preliminary Remediation Goal Calculation

Property of

APR - 4 2001

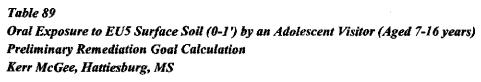
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Kerr McGee, Hattiesburg, MS

Intal	Intake (mg/kg-day) =		Ca*InhR*EF*ED*RF BW*AT	D*RF					
Ca - Concentration in air = InhR - Inhalation Rate = EF - Exposure Frequency = ED - Exposure Duration = RF _s - Retention Factor - semivolatiles = AT _n - Averaging Time noncarcinogenic = AT _c - Averaging Time carcinogenic = BW - Body Weight = E _i - Emission Rate (mg/sec) = Cs - Concentration in soil =	Ca - Concentration in air = mg/m³ see b InhR - Inhalation Rate = m³/shift 20 EF - Exposure Frequency = shifts/year 80 ED - Exposure Duration = years 1 antion Factor - semivolatiles = 0.75 ging Time noncarcinogenic = days 365 veraging Time carcinogenic = days 2555 BW - Body Weight = kg 70 E; - Emission Rate (mg/sec) = Cs*(PERv+PERe) Cs - Concentration in soil = mg/kg see b	mg/m³ m³/shift shifts/year years days days kg Cs*(PERv+1	see below 20 80 1 0.75 365 25550 70 PERe)	USEPA 1995, Region IV reasonable assumption reasonable assumption ICRP, 1968 USEPA 1991, HHEM USEPA 1991, HHEM USEPA 1991, RHEM	Ei - Emi	Concentration Rate of Com Hb - D V - Win r - We r - Re z - downw * Ln(Hb/r) -	Ca = Concentration in Air (mg/m³) = Ei / (Hb * W * V) Ei - Emission Rate of Component (mg/sec) = see below Hb - Downwind Ht (m) = 4.81 W - Width (m) = 50 V - Wind speed (m/sec) = 4.69 Length (downwind distance) (m) = 50 r - Roughness Ht. (m) = 0.20 z - downwind distance (m) = 50 z - downwind distance (m) = 50 z - downwind distance (m) = 50	Ei / (Hb * W * V see below 4.81 50 4.69 50 50 50 50 50 50 50 50 50 50 50 50 50	
Chemicals	Concentration in Soil mg/kg	Emission Rate mg/sec	Concentration in Air mg/m³	Average Daily Intake mg/kg-day	Inhalation Subchronic RfD mg/kg-day	Hazard	Average Lifetime Daily Intake mg/kg-day	Inhalation Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles									
Benzo(a)anthracene Benzo(a)ovrene	3.00E+01 1.10E+01	3.28E-02 1.20E-02	2.91E-05 1.07E-05	1.37E-06 5.01E-07	₹ ₹ ₹	A N	1.95E-08 7.16E-09	3.10E-01	6.05E-09
Benzo(b)fluoranthene	1.70E+01	1.86E-02		7.75E-07	NA	Y Y	1.11E-08	3.10E-01	3.43E-09
Benzo(k)fluoranthene	6.00E+00	6.56E-03	5.82E-06	2.73E-07	NA	NA	3.91E-09	3.10E-02	1.21E-10
Carbazole	2.40E+01	2.62E-02	2.33E-05	1.09E-06	NA	NA	1.56E-08	ΝΑ	A N
Chrysene	2.30E+01	2.51E-02	2.23E-05	1.05E-06	NA	NA	1.50E-08	3.10E-03	4.64E-11
Dibenz(a,h)anthracene	1.40E+00	1.53E-03	1.36E-06	6.38E-08	NA	NA.	9.11E-10	3.10E+00	2.83E-09
Indeno(1,2,3-cd)pyrene	4.90E+00	5.36E-03	4.75E-06	2.23E-07	NA	Ϋ́N	3.19E-09	3.10E-01	9.89E-10
Naphthalene	2.40E+02	2.62E-01	2.33E-04	1.09E-05	NA	NA	1.56E-07	NA	NA VA
	:								_

Total Cancer Risk: 3.57E-08





	BW*AT		
Cd - Concentration in sediment =	mg/kg	see below	
IngR - Ingestion rate for soil =	mg/day	100	USEPA 1997, EFH
EF - Exposure frequency =	days/year	12	reasonable assumption
ED - Exposure duration =	years	10	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
ME - Matrix effect =		1	Magee, et al., 1996
BW - Body weight =	kg	45	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	3650	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		_					<u>.</u>
Benzo(a)anthracene	2.90E-01	2.12E-08	NA	NA	3.03E-09	7.30E-01	2.21E-09
Benzo(a)pyrene	3.70E-01	2.70E-08	NA	NA	3.86E-09	7.30E+00	2.82E-08
Benzo(b)fluoranthene	7.60E-01	5.55E-08	NA	NA	7.93E-09	7.30E-01	5.79E-09
Benzo(k)fluoranthene	4.60E-01	3.36E-08	NA	NA	4.80E-09	7.30E-02	3.50E-10
Chrysene	3.70E-01	2.70E-08	NA	NA	3.86E-09	7.30E-03	2.82E-11
Dibenz(a,h)anthracene	6.60E-02	4.82E-09	NA	NA	6.89E-10	7.30E+00	5.03E-09
Indeno(1,2,3-cd)pyrene	2.90E-01	2.12E-08	NA	NA	3.03E-09	7.30E-01	2.21E-09

NA - Not Available Total Cancer Risk = 4.38E-08

Table 90

Dermal Exposure to EU5 Surface Soil (0-6') by a Maintenance Worker

Preliminary Remediation Goal Calculation

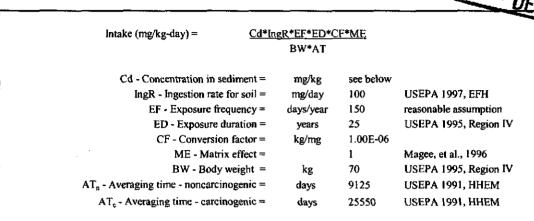
Kerr McGee, Hattiesburg, MS

Intake (mg/kg-day) = $\underline{\text{Cs*SA*}}$	AH*ABS*EF BW*AT	**ED*CF	
Cs - Concentration in soil =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm²/day	3000	calculated
SA _t - Total skin surface area =	cm ²	20000	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		15%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.038	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
EF - Exposure frequency =	days/year	150	reasonable assumption
ED - Exposure duration =	years	25	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	70	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	9125	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Solt mg/kg	Average Daily Intake mg/kg-day	Dermat Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.54E-02	1.91E-09	NA	NA	6.84E-10	1.46E+00	9.98E-10
Benzo(a)pyrene	1.18E-01	2.36E-09	NA	NA	8.43E-10	1.46E+01	1.23E-08
Benzo(b)fluoranthene	2.90E-01	5.82E-09	NA	NA	2.08E-09	1.46E+00	3.03E-09
Benzo(k)fluoranthene	1.55E-01	3.10E-09	NA	NA	1.11E-09	1.46E-01	1.62E-10
Chrysene	1.50E-01	3.01E-09	NA	NA	1.07E-09	1.46E-02	1.57E-11
Dibenz(a,h)anthracene	4.40E-02	8.83E-10	NA	NA	3.15E-10	1.46E+01	4.60E-09
Indeno(1,2,3-cd)pyrene	9.13E-02	1.83E-09	NA	NA	6.54E-10	1.46E+00	9.55E-10

NA - Not Available Total Cancer Risk = 2.21E-08

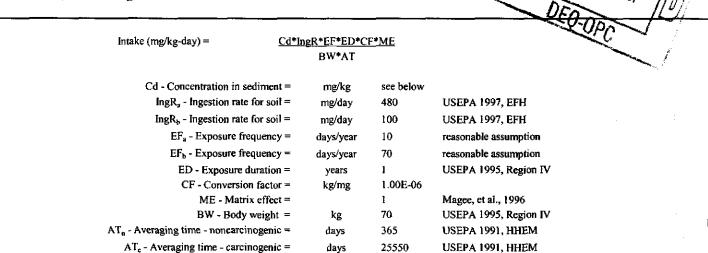
Table 91
Oral Exposure to EU5 Surface Soil (0-6') by a Maintenance Worker
Preliminary Remediation Goal Calculation
Kerr McGee, Hattiesburg, MS



Constituent	Concentration in Soil mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	9.54E-02	5.60E-08	NA	NA	2.00E-08	7.30E-01	1.46E-08
Benzo(a)pyrene	1.18E-01	6.91E-08	NA	NA	2.47E-08	7.30E+00	1.80E-07
Benzo(b)fluoranthene	2.90E-01	1.70E-07	NA	NA	6.08E-08	7.30E-01	4.44E-08
Benzo(k)fluoranthene	1.55E-01	9.08E-08	NA	NA	3.24E-08	7.30E-02	2.37E-09
Chrysene	1.50E-01	8.79E-08	NA	NA	3.14E-08	7.30E-03	2.29E-10
Dibenz(a,h)anthracene	4.40E-02	2.58E-08	NA	NA	9.22E-09	7.30E+00	6.73E-08
Indeno(1,2,3-cd)pyrene	9.13E-02	5.36E-08	NA	NA	1.91E-08	7.30E-01	1.40E-08

NA - Not Available Total Cancer Risk = 3.23E-07

Table 92 ral Exposure to EU5 Soil (0-20') by a Construction Worker Preliminary Remediation Goal Calculation Kerr McGee, Hattiesburg, MS



<u>Exposur</u>	e	Leve	ŀΑ

	Concentration in Soil	Average Daily Intake	Oral Chronic RfD	Hazard	Average Lifetime Daily Intake	Factor	
Constituent	mg/kg	mg/kg-day	mg/kg-day	Index _	mg/kg-day	1/(mg/kg-day)	Cancer Risk
Semivolatiles							
Benzo(a)anthracene	1.93E-01	3.62E-08	NA	NA	5.18E-10	7.30E-01	3.78E-10
nzo(a)pyrene	1.91E-01	3.59E-08	NA	NA	5.13E-10	7.30E+00	3.74E-09
enzo(b)fluoranthene	3.89E-01	7.30E-08	NA	NA	1.04E-09	7.30E-01	7.61E-10
Benzo(k)fluoranthene	1.90E-01	3.58E-08	NA	NA	5.11E-10	7.30E-02	3.73E-11
Chrysene	2.64E-01	4.95E-08	NA	NA	7.07E-10	7.30E-03	5.16E-12
Dibenz(a,h)anthracene	5.15E-02	9.68E-09	NA	NA	1.38E-10	7.30E+00	1.01E-09
Indeno(1,2,3-cd)pyrene	1.30E-01	2.45E-08	NA	NA	3.50E-10	7.30E-01	2.56E-10

Exposure Level B

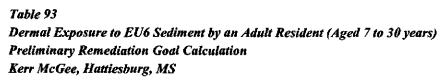
NA - Not Available

	Concentration in	Average Daily	Oral Chronic		Average Lifetime Dall	•	
	Soil	Inta ke	RM	Hazard	Intake	Factor	
Constituent	mg/kg	mg/kg-day	mg/kg-day	Index	mg/kg-day	1/(mg/kg-day)	Cancer Risi
Semivolatiles			-				
Benzo(a)anthracene	1.93E-01	5.28E-08	NA	NA	7.55E-10	7.30E-01	5.51E-10
Benzo(a)pyrene	1.91E-01	5.23E-08	NA	NA	7.47E-10	7.30E+00	5.46E-09
Benzo(b)fluoranthene	3.89E-01	1.06E-07	NA	NA	1.52E-09	7.30E-01	1.11E-09
Benzo(k)fluoranthene	1.90E-01	5.22E-08	NA	NA	7.45E-10	7.30E-02	5.44E-11
Chrysene	2.64E-01	7.22E-08	NA	NA	1.03E-09	7.30E-03	7.53E-12
Dibenz(a,h)anthracene	5.15E-02	1.41E-08	NA	NA	2.02E-10	7.30E+00	1.47E-09
Indeno(1,2,3-cd)pyrene	1.30E-01	3.57E-08	NA	NA	5.11E-10	7.30E-01	3.73E-10
NA - Not Available			-	 -		Cancer Risk =	9.02E-09

Total Cancer Risk = 1.52E-08

Cancer Risk =

6.19E-09

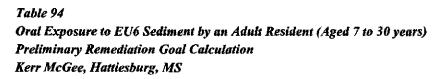


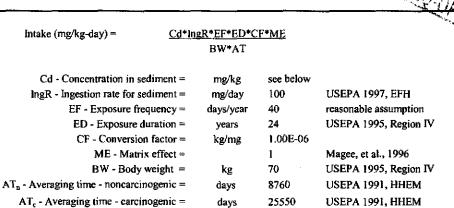


Intake (mg/kg-day) = $Cs*SA*$	AH*ABS*EI BW*AT	F*ED*CF	
$Cs - Concentration in sediment = \\ SA - Surface area available for exposure = \\ SA_t - Total skin surface area = \\ Fs - Fraction of skin surface area available for exposure = \\ AH - Adherence factor = \\ ABS_p - Absorption - cPAHs = \\ ABS_s - Absorption - other SVOCs = \\ ABS_s - ABS_s $	mg/kg cm²/day cm² mg/cm²	chem. spec. 6180 20000 30.9% 0.33 0.03	calculated USEPA 1997, EFH USEPA 1997, EFH USEPA 1997, EFH USEPA 1995, Region III USEPA 1995, Region III
EF - Exposure frequency = ED - Exposure duration = CF - Conversion factor = BW - Body weight = AT _n - Averaging time - noncarcinogenic = AT _c - Averaging time - carcinogenic =	days/year years kg/mg kg days days	40 24 1.00E-06 70 8760 25550	reasonable assumption USEPA 1995, Region IV USEPA 1995, Region IV USEPA 1991, HHEM USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles							
2-Nitroaniline	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	NA
2-Nitrophenol	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
3-Nitroaniline	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
4-Bromophenylphenylether	8.40E-02	2.68E-08	NA	NA	9.20E-09.	NA	NA
4-Chloro-3-methylphenol	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
4-Chlorophenylphenylether	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	NA
4-Nitroaniline	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
Benzo(a)anthracene	9.30E-01	8.91E-08	NA	NA	3.05E-08	1.46E+00	4.46E-08
Вепго(а)ругепе	9.70E-01	9.29E-08	NA	NA	3.19E-08	1.46E+01	4.65E-07
Велzo(b)fluoranthene	1.40E+00	1.34E-07	NA	NA	4.60E-08	1.46E+00	6.71E-08
Benzo(k)fluroanthene	5.00E-01	4.79E-08	NA	NA	1.64E-08	1.46E-01	2.40E-09
Bis(2-chloroethoxy)methane	8.40E-02	2.68E-08	NA	NA	9.20E-09	NA	NA
Bis(2-chloroethyl)ether	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	NA
Carbazole	2.20E-01	7.02E-08	NA	NA	2.41E-08	NA	NA
Chrysene	1.30E+00	1.25E-07	NA	NA	4.27E-08	1.46E-02	6.23E-10
Dibenz(a,h)anthracene	1.50E-01	1.44E-08	NA	NA	4.93E-09	1.46E+01	7.19E-08
Hexachlorobenzene	4.20E-02	1.34E-08	4.00E-04	3.35E-05	4.60E-09	NA	NA
Hexachlorocyclopentadiene	2.10E-01	6.70E-08	3.50E-03	1.92E-05	2.30E-08	NA	· NA
Indeno(1,2,3-cd)pyrene	5.40E-01	5.17E-08	NA	NA	1.77E-08	1.46E+00	2.59E-08
N-nitrosodi-n-propylamine	4.20E-02	1.34E-08	NA	NA	4.60E-09	NA	NA

