OIL SPILL
&
CLOSURE

R. Neal Goates
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March 5, 1998

Mr. Wayne Price
New Mexico Oil Conservation Division
Hobbs District Office
PO Box 1980
Hobbs, NM 88241-1980

RE: Limit Gross Excavation Procedure based on Expanded Risk Assessment Findings, Lea County, New Mexico

Dear Mr. Price:

Conoco is in receipt of the February 16, 1998 document "Crude Oil Spill SEMU DTB Battery UL J, Sec 15, T20S, R37E, Crude remaining in the ground (322-50) = 272 bbls".

Subsequent to Conoco's initial fate/transport assessment for the subject site, Conoco has addressed the OCD's concerns about the original model. Within that process, Conoco considered additional exposure pathways at the subject site to aid in estimating potential human health risk based on two additional scenarios for both worker and resident pathways.

Concerns from NMOCD February 16, 1998 document are as follows:

Concern: "OVM calibration was set for benzene only".
My statement on this subject from Conoco's previous document was false. The instrument does not screen for benzene only but instead utilizes 246 ppm isobutylene for calibration thus screens for common volatile constituents and their associated ions. Please refer to the attached fax copy from Philip Services to Conoco which identifies the common volatile constituents.

Concern: "Fate/Transport modeling was performed for only the first five feet of the soil".
I apologize for Conoco not highlighting the units of measurement. For all measurement, the model utilizes the metric system for all computation. 5 meters (16.4 feet) was the vertical dimension of the prism of material used to represent the contaminated soil. I hope this clears up any concerns relative to the original fate/transport output results.

Concern: "No assessment was modeled for the potential human health exposure".
Conoco expanded the fate/transport model to include a human-health risk assessment for a worker exposure scenario to include ingestion, dermal contact, and outdoor inhalation pathways. In addition, Conoco chose a second scenario to illustrate the magnitude of exposure necessary for the site to fail a risk assessment. The resident scenario calculates the exposure for indoor/outdoor inhalation, dermal and ingestion pathways. The results for human health risk are inclusive of the February 23, 1998 report from Steve Danbom. For ease of understanding, Steve printed color images in association with the steps necessary to determine risk. The worker scenario passes with flying colors, whereas the basement resident scenario (albeit unrealistic due to the location in question) does not.

Steve H. Danbom, Ph.D.
Sr. Consultant
Remediation Technology
RMNA

Conoco Inc.
P.O. Box 2197
Houston, TX 77252-2197
(281) 293-2636

February 23, 1998

Mr. Neal Goates
Midland Production Division
10 Desta Drive, Suite 100 West
Midland, TX 79705

Dear Neal:

In response to the letter from Wayne Price, Environmental Engineer with NMOCD, I would like take three actions: (1) go through the original model one screen at a time with more discussion to alleviate some misconceptions that I apparently left with him due to the succinct nature of my November 24, 1997 mailing (enclosed as an attachment); (2) extend this model from the domain of fate and transport modeling into the risk-assessment domain, calculating human-health consequences of the contaminated soil by computing the carcinogenic risk and hazard indices using a typical worker scenario and, although it is highly unlikely, an adult, basement-residential scenario; and (3) pass on to him the complete computer program, "Risk-Integrated Software for Cleanups (RISC) developed by Lynn Spence and BP Oil. Regarding item 3, there is no charge for the computer program RISC because BP OIL has made the program free of charge to regulators in order that they might understand the utility of such software.

I have made 38 color images taken from the computer screen while modeling using the program RISC and have numbered them in association with the Steps 1-6 as shown on the first screen of the program.

1ST SCREEN -- This is the first screen of the program RISC. Steps 1-6 show the various stages of development of the risk-assessment information. This first figure might be set aside so that the figures that follow, developed within the context of this figure's various steps, might be better understood.

FIGURE 1A -- Regarding the chemicals of concern with this Lea County, NM model, BETX is used for a crude oil spill by substituting the 200 bbl crude oil spill with a 200 bbl gasoline spill and speciating BETX concentrations from the gasoline using an available generic gasoline for percentages. This is a very conservative action to take. When I use the word "conservative" in this letter report, by that I mean a scenario that exaggerates the actual situation so as to err on the side of protecting human health.

FIGURE 2A -- For the possible exposure pathways, since the site has no shallow groundwater, the exposure pathways are limited to ingestion and dermal contact with soil and inhalation of outdoor air emissions from the soil.

FIGURE 3A – This program will use fate and transport models fully described in the RISC manual to compute the receptor point concentrations in outdoor air and will use the speciated BETX estimations for soil concentrations.

FIGURE 3B – This figure might be set aside for the next five figures so that details of each of these modeling elements might be discussed in detail.

FIGURE 3C – For the Box model described in the RISC manual, the height of the box fits an average worker, the width is the modeled Y dimension of the spill, and the wind speed is an average number that is appropriate for the site.

FIGURE 3D – This slide is included for completeness; the thickness of the lens is conservatively set at 0.

FIGURE 3E – The contamination source is a 5 x 20 x 20 meter prism that has no soil cover. This is a conservative estimate of the spill volume.

FIGURE 3F – Here are the modeled BETX and TPH concentrations. It should be noted that the entire contamination source prism has this concentration throughout. This conservatively accommodates the range in TPH measurements from borings B-1, B-2, and B3 at the site.

FIGURE 3G – These unsaturated zone geotechnical parameters are largely provided by the Philip Environmental Report with changes in fraction of organic carbon and residual water content that seemed unreasonable from that report. These values are replaced with values normally associated with the site's locale.

FIGURE 3H – A figure to indicate that we have computed fate and transport concentrations.

FIGURE 3I – A graph showing model-predicted outdoor air concentration as a function of modeled time.

FIGURE 3J – A graph showing model-predicted soil concentration as a function of modeled time.

FIGURE 3K – A graph showing volatilization losses each year as a function of modeled time.

FIGURE 3L – A graph showing cumulative volatilization losses as a function of modeled time.

FIGURE 4A – Beginning of the risk assessment showing a typical worker exposure scenario is to be used.

FIGURE 4B AND 4C -- These figures are combined for discussion as one has to scroll the screen in order to see all variable choices. This scenario is untouched from that which comes with the program. It is evident from examining each of the values that this exposure scenario is very conservative.

FIGURE 5A AND 5B -- Carcinogenic risk (due to benzene) and hazard indices (total of the hazard quotients for the non-carcinogens ethylbenzene, toluene, and xylene) for the typical worker exposure scenario as a function of route of exposure. Note that the largest risk is about 2×10^{-7} (or 0.2×10^{-6}) which is 5 times less than the very first threshold set by the EPA of $1.0\ 10^{-6}$ (it should be noted that this first risk standard of 1.0×10^{-6} or one-in-a-million has largely been replaced by the EPA with standards that are 10 and 100 times less stringent). EPA has no concern with hazard indices that are below 1.0, which is more than 100 times bigger than the largest value shown on FIGURE 5B.

I have included all of the input data for all aspects of the modeling and the highlights of the output data in two tables at the end of these modeling figures.

For a very unlikely future residential scenario, where an adult lived in a basement home for what the EPA considers a typical exposure scenario, basement resident versions of many of these same figures follow. Discussion of these figures will be limited to differences from the worker scenario.

BASEMENT RESIDENCE FIGURE 2A -- Notice the inclusion of an indoor air exposure pathway.

BASEMENT RESIDENCE FIGURE 3B -- This figure now includes a basement home.

BASEMENT RESIDENCE FIGURE 3D -- The lens is now finite and has default values from the sandy loam database.

BASEMENT RESIDENCE FIGURE 3E -- Notice the addition of one meter of fill and topsoil in transforming the site into a residence.

BASEMENT RESIDENCE FIGURE 3G -- Water content under house is a new variable.

BASEMENT RESIDENCE FIGURE 3 NEW -- These crucial basement home data are unknown for this hypothetical model. The equations are very conservative as well. The result is a scenario that is unrepresentative of reality. Research that should lead to a better understanding of the actual vapor flux into a basement home is widespread as witnessed by last year's Petroleum Hydrocarbon Conference technical sessions that pointed out the various problems with current models including the RISC indoor air models that are used here. Therefore, irrespective of whether or not one would build a home of any type on the site, much less a basement home, the RISC program has a model that will be changed once the EPA recognizes the correct model to substitute.

BASEMENT RESIDENCE FIGURE 3I -- Somewhat lower outdoor air concentrations due to the one meter topsoil for the residence.

BASEMENT RESIDENCE FIGURE 3J -- Somewhat more persistent soil concentrations due to the topsoil.

BASEMENT RESIDENCE FIGURE 3K -- Somewhat lower volatilization losses due to the topsoil.

BASEMENT RESIDENCE FIGURE 3L -- Somewhat lower cumulative volatilization losses due to the topsoil.

BASEMENT RESIDENCE FIGURE 3 NEW -- Notice the soil concentrations for the indoor air calculations not diminishing with time.

BASEMENT RESIDENCE FIGURE 3 NEW -- Vapor flux as a function of modeled time going into the basement.

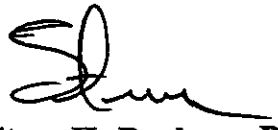
BASEMENT RESIDENCE FIGURE 3 NEW -- Rather constant air concentrations of BETX in the basement breathing space as a function of modeled time.

BASEMENT RESIDENCE FIGURE 4A -- Figure showing the typical adult resident as the new receptor.

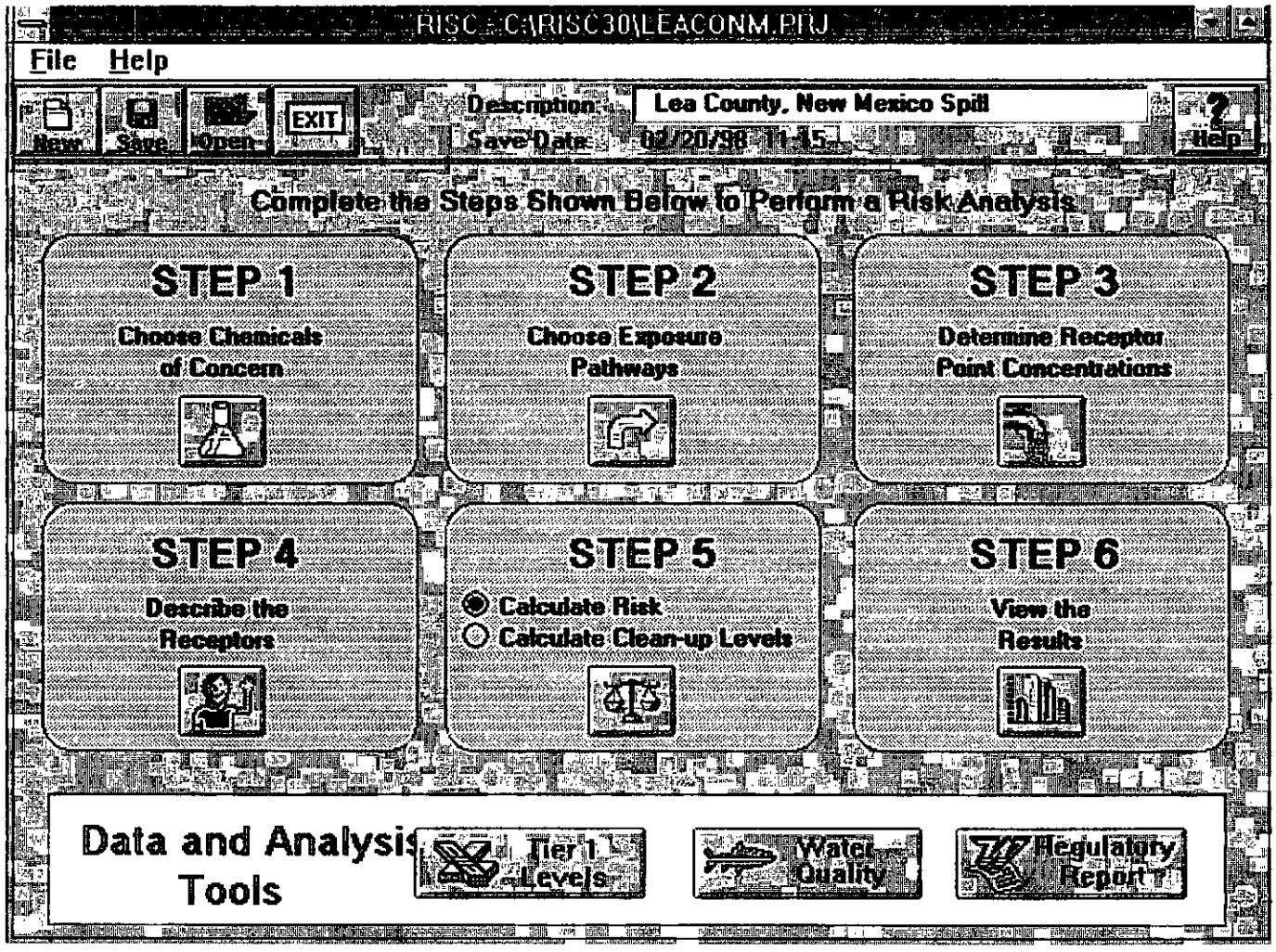
BASEMENT RESIDENCE FIGURE 4B and 4C -- For these two figures, notice the person lives in the house for 16 hours each day, only taking a vacation for two weeks during the year, ...etc...

BASEMENT RESIDENCE FIGURE 5A and 5B -- Notice for both the carcinogenic risk and the non-carcinogenic hazard indices, the only exposure route that is troublesome is the unrealistic calculations for risk and HI for the indoor air in the basement as discussed previously. The other exposure routes, which do not show up well at this graphical scale, can be found in the tables that follow to all be less than 1.0×10^{-7}.

Sincerely,



Steve H. Danbom, Ph.D.
Senior Consultant
Remediation Technology


RISC - C:\RISC30\LEACONM.PRJ
File Help
New
Save
Open
EXIT
Description:
Lea County, New Mexico Spill
Save Date:
02/20/98 11:45
Help
Complete the Steps Shown Below to Perform a Risk Analysis
STEP 1
Choose Chemicals of Concern
STEP 2
Choose Exposure Pathways
STEP 3
Determine Receptor Point Concentrations
STEP 4
Describe the Receptors
STEP 5
Calculate Risk
Calculate Clean-up Levels
STEP 6
View the Results
Data and Analysis Tools
Tier 1 Levels
Water Quality
Regulatory Report

1ST SCREEN

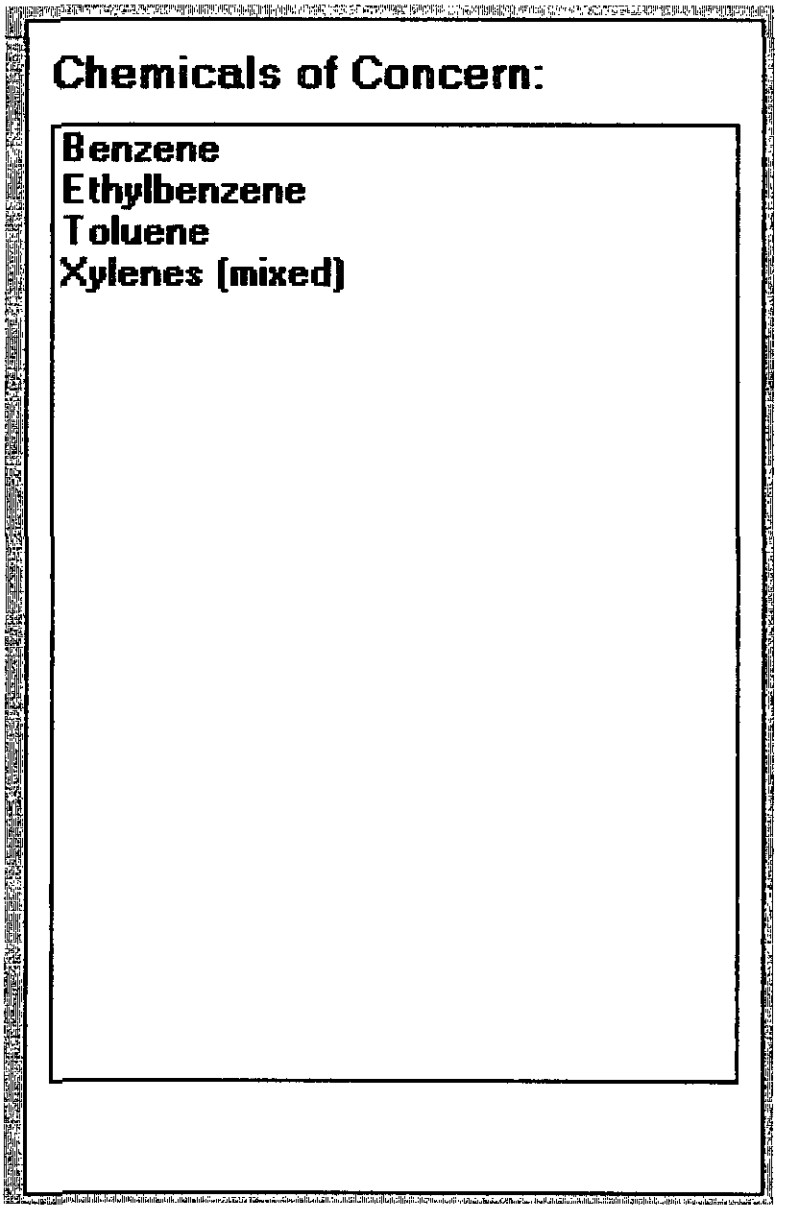

Chemicals of Concern:
Benzene
Ethylbenzene
Toluene
Xylenes (mixed)

FIGURE 1A

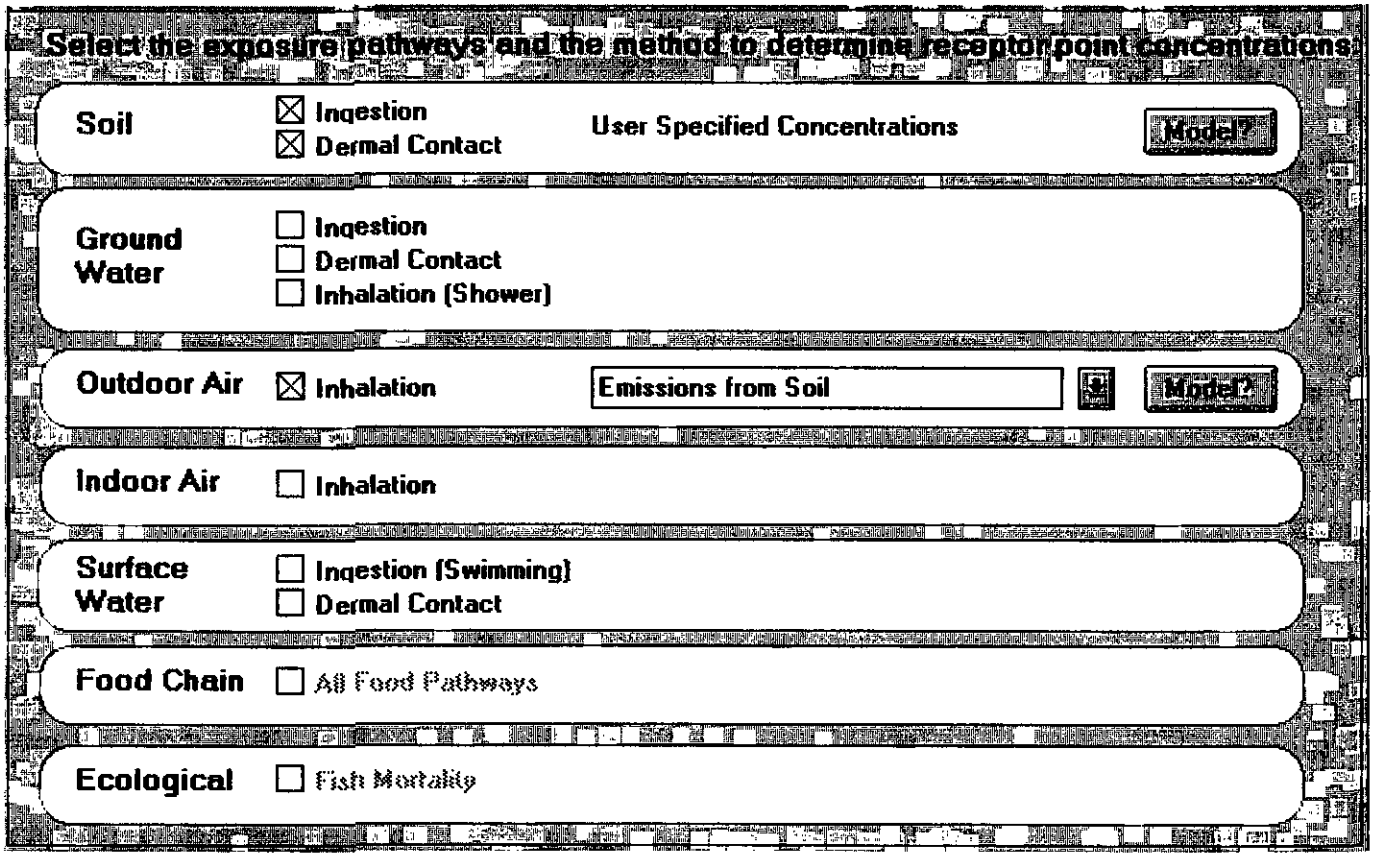

Select the exposure pathways and the method to determine receptor point concentrations:
Soil
Ingestion
Dermal Contact
User Specified Concentrations
Model?
Ground Water
Ingestion
Dermal Contact
Inhalation (Shower)
Outdoor Air
Inhalation
Emissions from Soil
Model?
Indoor Air
Inhalation
Surface Water
Ingestion (Swimming)
Dermal Contact
Food Chain
All Food Pathways
Ecological
Fish Mortality