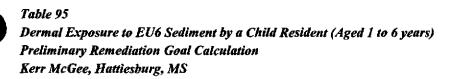
NA - Not Available Total Hazard Index = 5.27E-05 Total Cancer Risk = 6.78E-07

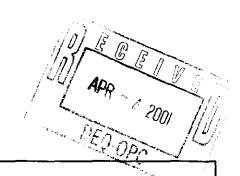




Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Chronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		- 					
2-Nitroaniline	4.20E-02	6.58E-09	NA	NA	2.25E-09	NA	NA
2-Nitrophenol	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
3-Nitroaniline	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
4-Bromophenylphenylether	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
4-Chloro-3-methylphenol	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
4-Chlorophenylphenylether	4.20E-02	6.58E-09	NA	NA	2.25E-09	NA	NA
4-Nitroaniline	8.40E-02	1.32E-08	NA ·	NA	4.51E-09	NA	NA
Benzo(a)anthracene	9.30E-01	1.46E-07	NA	NA	4.99E-08	7.30E-01	3.64E-08
Benzo(a)pyrene	9.70E-01	1.52E-07	NA	NA	5.21E-08	7.30E+00	3.80E-07
Benzo(b)fluoranthene	1.40E+00	2.19E-07	NA	NA	7.51E-08	7.30E-01	5.49E-08
Benzo(k)fluroanthene	5.00E-01	7.83E-08	NA	NA	2.68E-08	7.30E-02	1.96E-09
Bis(2-chloroethoxy)methane	8.40E-02	1.32E-08	NA	NA	4.51E-09	NA	NA
Bis(2-chloroethyl)ether	4.20E-02	6.58E-09	NA	NA	2.25E-09	1.10E+00	2.48E-09
Carbazole	2.20E-01	3.44E-08	NA	NA	1.18E-08	2.00E-02	2.36E-10
Chrysene	1.30E+00	2.04E-07	NA	NA	6.98E-08	7.30E-03	5.09E-10
Dibenz(a,h)anthracene	1.50E-01	2.35E-08	NA	NA	8.05E-09	7.30E+00	5.88E-08
Hexachlorobenzene	4.20E-02	6.58E-09	8.00E-04	8.22E-06	2.25E-09	1.60E+00	3.61E-09
Hexachlorocyclopentadiene	2.10E-01	3.29E-08	7.00E-03	4.70E-06	1.13E-08	NA ·	NA
Indeno(1,2,3-cd)pyrene	5.40E-01	8.45E-08	NA	NA	2.90E-08	7.30E-01	2.12E-08
N-nitrosodi-n-propylamine	4.20E-02	6.58E-09	NA	NA	2.25E-09	7.00E+00	1.58E-08

NA - Not Available Total Hazard Index = 1.29E-05 Total Cancer Risk = 5.76E-07

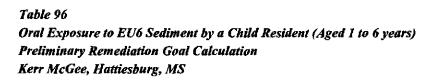


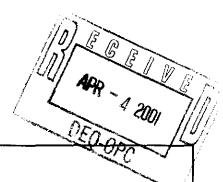


Intake (mg/kg-day) = $\underline{Cs*SA*}$	AH*ABS*EF	*ED* <u>CF</u>	
	BW*AT		
Cs - Concentration in sediment =	mg/kg	chem. spec.	
SA - Surface area available for exposure =	cm²/day	2229	calculated
SA ₁ - Total skin surface area =	cm ²	7213	USEPA 1997, EFH
Fs - Fraction of skin surface area available for exposure =		30.9%	USEPA 1997, EFH
AH - Adherence factor =	mg/cm ²	0.33	USEPA 1997, EFH
ABS_p - Absorption - cPAHs =		0.03	USEPA 1995, Region III
ABS _s - Absorption - other SVOCs =		0.1	USEPA 1995, Region III
EF - Exposure frequency =	days/year	40	reasonable assumption
ED - Exposure duration =	years	6	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
BW - Body weight =	kg	15	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	2190	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Dermal Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles		_			· · · · · · · · · · · · · · · · · · ·		-
2-Nitroaniline	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA	NA
2-Nitrophenol	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
3-Nitroaniline	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
4-Bromophenylphenylether	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
4-Chloro-3-methylphenol	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
4-Chlorophenylphenylether	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA :	NA
4-Nitroaniline	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
Benzo(a)anthracene	9.30E-01	1.50E-07	NA.	NA	1.29E-08	1.46E+00	1.88E-08
Benzo(a)pyrene	9.70E-01	1.56E-07	NA	NA	1.34E-08	1.46E+01	1.96E-07
Benzo(b)fluoranthene	1.40E+00	2.26E-07	NA	NA	1.93E-08	1.46E+00	2.82E-08
Benzo(k)fluroanthene	5.00E-01	8.06E-08	NA	NA	6.91E-09	1.46E-01	1.01E-09
Bis(2-chloroethoxy)methane	8.40E-02	4.51E-08	NA	NA	3.87E-09	NA	NA
Bis(2-chloroethyl)ether	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA	NA
Carbazole	2.20E-01	1.18E-07	NA	NA	1.01E-08	NA	NA
Chrysene	1.30E+00	2.10E-07	NA	NA	1.80E-08	1.46E-02	2.62E-10
Dibenz(a,h)anthracene	1.50E-01	2.42E-08	NA	NA	2.07E-09	1.46E+01	3.03E-08
Hexachlorobenzene	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA	NA
Hexachlorocyclopentadiene	2.10E-01	1.13E-07	NA	NA	9.67E-09	NA	NA
Indeno(1,2,3-cd)pyrene	5.40E-01	8.71E-08	NA	NA	7.46E-09	1.46E+00	1.09E-08
N-nitrosodi-n-propylamine	4.20E-02	2.26E-08	NA	NA	1.93E-09	NA	NA

NA - Not Available Total Cancer Risk = 2.85E-07





Intake (mg/kg-day) = <u>Cd*ln</u>	gR*EF*ED*C	F*ME	
	BW*AT		
Cd - Concentration in sediment = IngR - Ingestion rate for sediment =	mg/kg mg/đay	see below	USEPA 1997, EFH
EF - Exposure frequency =	days/year	40	reasonable assumption
ED - Exposure duration =	years	6	USEPA 1995, Region IV
CF - Conversion factor =	kg/mg	1.00E-06	
ME - Matrix effect =		1	Magee, et al., 1996
BW - Body weight =	kg	15	USEPA 1995, Region IV
AT _n - Averaging time - noncarcinogenic =	days	2190	USEPA 1991, HHEM
AT _c - Averaging time - carcinogenic =	days	25550	USEPA 1991, HHEM

Constituent	Concentration in Sediment mg/kg	Average Daily Intake mg/kg-day	Oral Subchronic RfD mg/kg-day	Hazard Index	Average Lifetime Daily Intake mg/kg-day	Oral Cancer Slope Factor 1/(mg/kg-day)	Cancer Risk
Semivolatiles						· · · · · · · · · · · · · · · · · · ·	
2-Nitroaniline	4-20E-02	6.14E-08	NA	NA	5.26E-09	NA	NA
2-Nitrophenol	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
3-Nitroaniline	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
4-Bromophenylphenylether	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
4-Chloro-3-methylphenol	8.40E-02	1.23E-07	NA -	NA	1.05E-08	NA	NA
4-Chlorophenylphenylether	4.20E-02	6.14E-08	NA	NA	5.26E-09	NA	NA
4-Nitroaniline	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
Benzo(a)anthracene	9.30E-01	1.36E-06	NA	NA	1.16E-07	7.30E-01	8.50E-08
Benzo(a)pyrene	9.70E-01	1.42E-06	NA	NA	1.21E-07	7.30E+00	8.87E-07
Benzo(b)fluoranthene	1.40E+00	2.05E-06	NA	NA	1.75E-07	7.30E-01	1.28E-07
Benzo(k)fluroanthene	5.00E-01	7.31E-07	NA	NA	6.26E-08	7.30E-02	4.57E-09
Bis(2-chloroethoxy)methane	8.40E-02	1.23E-07	NA	NA	1.05E-08	NA	NA
Bis(2-chloroethyl)ether	4.20E-02	6.14E-08	NA	NA	5.26E-09	1.10E+00	5.79E-09
Carbazole	2.20E-01	3.21E-07	NA	NA	2.76E-08	2.00E-02	5.51E-10
Chrysene	1.30E+00	1.90E-06	NA	NA	1.63E-07	7.30E-03	1.19E-09
Dibenz(a,h)anthracene	1.50E-01	2.19E-07	NA	NA	1.88E-08	7.30E+00	1.37E-07
Hexachlorobenzene	4.20E-02	6.14E-08	NA	NA	5.26E-09	1.60E+00	8.42E-09
Hexachlorocyclopentadiene	2.10E-01	3.07E-07	NA	NA	2.63E-08	NA	NA
Indeno(1,2,3-cd)pyrene	5.40E-01	7.89E-07	NA	NA	6.76E-08	7.30E-01	4.94E-08
N-nitrosodi-n-propylamine	4.20E-02	6.14E-08	NA	NA	5.26E-09	7.00E+00	3.68E-08

NA - Not Available Total Cancer Risk = 1.34E-06

kkoerber@envstd.com on 04/03/2001 09:09:51 AM



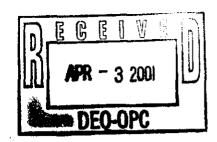
To:

Gretchen Zmitrovich@deq.state.ms.us

cc:

m.pisani@ix.netcom.com

Subject: RE: gulf states risk assessment



FILE COPY

Gretchen:

Attached is the text for the Hattiesburg Risk Assessment revised per your verbal comments from March 21. The revisions have been marked for ease of review and are limited to the Executive Summary, Section 6.8, and Section 8.0. Our conclusions and remediation plans do not change as a result of the revisions.

Hard copies of the revised tables are being sent to you for Wednesday AM delivery.

< <8Hattiesburg.doc > >

Thank you for your thorough review and we look forward to your approval of this report.

Kind regards,
Kathy Koerber
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----Original Message----

From: Gretchen_Zmitrovich@deq.state.ms.us [SMTP:Gretchen_Zmitrovich@deq.state.ms.us]

Sent: Wednesday, March 21, 2001 10:44 AM

To: kkoerber@envstd.com

Subject: g

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gulf states risk assessment

(See attached file: Gulf State risk assessment.xls)(See attached file: Gulf State Creosote data.xls) << File: Gulf State risk assessment.xls >> << File: Gulf State Creosote data.xls >>



- 8Hattiesburg.doc

HUMAN HEALTH RISK ASSESSMENT FOR THE FORMER GULF STATES CREOSOTING FACILITY, HATTIESBURG, MISSISSIPPI

March 1, 2001 April 3, 2001

Prepared for:

KERR-MCGEE CHEMICAL LLC

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Prepared by:

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Table of Contents

			<u>Page</u>	2
Exe	cutiv	e Summ	es-1	ί
1.0	Intr	oduction	n1-1	l
2.0	Haz	ard Ide	ntification and Conceptual Site Model2-1	L
3.0	Data	a Evalua	ation3-1	Ĺ
	3.1	Exposu	re Unit Delineation	
		3.1.1	Exposure Unit 1	Į.
		3.1.2	Exposure Unit 2	<u>.</u>
		3.1.3	Exposure Unit 3	Ļ
		3.1.4	Exposure Unit 4	ŀ
		3.1.5	Exposure Unit 5	-
		3.1.6	Exposure Unit 6	į
	3.2	Statistic	cal Evaluation3-6	j
	3.3	Determ	ination of Exposure-Point Concentrations	ļ
	3.4	COPC	Selection3-9	,
4.0	Exp	osure A	ssessment4-1	
	4.1	Recepto	or Identification4-1	
		4.1.1	Infrequent Site Visitor4-2	ļ
		4.1.2	Maintenance Worker4-3	i
		4.1.3	Construction Worker4-3	i
		4.1.4	Future On-Site Residents 4-4	ŀ
		4.1.5	Off-Site Residential Exposures4-4	۲
	4.2	Genera	l Intake Equation4-4	٢
		4.2.1	General Exposure Parameters4-5	i
		4.2	1.1.1 Exposure Frequency	į
		4.2	1.1.2 Exposure Duration4-8	;
		4.2	1.1.3 Averaging Time	ř

Table of Contents (Cont.)

				<u>Page</u>
		4.2.1.4	Body Weight	4-9
		4.2.2 Rout	te-Specific Exposure Parameters	4-9
		4.2.2.1	Dermal Exposure Parameters	4-10
		4.2.2.2	Ingestion Exposure Parameters	4-17
		4.2.2.3	Inhalation Exposure Parameters and Paradigms	4- <u>19</u> 18
5.0	Tox	icity Assessm	ent	5-1
6.0	Risl	k Characteriza	ation	6-1
7.0	Uno	ertainty Anal	ysis	7-1
	7.1	Uncertainty of	of Data Evaluation Factors	7-1
	7.2	Uncertainty of	of Toxicity Values	7-2
	7.3	Uncertainties	in Assessing Potential Exposure	7-3
8.0	Sun	amary of Find	lings	8-1

Bibliography

Figures

Tables

Executive Summary

A baseline human health risk assessment (HHRA) was conducted for the Former Gulf States Creosoting facility in Hattiesburg, Mississippi. The HHRA was performed in accordance with: Mississippi Commission on Environmental Quality's (MCEQ's) Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999); US EPA's Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (1989); US EPA Region 4 guidance entitled Technical Services Supplemental Guidance to RAGS, Region 4 Bulletins (1995); and other relevant US EPA guidance documents.

Creosoting constituents of potential health concern include polycyclic aromatic hydrocarbons (PAHs), of which benzo(a)pyrene is the predominant contributor to potential risks. Much of the former creosoting process area is currently covered with asphalt or large building structures. Potential future exposure scenarios included a construction worker, a maintenance worker, an infrequent Site visitor, and off-Site residents. Media of concern included soils, sediment, and surface water.

Hazards posed by chemical constituents in soils, sediment, and surface water for health effects other than an increased risk of cancer were well below a threshold of possible concern for each receptor evaluated in this risk assessment. Cancer risks for all exposure scenarios were within or below the US EPA's acceptable target risk range of 1×10^{-6} to 1×10^{-4} (i.e., one in one million to one in ten thousand) with the exception of maintenance worker exposure to soils in EU4 and off-site resident exposure to sediments in EU6. The added lifetime cancer risk conservatively estimated for a maintenance worker was $1 + 4 \times 10^{-34}$ for the entire Site, while that for the off-site resident was 2×10^{-4} for the entire Site. The potential risk for a construction worker was estimated to be 5×10^{-5} for the entire Site. The estimated potential risk for an adolescent Site visitor was $2 - 7 \times 10^{-5}$ for the entire Site. For the Site visitor, maintenance worker, and construction worker scenarios, oral contact with benzo(a)pyrenecarcinogenic PAHs in sediment and soils drove the cancer risk level. For the off-Site resident scenario, oral contact with benzo(a)pyrenecarcinogenic PAHs in sediment drove the cancer risk level.

Risk levels are mainly attributable to residual concentrations of carcinogenic polycyclic aromatic hydrocarbons (cPAH) in EUs 4, 5, and 6. Remedial actions currently planned for these areas, including deed restrictions, will result in incomplete exposure pathways thereby resulting in acceptable levels of risks to potential receptors. Proposed remediation activities to address impacted media in EUs 4, 5, and 6 include the following:

- Conduct in-situ biological treatment of impacted soils in the unpaved area between the former Process Area and the Southern railroad tracks (EU4);
- Attempt to recover free product from targeted areas within the former Process Area to address continuing sources (EU5);

- Remove impacted sediments from the northeast drainage ditch and install a culvert to provide for surface drainage (EU6);
- Establish deed restrictions limiting the use of property to non-residential (i.e., "restricted") purposes (EU4 and EU5); and
- Include in the deed restrictions provisions for maintaining pavement to preclude contact with impacted media left in place (EU5).

Constituent concentrations in surface soils at two isolated locations within EU2 also resulted in maintenance worker risk levels slightly greater than 1×10^{-6} . Because these locations are within a densely wooded area where no maintenance activities currently occur and remediation would require significant clearing, no remediation activities are planned to address surface soils at these locations. Deed restrictions limiting the use of properties within EU2 to non-residential purposes will be established.

1.0 Introduction

Environmental Standards, Inc. (Environmental Standards) was retained by Kerr-McGee Chemical Corporation (Kerr-McGee) to perform a human health risk assessment (HHRA) to evaluate hazards and risks potentially posed by residual levels of chemicals present at the Former Gulf States Creosoting facility (Site). The Site, located near the intersection of US Highways 49 and 11 in Hattiesburg, Mississippi, was formerly a wood treating facility that operated between the early 1900s and 1960. In the early 1960s, the Site was redeveloped for commercial and light industrial uses (Michael Pisani & Assoc., 1997). The land on which the Site is located is a portion of the Sixteenth Section land owned by the Hattiesburg Public School District and leased to the current tenants under a 99-year lease, granted on July 7, 1947. At the time of this report, the Site, with the exception of the grassy and wooded areas in the south and southwest, respectively, was primarily used for automobile dealerships. There are no residential or institutional (i.e., schools) uses of the Site (Michael Pisani & Assoc., 1997).

Operations at the Site consisted of a small-scale wood preserving process using creosote. The creosoting process was primarily confined to a 2.5-acre area in the northeast corner of the Site; this is known as the former Process Area and is currently occupied by Courtesy Ford. During the redevelopment of the Site in the early 1960s, construction debris (e.g., broken concrete, asphalt, etc.) appears to have been relocated to the southwestern corner of the Site along Gordon's Creek. This area is known as the Fill Area and currently remains undeveloped.

This assessment has been conducted as a result of an agreement between Kerr-McGee, the Mississippi Department of Environmental Quality (MDEQ), and the Mississippi Commission on Environmental Quality (MCEQ) pursuant to the Uncontrolled Site Voluntary Evaluation Program. The MDEQ Office of Pollution Control, Uncontrolled Sites Section has been providing oversight and review of investigations and reports relating to the former Gulf States Creosoting facility.

This report will address the potential for on-Site exposures to human receptors and off-Site exposures to humans along the northeast drainage ditch.

The primary guidance used to develop this risk assessment was the MCEQ Final Regulations Governing Brownfields Voluntary Cleanup and Redevelopment in Mississippi (1999). US EPA Region 4's Technical Services Supplemental Guidance to RAGS: Region 4 Bulletins (1995) were also referred to for guidance. Additional US EPA guidance documents cited herein include:

- Guidance for Remediation of Uncontrolled Hazardous Substance Sites in Mississippi (MDEQ, 1990);
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual/ Part A (RAGS/Part A) (US EPA, 1989);
- Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" (US EPA, 1991);
- Exposure Factors Handbook (US EPA, 1997);
- Guidelines for Exposure Assessment (US EPA 1992);
- Dermal Exposure Assessment: Principles and Applications (US EPA, 1992);

These documents are not listed in a hierarchical manner; other US EPA guidance documents and peer-reviewed technical papers may have also been referenced in this risk assessment report.

2.0 Hazard Identification and Conceptual Site Model

As a result of the historical wood preservation process, residual levels of creosote-related chemicals are present in soils in the former Process Area. Sediment and surface water in a drainage ditch along the southeast border of the former Process Area also contain chemical residuals. These Site-related chemicals, mostly polycyclic aromatic hydrocarbons (PAHs) are also present in the Fill Area. Residual levels of PAHs have been found in soil in the Fill Area and in Gordon's Creek surface water and sediment.

PAH residuals have also been detected in shallow groundwater underlying the Site. Currently, there are no private water wells located on-Site that access this shallow groundwater for potable purposes. The results of a door-to-door survey conducted by Michael Pisani and Associates on October 3, 2000 indicated no private uses of shallow groundwater downgradient of the Site. For these reasons, the groundwater exposure pathway, both on- and off-Site, was considered incomplete and not evaluated in this assessment.

A conceptual site model (CSM) was developed for the Site to aid in determining the potential receptors and exposure units to be evaluated under current and future potential land use (Figure 1). These receptors were identified as infrequent Site visitors, maintenance workers, construction workers, and off-Site residents.

Under current land use assumptions, Site visitors may potentially contact residual chemicals in Gordon's Creek surface water and sediment, and/or surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the drainage ditch along side of the former Process Area. Visitors may also potentially contact surface soil, surface water, and sediment along the former Process Area drainage ditch. The remaining affected areas of the Site are covered with either buildings or pavement precluding casual direct contact with surface soils. As a conservative measure, however, visitor exposure to soils from these paved areas was also assessed.

Under both current and future land use assumptions, a maintenance worker may contact surface soils in the Fill Area and surrounding woods, the grassy field southeast of the Fill Area, and/or the former Process Area and surrounding affected areas, including the drainage ditch located to the southeast of the former Process Area. Although most of the former Process Area and vicinity are paved, maintenance activities may involve some shallow digging; therefore, direct contact with shallow soils in this area was assessed. As a conservative measure, exposure to surface water and sediment in Gordon's Creek was assessed. The remainder of the Site was relatively unaffected by historical creosoting activities.

Although there are currently no major construction activities at the Site, these types of activities may occur at some time in the future. As with the maintenance worker scenario, construction activities could potentially occur in the Fill Area and vicinity, the grassy field southeast of the Fill Area, and the former Process Area and vicinity. Construction workers may be exposed to both surface and subsurface soils (down to the water table). Construction worker exposure to surface water and sediment in Gordon's Creek was assessed as a conservative measure. The remainder of the Site was relatively unaffected by historical creosoting activities.

Areas of the Site affected by historical creosoting activities will be deed restricted prohibiting future residential development. Off-Site areas along the northeast Drainage Ditch, currently a residential neighborhood, were assessed for residential exposures to soil, sediment, and surface water.

3.0 Data Evaluation

To characterize potential exposures to Site-related chemicals, the former Gulf States Creosoting facility was divided into six exposure units (EUs). Each exposure unit outlines potentially affected areas of the Site and adjacent on-Site locales that may be frequented by individuals accessing the Site for recreational or occupational purposes. The use of EUs is encouraged by the US EPA Region 4 (1995), which defines an EU as "an areal extent of a receptor's movements during a single day...." Each of these exposure units is depicted on Figure 2 and is discussed below.

A sixth EU was created for off-Site residential exposures to surface water and sediment along the northeast Drainage Ditch. This EU is delineated on Figure 3.

3.1 Exposure Unit Delineation

The following EUs were delineated based upon the presence of residual chemicals and the potential for receptors to contact those chemicals. Areas of the Site most affected were included in at least one of the five EUs while areas with relatively low or non-detectable concentrations of residuals were not included in an EU. By limiting Site-wide exposures to the EUs most affected by historical activities at the Site, worst-case scenarios were created.

3.1.1 Exposure Unit 1

EU1 outlines the on-Site areas in, adjacent to, and downstream of the Fill Area along Gordon's Creek (Figure 2). EU1 includes exposures to surface water and sediment by an infrequent Site visitor, future maintenance worker, and future construction worker. Although US EPA Region IV guidance indicates that "In most cases it is unnecessary to evaluate human exposures to sediments covered by surface water," (US EPA, 1995) dermal and oral surface water exposures were conservatively assessed herein at the request of the MDEQ (2000). Sediment samples included in EU 1 were SD07 and SD08. Surface water samples included in were SW-07 and SW-08.

Soil samples from this area were considered part of EU2 and exposures were assessed accordingly.

3.1.2 Exposure Unit 2

EU2 delineates the upland areas of the Fill Area and adjacent woody and grassy areas (Figure 2). Surface soils from zero to one foot and zero to six feet below ground surface [bgs] in this area were evaluated for potential visitor and future hypothetical maintenance worker scenarios, respectively. Surface and subsurface soils were also evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table (approximately 10 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU2 are presented in the table below:

Soils (0-1' bgs)	GEO-13/0-1'	SS-1	SS-2	SS-3	SS-4
	SS-5	SS-6	SS-7	SS-8	SS-9
	SS-10	SS-11	SS-12	SS-13	
Soils (0-6' bgs)	GEO-03/2-3'	GEO-03/5-6''	GEO-10/2-3	GEO-10/5-6	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-44/5-6'	SS-1	SS-2
	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
	SS-13				
Soils (0-10' bgs)	GEO-03/2-3'	GEO-03/5-6'	GEO-10/2-3	GEO-10/5-6'	GEO-13/0-1'
	GEO-13/2-3'	GEO-13/5-6'	GEO-43/7-8'	GEO-44/5-6'	GEO-45/7-8'
	SB-03/8-9.3	SB-05/4-9	SB-07/5-7	SS-1	SS-2
	SS-3	SS-4	SS-5	SS-6	SS-7
	SS-8	SS-9	SS-10	SS-11	SS-12
	SS-13				

3.1.3 Exposure Unit 3

In the southwest corner of the Site there exists a grassy field east of West Pine Street between Henson Auto Sales and Eagan Cars and Trucks. This grassy area has been defined as EU3 for purposes of this risk assessment (Figure 2). Similar to EU2, surface soil from zero to one foot and zero to six feet bgs were evaluated in EU2 for visitor and hypothetical future maintenance worker scenarios, respectively. Surface and subsurface soils in this EU were evaluated for a hypothetical future construction worker scenario. Available data for subsurface soils for a construction scenario were evaluated from the surface to the water table(approximately 20 feet bgs) as recommended by the MDEQ (2000). Soil samples included in EU3 are presented in the table below:

Soils (0-1' bgs)	SS-15	SS-16	SS-17		
Soils (0-6' and 0-20' bgs)	GEO-16/2-3'	GEO-16/5-6'	GEO-17/2-3'	GEO-17/5-6'	SS-15
	SS-16	SS-17			

3.1.4 Exposure Unit 4

EU 4 encompasses the grassy drainage ditch area along the fenceline behind Courtesy Ford in the northeast corner of the Site and continues parallel to the railroad tracks, and west through EU 3 and EU 2 (Figure 2). EU 4, along the southeast side of the former Process Area, has been widened to include soil data from that area. Receptors associated with EU 4 included Site visitor exposures via casual contact with surface soil, sediment, and surface water. Maintenance worker and construction worker scenarios were also evaluated for exposures to surface water and sediment in EU 4 as well as soils in EU 4 near the former Process Area. Soils down to six feet bgs were evaluated for maintenance workers while soils down to the water table (approximately20 feet bgs) were evaluated for construction workers in this EU as requested by the MDEQ (2000). Sediment, surface water, and soil samples included in EU4 are presented in the following table:

Sediment	SD-02	SD-12	SD-18	SD-19	SD-20
	SD-21	SD-22	SD-23		
Surface Water	SW-02				
Soils (0-1' bgs)	GEO-19/0-1'	GEO-20/0-1'	GEO-21/0-1'	GEO-46/0-1'	GEO-47/0-1'
	GEO-48/0-1'				
Soils (0-6' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6'	GEO-20/0-1	GEO-20/2-3'
	GEO-20/5-6'	GEO-21/0-1'	GEO-21/2-3'	GEO-21/5-6'	GEO-46/0-1'
	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1'	GEO-47/2-3'	GEO-47/5-6'
	GEO-48/0-1'	GEO-48/2-3'	GEO-48/5-6'		
Soils (0-20' bgs)	GEO-19/0-1'	GEO-19/2-3'	GEO-19/5-6'	GEO-20/0-1'	GEO-20/2-3°
	GEO-20/5-6'	GEO-20/9-10'	GEO-21/0-1'	GEO-21/2-3'	GEO-21/5-6'
	GEO-21/9-10'	GEO-46/0-1'	GEO-46/2-3'	GEO-46/5-6'	GEO-47/0-1'
	GEO-47/2-3'	GEO-47/5-6'	GEO-47/7-8'	GEO-48/0-1'	GEO-48/2-3'
	GEO-48/5-6'				

3.1.5 Exposure Unit 5

EU5 outlines the former Process Area and the historical drip track and treated wood storage areas of the former Gulf States Creosoting facility (Figure 2). Surface soils from zero to six feet bgs were evaluated in EU5 for a hypothetical maintenance worker scenario. Available data for soils down to the water table (approximately 20 feet bgs) were evaluated in EU5 for a hypothetical future construction worker scenario. Soil samples included in EU5 are presented in the table below:

Soils (0-1' bgs)	GEO-28/0-1'	GEO-29/0-1'	GEO-30/0-1'	GEO-31/0-1'	GEO-32/0-1'
	GEO-33/0-1'	GEO-59/0-1'	GEO-60/0-1'		
Soils (0-6' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
	GEO-29/5-6'	GEO-30/0-1'	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
	GEO-33/0-1'	GEO-33/2-3'	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1'	GEO-60/2-3'	GEO-60/5-6'	
Soils (0-20' bgs)	GEO-28/0-1'	GEO-28/2-3'	GEO-28/5-6'	GEO-29/0-1'	GEO-29/2-3'
	GEO-29/5-6'	GEO-30/0-1'	GEO-30/2-3'	GEO-30/5-6'	GEO-31/0-1'
	GEO-31/2-3'	GEO-31/5-6'	GEO-32/0-1'	GEO-32/2-3'	GEO-32/5-6'
į	GEO-33/0-1'	GEO-33/2-3'	GEO-33/5-6'	GEO-59/0-1'	GEO-59/2-3'
	GEO-59/5-6'	GEO-60/0-1'	GEO-60/2-3'	GEO-60/5-6'	GEO-60/7-8'
	SB-01/8-10	SB-02/9-11	SB-05/10.5-12.5	SB-06/6-10	SB-07/14-16

3.1.6 Exposure Unit 6

EU6 outlines a stretch (approximately 2700 feet in length) of the northeast drainage ditch that leads from the Site into the neighboring residential area. EU6 exposures include oral and dermal exposures by off-Site residents to sediment and surface water along the northeast drainage ditch. Soil exposures were not assessed in this area for lack of soil data. Also, it was anticipated that sediment exposures in this area represent a more conservative estimate of exposure in that chemical concentrations in the exposed sediment along the drainage ditch are likely to be greater than concentrations in the surrounding soils. Sediment and surface water samples included in EU6 are presented in the table below:

Sediment	SD-03	SD-04	SD-05	SD-13
	SD-14	SD-15	SD-16	SD-17
Surface Water	SW-03	SW-04		

3.2 <u>Statistical Evaluation</u>

Environmental samples undergo laboratory analyses that are designed to quantitate the concentrations of constituents in the various environmental media. As a result of the analytical procedures, a constituent may be detected and its concentration measured, detected but not able to be quantitated, or not detected at all in a sample. The data set for the Site contains a number of nondetections for some chemicals of potential concern (COPCs) in various samples. Assuming that the COPC is present in these samples at the achieved detection limit is biased because the chemical may be absent altogether. Assuming a concentration of zero is also flawed because the chemical could be present at a level below laboratory capabilities to detect and quantify the concentration. Consequently, in the event that an analyte identified at least once in a given medium was not detected in a given sample, it was conservatively assumed for the risk assessment purposes to be present at a concentration equivalent to one-half of the sample quantitation limit (SQL). In addition, samples labeled with an "R" (rejected) qualifier were not included in the data analysis because those data were deemed unreliable and, therefore, unusable. Constituents that were not detected in any sample from a particular medium were eliminated from further consideration in accordance with US EPA guidelines (1989).

Site analytical data used in this assessment were collected during the Phase I (1997) and Phase II (1998) remedial investigations as well as the additional investigation conducted in 2000 at the request of the MDEQ. These data were fully validated by qualified technical professionals using standard data validation protocols, as required by the MCEQ (1999).

Previous investigations at the Site have been conducted since 1990. These investigations included the following:

- 1990 soil gas and soil sampling by Roy F. Weston
- 1991 MDEQ Site inspections and Phase II report
- 1994 Phase II Site investigation by Environmental Protection Systems (EPS)
- 1994 Site investigation by Bonner Analytical Testing Company (BATCO)

- 1994 preliminary subsurface investigation by BATCO
- 1995 three-dimension resistivity surveys by American Remediation Technology
- 1996 investigation by McLaren/Hart
- 1996 investigation by Kerr McGee Chemical Corporation

Data acquired from these historical (pre-1997) investigatory activities were not used in this assessment as they were not validated by qualified chemists and sampling locations for some of the data could not be accurately established. These historical data were not considered valid and were, therefore, not appropriate to use in this assessment of risks. Only validated data that were considered to be representative of Site conditions with a reasonable level of confidence were used for this assessment.

The validated laboratory data from 1997, 1998, and 2000 investigations were compiled into data sets representing areas of potential exposure (EUs) for each potential receptor. Each data set was analyzed statistically using SiteStat[®], a commercially available software package, to calculate the minimum, maximum, arithmetic mean, logarithmic mean, standard error of the mean, and the 95% upper confidence limit of the mean concentration (95% UCL) for each constituent based on distributional analysis of the data (*i.e.*, utilizing goodness-of-fit statistical tests to determine whether the data are distributed normally or lognormally). The data qualifier associated with the minimum and maximum detected concentrations as well as the location of the maximum detected concentration for each EU were also determined. Results of the quantitative and statistical analyses for each of the EUs discussed above are presented in Tables 1 through 18.

Standard sampling protocol requires the collection of duplicate field samples used to ensure the quality of a laboratory analysis (i.e., to ensure that analytical results can be replicated). As such, duplicate sample results were provided as part of the database for the Hattiesburg Site. In accordance with US EPA guidance (1989), duplicate sample results were averaged (for any sample

containing duplicates) and the average concentration was used as a single concentration for that sample in the calculation of summary statistics as discussed below.

Soils down to one foot deep were assumed to be representative of surface soils at the Site for infrequent visitor exposures. A depth of 0 to 6 feet was used to define surface soils for maintenance worker exposures. These assumptions were recommended by the MDEQ (2000). The groundwater table was considered the extent of subsurface soils as recommended by MDEQ (2000). This value (depth-to-groundwater) varies significantly across the Site and, as such, the extent of subsurface soil was EU-specific as follows:

EU2 - soils down to 10 feet

EU3 – soils down to 20 feet

EU4 - soils down to 20 feet

EU5 – soils down to 20 feet

This risk assessment focuses mainly on environmental data collected from the former Process and Fill Areas and any other portions of the Site that were affected by former creosoting operations. Virtually unaffected areas (e.g., the developed area north of West Pine Street) as delineated using historical data were not considered to contribute significantly to risk levels and, therefore, were excluded from this risk assessment.

3.3 Determination of Exposure-Point Concentrations

Exposure-point concentrations were determined to be the 95% UCL or the maximum concentration of a COPC in an EU, whichever was lower. This methodology is in accordance with US EPA guidance (1989). If the distribution of the concentration data was determined to be lognormal, then the lognormal 95% UCL was compared to the maximum concentration to determine the exposure-point concentration. In the event that the distribution of a chemical in any given medium could not be confidently labeled as normal or lognormal, it is termed either "unknown" or "normal/lognormal." In these cases, the lognormal 95% UCL was compared to

maximum concentration when determining the exposure-point concentration. It should be noted, however, that in cases where the distribution is "unknown," the normal and lognormal 95% UCLs could not be reliably predicted. Assuming a lognormal distribution of the data increases the uncertainty associated with this step of the risk assessment process; however, hazard and risk estimates are likely to be less uncertain than if the maximum concentrations were used.

Exposure-point concentrations are provided on the statistical summary tables, Tables 1 through 18.

3.4 COPC Selection

Soils (both surface and subsurface) were screened according to MCEQ (1999) guidance. The first tier of the screening process compared maximum concentrations of a constituent in an EU with the Restricted Tier 1 target remediation goal (TRG) for maintenance worker and construction worker scenarios. Restricted TRGs were used because the Site is not currently used for residential purposes and the current commercial/industrial land-use is anticipated to remain into the future as a result of the implementation of deed restrictions on the impacted areas of the Site. If a maximum concentration of a constituent was less than the Restricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment.

Surface soil data (zero to one foot bgs) for the visitor scenario were screened using Unrestricted Tier 1 TRGs at the request of MDEQ (2000). If a maximum concentration of a constituent was less than the Unrestricted Tier 1 TRG, then that constituent was eliminated from further quantitative assessment. Conversely, if the maximum concentration of a constituent exceeded the Tier 1 TRG, that constituent was retained for quantitative analysis.

If the maximum concentration of a constituent in an EU exceeded the Tier 1 TRG, then the 95% UCL of the constituent was compared to the Tier 1 TRG (Restricted or Unrestricted, depending on the exposure scenarios as described above) as part of the Tier II screening process. In the event that the concentrations of a chemical were distributed lognormally, the lognormal 95%

UCL of that constituent was compared to the Tier 1 TRG. If the distribution of data of a chemical could not be positively identified as either normal or lognormal, the lognormal 95% UCL was used in the screening process. In these cases, either the maximum concentration or the lognormal 95% UCL can be conservatively used. The US EPA, however, justifies the use of an average concentration as the exposure-point concentration by explaining that toxicity criteria for both carcinogenic and non-carcinogenic effects are based on lifetime average exposures and that the "average concentration is most representative of the concentration that would be contacted at a site over time" (Supplemental Guidance to RAGS: Calculating the Concentration Term, 1992). Other US EPA guidance states that "...in most situations, assuming long-term contact with the maximum concentration is not reasonable" (Risk Assessment Guidance for Superfund, Part A, 1989). US EPA Region 4 also states that, generally, it is reasonable to assume that soil data are distributed lognormally (1995). In keeping with these guidances, the lognormal 95% UCL was considered in the screening process where the data distribution for a compound could not be defined as specifically normal or lognormal.

If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent was less than the Tier 1 TRG, then that constituent was eliminated from further quantitative analysis. If the 95% UCL (or lognormal 95% UCL where appropriate) of a constituent in soil exceeded the Tier 1 TRG, then that constituent was retained for quantitative analysis in the Site-specific risk assessment (Tier III).

MCEQ guidance (1999) does not specify screening levels for constituents in sediment or surface water; therefore, Region 4 was referred to for guidance (1995). Sediment is only found on the Site in drainage ditches that contain little to no water most of the time. US EPA Region 4 guidance states that sediments in an intermittent stream (or ditch) should be considered as surface soil for the portion of the year the stream is without water. Based on these factors and comments provided by the MDEQ (2000), the maximum detected constituent concentrations in sediment was compared to MCEQ unrestricted Tier 1 TRGs. The screening process then followed the same procedure as mentioned above for other soils.

For surface water, the maximum detected concentration of a constituent in an EU was compared to the US EPA Human Health Water Quality Standard (WQS) for consumption of water and organisms in accordance with US EPA Region 4 guidance (1995). If the maximum concentration of a constituent in surface water was less than the WQS, then that constituent was eliminated from quantitative analysis. If the maximum concentration of a constituent in surface water exceeded the WQS, then that constituent was retained for quantitative analysis.

At the request of MDEQ (2000), if any single carcinogenic polycyclic aromatic hydrocarbon (cPAH) was retained as a COPC in a medium, then all cPAHs were also retained as COPCs in that medium. This guidance refers to the following chemicals: benzo(a)anthracene, benzo(b)fluoroanthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. To establish an exposure point concentration for undetected cPAHs retained as COPCs in an EU, one-half the maximum detection limit was used.

The results of the screening process are presented on the statistical summary tables, Tables 1 through 18. The screening process eliminated detected constituents from the subsurface soil dataset down to 20 feet bgs and surface soil dataset down to 6 feet bgs in EU3 For this reason, construction worker and maintenance worker exposures to soils in EU3 were not evaluated quantitatively in this assessment.

4.0 Exposure Assessment

Currently, a majority of the Site is used for commercial and light industrial purposes and is paved for roads and parking lots. Unpaved areas are limited to Gordon's Creek (EU 1), the wooded portion in and around the Fill Area (EU2) and the grassy field outlined by EU 3, and the drainage ditches and surrounding area delineated by EU 4 (Figure 2). Since the developed and undeveloped areas of the Site vary considerably with respect to both residual chemical concentrations and land use, the Site was divided into five EUs for the exposure assessment. A sixth EU was created to assess off-Site residential exposures. Chemical data from each EU were combined with EU-specific exposure parameter values and receptor scenarios to determine the chemical intake for each receptor potentially accessing an EU for occupational, recreational, or residential purposes.

4.1 Receptor Identification

The following exposures pathways (indicated with an "X") have been selected for this risk assessment as reasonable and realistic scenarios under current and future land-use assumptions:

EU/Media:	EU1		EU2	EU3		EU4				EU6	
Receptor/Route:	Sed.	Surf. Water	Soil	Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water	
Visitor				 					†		
Dermal	X	X	X	X	X	X	X	X		***************************************	
Oral	X	X	X	X	Х	X	X	Χ	1		
Inhalation	an control and testiman summings ()		on Washington, consideration and second		N						
Maint. Worker	personal control of the second		nge statigted kommentenstensen i der i			NO. Alter Propagation processors	An annual section of the section of			VVPNS((m/m) =	
Dermal	X	X	X	X	X	X	X	X		A. A	
Огаі	X	X	Х	X	х	X	X	X		er in samen det samen en	
Inhalation	#2: W. Libbarows		man of 2 ft of a commonly								
Const. Worker	p ⁵ ************************************		**************************************					***************************************		MART I VIO I NIGO I SEGUIDI MARTINI ANT ANTICONIA	
Dermal	X	Х	Х	X	Х	Х	X	Х		on annual management, a page from the annual medical management	
Ота	X	X	X	X	Х	X	X	X		Marie Marie (no conservacione any Minima Minima (no Authority)	
Inhalation	, \		X	X	х			X			
Off-Site Resident	gg - 1900,000 (' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '	and the second s	N				n ga sangagi Hillianin ara ara araba abada da		** designa a, regarde and se	ar a mara a gampaga saga at a gama sa sagai da a di da da a sa	

EU/Media:	EU1		EU1 EU2		EU3 EU4			EU5 I		EU6
Receptor/Route:	Sed.	Surf. Water	Soil	Soil	Soil	Sed.	Surf. Water	Soil	Sed.	Surf. Water
Dermal			··········	-					Х	X
Oral										Х
Inhalation	ye ere ene en en _e logiya yanın, y		Marian and application of the	e e e e e e e e e e e e e e e e e e e	1.0		the common hour or the rights like a decreased			and the second section of the second
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Surface water present on-Site is either ephemeral or very shallow and is conducive only to wading-type activities. Ingestion of Site surface water was considered an insignificant exposure pathway since on-Site drainage ditches "contain little or no water most of the time" (MDEQ, 2000). In addition, US EPA IV guidance indicates that "In most cases, it is unnecessary to evaluate human exposures to sediments covered by surface water" (1995). At the request of MDEQ (2000), however, dermal and oral exposures to surface water were assessed for visitors, maintenance workers, and construction workers in EUs 1 and 4. Surface water exposures were also assessed for residents in off-Site EU 6.

Each of the potential receptors is discussed below.