FIGURE 2A

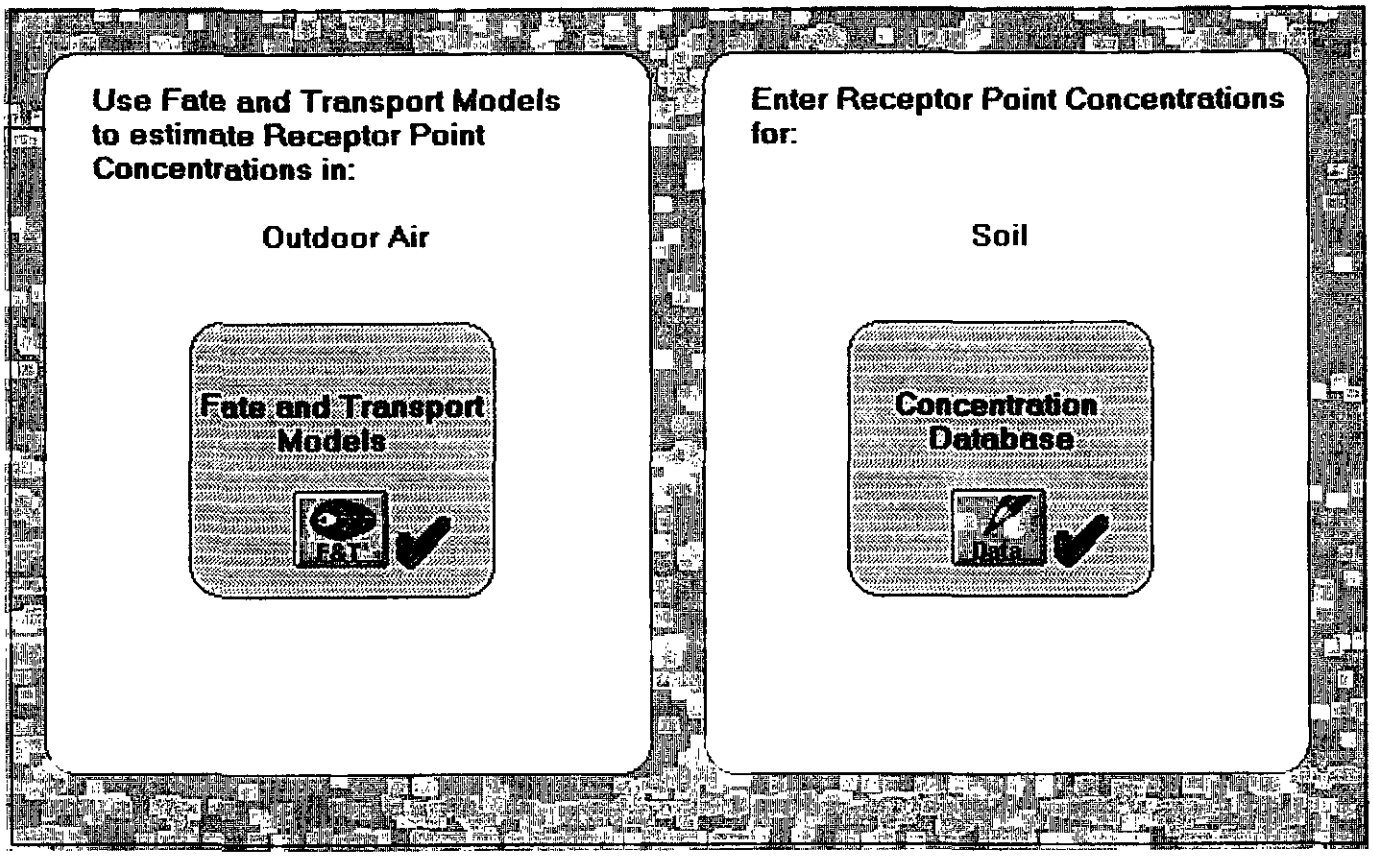

Use Fate and Transport Models to estimate Receptor Point Concentrations in:
Outdoor Air
Fate and Transport Models
F&T
Enter Receptor Point Concentrations for:
Soil
Concentration Database
Data

FIGURE 3A

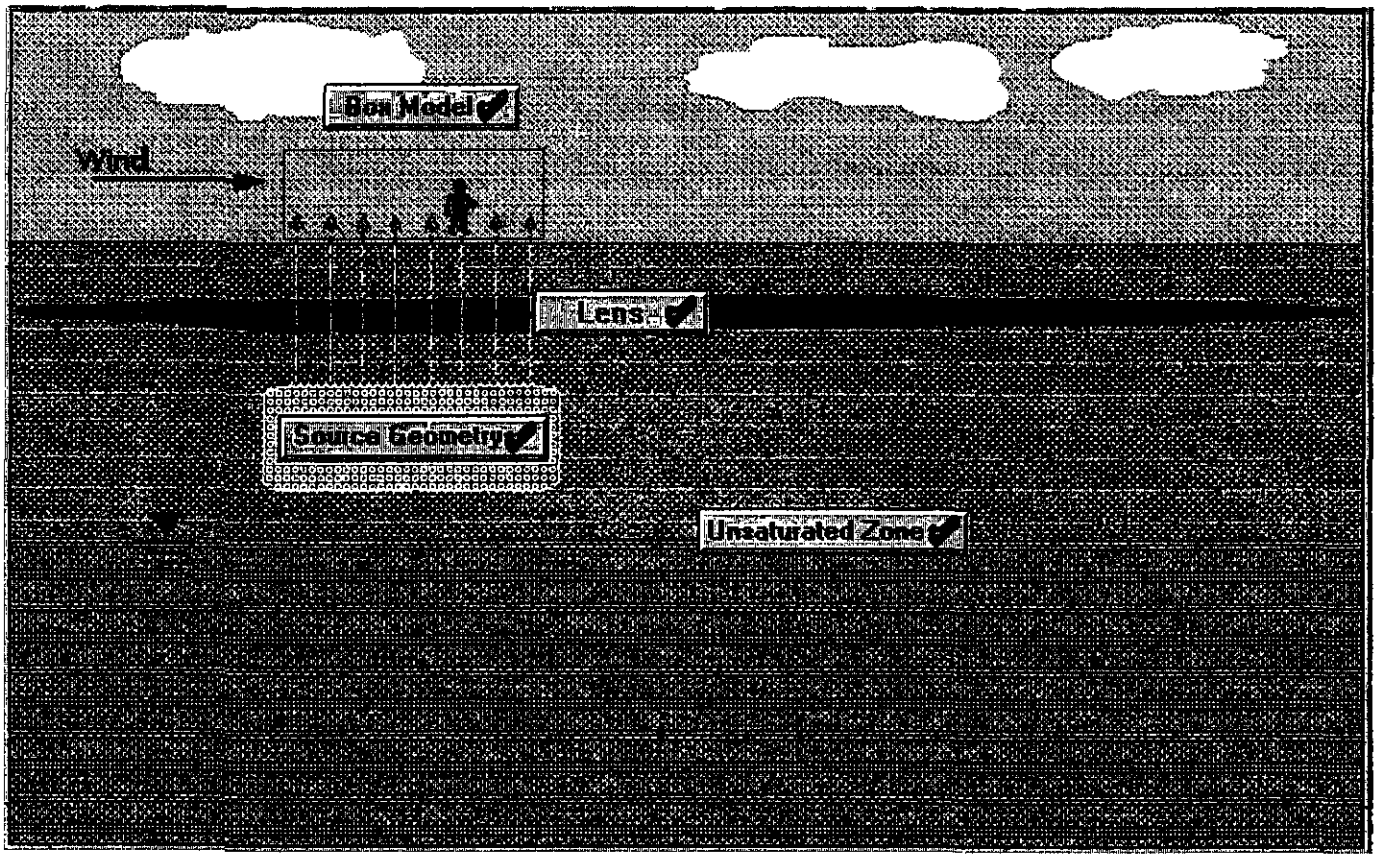


FIGURE 3B

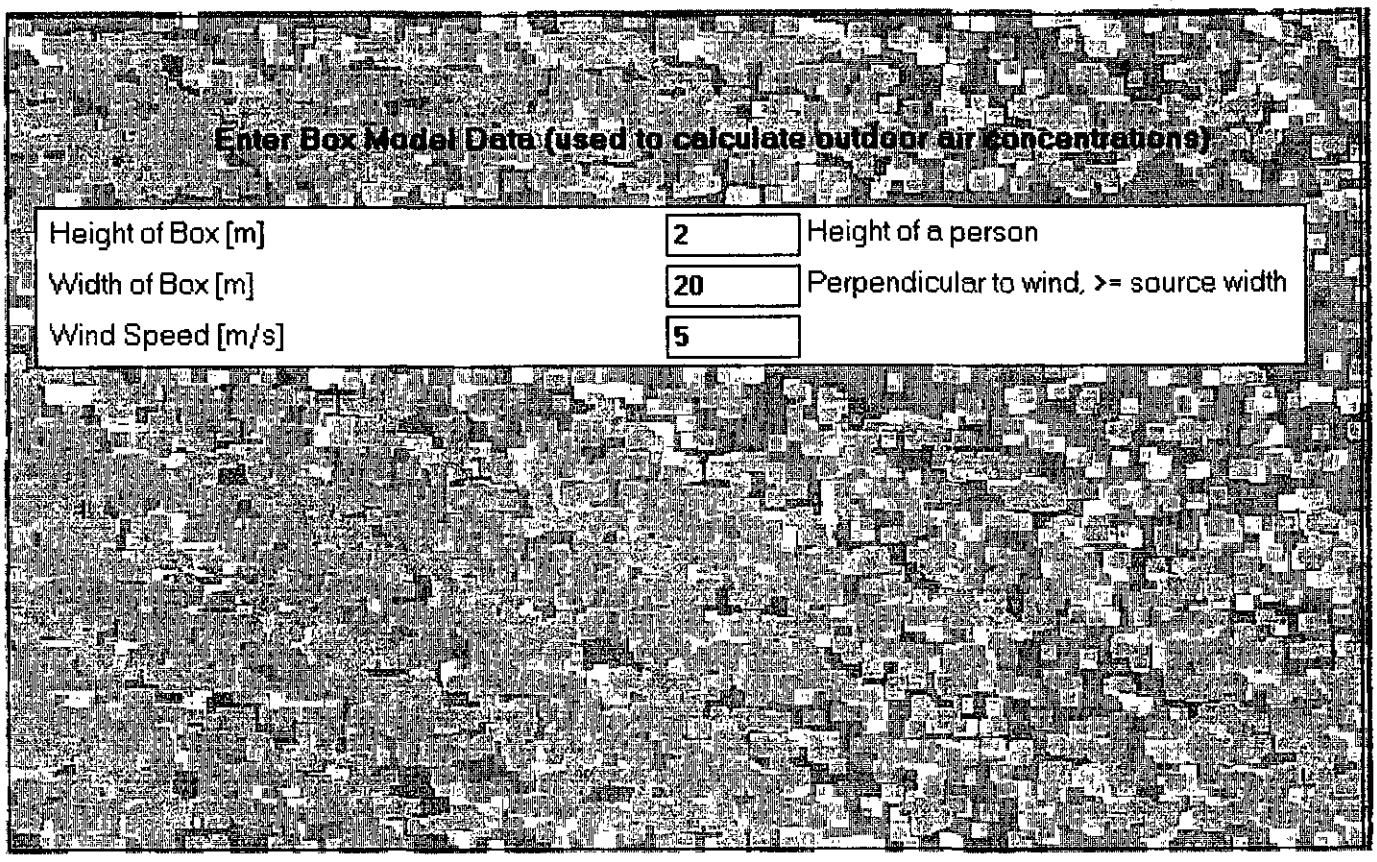

Enter Box Model Data (used to calculate outdoor air concentrations)
Height of Box [m]
2
Height of a person
Width of Box [m]
20
Perpendicular to wind, >= source width
Wind Speed [m/s]
5

FIGURE 3C

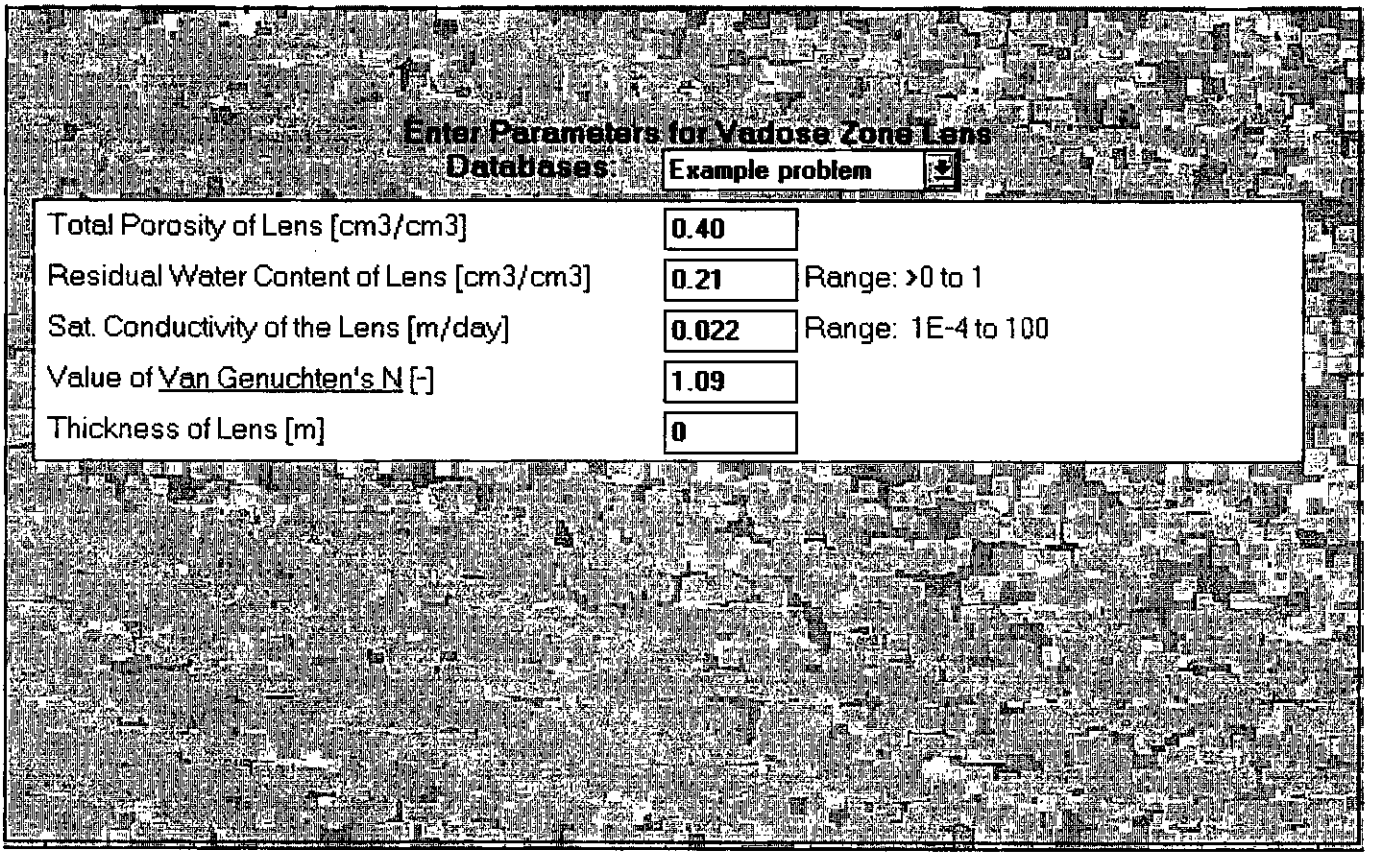

Enter Parameters for Vadose Zone Lens
Databases:
Example problem
Total Porosity of Lens [cm3/cm3]
0.40
Residual Water Content of Lens [cm3/cm3]
0.21
Range: >0 to 1
Sat. Conductivity of the Lens [m/day]
0.022
Range: 1E-4 to 100
Value of Van Genuchten's N [-]
1.09
Thickness of Lens [m]
0

FIGURE 3D

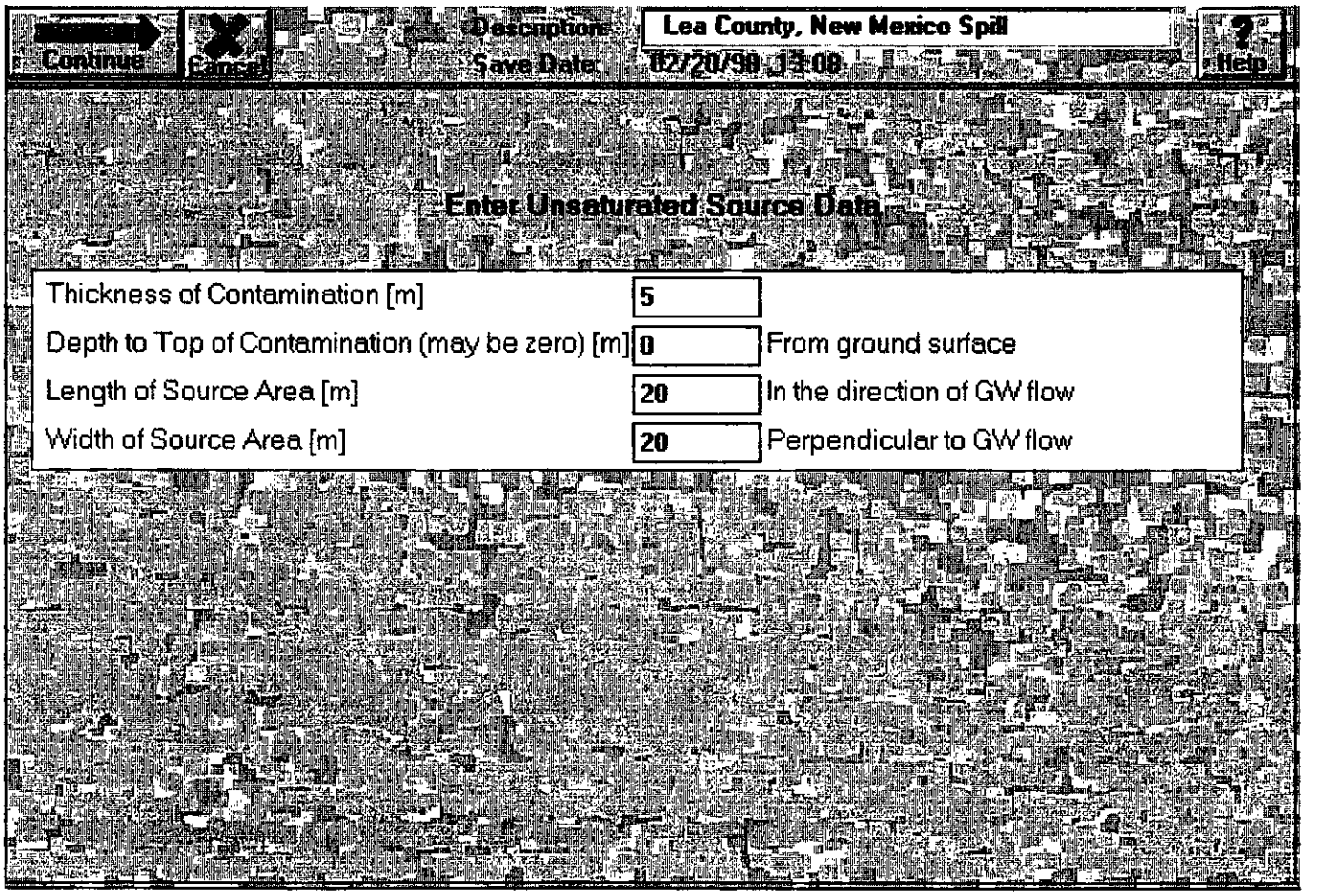

Continue
Cancel
Description:
Lea County, New Mexico Spill
Save Date:
02/20/98 13:08
Help
Enter Unsaturated Source Data
Thickness of Contamination [m]
5
Depth to Top of Contamination (may be zero) [m]
0
From ground surface
Length of Source Area [m]
20
In the direction of GW flow
Width of Source Area [m]
20
Perpendicular to GW flow