4.1.1 Infrequent Site Visitor

Since the Site is not currently fenced or guarded, the general public has access to most areas of the Site at any given time. It is possible, though unlikely, that an individual may use some areas of the Site, such as EU1, EU2, or EU3, for recreational purposes. For this reason, sediment and surface water exposures to visitors in EU1, and surface soil exposures in EU2 and EU3 were assessed for the visitor scenario. The vast majority of the remainder of the Site (EU5) is covered with either buildings or pavement, precluding direct contact with surface soils; however, a small exposed area encompassing a drainage ditch exists along side of the former Process Area (EU4). Although this area is not attractive for recreational purposes, it is possible that an individual traversing the Site may contact surface soils, sediment, or surface water in this EU; therefore, these potential exposures were assessed. Sediment exposures in EU1 and EU4 were addressed in accordance with US EPA Region 4 guidance that recommends evaluating sediment exposures in intermittent streams. At the request of MDEQ (2000), soil exposures were assessed for visitors

in EU5 regardless of the existence of buildings and pavements precluding almost all potential direct contact with soils in this area.

4.1.2 Maintenance Worker

Currently, maintenance activities are most likely limited to the developed portions of the Site. Of these, the former Process Area and adjacent former drip track and treated wood storage areas (EU5) were most affected by historical wood preserving processes. Although these areas are mostly paved or built upon, it is possible that maintenance activities may require some shallow digging in unpaved areas; therefore, exposures to surface soils in EU5 were assessed. As a conservative measure, surface soil data from sample locations located in paved areas were evaluated in conjunction with surface soil data from exposed areas in EU5. If the currently undeveloped portions of the Site (EU2 and EU3) become developed in the future, similar maintenance activities may be required and, therefore, exposures to surface soils in EU2 and EU3 were also assessed. The drainage ditch encompassed by EU4 requires periodic maintenance; therefore, exposures to soil, sediment, and surface water in this area were assessed. At the request of MDEQ (2000), maintenance worker exposures to surface water and sediment in EU1 were also assessed.

4.1.3 Construction Worker

Although there are currently no major construction activities at the Site, such activities may hypothetically occur in the future. Thus, exposures to surface water and sediment in EUs 1 and 4, and exposures to soil in EUs 2 through 5 were assessed herein. Construction workers may be exposed to both surface and subsurface soils during activities such as excavating. Subsurface soils, for purposes of this assessment, were defined as those soils at the water table and shallower. Since the depth to the water varies significantly across the Site, so does the definition of "subsurface" soils. Accordingly, subsurface soils were evaluated down to 10 feet for EU2 and 20 feet for EUs 3, 4, and 5.

4.1.4 Future On-Site Residents

The affected areas of the Property (the Site) are currently zoned for industrial or light-commercial use, and, at the time of this report, there were no plans to develop the Site for residential housing. In fact, deed restrictions preventing residential development are in the process of being implemented for the impacted areas on Site. Because of these deed restrictions, it is reasonable and realistic to assume that the Site will remain commercial/industrial in the future; therefore, on-Site residential exposures were not addressed in this risk assessment.

4.1.5 Off-Site Residential Exposures

The northeast drainage ditch extends from the former Process Area to the northeast into a nearby residential community. Surface water and sediment data from areas along the northeast drainage ditch (EU6, Figure 3) were evaluated for off-Site residential exposures. For purposes of exposure assessment, a child resident between the ages of 1 and 6 years and an adolescent/adult resident between the ages of 7 and 30 years were evaluated. Hazards and risks for these two receptors were then combined (summed) to reflect the exposures incurred by a single individual living off-Site in the vicinity of the northeast drainage ditch for 30 years.

4.2 _ General Intake Equation

Chemical exposure/intake is expressed as the amount of the agent at the exchange boundaries of an organism (i.e., skin, lungs, gut) that is available for systemic absorption. An applied dose is defined as the amount of a chemical at the absorption barriers such as skin, lung, digestive tract, available for absorption and is (usually expressed in milligrams, or mg) absorbed per unit of body weight of the receptor (usually expressed in units of kilogram, or kg). Absorbed dose can be defined as the amount of chemical that penetrates the exchange boundaries. If the exposure occurs over time, the total exposure can be divided by the time period of interest to obtain an average exposure rate (e.g., mg/kg-day). The general equation, as defined by US EPA, for estimating a time-weighted average intake is:

Intake (mg/kg - day) =
$$\frac{C \times IR \times EF \times ED}{BW \times AT}$$

[Equation 1]

where:

C = chemical concentration at the exposure point (e.g., mg/m^3 air);

IR = intake rate $(e.g., m^3/hr)$;

EF = exposure frequency (days/year);

ED = exposure duration (years);

BW = body weight of exposed individual (kg); and

AT = averaging time (period over which exposure is averaged, usually

measured in days).

Additional parameters (e.g., skin surface area) were incorporated into the above general equation to evaluate the different potential exposure routes (dermal, oral, inhalation).

Table 19 presents the general and pathway-specific exposure parameters utilized for the intake equations in this assessment.

4.2.1 General Exposure Parameters

Although some of the parameters used to calculate potential exposure are pathway- or route-specific, exposure frequency (EF), exposure duration (ED), averaging time (AT; determined separately for carcinogenic and non-carcinogenic exposures), and body weight (BW) are present in each intake model. These general parameters remain consistent throughout the intake calculations for each specific receptor.

4.2.1.1 Exposure Frequency

The exposure frequency (EF) describes the number of times per year an event is likely to occur. It is most often expressed in units of days/year or events/year, depending on the scenario. Variables such as weather, vacations, sick days, and institutional controls often aid in determining reasonable and realistic exposure frequencies.

The EF for an adolescent visitor was extracted from US EPA Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) Interim Final (1989). This EF value of 12 days/year per EU is a reasonable estimate that assumes an adolescent would most likely be engaged in outdoor activity on the unpaved areas of the Site for one day a week during the three warmest months of the year. This value was used for soil, sediment, and surface water exposures.

Typical construction projects, especially at industrial complexes, generally involve several phases of activity prior to completion. The EF parameter used for oral exposure in construction workers, therefore, was subdivided into two exposure events. The first event hypothetically lasts for 10 days (used in relevant exposure model calculations under "Exposure Level A") and would involve earth-moving activities such as foundation. The second exposure event to the same individual hypothetically lasts for 70 days (for a total of 80 days at the Site for an individual; this value was used in relevant exposure model calculations under "Exposure Level B") and included remaining construction activities such as building framing, plumbing installation, electrical installation, and roofing. Generally, to complete each of these phases, a different team of specialized contractors is employed to perform the tasks for which they are most qualified. As a result, an individual may only remain at the construction site for a few days or weeks until his/her task has been completed and the next phase has begun. This is especially true for those activities involving direct contact with soil such as excavating and foundation pouring. Individuals performing these tasks are not usually qualified or employed to continue with the actual building processes. For dermal and inhalation exposures, however, an 80-day EF was used and accounted for an individual to be involved in construction activities for four entire months of the year (assuming five-day work weeks).

For surface water and sediment exposures to construction workers, an EF value of 8 days/year was used. This value represents 1/10th of the time a worker may be on-Site for construction-type activities and is conservative in that it is unlikely that construction workers would be exposed at all to Site surface water or sediment.

The EF value used for the maintenance worker scenario was 150 days/year for surface soil exposures in EUs 2, 3, and 5. This is also a conservative assumption in that the currently developed areas of the Site are covered with buildings or pavement. Maintenance activities in these areas would require little contact with the obscured surface soils. The undeveloped areas of the Site currently require little or no maintenance as they are only occasionally mowed or allowed to grow naturally. Should these areas become developed, they will most likely take on the appearance of the remainder of the Site, including industrial/commercial buildings and paved roads or parking lots. Once again, extensive direct contact with surface soils would be minimal for a maintenance worker.

For maintenance worker sediment and surface water exposures in EUs 1 and 4 and surface soil exposures in EU 4, an EF value of 30 days/year was used. Historically, the northeast drainage ditch has been maintained on an as-needed basis (less than annually). Maintenance worker exposures to sediment and surface water in these areas were assessed at the request of the MDEQ (2000). An EF value of 30 days/year is amply conservative in that both Gordon's Creek (EU 1) and the northeast drainage ditch (EU 4) are currently maintained less than annually.

For residential soil exposures, an exposure frequency of 350 days/year was used in accordance with Region IV guidance. This value assumes that 15 days/year are spent away from home (US EPA, 1991).

Sediments along the bank of the northeast drainage ditch are not comparable to surface soils comprising a yard with respect to exposure. Typically, yard soils include relatively large areas where children frequently play and where surface soils are tracked into the home to become part of the household dust that can be ingested, particularly by crawling infants, on a daily basis. These are the assumptions that underlie the standard residential soil exposure algorithm and parameter values. However, it is not realistic to assume that infants, children, or adults will directly contact a relatively small area of sediments on the banks of a drainage ditch on a daily

basis. A more realistic exposure scenario for this unique area under an assumption of residential land use is for a resident child to play on occasion in the drainage ditch that traverses the residential property. An exposure frequency of 40 days/year, two hours per exploring event, is conservatively plausible.

4.2.1.2 Exposure Duration

The ED parameter represents the number of years during which an event is likely to occur. Factors affecting this parameter include variables such as age of receptor, population mobility, and occupational mobility. Exposure durations of less than seven years typically correspond to subchronic exposures while those greater than seven years are typically considered chronic exposures (US EPA, 1989). Toxicity indices are selected based on subchronic or chronic exposure durations.

The future construction worker scenario used an ED of one year because it is highly unlikely that a future construction worker would remain on one site for more than a year. Often, two months is considered the maximum amount of time a construction worker may reasonably remain at the same site.

The future maintenance worker ED, on the other hand, is based on occupational mobility studies. The ED of 25 years was obtained from US EPA (1991) which recommends a 95th percentile value of 25 years based on a study by the Bureau of Labor Statistics as of 1987. US EPA Region 4 also recommends a default value of 25 years for worker scenarios (1995).

The adolescent visitor scenario used an ED of 10 years. An adolescent was defined in this assessment as an individual aged seven to 16 years in accordance with US EPA Region 4 (1995); therefore, an exposure duration of 10 years was most appropriate.

An ED of 30 years (US EPA Region 4, 1995) was used for off-Site residents. This value assumes an individual spends 6 years as a child and 24 years as an adolescent/adult in the same location.

4.2.1.3 _ Averaging Time

The averaging time (AT) parameter is the time period over which exposure is averaged. For human health cancer risk calculations, the AT_c value prorates a total cumulative dose over a lifetime. As a conservative approach, the AT_c value for each receptor is the product of a 365-day year and a 70-year life span, equaling 25,550 days.

The AT_n used for non-carcinogenic effects is the product of a 365-day year and the exposure duration (i.e., AT_n = 365 days × ED). Because the ED parameter changes for each receptor, the AT_n changes as well. The AT_n values used for each receptor are summarized below:

Future Construction Worker - 365 days

Maintenance Worker - 9125 days

Adolescent Visitor - 3650 days

Off-Site Child Resident - 2,190 days

Off-Site Adult Resident - 8,760 days

4.2.1.4 Body Weight

The body weight used for the adult exposures (future construction worker and maintenance worker) analyzed in this assessment was the current US EPA default value of 70 kg (US EPA, 1989; US EPA Region 4, 1995). This value was also used for the adolescent/adult off-Site resident scenario. The adolescent body weight used for the visitor scenarios was 45 kg. This value was extracted from US EPA Region 4 guidance (1995). For the child resident scenario, a body weight of 15 kg was used as recommended by US EPA (1991).

4.2.2 Route-Specific Exposure Parameters

The general intake equation discussed above (Equation 1) was modified by including route-specific exposure parameters in order to calculate route-specific intake values. For dermal exposures, skin surface area, adherence factor, exposure time (surface water exposures only), and absorption factor

parameters were included in the intake equation. For ingestion exposures, an ingestion rate and a matrix effect were included in the intake calculation. For inhalation exposures, an inhalation rate and a retention factor for fugitive dusts were included in the intake equation. Also, for inhalation exposures, an additional paradigm was necessary to convert soil concentrations to concentrations in air available for intake.

4.2.2.1 <u>Dermal Exposure Parameters</u>

Skin Surface Area

The total skin surface area used for adult receptors in this assessment was 20,000 cm². This is a US EPA default value extracted from the *Exposure Factors Handbook* (1997). For adolescent exposures, a value of 12,768.3 cm² was used for total skin surface area. This was a mean value calculated based on the distributions of total skin surface areas for males and females between the ages of 7 and 16 as presented in *Exposure Factors Handbook* (1997). For the off-Site child resident scenario, a skin surface area of 7,213 cm² was used. This value was based on skin surface area data for male and female children provided in *Exposure Factors Handbook* (1997).

For purposes of exposure, it was assumed that only portions of the body would be exposed to the affected media on the Site. For the construction worker scenario, it was assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. These body parts comprise 27.8% of the total skin surface area, or 5560 cm².

For maintenance worker exposures to Site soils, it was assumed that the hands, forearms, and face would be exposed. These body parts comprise 15 percent of the total skin surface area, or 3000 cm².

For surface water and sediment exposures, exposed body parts for construction and maintenance workers included hands, forearms, and face or 3000 cm² (15% of the total skin surface area).

The visitor and off-Site resident scenarios assumed that the hands, forearms, and lower legs would be exposed for contact with Site soils. These body parts comprise 23.9% of the total skin surface area, or 3052 cm² for adolescent visitors, 1724 cm² for child residents, and 4780 cm² for adult residents. For exposures to surface water and sediment, hands, forearms, lower legs, and feet were assumed exposed for adolescent visitor and off-Site resident scenarios. These body parts comprise 30.9 % of the total skin surface area or 3945 cm² for adolescent visitors, 2229 cm² for child residents, and 6180 cm² for adult residents.

Soil Adherence Factor

Until recently, the US EPA-recommended default for soil adherence on skin ranged from 0.2 to 1.0 mg/cm² for the entire exposed surface area, without consideration of the type of activity (US EPA, 1992). However, the data from which that range was derived were primarily the result of indirect measurements, artificial activities, and sampling of hands only. A more recent study has presented the results of direct measurement of soil loading on skin surfaces before and after normal occupational and recreational activities that might result in soil contact (Kissel et al., 1996). A fiveorder of magnitude range (roughly 10^{-3} to 10^{+2} mg/cm²) was reported for observed activity-related hand loadings. That report indicated that hand loadings within the range of 0.2 to 1.0 mg/cm² were produced by activities in which there was vigorous soil contact (e.g., rugby, farming); but for activities in which there was less soil contact (e.g., soccer, professional grounds maintenance), loadings substantially less than 0.2 mg/cm² were found on hands and other body parts. Kissel et al. (1996) concluded that, because non-hand loadings attributable to higher contact activities exceeded hand loadings resulting from lower contact activities, hand data from limited activities cannot be used as a conservative predictor of loadings that might occur on other body surfaces without regard to activity. Furthermore, because exposures are activity-dependent, dermal exposure to soil should be quantified using data describing human behavior (e.g., type of activity, frequency, duration, including interval before bathing, clothing worn, etc.).

The most recent version of the Exposure Factors Handbook (1997) states:

In consideration, of these general observations and the recent data from Kissel et al. (1996, 1997), this document recommends a new approach for estimating soil adherence to skin. First use Table 6-12 [Summary of Field Studies, Kissel et al., 1996a] to select the activity which best approximates the exposure scenario of concern. Next, use Table 6-13 [Mean Soil Adherence by Activity and Body Region, Kissel et al., 1996a] to select soil loadings on exposed skin surfaces which correspond to the activity of interest. This table contains soil loading estimates for various body parts. The estimates were derived from soil adherence measurements of body parts of individuals engaged in specific activities described in Table 6-12. These results provide the best estimate of central loadings, but are based on limited data. Therefore, they have a high degree of uncertainty such that considerable judgment must be used when selecting them for an assessment.

In another study that assessed the percentage of skin coverage in several soil contact trials in a greenhouse and an irrigation pipe laying trial, Kissel *et al.* (1996) concluded that adjusted loadings may be two to three orders of magnitude larger than average loadings if average loadings are small.

The activity-specific soil adherence factor for exposures to a maintenance worker was calculated based on data presented by Kissel *et al.* (1996) for grounds keepers, as presented below:

		Soil Adherence Factor by Body Part (mg/cm²)				
Receptor	Representative Activity	Hands	Arms	Lower Legs	Face	
Maintenance Worker	Grounds Keepers	0.030 - 0.15	0.0021 - 0.023	0.0008 - 0.0012	0.0021 - 0.01	

Data for the grounds keepers were used for the maintenance worker estimates because the activities of a grounds keeper best mimic those of a maintenance worker.

Soil adherence factors were calculated by normalizing each body part-specific soil adherence value (using the mid-points of the ranges tabulated above) with regard to the percentage of total body surface area represented by the respective body part (extracted from the US EPA *Dermal*

Exposure Assessment: Principles and Applications [US EPA, 1992]). The maintenance worker adherence factor for soil was calculated based upon exposure to the hands, forearms and face. Surface area percentages for the hands, forearms, and face are 5.2, 5.9, and 3.9 percent, respectively (US EPA, 1997). Those body parts comprise 15 percent of the total body surface area. The normalized values for all body parts of interest were added, and the sum was divided by the total percentage of body surface area occupied by the parts. For example, the soil and sediment adherence factors for maintenance worker soil exposures (0.038 mg/cm²) were calculated as follows:

AF (mg/cm²) =
$$\frac{(0.09 \times 0.052) + (0.0126 \times 0.059) + (0.006 \times 0.039)}{0.15}$$
 = 0.038

The construction worker adherence factor was also calculated in this fashion. This exposure scenario assumed that the hands, forearms, lower legs, and face would be exposed to Site soils. Soil loadings for the upper torso (chest and back) were not measured by Kissel *et al.* (1996) for construction workers because this body area is generally covered. However, to account for exposure to the upper torso during the very hot months of the year, the total area of the forearms, legs, hands, and face were assumed to be completely exposed. The hands, forearms, legs, and face comprise 5.2%, 5.9%, 12.8%, and 3.9% of the total skin surface area, respectively (with the face comprising one-third the surface area of the head), for a total of 27.8% exposed surface area. The construction worker soil adherence factor was based on data from Kissel *et al.* (1996) for construction workers as follows:

		Soil Adh	erence Fact	or by Body Part ((mg/cm²)
Receptor	Representative Activity	Hands	Arms	Lower Legs	Face
Construction Worker	Construction Worker	0.24	0.098	0.066	0.029

The soil adherence factor for the construction worker scenario was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.066 \times 0.128) + (0.029 \times 0.039)}{0.278} = 0.1$$

For sediment exposures, the soil adherence factor was calculated for the construction worker scenario using adherence data from Kissel *et al.* (1996) for construction workers (as tabulated above) for the hands, forearms, and face. The hands, forearms, and face comprise 5.2, 5.9, and 3.9 percent of the total skin surface area, respectively (totaling 15 percent). Thus, the adherence factor for construction workers exposed to sediment (0.13 mg/cm²) was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.24 \times 0.052) + (0.098 \times 0.059) + (0.029 \times 0.039)}{0.15}$$
 = 0.13

The adherence factor for visitor and off-Site resident exposures to soil assumed that the forearms, hands, and lower legs would be exposed to soil or sediment. The data used in these calculation were based on data by Kissel *et al.* (1996) for soccer players (exposed to a playing field of roughly one-half grass and one-half bare earth in a light mist) as presented below:

		Soil Adherence	Factor by Body	Part (mg/cm ²)
Receptor	Representative Activity	Arms	Hands	Lower Legs
Visitor and Off- Site Resident	Soccer Players	0.0029 - 0.011	0.019 - 0.11	0.0081 - 0.031

The forearms, hands, and lower legs comprise 5.9%, 5.2%, and 12.8% of the total skin surface area, respectively, for a total of 23.9% (US EPA *Exposure Factors Handbook*, 1997). The adherence factor was then calculated for visitor and off-Site resident dermal exposures to soil as follows:

$$AF (mg/cm^2) = \frac{(0.00695 \times 0.059) + (0.0645 \times 0.052) + (0.0196 \times 0.128)}{0.239} = 0.026$$

A value of 0.026 mg/cm² was used as the soil adherence factor for visitors to the Site and off-Site residents.

Soil adherence factors for sediment exposures to Site visitors and off-Site residents were calculated using adherence data for the hands, forearms, lower legs, and feet. Adherence data for reed gatherers were used for these exposures to best mimic activities that may incur sediment exposures. The reed gatherers studied by Kissel et al. (1996) periodically visited tidal flats to collect raw materials for basket weaving. The data from Kissel et al. (1996) presented in Exposure Factors Handbook (US EPA, 1997) were as follows:

		Soil Adher	rence Factor	by Body Part (n	ng/cm²)
Receptor	Representative Activity	Hands	Arms	Lower Legs	Feet
Visitors and Off-Site Residents	Reed Gatherers	0.66	0.036	0.128	0.63

The hands, forearms, lower legs, and feet comprises 5.2, 5.9, 12.8 and 7.0 percent of the total skin surface area, respectively (totaling 30.9 percent). Thus, the adherence factor for visitors and off-Site residents exposed to sediment (0.33 mg/cm²) was calculated as follows:

AF (mg/cm²) =
$$\frac{(0.66 \times 0.052) + (0.036 \times 0.059) + (0.16 \times 0.128) + (0.63 \times 0.07)}{0.309} = 0.33$$

Exposure Time

To estimate intakes as a result of dermal exposure to surface water, an exposure time (ET) parameter was included in the intake formula for Site visitors and off-Site residents. The parameter value of 1.0 hour/day was estimated using best professional judgement. This value represents the amount of time a Site visitor or off-Site resident may spend exposed to surface water in any one EU.

Dermal Permeability Constant

The permeability constant, Kp, accounts for the movement of a constituent dissolved in water through the skin, across the stratum corneum, and into the blood stream. Kp values for the constituents examined in this assessment for surface water exposures were obtained from US EPA Dermal Exposure Assessment: Principles and Applications (1992). For values not available in US EPA Dermal Exposure Assessment (1992), the Kp value were calculated using the equations provided by the US EPA in the same document.

Dermal Absorption Factor

The final parameter included in the dermal intake paradigm was a dermal absorption factor. In general, the skin provides an effective barrier to environmental toxins. For example, certain hair-coloring formulations which are vigorously rubbed onto the scalp on a daily basis contain lead acetate at concentrations up to 200,000 ppm, yet lead toxicity does not appear to result. Moore *et al.* (1980) determined that the rate of lead absorption from 203^{Pb} labeled lead acetate in cosmetic preparations containing six mmol Pb acetate/L in male volunteers over 12 hours was 0.06% during normal use of such preparations. For most inorganic salts, percutaneous (skin) absorption is considered insignificant relative to incidental ingestion (for example, US EPA, 1986). On the other hand, some drugs (*e.g.*, nicotine) are effectively administered and absorbed into the blood stream from dermal "patches."

Most dermal bioavailability data for impacted soil have been obtained in laboratory animals or in vitro test systems. This introduces a significant source of uncertainty for predicting the human response. Safety factors have sometimes been applied to dermal absorption data obtained in

animals to conservatively estimate the upper-bound of likely human percutaneous uptake of a certain constituent from skin exposure. This is usually unnecessary because human skin has generally been shown, for a diverse group of constituents, to be about 10-fold less permeable than the skin of typical animal species, such as rabbits and rats (Bartek and LaBudde, 1975; Shu et al., 1988).

US EPA Region III evaluated available data concerning the dermal absorption of specific constituents and classes of constituents and provided several recommendations (US EPA Region 3, 1995). For semivolatile compounds, such as bis(2-ethylhexyl)phthalate, the US EPA recommends a range of 1% to 10% (US EPA, 1995). Kao et al. (1985) reported 2.7 percent for absorption of topically applied pure benzo(a)pyrene by human skin in vitro. The US EPA Region 3 recommends using 10% as a conservative assumption based on the Ryan et al. study (1987). In addition, US EPA Region 4 guidance (1995) states that a soil dermal absorption factor "of 1.0% for organics and 0.1% for inorganics should be used as defaults in determining the uptake associated with dermal exposure" (see the Dermal Contact subsection of Exposure Assessment section of the 1995 guidance). For the purpose of this risk assessment, an ABS of 3% for cPAHs and of 10% for other SVOCs were conservatively assumed for dermal absorption, in keeping with US EPA Region 3's and MDEQ's recommendations.

4.2.2.2 <u>Ingestion Exposure Parameters</u>

Ingestion Rate

US EPA's Exposure Factors Handbook (1997) discusses three adult soil ingestion studies with results ranging from 10 mg/day to 480 mg/day. Hawley's (1985) value of 480 mg/day (as recommended by the MDEQ) was "derived from assumptions about soil/dust levels on hands and mouthing behavior" (US EPA, 1997). Since no supporting measurements were made for Hawley's study, the US EPA states that Hawley's estimate "must be considered conjectural" (1997). As such, the US EPA goes on to suggest adult soil ingestion rates of 50 mg/day for industrial settings and 100 mg/day for residential and agricultural settings, although "50 mg/day still represents a reasonable central estimate of adult soil ingestion and is the recommended

value..." (1997). Accordingly, a value of 100 mg/day for the maintenance worker and adult off-Site resident is amply conservative and was used in this assessment. In conjunction with the use of a two-tiered EF to reflect the different stages of potential future construction activities (see Section 4.2.1.1), the soil ingestion s for the construction worker scenario was also divided into two exposure levels for a single individual. A highly conservative ingestion rate of 480 mg/day (used in relevant exposure model calculations under "Exposure Level A") was used for construction workers for the first 10 days of exposure to address direct contact with soil during earth-moving activities such as foundation excavating. A soil ingestion rate of 100 mg/day (used in relevant exposure model calculations under "Exposure Level B") was used for the remainder of the construction worker exposure (70 days). Risks were then summed for both exposure levels to estimate the total potential risk posed to an individual construction worker

The ingestion rate used for the adolescent visitor scenario was 100 mg/day. The US EPA Region IV (1995) recommends a value of 200 mg/day as a mean ingestion rate for children under six years of age. This value was conservatively used in this assessment to estimate soil and sediment ingestion exposures for an off-Site resident child aged one to six years.

Gastrointestinal Matrix Effects of Soil

Incidental ingestion incorporates the matrix effect (ME; sometimes called the absorption adjustment factor [AAF]) into the general intake equation. When constituents are administered in solid vehicles such as food and soil, only a fraction of the ingested dose is extracted from the vehicle and subsequently absorbed through the gastrointestinal tract (US EPA *Estimated Exposure to Dioxin-like Compounds*, 1992). Gastrointestinal absorption of constituents sorbed onto such a medium is inhibited by physical-constituent bonding to the matrix (Hawley, 1985). This phenomenon is referred to as the gastrointestinal matrix effect of soil. Several studies referenced in the US EPA's *Estimated Exposure to Dioxin-like Compounds* (1992) have been performed to estimate the oral absorption factors of constituents from soil. At the request of MDEQ (2001), however, a gastrointestinal matrix effect of 1.0 was used in accordance with US EPA Region IV guidance (1995), although this approach is highly conservative and does not

account for scientific studies that indicate the absorption of chemical constituents through the gastrointestinal tract is less than 100%.

4.2.2.3 Inhalation Exposure Parameters and Paradigms

Inhalation Rate

The inhalation rate used for the construction worker scenario was 20 m³/day. This is a common US EPA default value and was recommended by US EPA Region 4 (1995).

Retention Factor

According to the International Commission on Radiological Protection (ICRP), 75 percent of respirable dust particles (PM₁₀, or particles less than 10 microns in aerodynamic diameter) are retained when inhaled, the vast majority of which is potentially subsequently swallowed (ICRP, 1968). This 75% was included in the inhalation intake equation as the retention factor parameter (RF). This parameter applies only to non-VOC constituents entrained onto dust particles.

Concentration in Air

To estimate airborne dust levels during hypothetical construction activities, an emission rate of suspendible particles of less than 15 microns in aerodynamic diameter (PM₁₅) was calculated (grams/second); particles less than 10 microns were considered to be respirable. Considering particles of 15 microns or less in diameter in the emission rate calculation is a conservative assumption, inasmuch as only particles with an aerodynamic diameter of less than five to seven microns are inhaled into the lung.

The two types of construction activities at the Site that have the potential to emit fugitive dusts are vehicular movement over bare (unpaved or unvegetated) surfaces and the excavation of soil. Estimation of fugitive dust emissions caused by each activity were examined separately, as follows, and were derived from existing estimates of general construction exposure. The sum of the emissions from these two activities was multiplied by the concentration of constituent in the soil (Cs) in order to derive the total emission rate (Ei) for non-VOCs as follows:

$$Ei = C_s \times (PERv + PERe)$$
 [Equation 2]

where:

Ei = Emission rate (mg/sec);

 C_s = Concentration in soil (mg/kg);

PERv = Particulate emission rate for vehicular movement (lb/vehicle mile);

and

PERe = Particulate emission rate for excavation (lb/vehicle mile).

The following empirical expression (US EPA, 1988) was used to estimate the fugitive dust generated by vehicles during construction activities:

PERv (lbs/vehicle mile) = $k \times 5.9 \times (s/12)(S/30) \times (mvw/3)^{0.7} \times (ww/4)^{0.5} \times ((365 - p)/365)$ [Equation 3]

where:

PERv = Vehicle particle emission rate (lb/vehicle mile traveled);

s = Percent silt content (unitless);

k = Particle size multiplier (unitless);

S = Mean vehicle speed (mph); mvw = Mean vehicle weight (ton);

ww = Mean number of wheels per vehicle (unitless); and

p = Mean number of days with ≥ 0.01 inches of precipitation per year

(unitless).