FIGURE 3E

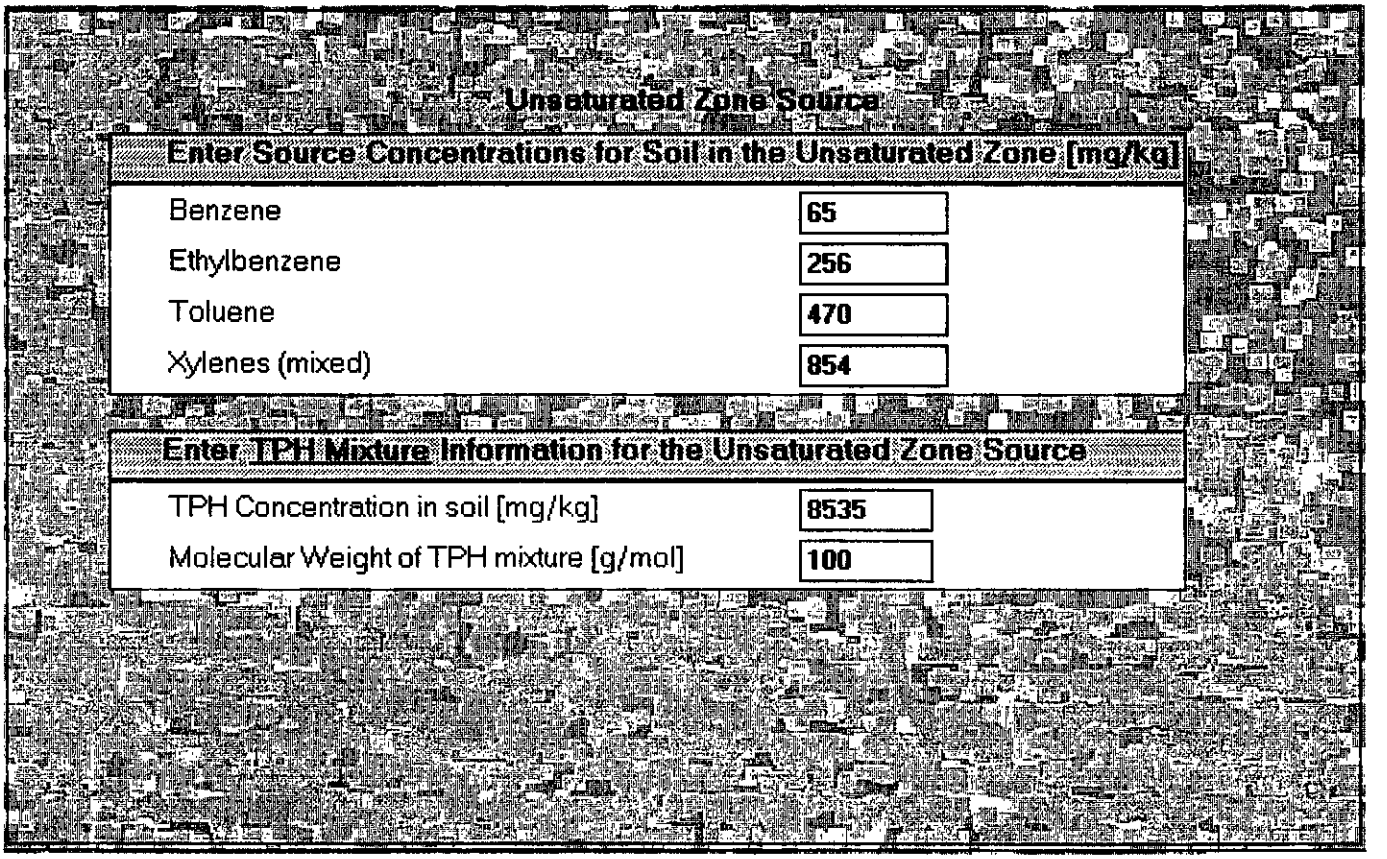

Unsaturated Zone Source
Enter Source Concentrations for Soil in the Unsaturated Zone [mg/kg]
Benzene
65
Ethylbenzene
256
Toluene
470
Xylenes (mixed)
854
Enter TPH Mixture Information for the Unsaturated Zone Source
TPH Concentration in soil [mg/kg]
8535
Molecular Weight of TPH mixture [g/mol]
100

FIGURE 3F

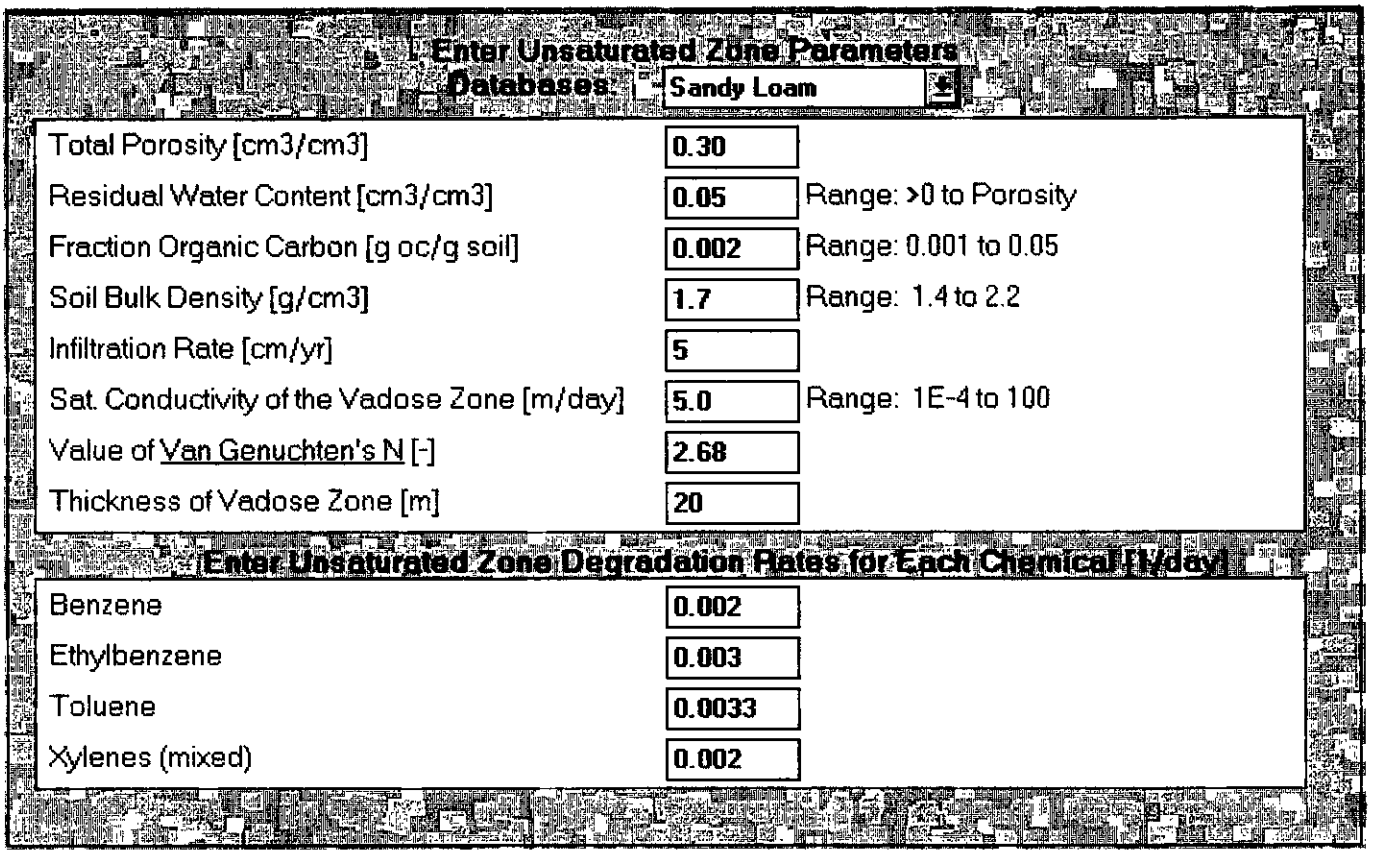

Enter Unsaturated Zone Parameters
Databases
Sandy Loam
Total Porosity [cm3/cm3]
0.30
Residual Water Content [cm3/cm3]
0.05
Range: >0 to Porosity
Fraction Organic Carbon [g oc/g soil]
0.002
Range: 0.001 to 0.05
Soil Bulk Density [g/cm3]
1.7
Range: 1.4 to 2.2
Infiltration Rate [cm/yr]
5
Sat. Conductivity of the Vadose Zone [m/day]
5.0
Range: 1E-4 to 100
Value of Van Genuchten's N [-]
2.68
Thickness of Vadose Zone [m]
20
Enter Unsaturated Zone Degradation Rates for Each Chemical [1/day]
Benzene
0.002
Ethylbenzene
0.003
Toluene
0.0033
Xylenes (mixed)
0.002

FIGURE 3G

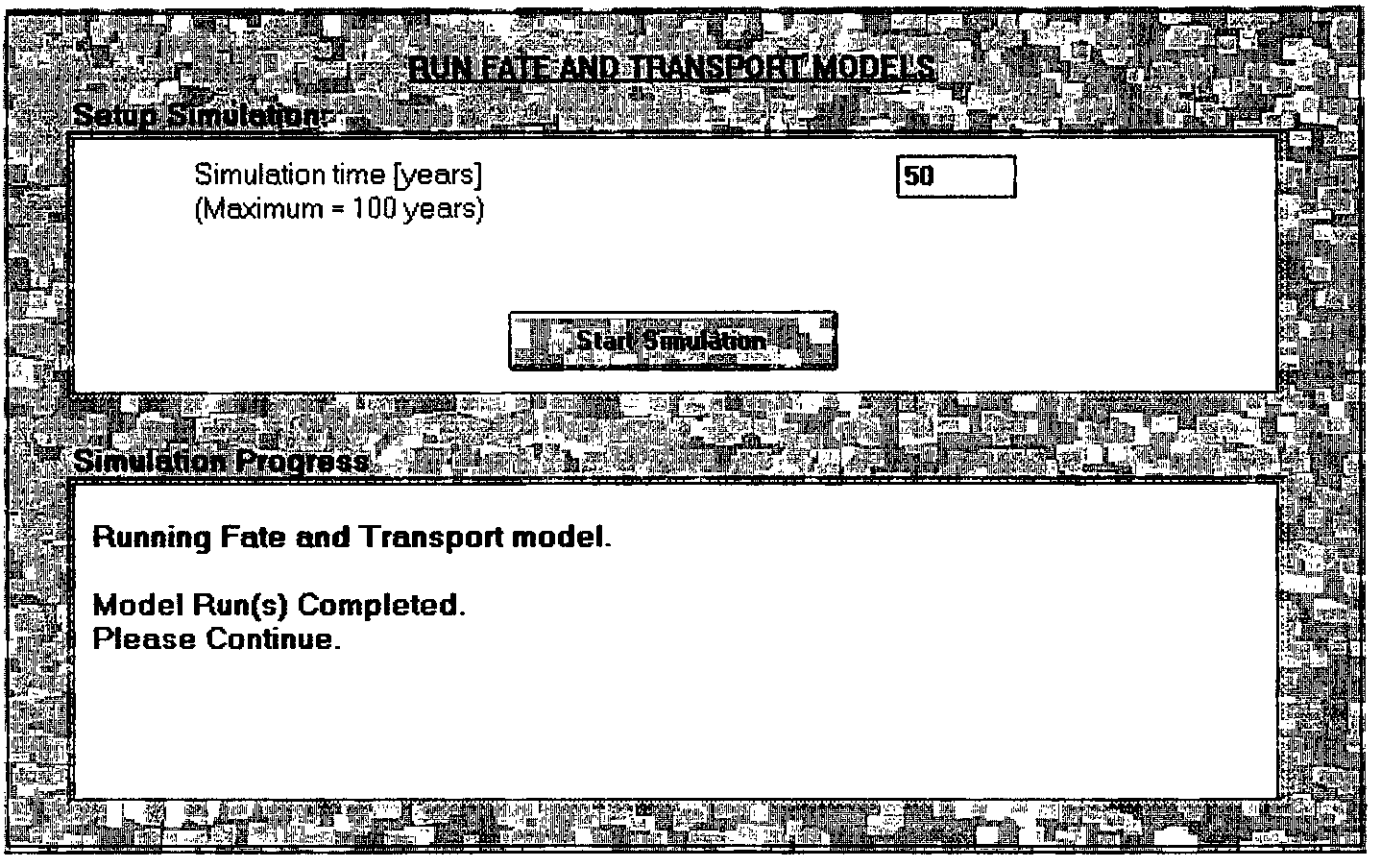

RUN FATE AND TRANSPORT MODELS
Setup Simulation:
Simulation time [years]
(Maximum = 100 years)
50
Start Simulation
Simulation Progress
Running Fate and Transport model.
Model Run(s) Completed.
Please Continue.

FIGURE 3H

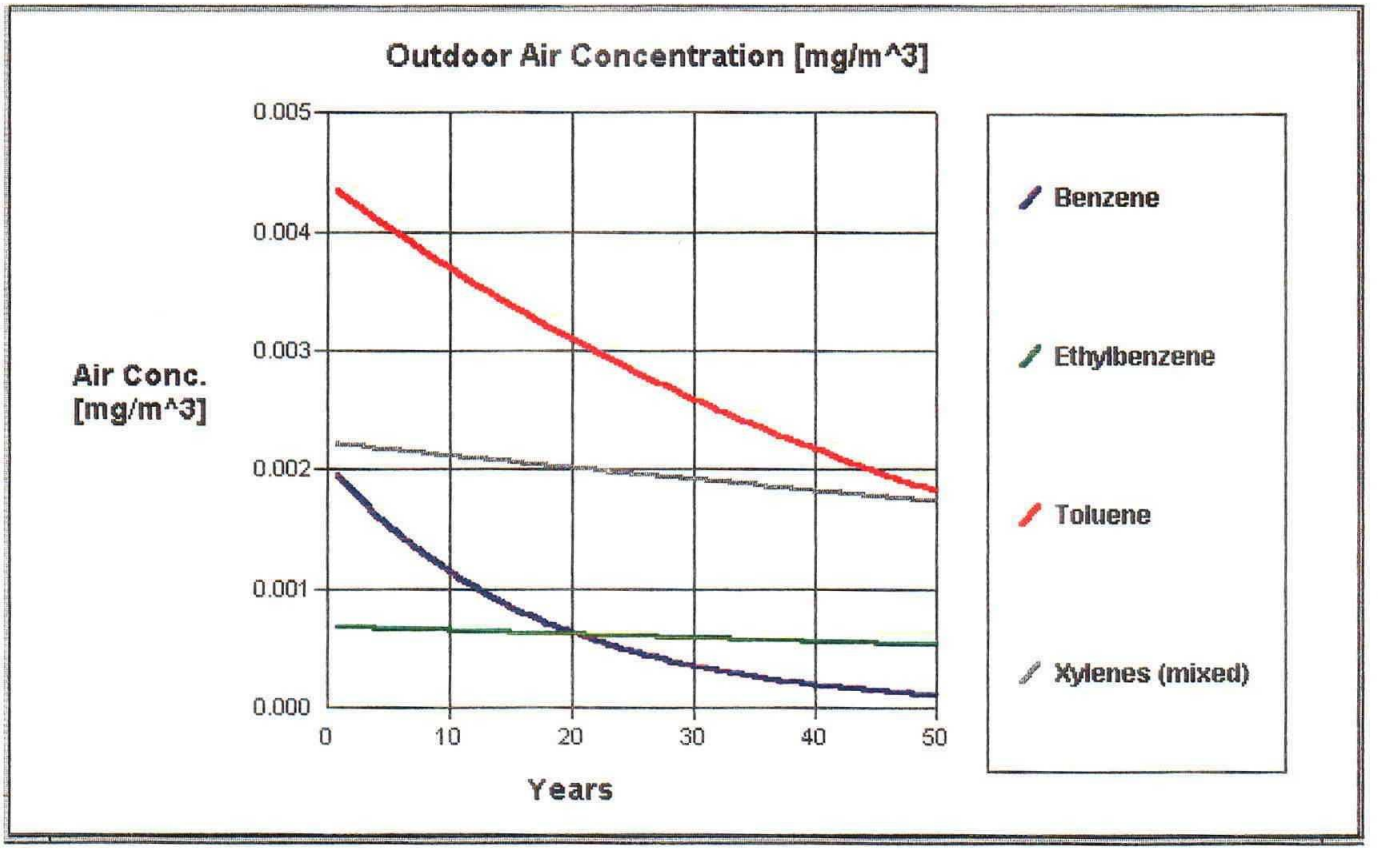

Outdoor Air Concentration [mg/m^3]
Air Conc. [mg/m^3]
0.005
0.004
0.003
0.002
0.001
0.000
0
10
20
30
40
50
Years
Benzene
Ethylbenzene
Toluene
Xylenes (mixed)

FIGURE 3I

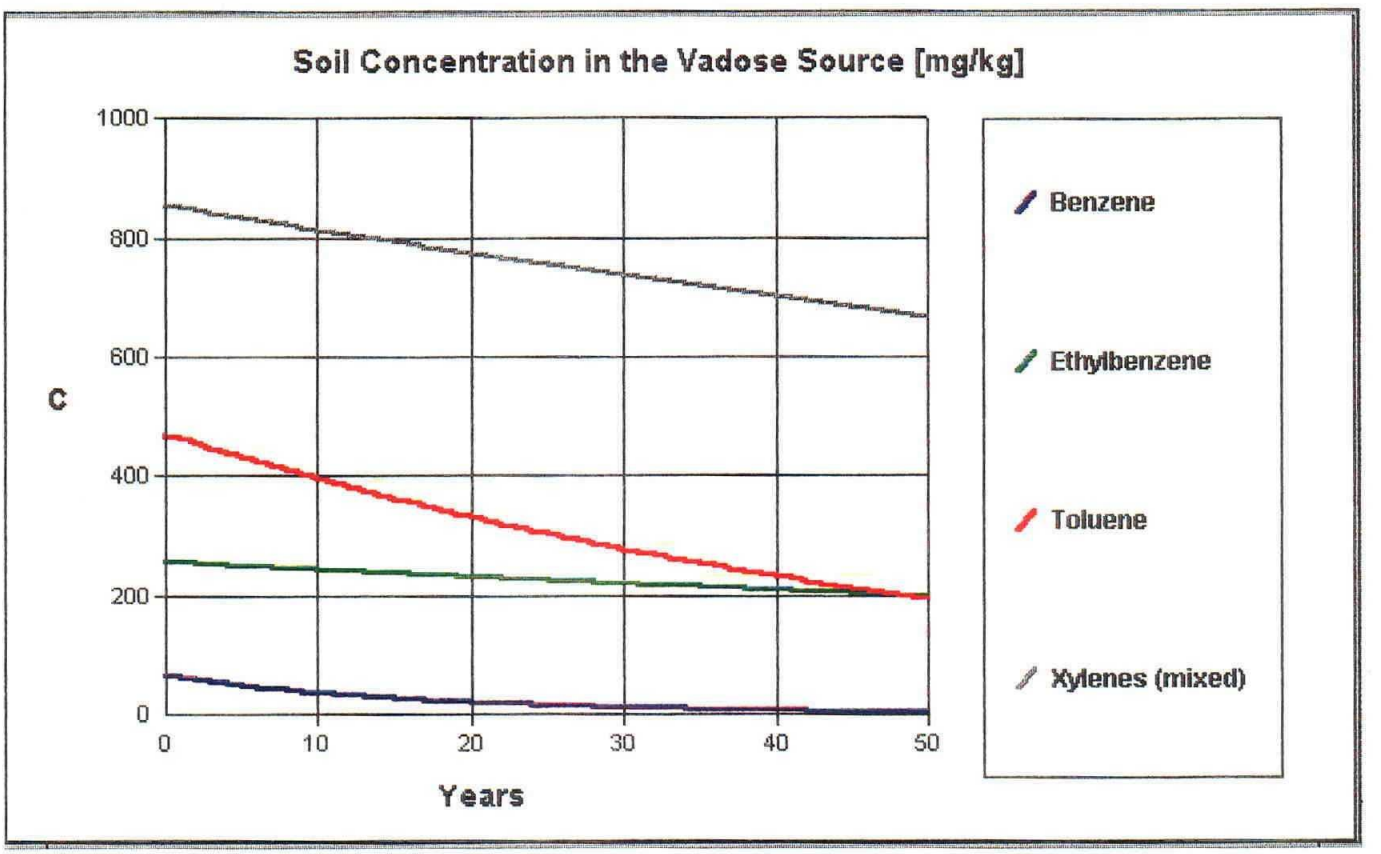

Soil Concentration in the Vadose Source [mg/kg]
1000
800
600
400
200
0
C
0
10
20
30
40
50
Years
Benzene
Ethylbenzene
Toluene
Xylenes (mixed)