It was assumed that the vehicle travels during 40% of the 80-day exposure duration and 0.5 miles per day. The result is a value of 16 miles per construction event. Percent silt content was estimated to have a mean value of 50%, based on geotechnical data provided in the *Remedial Investigation Report* (Pisani & Assoc., 1997). US EPA default values were utilized and referenced for all other parameters. The particle size multiplier was assumed to be 0.50, corresponding to particles less than 15 microns (US EPA, 1996). Vehicle characteristics consist of the following: mean vehicle speed was assumed to be 15 mph, with mean vehicle weight assumed to be approximately 12.5 tons, for 8-wheeled vehicles (US EPA, 1988). The estimated mean number of days with precipitation equal to or greater than 0.01 inches per year is 110 (US EPA, 1988). Total resultant dust emissions for constituents during vehicular movement activities were estimated to be approximately 16.5 lbs/vehicle mile traveled, or 0.0001 kg/sec. Calculations are summarized in Table 20.

Future excavation may be performed by bulldozers, a backhoe, or other heavy construction equipment. The following estimate of particulate emissions, less than 15 μm in diameter resulting from bulldozing activity, was based on the approach described in the US EPA Compilation of Air Pollution Emission Factors (1996), as developed from studies of emissions from uncontrolled open dust sources resulting from bulldozing at western surface coal mines.

PERe (lb/hour) =
$$\frac{1.0 \times s^{1.5}}{M^{1.4}}$$
 [Equation 4]

where:

PERe = Excavation particle emission rate (lb/hr);

s = Percent silt content (unitless); and

M = Soil moisture content (unitless).

Percent soil moisture content was assumed to be 15.1%, an average of Site-specific soil moisture data and percent silt content 50%, as described above.

The resultant fugitive dust emission rate during excavation activities was 7.9 lbs/hr or 0.001 kg/sec. Table 20 summarizes these calculations.

Once the emission rate (Ei in Equation 2) was calculated, it was converted to a concentration in ambient air. Gaussian models are conventionally used to determine downwind ambient air concentrations, Ca, from the emission rate, Ei, estimated. However, in this scenario, such models have limited applicability when the receptor(s) is at or very near the source of emission. In this case, a bulldozer operator, for example, is situated directly within the area of ground emissions of vapors and dusts. Average ambient air concentrations in this circumstance are best estimated by use of a near-field box model (US EPA, 1988).

The near-field box model assumes uniform wind speed and uniform mixing throughout the box. The release and mixing of VOCs or respirable dusts in ambient air is estimated as follows:

Ca (mg/m³) =
$$\frac{Ei}{W_b \times H_b \times V}$$
 [Equation 5]

where:

Ca = Concentration of constituent in ambient air (mg/m³);

Ei = Emission rate of constituent (mg/sec);

W_b = Width of box in crosswind dimension within the area of residual

constituent in soil (m);

 H_b = Downwind height of box (m); and

V = Average wind speed through the box (m/sec).

The value of H_b in this calculation is determined by the downwind distance and the atmospheric turbulence at ground level, which determines the trajectory of a release from the upwind edge of the source of vapor or dust emissions. For neutral atmospheric conditions, the height at the downwind boundary (H_b) may be expressed by the following function (Pasquill 1975, Horst 1979):

$$z = 6.25 \text{ r} [H_b/r \times \ln (H_b/r) - 1.58 H_b/r + 1.58]$$
 [Equation 6]

where:

 $H_b = Downwind height of box (m);$

z = Downwind distance to boundary (m); and

r = A terrain-dependent roughness height (m)

H_b (defined in Equation 5) is adjusted until the z parameter is equal to W_b (defined in Equation 5). The resulting H_b value is the height of the box. On any given workday, it is estimated that grading or excavation activities occur over the entire "workable" Site area (exposure unit) from which dusts are generated. This area is estimated to be 2,500 m², with length of the box estimated to be 50 meters (downwind distance) and the width of the box (W) estimated to be 50 meters. The greater the roughness height, the greater the wind turbulence and constituent dilution (i.e., the height of the box increases). For the purposes of this risk assessment, it is conservatively assumed that the roughness height is 0.20 meters, which corresponds to a terrain with grass, some small bushes, and occasional trees (US EPA Rapid Assessment of Exposure to Particulate Emission from Surface Contamination Sites, 1985). This

assumption is appropriate for the actual Site conditions. An annual average wind speed (4.69 m/sec) is obtained from the STAR data set, accessed through the Personal Computer Graphical Exposure Modeling System (PCGEMS), for STAR station 03940, Jackson/Thompson, MS for the period 1974-1978 (Table 21).

5.0 Toxicity Assessment

The toxicity assessment involves the evaluation of available toxicity information to be utilized in the risk assessment process. Toxicity values derived from a dose-response relationship can be used to estimate the potential for the occurrence of adverse effects in individuals exposed to various constituent levels.

Exposure to a constituent does not necessarily result in adverse effects. The relationship between dose and response defines the quantitative indices of toxicity required to evaluate the potential health risks associated with a given level of exposure. If the nature of the dose-response relationship is such that no effects can be demonstrated below a certain level of exposure, a threshold can be defined and an acceptable exposure level derived. Humans are routinely exposed to naturally-occurring constituents and man-made constituents through the typical diet, air, and water, with no apparent adverse effects. However, the potential for adverse effects may occur if the exposure level exceeds the threshold in a variably sensitive population. This threshold applies primarily to constituents which produce non-carcinogenic (systemic) effects, although there is a growing body of scientific evidence which suggests that exposure thresholds may exist for certain carcinogenic constituents as well.

Adverse effects can be caused by acute exposure, which is a single or short-term exposure to a toxic substance, or by chronic exposure on a continuous or repeated basis over an extended period of time. "Acceptable" acute or chronic levels of exposure are considered to be without any anticipated adverse effects. Such exposure levels are commonly expressed as reference doses (RfDs), health advisories, etc. An acceptable exposure level is calculated to provide an "adequate margin of safety."

Chronic RfDs, which have been derived by the US EPA for a large number of constituents, were utilized to evaluate exposures lasting seven to 70 years (US EPA, 1989). Activities involving exposures of shorter duration to COPCs at the Site are anticipated to result in hazard and risk

estimates that are lower than those associated with the long-term exposures. Identification of subchronic toxicity values corresponding to shorter-term exposure scenarios (*i.e.*, less than seven years) are included in the risk assessment to ensure that both short-term and long-term risks can be addressed.

Currently, the US EPA has not developed toxicity values to be utilized in dermal exposure scenarios; however, the US EPA does provide the following guidance for dermal exposure:

No RfDs or slope factors are available for the dermal route of exposure. In some cases, however, non-carcinogenic or carcinogenic risks associated with dermal exposure can be evaluated using an oral RfD or oral slope factor, respectively. (US EPA, 1989).

Provisional dermal toxicity values were developed and utilized in the dermal exposure pathways considered in the human health risk assessment to provide a more accurate Site-specific risk assessment. These dermal RfD values were developed by multiplying the published oral RfD for a given constituent by the fraction of that constituent that can be absorbed through the gastrointestinal tract (stomach/intestine lining). The absorption fraction utilized was 50% for semivolatiles as extracted from US EPA Region 4 guidance (1995).

A number of sources of toxicity information exists, and these sources vary with regard to the availability and strength of supporting evidence. The following protocol has been established for the determination of toxicity indices; it defines a hierarchy of sources to be consulted and the methodology for the determination of toxicity values. This protocol has been developed in accordance with current US EPA methodology. Toxicity values for the COPCs at the Site were obtained with reference to the following hierarchy of sources developed in accordance with MCEQ guidance (1999):

1) Toxicity values were obtained from the *Integrated Risk Information System* (IRIS, 1999) database. This database contains the RfDs and Cancer Slope Factors (CSFs), which have been verified by the US EPA's RfD and Carcinogen Risk

Assessment Verification Endeavor (CRAVE) workgroups, and is, thus, the agency's preferred source for toxicity values. IRIS supersedes all other information sources.

- 2) For toxicity values which are unavailable on IRIS, the most current source of information is the Health Effects Assessment Summary Tables (HEAST, US EPA, 1997), published by the US EPA. HEAST contains interim, as well as verified RfDs and CSFs. Supporting toxicity information for verified values is provided in an extensive reference section of HEAST.
- In cases where IRIS or HEAST could not provide toxicity values, US EPA Region III's Risk-Based Concentration (RBC) Tables were visited. These tables often provide toxicity values generated by reliable sources other than IRIS or HEAST. For example, in response to specific requests from risk assessors, the US EPA National Center for Environmental Assessment (NCEA) develops provisional RfDs or CSFs for chemicals not listed in IRIS or HEAST. Region III's RBC tables will list such provisional values. Also, RfDs or CSFs that have since been withdrawn from IRIS or HEAST may still be listed on the Region III RBC tables, although they are flagged with a "W." These toxicity values were no longer agreed upon by US EPA scientists; however, the Region III RBC tables continue to publish such values because risk assessors still need to quantify exposures to these chemicals. Lastly, the Region III RBC tables will list toxicity indices found in "other" US EPA documents. These values are flagged with an "O" on the tables.

The US EPA has derived carcinogenic slope factors for both oral and inhalation pathways, and these are utilized to quantitatively estimate risks. In the first step of the US EPA's evaluation, the available data are analyzed to determine the likelihood that the agent is a human carcinogen. The evidence is characterized separately for human studies and animal studies as sufficient, limited, inadequate, no data, or evidence of no effect. The characterizations of these two types of data are combined, and based on the extent to which the agent has been shown to be a carcinogen in experimental animals or humans, or both, the agent is given a provisional weight-of-evidence classification. The US EPA scientists then adjust the provisional classification upward or downward, based on other supporting evidence of carcinogenicity (see Section 7.1.3, US EPA, 1989). For a further description of the role of supporting evidence, see the US EPA guidelines (US EPA, 1986).

The US EPA classification system for weight of evidence is shown in the table below. This system is adapted from the approach taken by the International Agency for Research on Cancer.

	US EPA WEIGHT-OF-EVIDENCE CLASSIFICATION SYSTEM FOR CARCINOGENICITY
Group	Description
A	Human carcinogen
B1 or B2	Probable human carcinogen
22	B1 indicates that limited human data are available
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
С	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
Е	Evidence of non-carcinogenicity for humans

(US EPA, 1989)

Table 22 summarizes the available toxicity values for the identified COPCs. COPCs lacking published toxicity values were not able to be quantitatively evaluated in this assessment in accordance with MCEQ guidance (1999). The MCEQ limits the use of toxicity values to those that have been published in IRIS, HEAST, ATSDR toxicity profiles, or other peer-reviewed reference sources or literature approved by the MCEQ (1999). The MDEQ (2001), however, requested that risks from dermal exposure to cPAHs be estimated using the oral cancer slope

factor for benzo(a)pyrene, applying benzo(a)pyrene relative potency factors, and accounting for an absorption efficiency of 50%. This methodology was used accordingly.

6.0 Risk Characterization

The objective of the risk characterization is to determine potential risk to receptors by combining the results of the exposure and toxicity assessments. Non-carcinogenic effects and carcinogenic risks are summarized in Table 23. Tables 24 through 78 provide algorithms and parameters for each pathway.

The estimated intakes calculated for each exposure pathway considered and each COPC were compared to RfDs for non-carcinogenic effects. The following formula was used to estimate the potential for non-carcinogenic health effects for each COPC.

HQ = ADI/RfD

{Equation 7}

where:

HQ = Hazard quotient - potential for noncancer health effects (unitless);

ADI = Average daily intake of COPC (mg/kg-day); and

RfD = Reference dose (mg/kg-day).

RfDs have been developed by the US EPA for chronic (e.g., lifetime) and/or subchronic exposure to constituents based on the most sensitive non-carcinogenic effects. The chronic RfD for a constituent is an estimate of a lifetime daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. The potential for noncancer health effects was evaluated by comparing the Site-specific exposure level with the RfD derived by the US EPA for a similar exposure period. This ratio of exposure to toxicity is called the hazard quotient (HQ). If the Site-specific exposure level exceeds the threshold (i.e., the HQ exceeds a value greater than 1.0), there may be concern for potential noncancer effects.

To assess the overall potential for noncancer effects posed by multiple constituents, a hazard index (HI) is derived by summing the individual HQs. This approach assumes additivity of critical effects of multiple constituents. This is appropriate only for compounds that induce the

same effect by the same mechanism of action. This conservative approach significantly overestimates the actual potential for adverse health impacts.

In cancer risk assessment, the US EPA has required the use of the upper limit which produces an estimate of potential risk that has a 95% probability of exceeding the actual risk, which may, in fact, be zero. The following formula was utilized to estimate the upper bound excess cancer risk for each carcinogen (note that not all COPCs are carcinogens):

 $TR = CLDI \times SF$ [Equation 8]

where:

TR = Target risk - excess probability of an individual developing cancer

(unitless);

CLDI = Calculated lifetime average daily intake of carcinogenic COPC

(mg/kg-day); and

 $SF = Cancer slope factor (mg/kg-day)^{-1}$.

For exposures to multiple carcinogens, the upper limits of cancer risks are summed to derive a total cancer risk. The US EPA recognizes that it is not technically appropriate to sum upper confidence limits of the risk to produce a realistic total probability, but requires this approach be used.

Carcinogenic risk refers to the probability of developing cancer as a result of exposure to known or suspected carcinogens. The National Contingency Plan (NCP) endorses an acceptable risk range of 10^{-4} to 10^{-6} for exposure to multiple carcinogens. This range represents an incremental increase of 1 in 10,000 to 1 in 1,000,000 in the chance of developing cancer over a lifetime. The MCEQ (1999) indicates that the target risk level is 1×10^{-6} per individual carcinogen and an acceptable cumulative risk level is 1×10^{-4} . As such, risk levels totaled across oral, dermal, and inhalation pathways may exceed 1×10^{-6} and still be in compliance with MCEQ requirements (1999) as long as no single carcinogen exceeds 1×10^{-6} and the cumulative risk for a single receptor does not exceed 1×10^{-4} .

Table 23 provides a summary of the non-carcinogenic effects and carcinogenic risks associated with each of the pathways evaluated in this assessment.

The overall hazard index across the assessed pathways and EUs was 0.1 for the Site visitor scenario. This value is below the acceptable benchmark of 1.0. The highest hazard index associated with the Site visitor scenario was 0.07 corresponding to dermal exposure to sediment in EU4. The overall cancer risk for exposures to Site visitors was estimated to be 2.7×10^{-5} and is primarily attributable to oral and dermal exposure to benzo(a)pyrene and associated cPAHs in EU4 soil and sediments. Oral exposure to the same constituents in EU4 and EU5 surface soils also contributed to the cancer risk estimate for the site visitor. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the maintenance worker scenarios was 0.108 and is below the acceptable benchmark of 1.0. The highest hazard index associated with the maintenance worker scenario was 0.1.05 corresponding to oral exposure to surface soilsediment in EU4. The overall cancer risk for the maintenance worker scenario was 1.4×10^{-3} and was primarily attributable to dermal and oral exposure to benzo(a)pyrene and other cPAHs in surface soils in EUs 2, 4, and 5. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The overall hazard index for the hypothetical future construction worker was $0.\underline{000}003\underline{6}$ and is well below the acceptable benchmark of 1.0. The highest hazard index associated with the construction worker scenario was 0.0039×10^{-7} corresponding to oral-dermal exposure to soils surface water in EU 54. The overall cancer risk for the hypothetical future construction worker scenario was—-was 5 × 10⁻⁵ and is attributable to benzo(a)pyrene and associated cPAH oral exposure in EU4 sediment and oral and dermal exposure to EU4 and EU5 soils. Additional discussion regarding remediation goals for this scenario has been provided in section 8.0.

The off-Site resident scenario revealed a hazard index of $\pm 6 \times 10^{-4}$. This value is considerably below the acceptable benchmark of 1.0. The overall cancer risk for the resident exposure scenario was estimated to be 2×10^{-4} and is attributable to oral and dermal exposure to benzo(a)pyrene and associated cPAHs in EU6.

7.0 Uncertainty Analysis

Risk assessment uses a wide array of information sources and techniques. Even in those rare circumstances where constituent intake for an exposed individual may be measured relatively precisely, assumptions will still be required to evaluate the associated risk. Generally, data are not available for critical aspects of the risk assessment, and the use of professional judgment, inferences based on analogy, the use of default values, model estimation techniques, etc., result in uncertainty of varying degrees.

The expressions of risk in this assessment are not probabilistic; the expressions of risk are conditional, based on the conditions represented by the single-point values selected for the analysis. This section is intended to identify and qualitatively evaluate the more salient Site-specific uncertainties and their potential influence on the credibility of the estimated Site risks.

7.1 Uncertainty of Data Evaluation Factors

Uncertainties in data analysis include analytical error, selection of COPCs, adequacy of sampling design, etc. Generally, there is far less uncertainty in this phase of the risk assessment process than other aspects contribute.

Laboratory analysis is extremely accurate relative to the potential error of "professional judgment" in exposure assessments. The uncertainty of analytical data is likely to be less than 25 percent, most of the time.

The adequacy of the sampling strategies to characterize Site conditions is a potentially large source of uncertainty. Because of the limited availability of resources, sample collection is generally limited. However, sampling (especially in multiple surveys) is not random, but is designed to locate the areas with the highest levels of constituents. Thus, test data are biased toward overestimation of average constituent levels. In addition, in most instances, the upper

95-percent confidence limit of the average concentration is utilized as an exposure-point concentration in the risk assessment. The use of this value likely will result in an overestimation of risk, as the 95% UCL represents a value that will be greater than the true average 95% of the time.

Oftentimes, only a portion of detected constituents are carried through the risk assessment process because constituents are eliminated through COPC screening procedures (US EPA, 1989). This could result in an underestimation of risk, although the COPC selection process is intended to identify those constituents that account for the vast majority of potential risk. COPCs lacking published RfD values were not quantitatively evaluated and this may result in an underestimation of potential hazards (non-carcinogenic effects).

7.2 Uncertainty of Toxicity Values

The US EPA's IRIS states that the uncertainty associated with RfD values for non-carcinogenic endpoints of toxicity "span perhaps an order of magnitude." In fact, the uncertainty of extrapolating dose-response data from animals to humans with the application of multiple safety factors (100 to 10,000 or more) is likely to be several orders of magnitude. Current policies for deriving RfD values will often result in an overestimation of risk.

The uncertainty associated with the estimation of cancer risk contributes, by far, the major source of potential error and uncertainty. It is beyond the scope of this analysis to explore this toxicity assessment factor in any detail. However, a few salient points are noted below.

Some constituents classified as carcinogens have been shown to produce an increased incidence of cancer in mice but not rats, for example. If the mouse is not an adequate model for the rat, it may be wondered how reliable a model it is for human beings. The assumption of linearity and a non-threshold phenomenon in the dose versus risk relationship may not be valid and could result in a very large overestimation of actual cancer risk, if any even exist at low doses in humans.

The US EPA evaluated the uncertainty of cancer risk estimates from exposures to trichloroethene and several other related VOCs in public drinking water supplies (Cothern *et al.*, 1984). These US EPA scientists concluded the following:

- The largest uncertainty in the calculations is due to the choice of the model [Multistage, Weiball, Logit, Probit, etc.] used in extrapolating risk to low doses in humans, and is 5 to 6 orders of magnitude;
- If a single model were chosen [assumed to be valid], the overall uncertainty in risk estimates would be 2 to 3 orders of magnitude;
- The exposure estimates contribute, at most, an order of magnitude to the uncertainty; and
- It would appear that until a particular compound's mechanisms of cancer are better known, it is likely that the uncertainty in the toxicity will not be improved.

7.3 Uncertainties in Assessing Potential Exposure

Ideally, Site-specific exposure values should be used when assessing potential intakes of chemicals at a Site. Oftentimes, however, Site-specific data are not available; therefore, the risk assessor must estimate values that most accurately reflect Site conditions. In doing so, US EPA or other regulatory default values were utilized in place of Site-specific data. These values may over- or under-estimate risks, depending on Site conditions and the percentile range in which the default values fall (e.g., 50th, 95th).

Although a considerable amount of published data is available on the most common exposure parameters (e.g., body weight, skin surface area), even these data contain uncertainties. Studies conducted by different scientists often provide differing levels of detail, statistics, and accuracy based on sample size, study design, geographic area, etc. Such discrepancies can increase uncertainty when the data are combined to derive a single-point default value. These data may be the best available; however, the reflection of reality may still be imprecise.

Where published exposure parameters were not available, best professional judgment had to be used, thereby increasing uncertainty. The default or estimated exposure parameters used in this assessment likely resulted in a moderate over-estimation of risk.

The intakes estimated for dermal absorption of PAHs adsorbed into soils adhering to skin may overestimate risks for a host of reasons. Early studies conducted by Falk and coworkers indicated that the carcinogenic effect of B(a)P on subcutaneous injection in mice could be markedly inhibited by the simultaneous administration of various non-carcinogenic PAHs (Falk et al., 1964, as cited in ATSDR, 1988. In other subcutaneous injection and skin-painting studies with mice, it was shown that a combination of several non-carcinogenic PAH compounds, mixed according to the proportion occurring in auto exhaust, did not enhance or inhibit the action of two potent PAH carcinogens, B(a)P and dibenz(a,h)anthracene- (ATSDR, 1988).

The carcinogenic potency of B(a)P and other carcinogenic PAHs is generally determined by injecting solutions under the skin, painting the skin with the carcinogenic PAH dissolved in a solvent, or dissolved in corn oil in feeding studies. This vehicle or matrix affords a high level of bioavailability of the carcinogenic PAH compound. Recently, Krueger et al. (1999) conducted in vitro percutaneous absorption studies with contaminated soils and organic solvent extracts of contaminated soils collected at former manufactured gas plant (MGP) sites. The MGP tarcontaminated soils contained PAHs at levels ranging from 10 to 2400 mg/kg. The dermal penetration rates of PAH from the MGP tar-contaminated soils and soil solvent extracts were determined experimentally through human skin using tritrum-labelled B(a)P as a surrogate. Results showed reductions of two to three orders of magnitude in PAH absorption through human skin from the most contaminated soils in comparison to the soil extracts. Reduction in PAH penetration was attributed to soil matrix properties. That is, PAH compounds adsorbed to organic carbon in a soil matrix are far less bioavailable for dermal flux than PAH compounds dissolved in a solvent. [No correction for such a profound soil matrix effect was applied in quantitatively estimating cancer risks due to dermal absorption of B(a)P and other carcinogenic PAHs in this assessment.]

8.0 Summary of Findings

The results of the baseline human health risk assessment indicate potentially unacceptable risk levels for the following exposure scenarios:

Potentially Exposed Population	Media	EU
Site Visitor	Sediment	4
	Surface Soil	4, 5
Maintenance Worker	Sediment	4
	Surface Soil	2, 4, 5
Construction Worker	Sediment	4
	Subsurface Soil	4, 5
Off-Site Resident	Sediment	6

The risk levels associated with the above scenarios were driven by cPAHs, particularly benzo(a)pyrene. To determine the extent of remediation necessary to reduce these risks to acceptable levels, sediment and soil data for cPAHs in EUs 2, 4, 5, and 6 were closely examined.

The benzo(a)pyrene exposure-point concentration used to evaluate maintenance worker exposures to surface soil in EU2 was 5.2 mg/kg (sample location GEO-13/0-1'). This was the maximum benzo(a)pyrene concentration found in surface soil in EU2. The next highest concentration of benzo(a)pyrene in sediment was found at SS-10 (2.4 mg/kg). However, as previously noted, these samples were collected at locations within a densely wooded area. No remediation is planned to address surface soils at these locations for the following reasons:

- No maintenance activities are currently conducted in this area;
- Any remediation would require significant clearing; and
- Cancer risks associated with surface soils at these locations only slightly exceed 1×10^{-6} for two individual constituents, and the total cancer risk level is still less than 1×10^{-5} .

In EU4, the maximum concentration of benzo(a)pyrene was used as the exposure-point concentration for site visitor, maintenance worker, and construction worker exposure to sediment. The benzo(a)pyrene exposure-point concentration used to evaluate these in EU4 was 130 mg/kg (sample location SD-02, see Figure 2). The next two highest concentrations of benzo(a)pyrene in sediment was-were found at SD-12 (71 mg/kg) and SD-23 (5.57 mg/kg), respectively. Implementing a remedy to remove, treat, or preclude contact with sediment at sample locations SD-02-and-, SD-12, and SD-23 would leave a concentration of 5.573.1 mg/kg (sample location SD-2318) as the maximum concentration in sediment that could be potentially contacted by site visitors, maintenance workers, and/or construction workers in EU 4. Excluding samples SD-02, SD-12, and SD-23SD-02 and SD-12 and using 5.573.1 mg/kg as the exposure-point concentration drops the risk level for dermal and oral contact with sediment by a visitor and oral contact with sediment by a maintenance worker or construction worker to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 79 - 8283).

In EU4, the maximum concentration of benzo(a)pyrene was also used as the exposure-point concentration for site visitor, maintenance worker, and construction worker soil exposures. Each of these receptors could potentially be exposed to soils at different depth ranges: visitor 0-1' bgs, maintenance worker 0-6' bgs, and construction worker 0-20' bgs. The sample locations and corresponding concentrations of benzo(a)pyrene that contributed to elevated risk estimates in the three exposure scenarios are presented in the table below:

Sample Location	Benzo(a)pyrene Concentration
	(mg/kg)
GEO-48/0-1'	500
GEO-21/0-1'	230
GEO-21/2-3'	190

Sample Location	Benzo(a)pyrene Concentration
	(mg/kg)
GEO-19/0-1'	56
GEO-46/0-1'	16
GEO-20/5-6'	11
GEO-47/5-6'	9.6
GEO-48/2-3'	6.1
GEO-20/0-1'	3.2
GEO-47/0-1'	3
GEO-19/2-3'	2.4

Implementing a remedy to remove, treat, or preclude contact with the soilssurface (0-1' bgs) soil sample locations tabulated above above would result in eliminating exposures for the site visitor scenario (i.e., the 0-1' bgs samples listed above comprise the entire data set for visitor exposures to surface soils in EU4). In addition, implementation of a remedy addressing the sample locations tabulated above would leave a maximum subsurface soil benzo(a)pyrene concentration of 0.29 mg/kg (sample location GEO-19/5-6'). Using the concentration of 0.29 mg/kg as the exposure-point concentration for estimating risk to—state and construction workers drops the risk levels to within acceptable levels (Tables 82-84-8788). In situ biological treatment is proposed to address impacted soils within EU4. This will include clearing, tilling, application of inorganic nutrients, and, once soils are remediated to the extent practicable, placement of concrete cover. The area to be remediated will extend at least from Courtesy Ford to the edge of the railroad right-of-way, and may extend onto the railroad right-of-way with the permission of the Southern railway.

In EU5, the surface soil sample locations contributing most to elevated risk levels for the maintenance worker, construction worker, and site visitor scenarios were GEO-33/0-1', GEO-33/2-3', GEO-30/0-1', GEO-59/0-1, GEO-29/0-1', and GEO-28/0-1' (see Figure 2). All sample locations, with the exception of GEO-59/0-1', are located underneath paved areas in a parcel of

land extending from Courtesy Ford to the southeast (Figure 2). Pavement in this area precludes direct contact with surface and subsurface soils; therefore, it is not anticipated that current or future maintenance workers or site visitors will have access to soils in or around these sample locations. In addition, a deed restriction will be implemented requiring the maintenance of the paved areas to ensure protection of human health in the future. Sample location GEO-59/0-1', with a benzo(a)pyrene exposure point concentration is 6.1 mg/kg, however, is adjacent to West Pine Street in an unpaved area. Implementing a remedy to remove, treat, or preclude contact with surface soil at this location would leave a concentration of 0.37 mg/kg (GEO-60/0-1') as the maximum concentration in surface soil not covered by pavement that could potentially be contacted by any of the three receptors in this EU. Excluding sample GEO-59/0-1' and using 0.37 mg/kg as the exposure-point concentration drops the estimated exposures in EU5 to within acceptable levels (i.e., no risk level associated with a single carcinogen exceeds 1 × 10⁻⁶; Tables 88-89 - 9192).

The benzo(a)pyrene exposure-point concentration used to evaluate adult and child resident exposures to sediment in EU6 was 49 mg/kg (sample location SD-03, see Figure 3). This was the maximum benzo(a)pyrene concentration found in sediments in EU6. Sample locations SD-04, SD-14, SD-13, SD-16, SD-15, and SD-17 (33, 12.2, 3.27, 2.8, 2.42, and 2.26 mg/kg, respectively) also contributed to elevated cancer risk estimates for both receptors. Implementing a remedy to remove, treat, or preclude contact with sediment at these sample locations would leave a concentration of 0.97 mg/kg (sample location SD-05). Using the benzo(a)pyrene concentration of 0.97 mg/kg as the exposure-point concentration for sediment exposure to adult and child residents reduces the risk estimate to within acceptable limits (i.e., no risk level associated with a single carcinogen exceeds 1×10^{-6} ; Tables 92-93-9596). Remediation activities are proposed to remove impacted sediment and preclude contact with residuals in the northeast drainage ditch. These activities include removal and off-Site treatment and/or disposal of impacted sediments, installation of a storm water collection and conveyance pipe, backfilling around the culvert, and planting with native grass.

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