FIGURE 3J

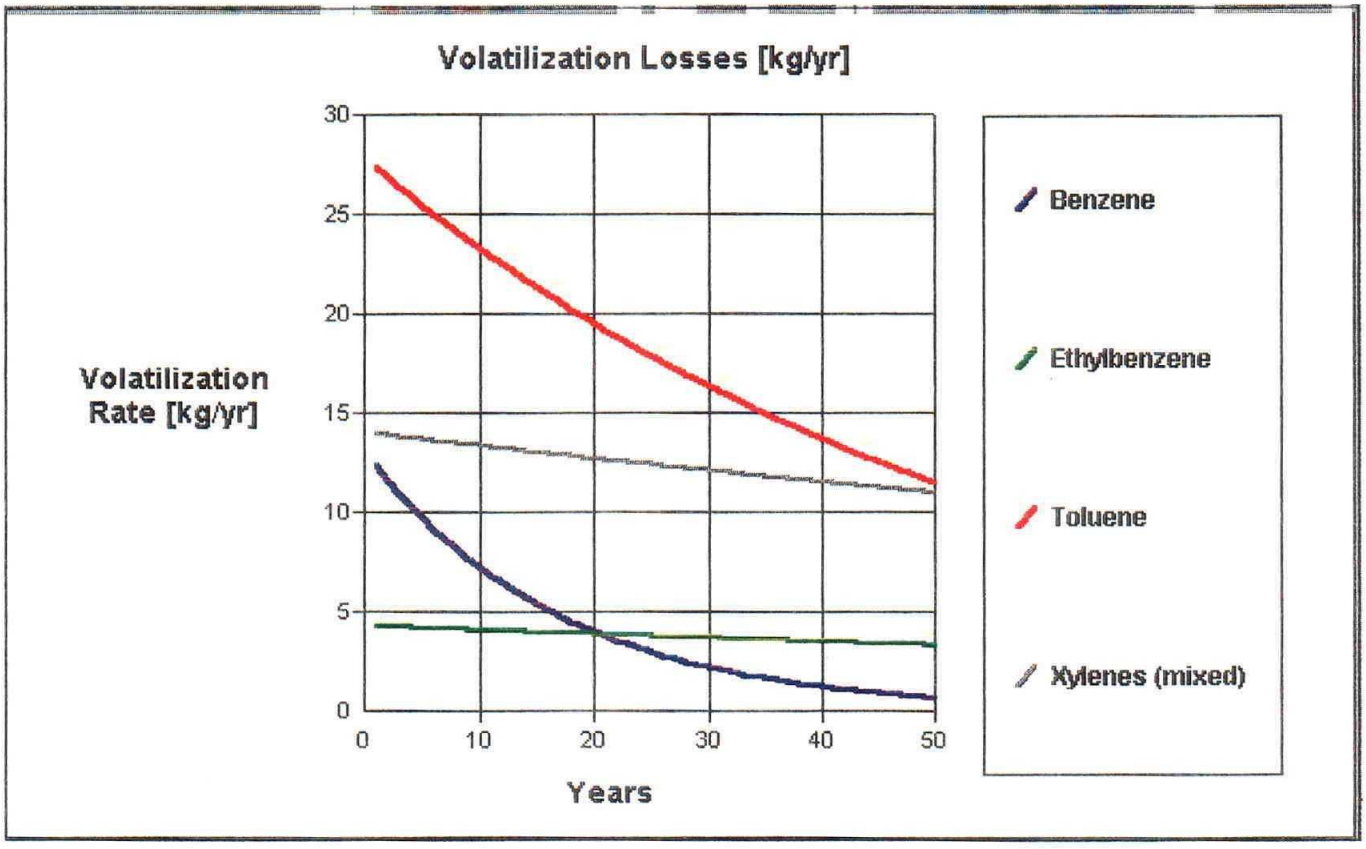

Volatilization Losses [kg/yr]
Volatilization Rate [kg/yr]
30
25
20
15
10
5
0
0
10
20
30
40
50
Years
Benzene
Ethylbenzene
Toluene
Xylenes (mixed)

FIGURE 3K

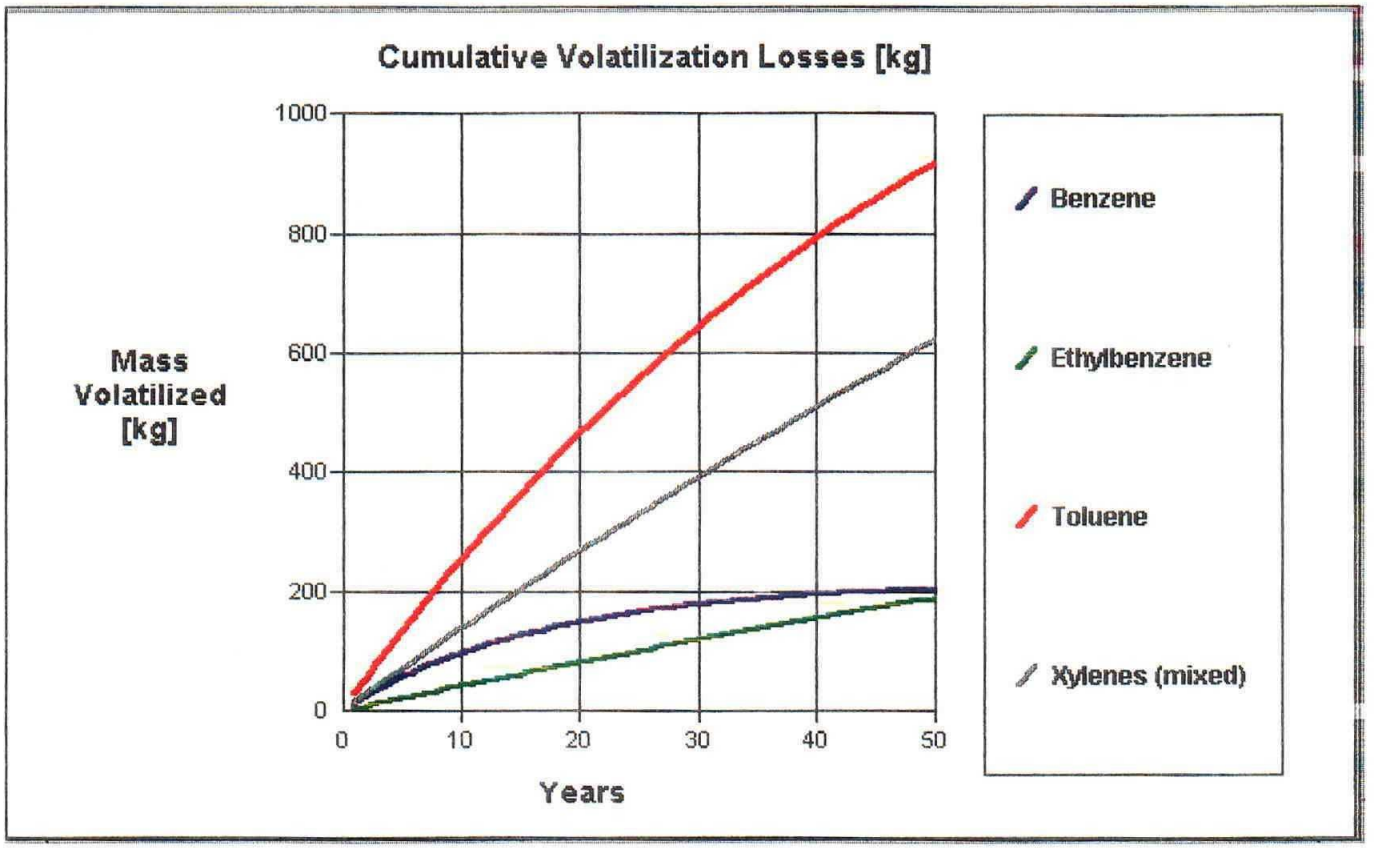

Cumulative Volatilization Losses [kg]
Mass Volatilized [kg]
1000
800
600
400
200
0
0
10
20
30
40
50
Years
Benzene
Ethylbenzene
Toluene
Xylenes (mixed)

FIGURE 3L

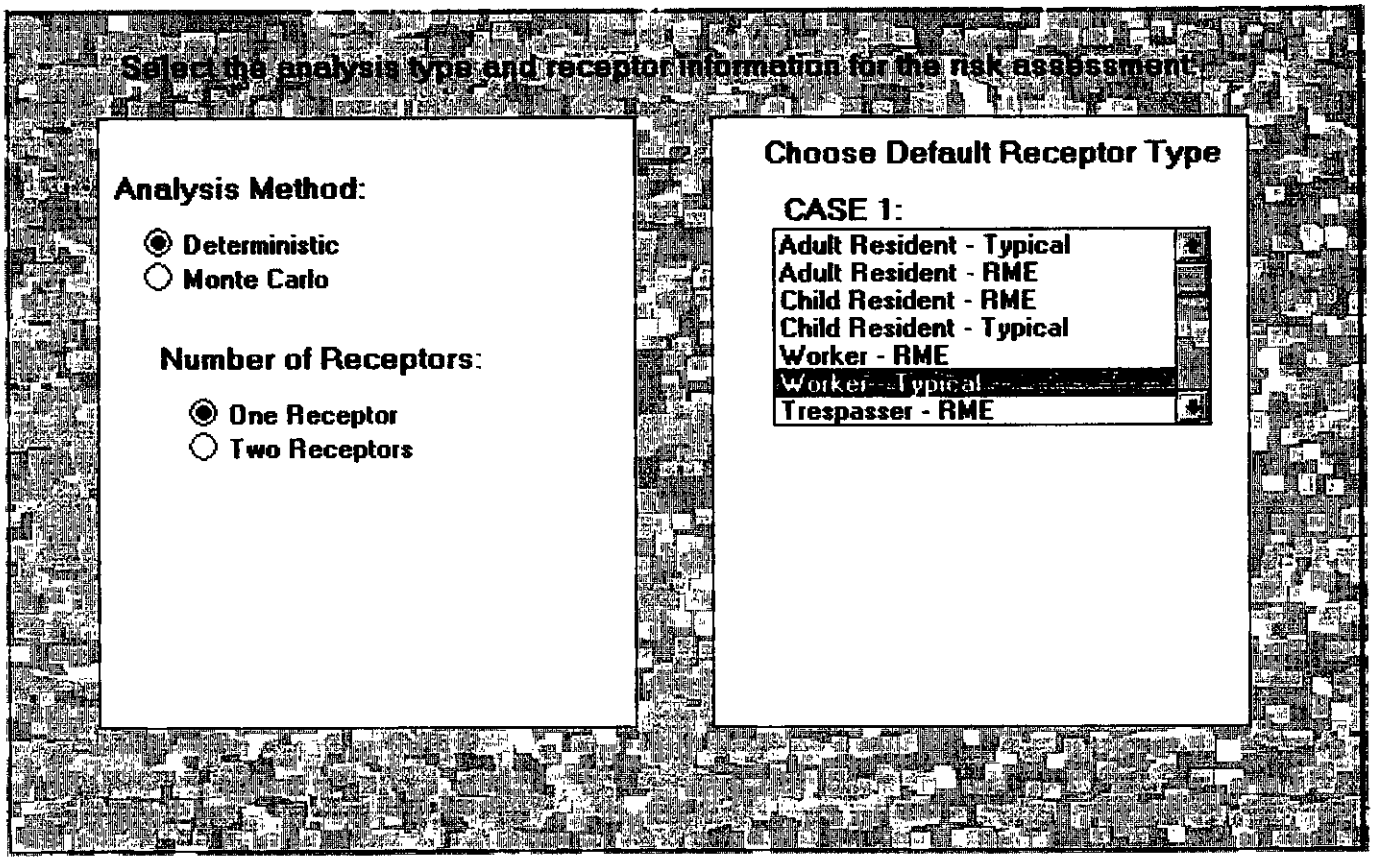

Select the analysis type and receptor information for the risk assessment:
Analysis Method:
Deterministic
Monte Carlo
Number of Receptors:
One Receptor
Two Receptors
Choose Default Receptor Type
CASE 1:
Adult Resident - Typical
Adult Resident - RME
Child Resident - RME
Child Resident - Typical
Worker - RME
Worker - Typical
Trespasser - RME

FIGURE 4A

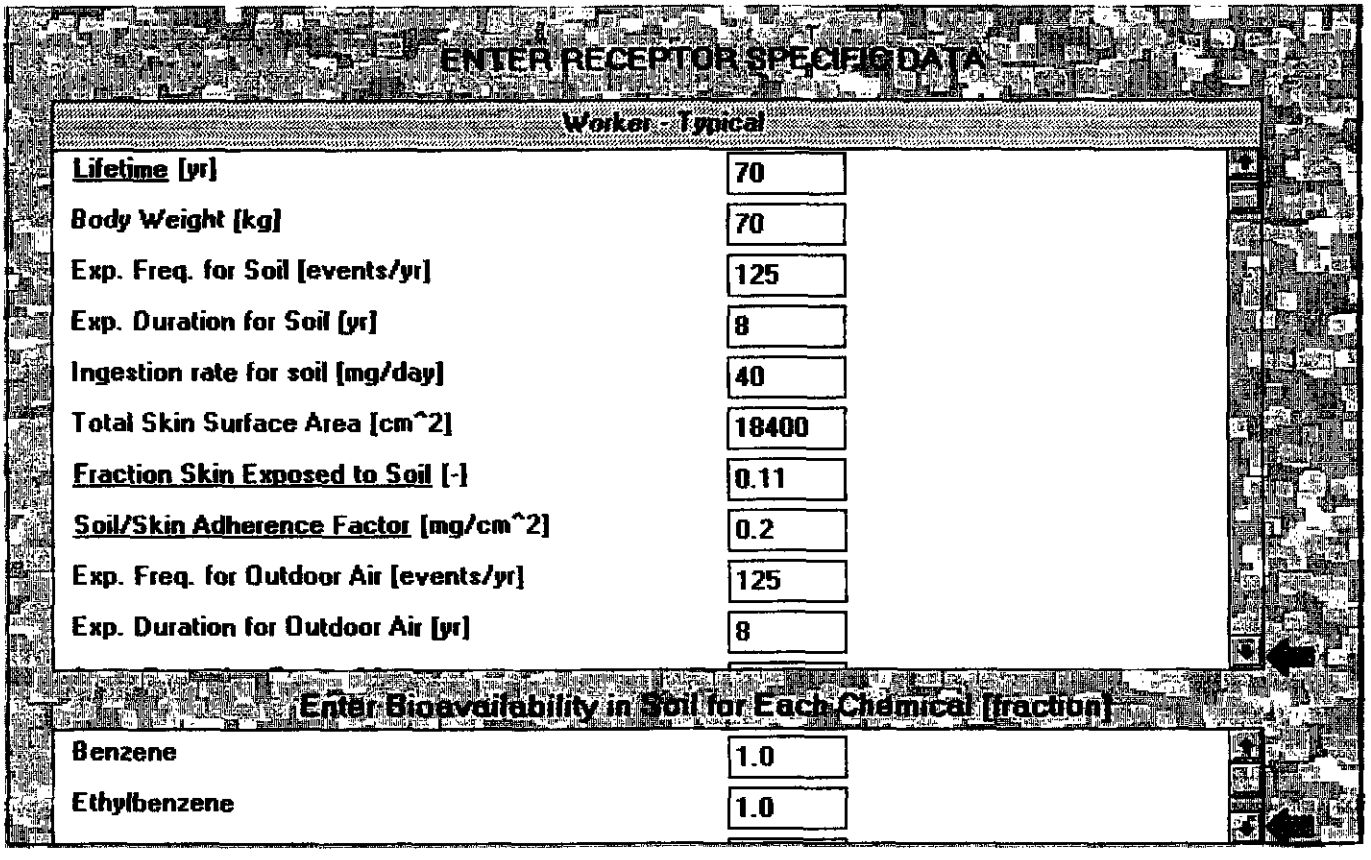

ENTER RECEPTOR SPECIFIC DATA
Worker - Typical
Lifetime [yr] 70
Body Weight [kg] 70
Exp. Freq. for Soil [events/yr] 125
Exp. Duration for Soil [yr] 8
Ingestion rate for soil [mg/day] 40
Total Skin Surface Area [cm^2] 18400
Fraction Skin Exposed to Soil [-] 0.11
Soil/Skin Adherence Factor [mg/cm^2] 0.2
Exp. Freq. for Outdoor Air [events/yr] 125
Exp. Duration for Outdoor Air [yr] 8
Enter Bioavailability in Soil for Each Chemical [fraction]
Benzene 1.0
Ethylbenzene 1.0

FIGURE 4B

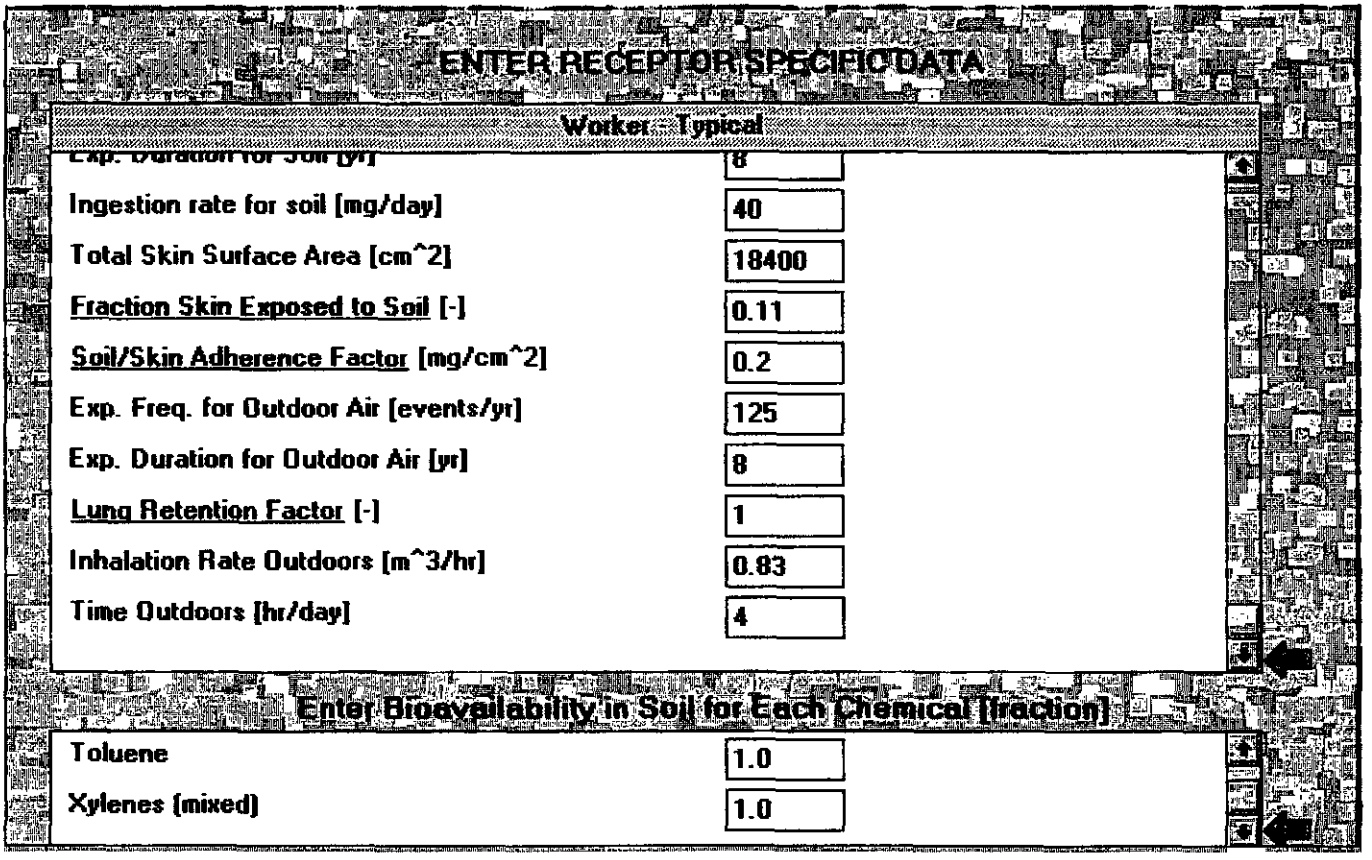

ENTER RECEPTOR SPECIFIC DATA
Worker - Typical
Exp. Duration for Soil [yr]
8
Ingestion rate for soil [mg/day]
40
Total Skin Surface Area [cm^2]
18400
Fraction Skin Exposed to Soil [-]
0.11
Soil/Skin Adherence Factor [mg/cm^2]
0.2
Exp. Freq. for Outdoor Air [events/yr]
125
Exp. Duration for Outdoor Air [yr]
8
Lung Retention Factor [-]
1
Inhalation Rate Outdoors [m^3/hr]
0.83
Time Outdoors [hr/day]
4
Enter Bioavailability in Soil for Each Chemical [fraction]
Toluene
1.0
Xylenes (mixed)
1.0

FIGURE 4C

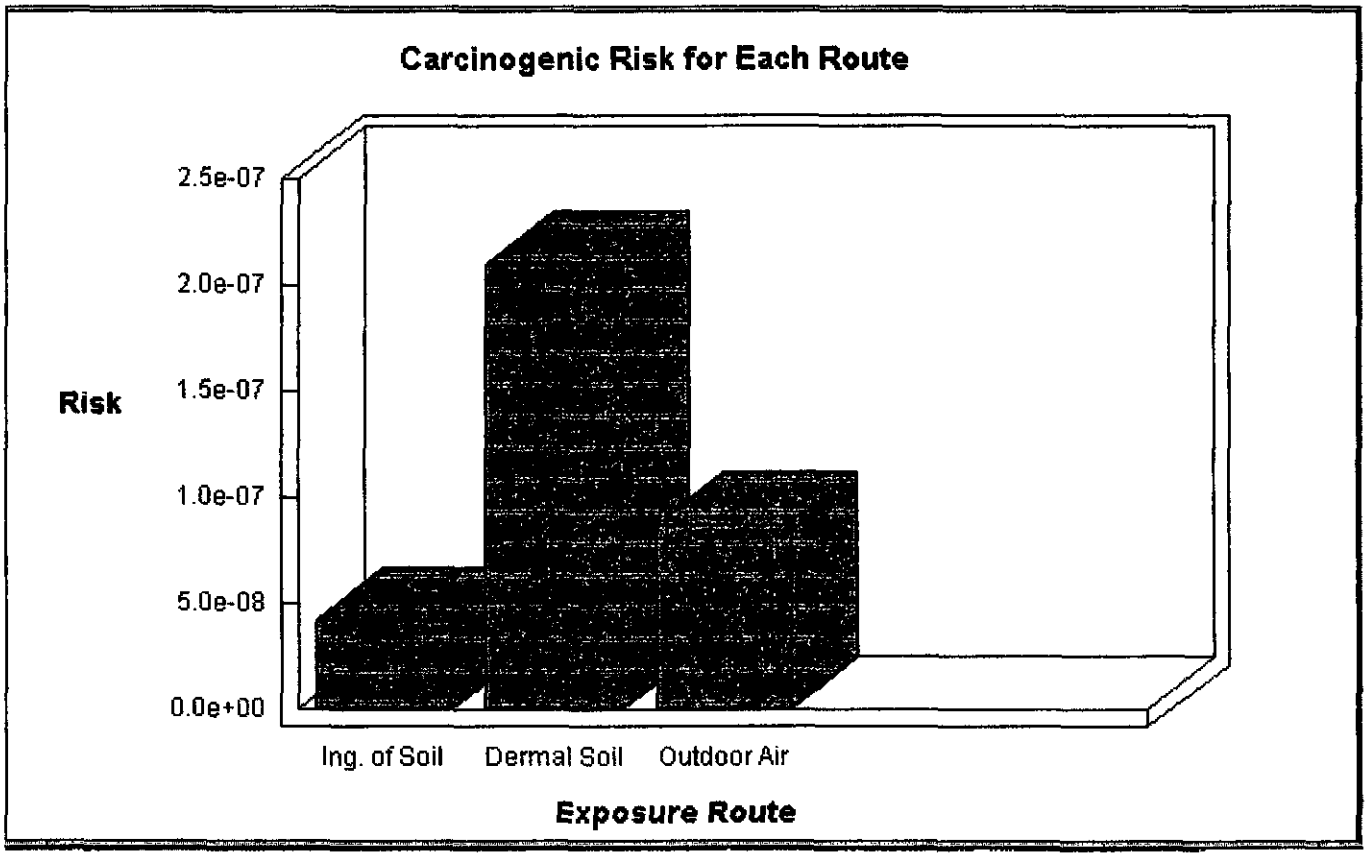

Carcinogenic Risk for Each Route
Risk
2.5e-07
2.0e-07
1.5e-07
1.0e-07
5.0e-08
0.0e+00
Ing. of Soil
Dermal Soil
Outdoor Air
Exposure Route

FIGURE 5A

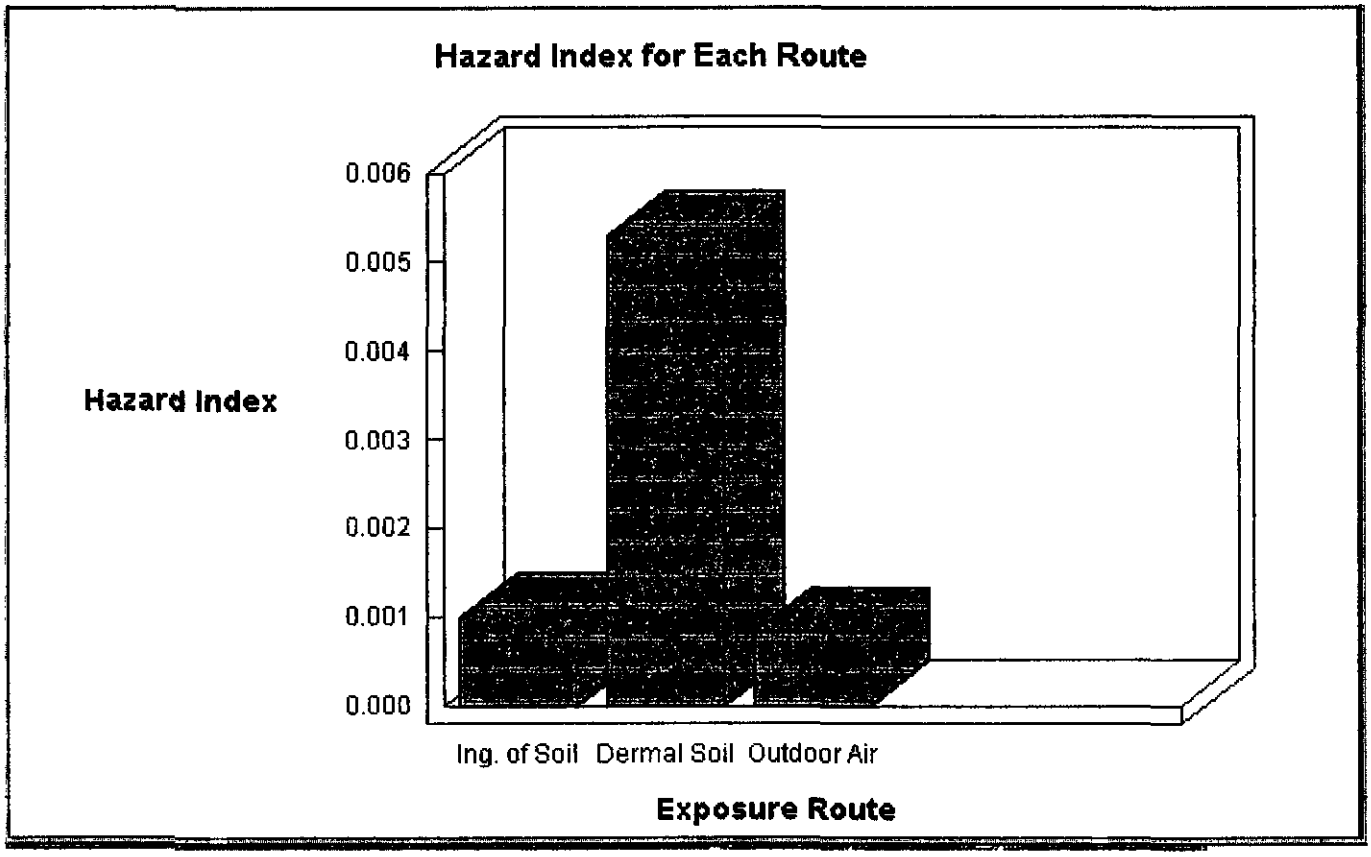
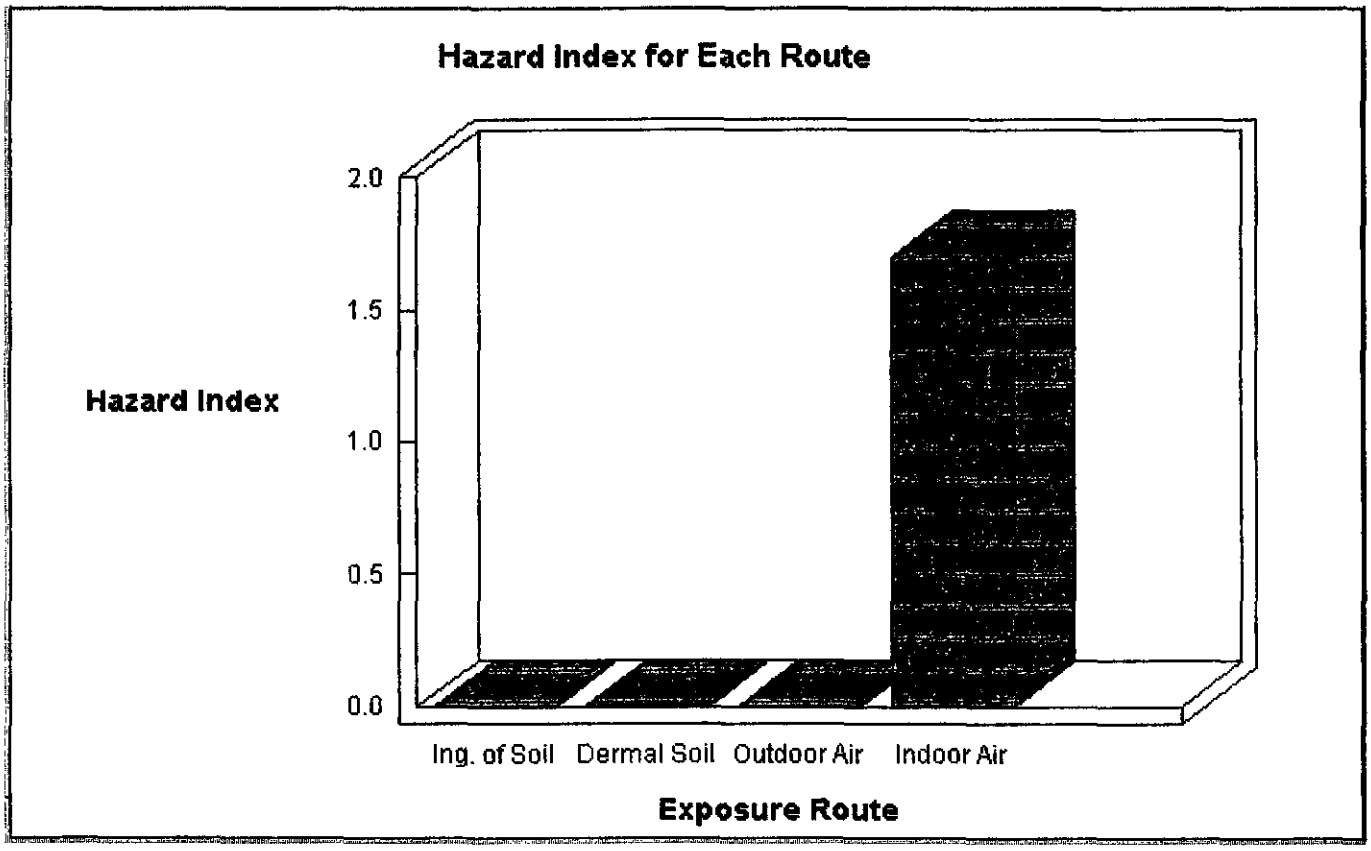
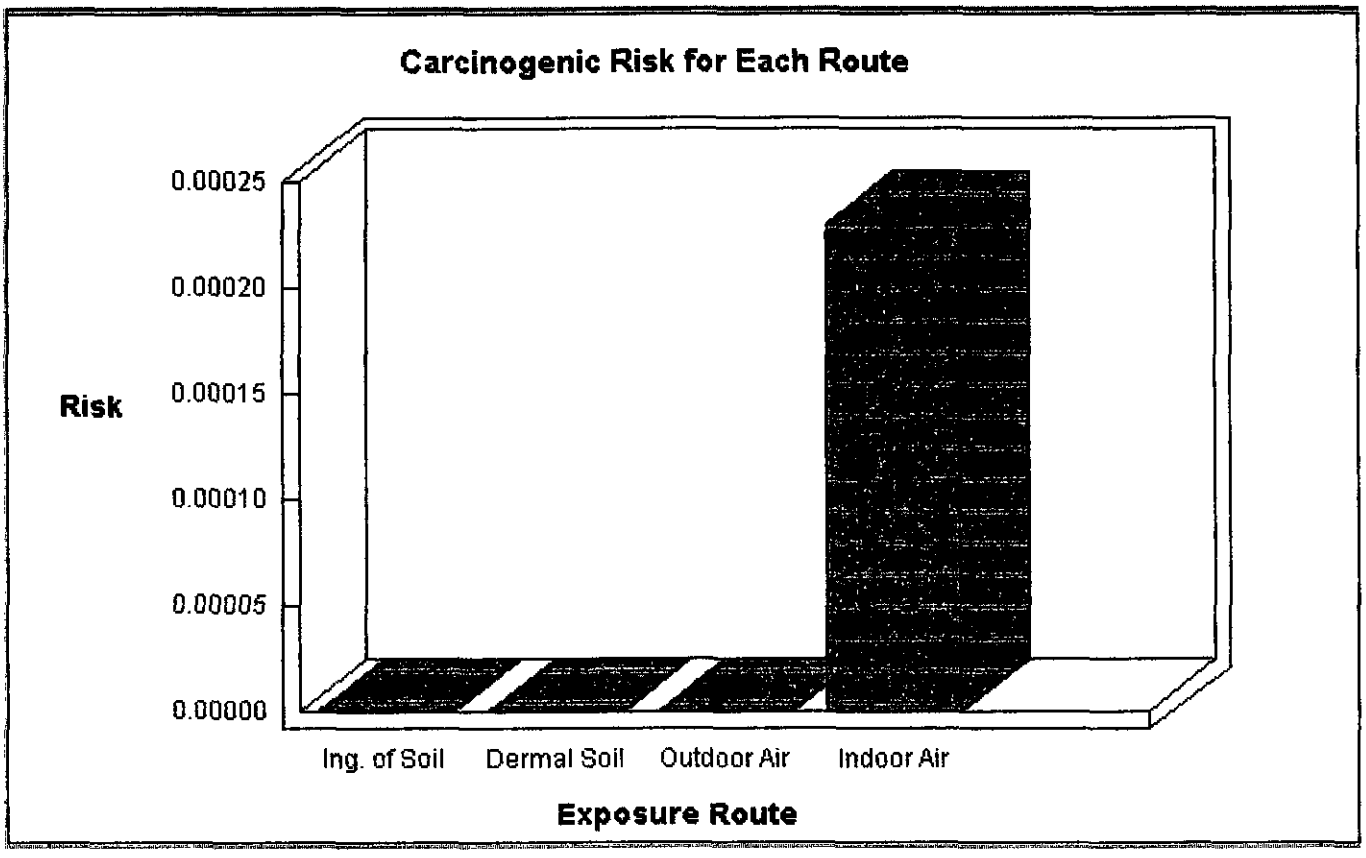

Hazard Index for Each Route
Hazard Index
0.006
0.005
0.004
0.003
0.002
0.001
0.000
Ing. of Soil
Dermal Soil
Outdoor Air
Exposure Route

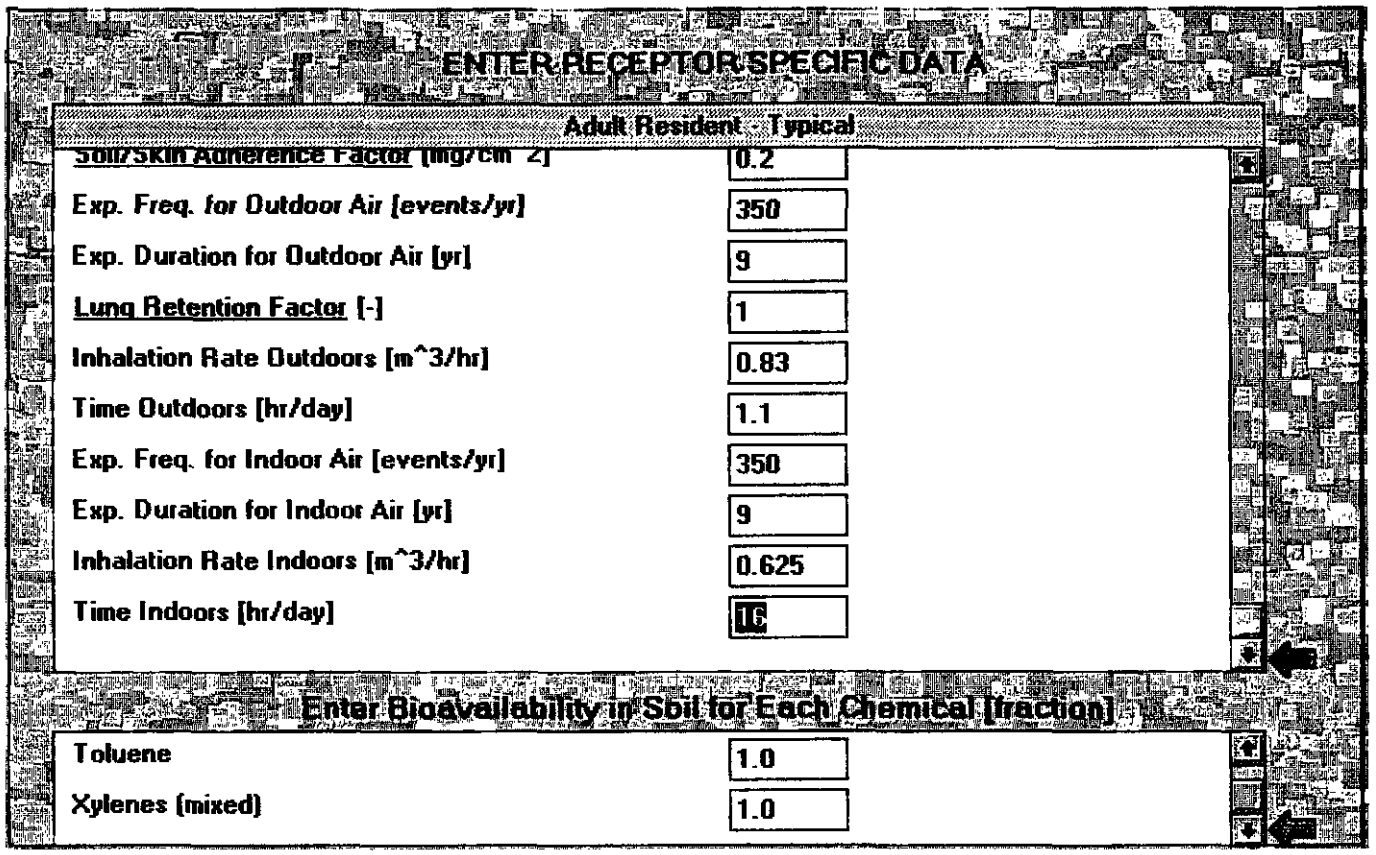
FIGURE 5B



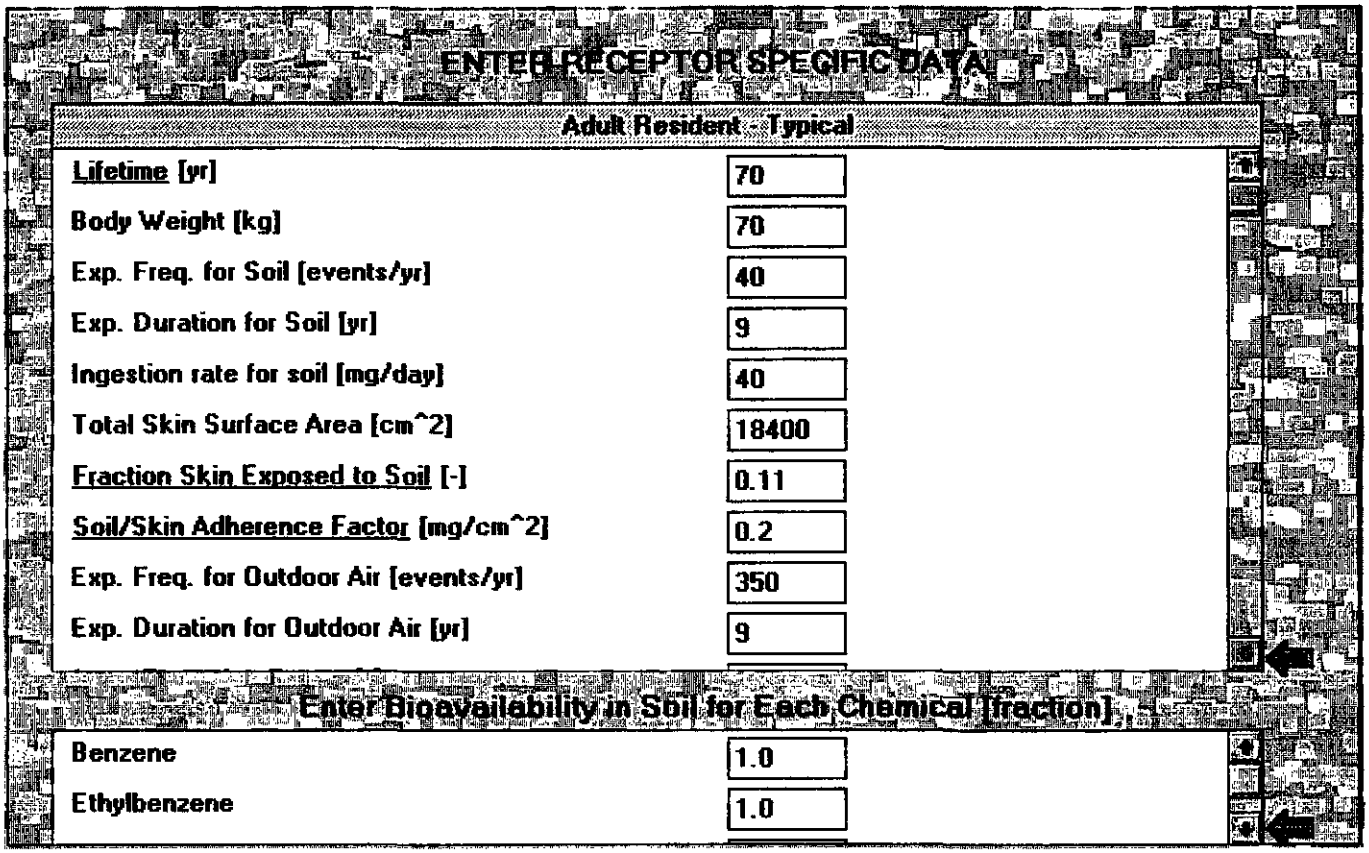
BASEMENT RESIDENCE
FIGURE 5B



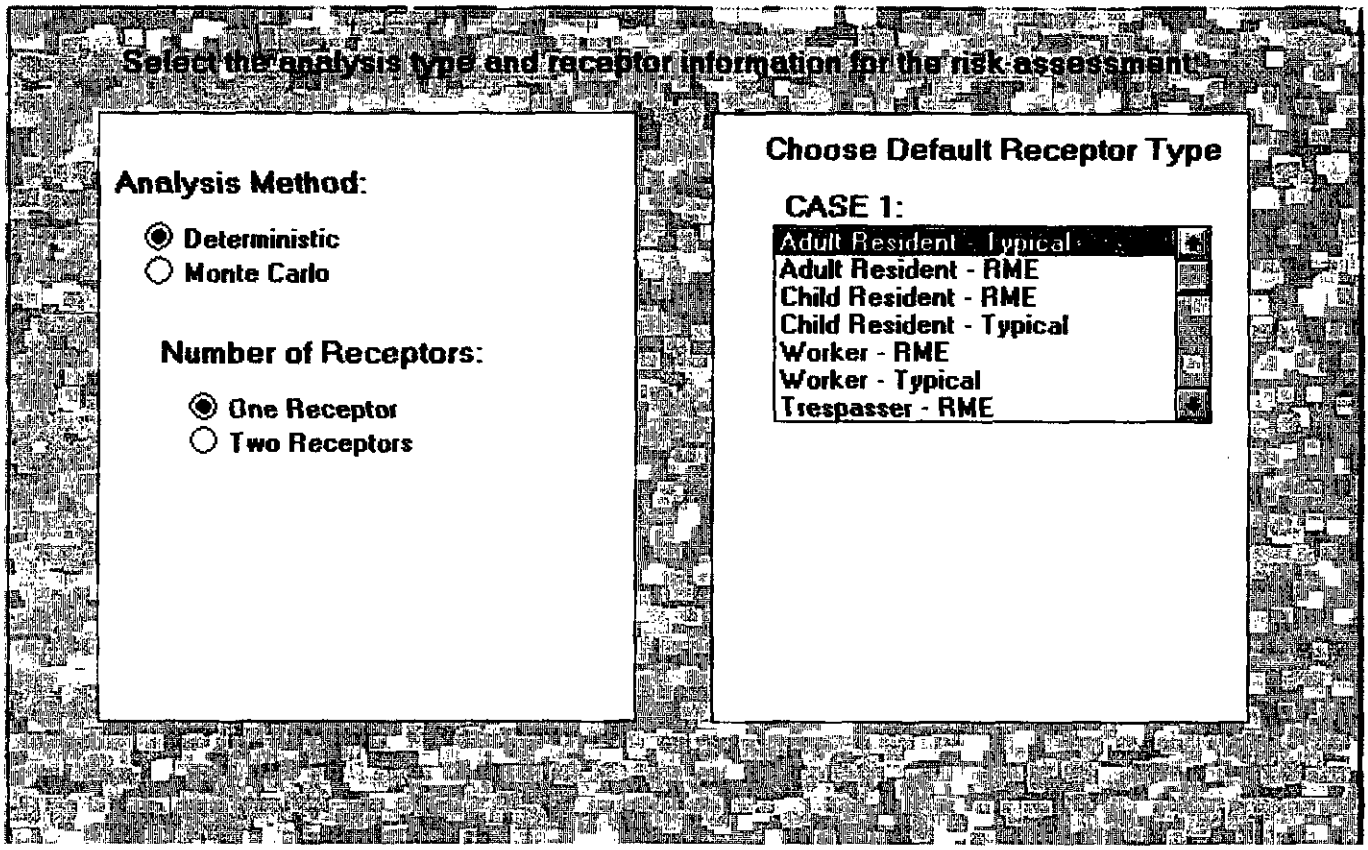
BASEMENT RESIDENCE
FIGURE 5A



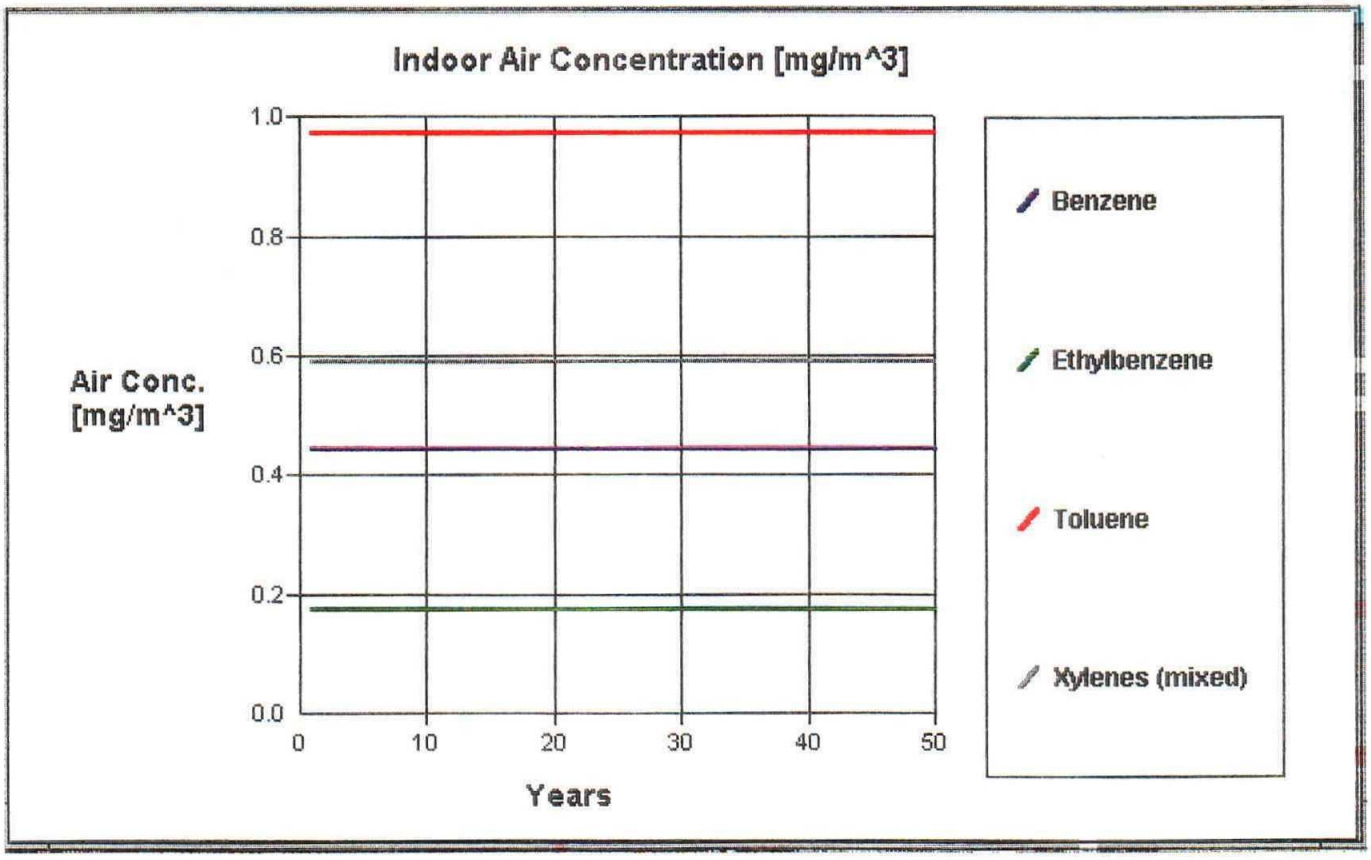
BASEMENT RESIDENCE
FIGURE 4C



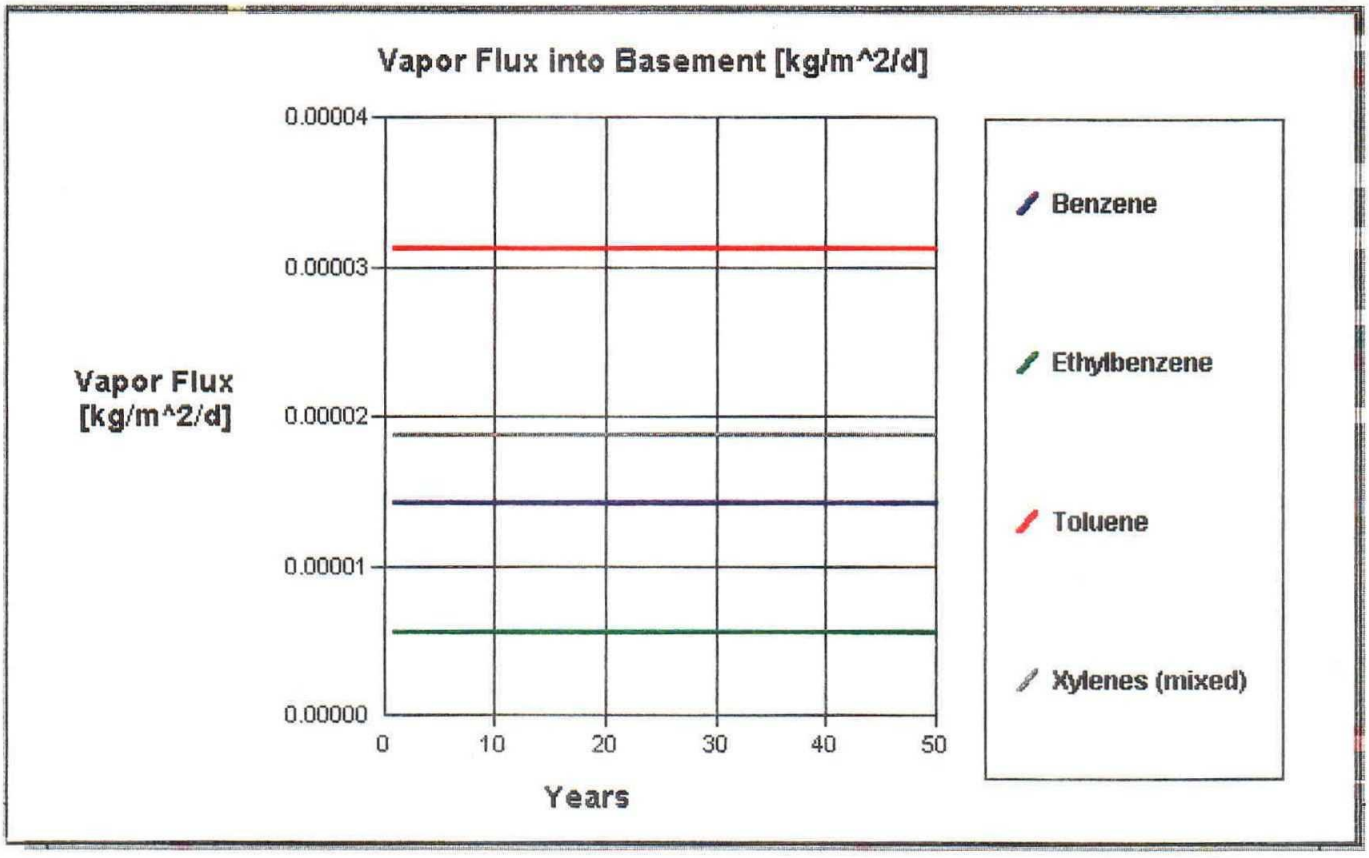
BASEMENT RESIDENCE
FIGURE 4B



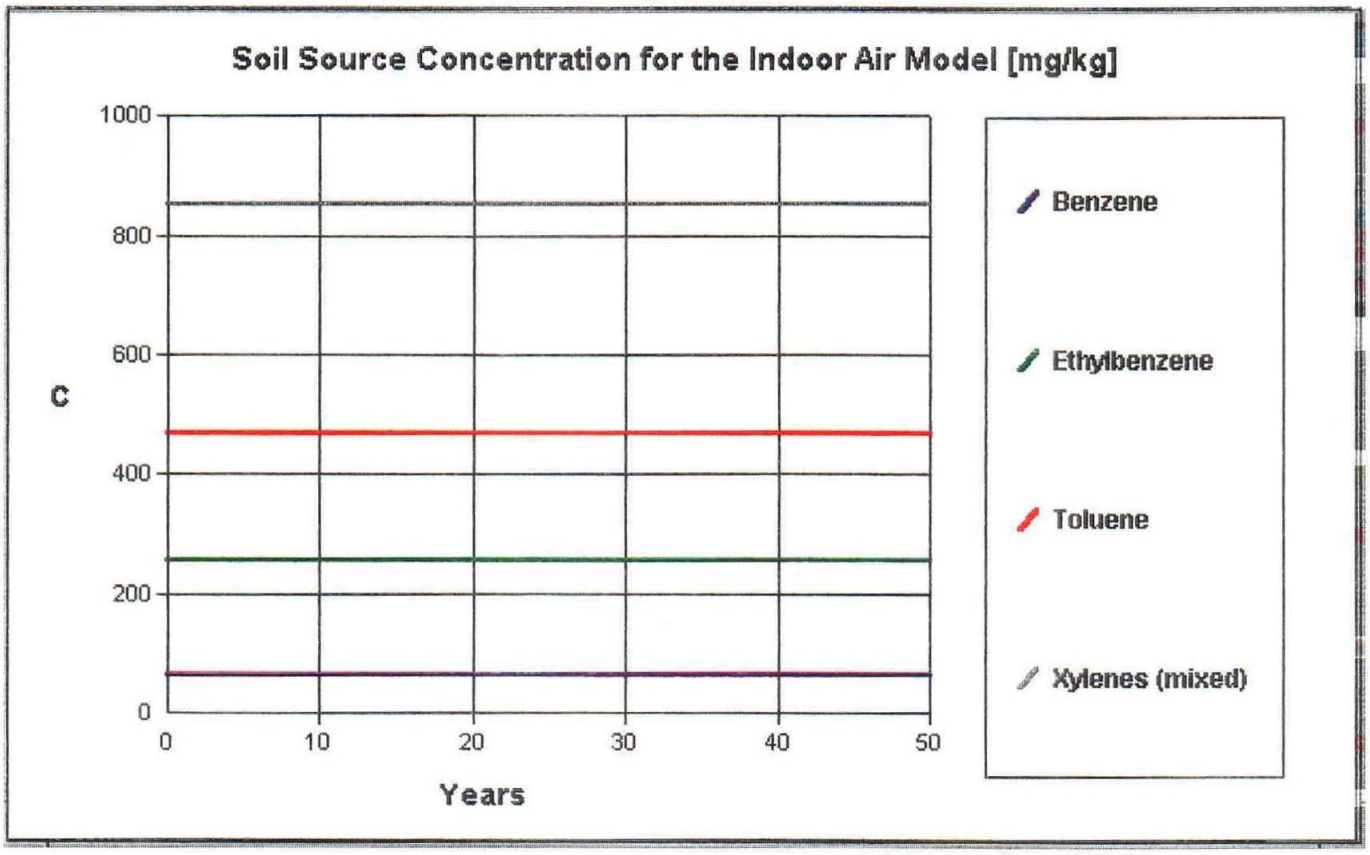
BASEMENT RESIDENCE
FIGURE 4A



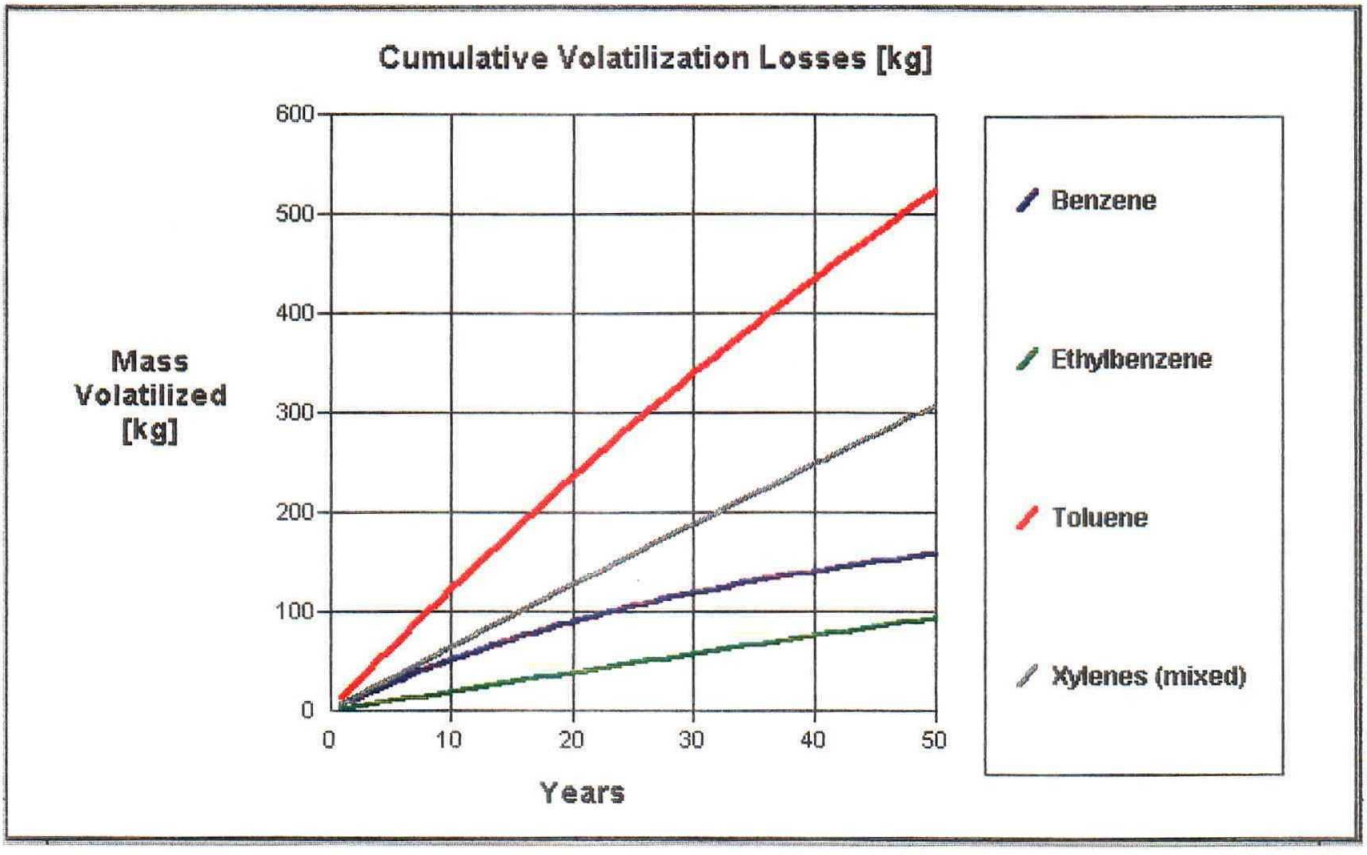
BASEMENT RESIDENCE
FIGURE 3 - NEW



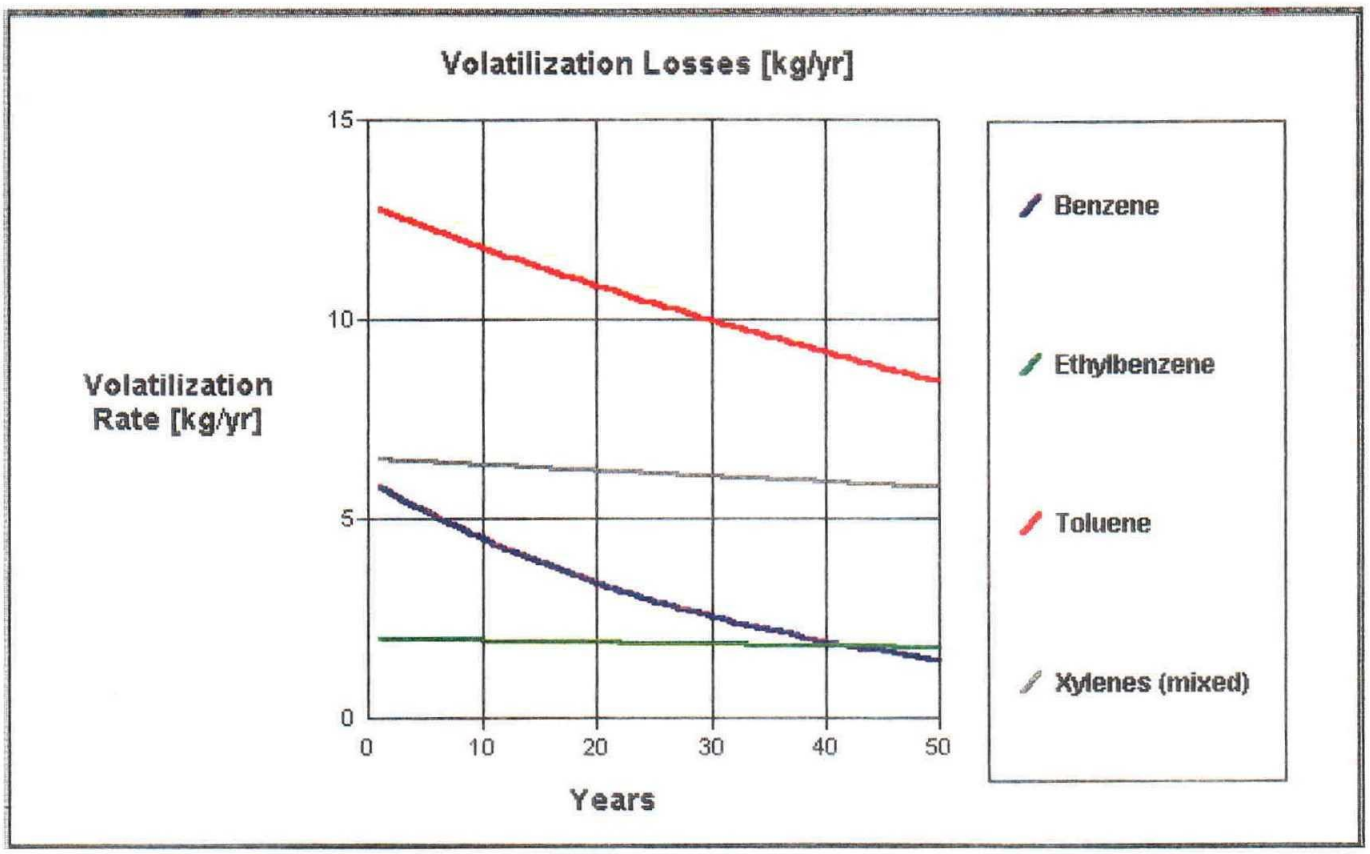
BASEMENT RESIDENCE
FIGURE 3 - NEW



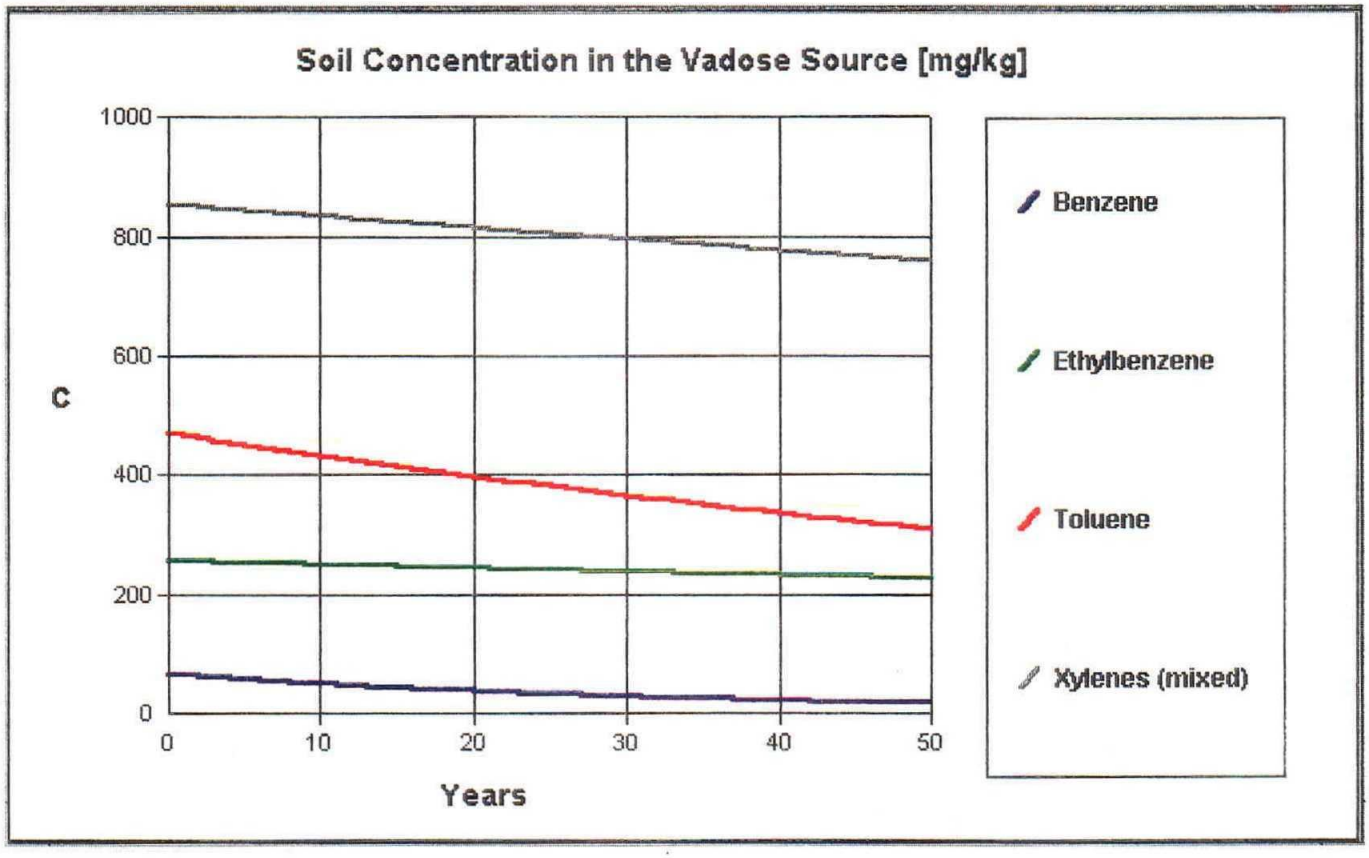
BASEMENT RESIDENCE
FIGURE 3 - NEW



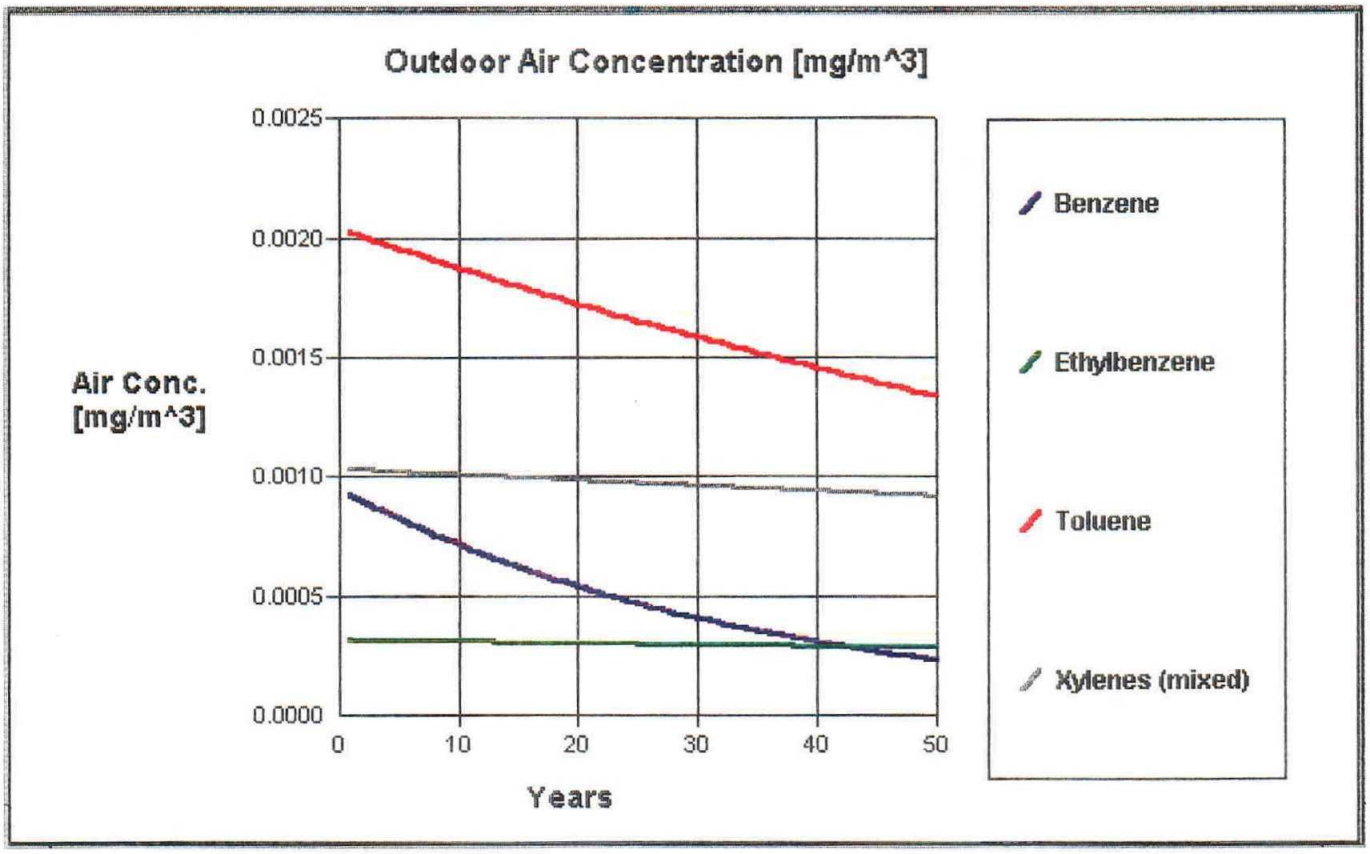
BASEMENT RESIDENCE
FIGURE 3L



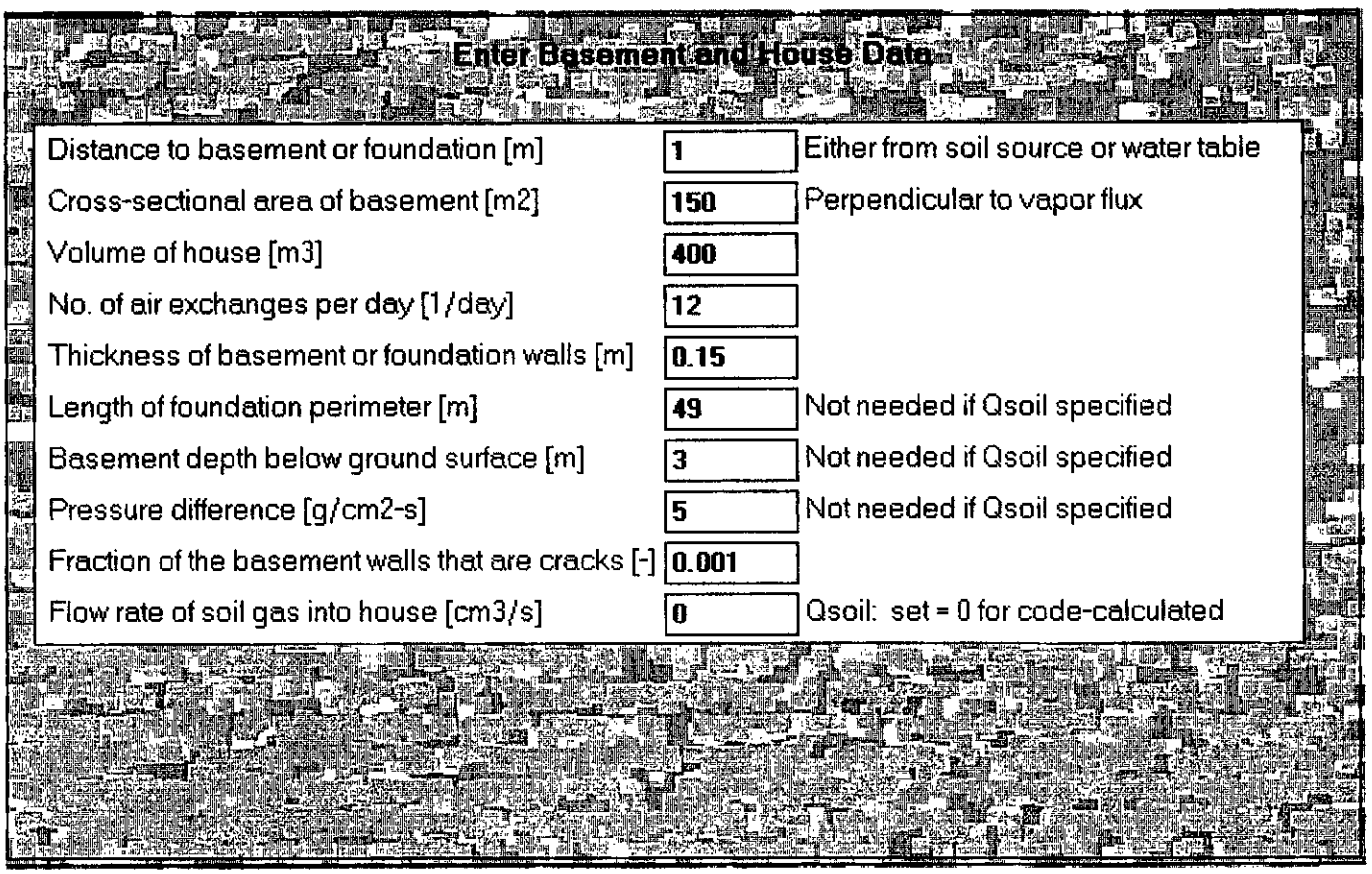
BASEMENT RESIDENCE
FIGURE 3K



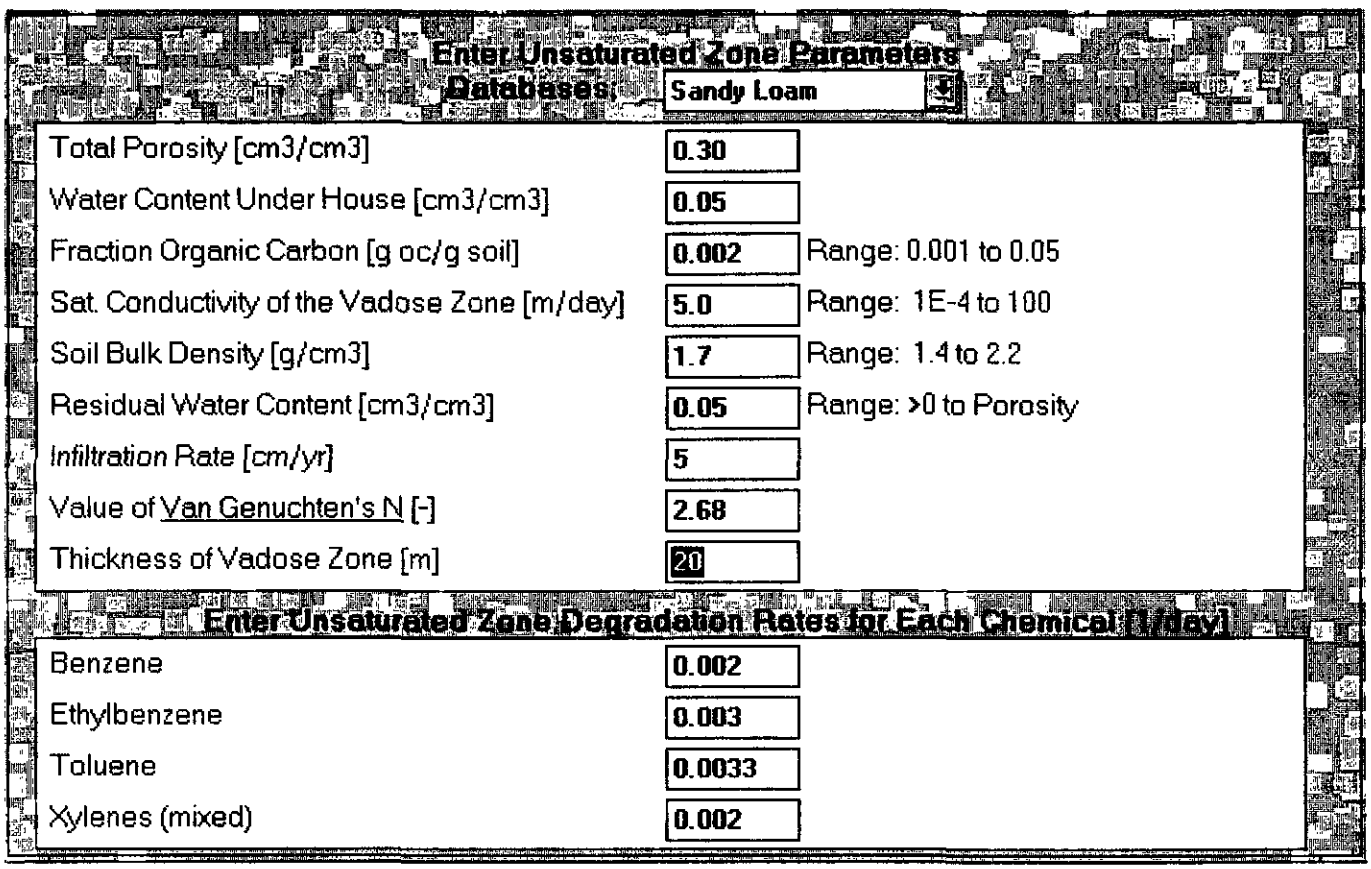
BASEMENT RESIDENCE
FIGURE 3.1



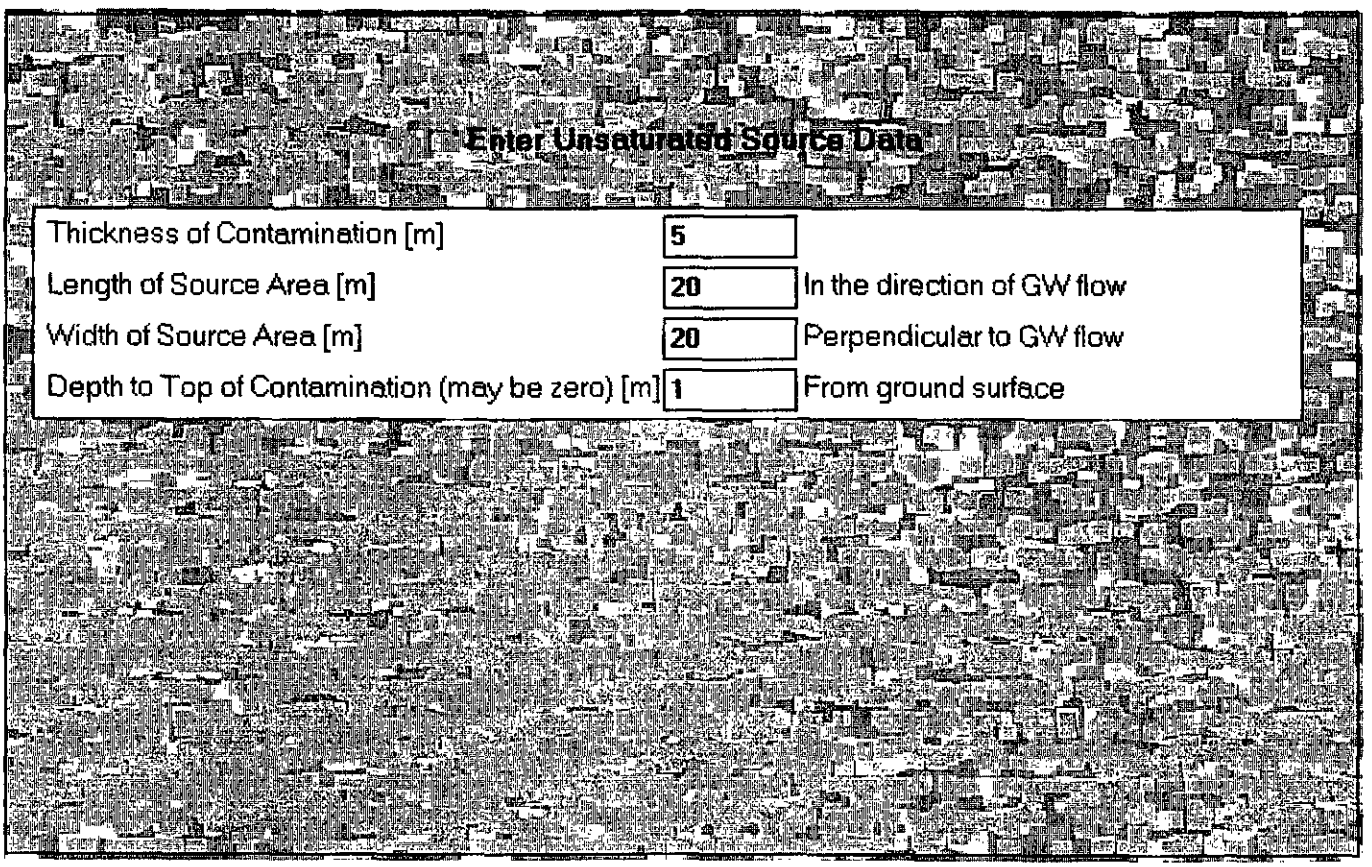
BASEMENT RESIDENCE
FIGURE 3I



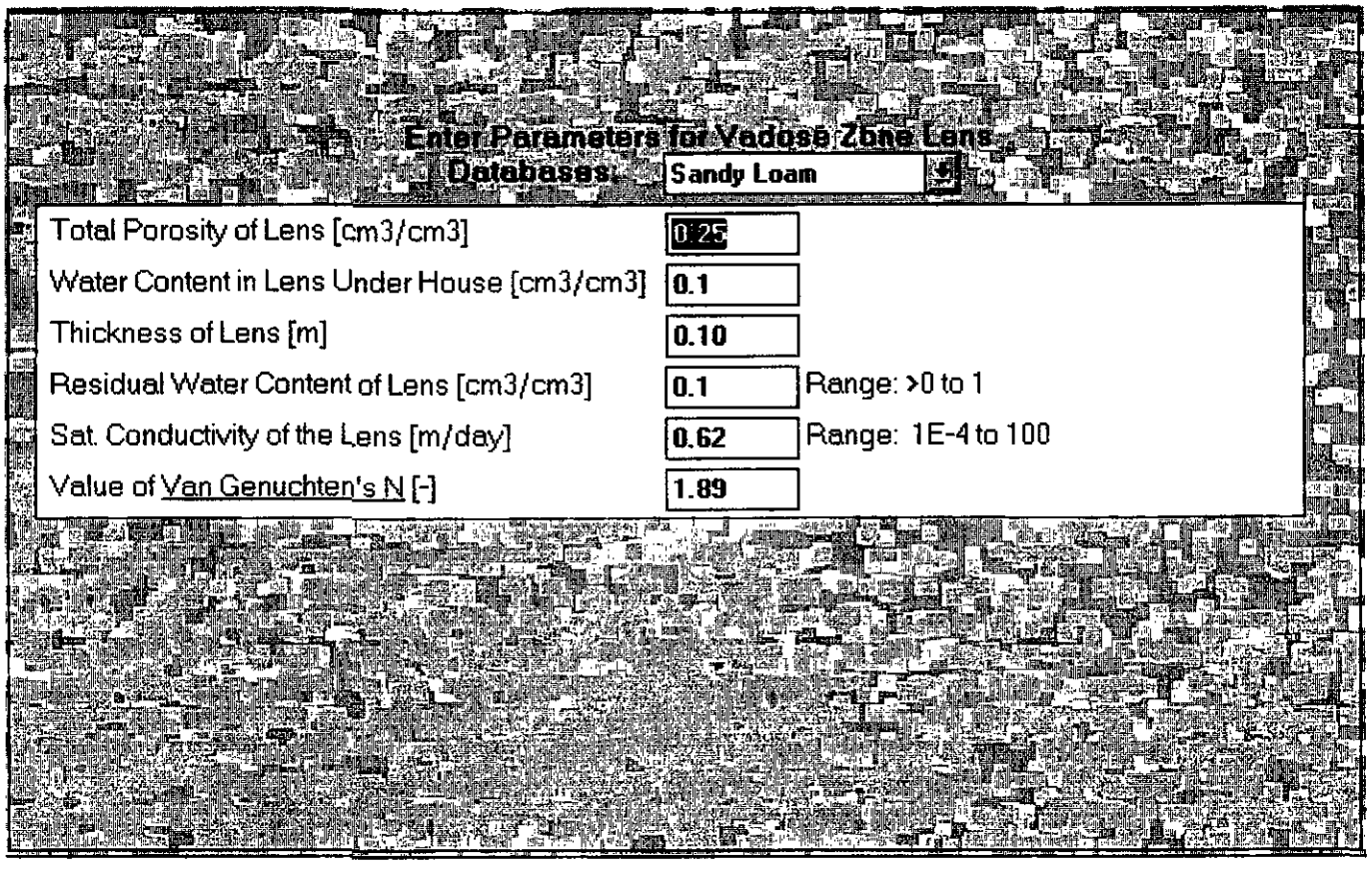
BASEMENT RESIDENCE
FIGURE 3 - NEW



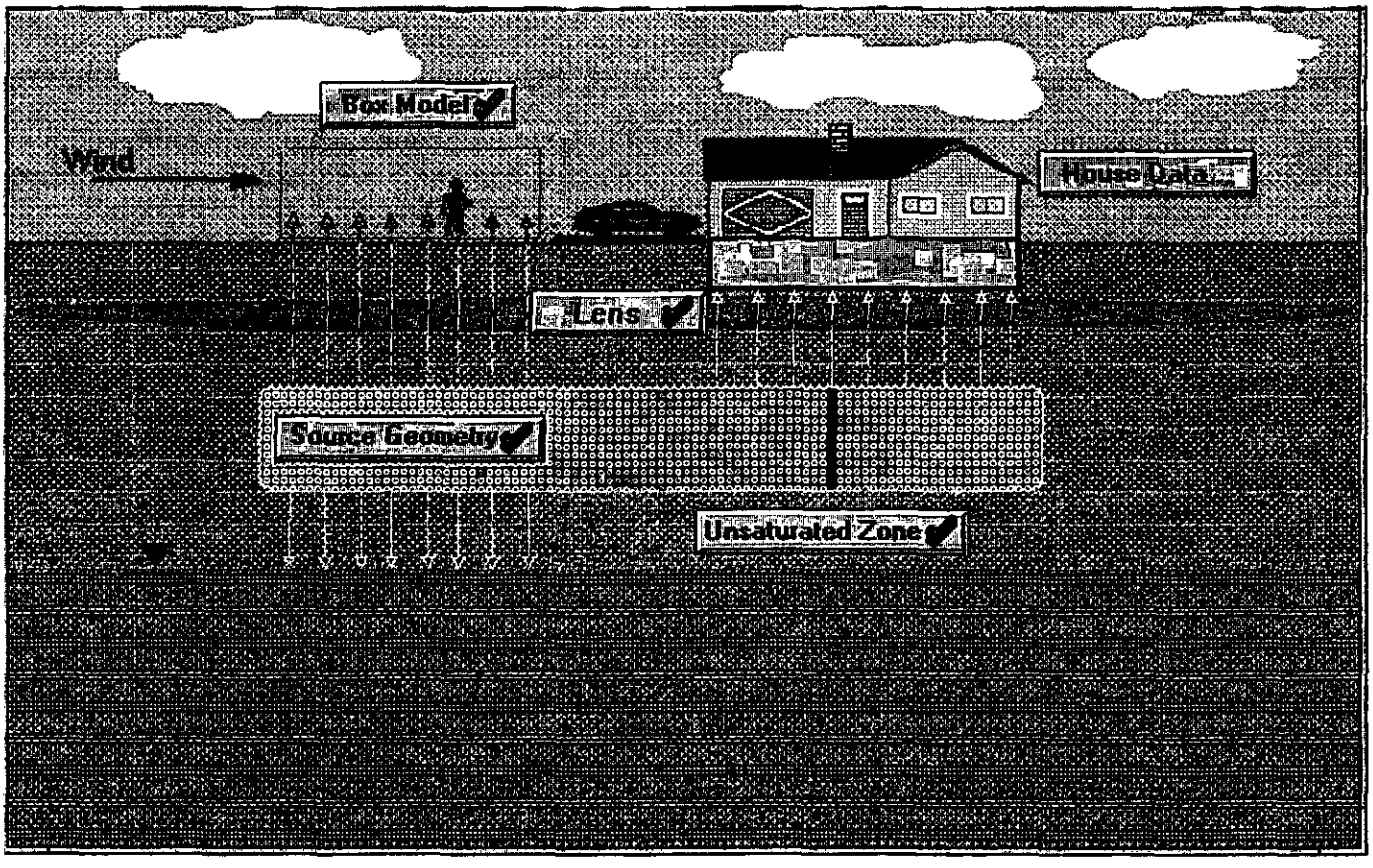
BASEMENT RESIDENCE
FIGURE 3G



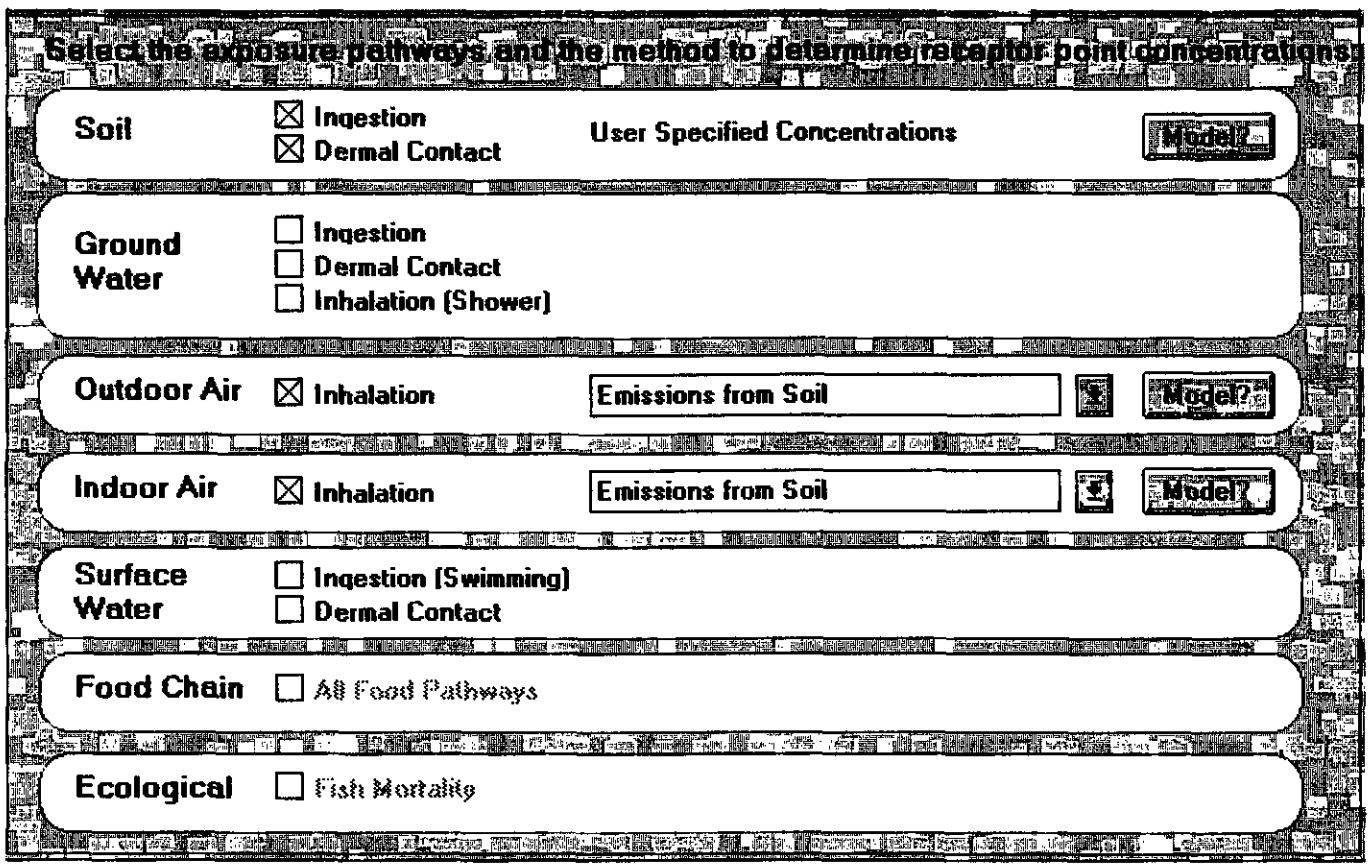
BASEMENT RESIDENCE
FIGURE 3F



BASEMENT RESIDENCE
FIGURE 3D



BASEMENT RESIDENCE
FIGURE 3B



BASEMENT RESIDENCE
FIGURE 2A

Title:
Lea County, New Mexico Soil
02/20/98 11:15

Scenarios:
Worker - Typical

Routes:
INGESTION OF SOIL
DERMAL CONTACT WITH SOIL
INHALATION OF OUTDOOR AIR

Chemicals:
- Benzene
- Ethylbenzene
- Toluene
- Xylenes (mixed)

SUMMARY OF INPUT PARAMETERS	SCENARIO: 1
Lifetime and Body Weight	
Body Weight (kg)	70.00
Lifetime (years)	70.00
INGESTION OF SOIL	
Soil Ingestion Rate (mg/day)	40.00
Exp. Frequency Soil (events/year)	125.00
Exp. Duration Soil (years)	8.00
Absorption Adjustment Factor for Ingestion of Soil (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0
Soil Bioavailability (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0
DERMAL CONTACT WITH SOIL	
Fraction Skin Exposed to Soil (-)	0.11
Adherence Factor for Soil (mg/cm^2)	0.20
Exposure Freq. Soil (events/year)	125.00
Exposure Duration Soil (years)	8.00
Absorption Adjustment Factor for Dermal Exposure to Soil (-)	
Benzene	0.50
Ethylbenzene	0.50
Toluene	0.50
Xylenes (mixed)	0.50
Soil Bioavailability (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0

INHALATION OF OUTDOOR AIR

Inhalation rate (m^3/hr)	0.83
Time outdoors (hours/day)	4.00
Lung Retention Factor (-)	1.00
Exp. Freq. Outdoor Air (events/yr)	125.00
Exp. Duration Outdoor Air (yr)	8.00
Absorption Adjustment Factor for Inhalation (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0

MEDIA CONCENTRATIONS

Concentration in Outdoor Air (mg/m^3)
Obtained from Fate and Transport output
AVERAGE Concentration (over exposure duration)
(used to calculate carcinogenic risk)

Exposure Duration (years)	8.0
Benzene	1.61E-03
Ethylbenzene	6.67E-04
Toluene	4.09E-03
Xylenes (mixed)	2.18E-03

Concentration used to calculate hazard index
(Minimum of 7 years or exposure duration)

Exposure Duration (years)	7.0
Benzene	1.65E-03
Ethylbenzene	6.69E-04
Toluene	4.12E-03
Xylenes (mixed)	2.19E-03

Concentration in Soil (mg/kg)
Used in calculating carcinogenic risk and hazard index

Benzene	65.
Ethylbenzene	2.56E+02
Toluene	4.70E+02
Xylenes (mixed)	8.54E+02

SLOPE FACTORS AND REFERENCE DOSES

Ingestion Slope Factor [1/(mg/kg-day)]

Benzene	2.90E-02
Ethylbenzene	ND
Toluene	ND
Xylenes (mixed)	ND

Ingestion Reference Dose (mg/kg-day)

Benzene	ND
Ethylbenzene	0.10
Toluene	0.20
Xylenes (mixed)	2.0

Inhalation Slope Factor [1/(mg/kg-day)]

Benzene	2.90E-02
Ethylbenzene	ND
Toluene	ND
Xylenes (mixed)	ND

Inhalation Reference Dose (mg/kg-day)

Benzene	ND

	Ethylbenzene	0.29
	Toluene	0.[illegible]
	Xylenes (mixed)	0.20

Dermal Slope Factor [1/(mg/kg-day)]

Benzene	2.90E-02
Ethylbenzene	ND
Toluene	ND
Xylenes (mixed)	ND

Dermal Reference Dose (mg/kg-day)

Benzene	ND
Ethylbenzene	0.10
Toluene	0.20
Xylenes (mixed)	2.0

SUMMARY OF RESULTS

INGESTION OF SOIL

Benzene	
CDI (mg/kg-day)	1.27E-05
LADD (mg/kg-day)	1.45E-06
Cancer Risk (-)	4.22E-08
Hazard Index (-)	0.00E+00
Ethylbenzene	
CDI (mg/kg-day)	5.01E-05
LADD (mg/kg-day)	5.73E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	5.01E-04
Toluene	
CDI (mg/kg-day)	9.20E-05
LADD (mg/kg-day)	1.05E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	4.60E-04
Xylenes (mixed)	
CDI (mg/kg-day)	1.67E-04
LADD (mg/kg-day)	1.91E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	8.36E-05

DERMAL CONTACT WITH SOIL

Benzene	
CDI (mg/kg-day)	6.44E-05
LADD (mg/kg-day)	7.36E-06
Cancer Risk (-)	2.13E-07
Hazard Index (-)	0.00E+00
Ethylbenzene	
CDI (mg/kg-day)	2.53E-04
LADD (mg/kg-day)	2.90E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	2.53E-03

Toluene

CDI (mg/kg-day)	4.65E-04
LADD (mg/kg-day)	5.32E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	2.33E-03

Xylenes (mixed)

CDI (mg/kg-day)	8.46E-04
LADD (mg/kg-day)	9.66E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	4.23E-04

INHALATION OF OUTDOOR AIR

Benzene

CDI (mg/kg-day)	2.68E-05
LADD (mg/kg-day)	2.98E-06
Cancer Risk (-)	8.66E-08
Hazard Index (-)	0.00E+00

Ethylbenzene

CDI (mg/kg-day)	1.09E-05
LADD (mg/kg-day)	1.24E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	3.75E-05

Toluene

CDI (mg/kg-day)	6.69E-05
LADD (mg/kg-day)	7.58E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	6.08E-04

Xylenes (mixed)

CDI (mg/kg-day)	3.55E-05
LADD (mg/kg-day)	4.05E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	1.77E-04

Indoor air model with volatile emissions from soil

Vadose zone model used to estimate outdoor air concentration

Title: Lea County, New Mexico Spill

Simulation time (years)..... 50

Vadose Zone Source Parameters

Thickness of contamination (m).....	5.00
Depth to top of contamination (m).....	1.00
Length of source (m).....	20.0
Width of source (m).....	20.0

Unsaturated Zone Properties

Total Porosity in vadose zone (cm3/cm3)	.300
Residual water content (cm3/cm3).....	5.000E-02
Fraction organic carbon (g oc/g soil)...	2.000E-03
Soil bulk density (g/cm3).....	1.70
Infiltration Rate (cm/yr).....	5.00
Saturated conductivity (m/d).....	5.00
Van Genuchten"s N.....	2.68
Thickness of vadose zone (m).....	20.0
Water content under house(cm3/cm3).....	5.000E-02
Air content in capillary fringe(cm3/cm3)	.000

Lens Parameters

Total porosity in lens (cm3/cm3).....	.250
Residual water content--lens (cm3/cm3)..	.100
Saturated conductivity (m/d).....	.620
Van Genuchten N in lens.....	1.89
Water content--lens under house(cm3/cm3)	.100
Thickness of lens (m).....	.100

OUTDOOR AIR PARAMETERS

Height of box (breathing zone) (m).....	2.00
Width of box (m).....	20.0
Wind speed (m/s).....	5.00

Basement and House Data

Distance from source to basement (m)....	1.00
Cross-sect. area of basement (m2).....	150.
Volume of house (m3).....	400.
Number of air changes per day.....	12.0
Foundation thickness (m).....	.150
Length of foundation perimeter (m).....	49.0
Depth of foundation (m).....	3.00
Pressure difference (g/cm-s2).....	5.00
Fraction of cracks (cm3/cm3).....	1.000E-03
Permeability of soil to vapors (cm2)....	5.903E-08

Intrinsic Permeability calculated from conductivity

--->Volumetric flow rate of soil gas into house

will be estimated from above five input parameters.

Vapor viscosity (for air) (g/cm-s)..... 1.800E-04
(This parameter is fixed)

TPH Data for Unsaturated Zone Source

Concentration of TPH in soil (mg/kg).... 8.535E+03
Molecular weight of TPH (g/mol)..... 100.

CHEMICAL DATA INPUT: Benzene

Diffusion coeff. in air (cm2/s)..... 8.800E-02
Diffusion coeff. in water (cm2/s)... 9.800E-06
Solubility (mg/l)..... 1.750E+03
KOC (ml/g)..... 58.9
Henry"s Law Coefficient (-)..... .228
Molecular Weight (g/mol)..... 78.0
Density of chemical (g/cm3)..... .877
Degradation rate sat. zone (1/d).... .000
Degradation rate unsat. zone (1/d).. 2.000E-03

Source Concentrations: Benzene

Source Conc. for unsaturated zone model (mg/kg)... 65.0

CHEMICAL DATA INPUT: Ethylbenzene

Diffusion coeff. in air (cm2/s)..... 7.500E-02
Diffusion coeff. in water (cm2/s)... 7.800E-06
Solubility (mg/l)..... 169.
KOC (ml/g)..... 363.
Henry"s Law Coefficient (-)..... .323
Molecular Weight (g/mol)..... 106.
Density of chemical (g/cm3)..... .867
Degradation rate sat. zone (1/d).... .000
Degradation rate unsat. zone (1/d).. 3.000E-03

Source Concentrations: Ethylbenzene

Source Conc. for unsaturated zone model (mg/kg)... 256.

CHEMICAL DATA INPUT: Toluene

Diffusion coeff. in air (cm2/s)..... 8.700E-02
Diffusion coeff. in water (cm2/s)... 8.600E-06
Solubility (mg/l)..... 526.
KOC (ml/g)..... 182.
Henry"s Law Coefficient (-)..... .272
Molecular Weight (g/mol)..... 92.1

Density of chemical (g/cm3)..... .867
Degradation rate sat. zone (1/d).... .000
Degradation rate unsat. zone (1/d).. 3.300E-03

Source Concentrations: Toluene

Source Conc. for unsaturated zone model (mg/kg)... 470.

CHEMICAL DATA INPUT: Xylenes (mixed)

Diffusion coeff. in air (cm2/s)..... 7.200E-02
Diffusion coeff. in water (cm2/s)... 8.500E-06
Solubility (mg/l)..... 185.
KOC (ml/g)..... 386.
Henry"s Law Coefficient (-)..... .301
Molecular Weight (g/mol)..... 106.
Density of chemical (g/cm3)..... .870
Degradation rate sat. zone (1/d).... .000
Degradation rate unsat. zone (1/d).. 2.000E-03

Source Concentrations: Xylenes (mixed)

Source Conc. for unsaturated zone model (mg/kg)... 854.

Title:
Lea County, New Mexico S[redacted]1
02/23/98 10:56

Scenarios:
Adult Resident - Typical

Routes:
INGESTION OF SOIL
DERMAL CONTACT WITH SOIL
INHALATION OF OUTDOOR AIR
INHALATION OF INDOOR AIR

Chemicals:
- Benzene
- Ethylbenzene
- Toluene
- Xylenes (mixed)

SUMMARY OF INPUT PARAMETERS	SCENARIO: 1
Lifetime and Body Weight	
Body Weight (kg)	70.00
Lifetime (years)	70.00
INGESTION OF SOIL	
Soil Ingestion Rate (mg/day)	40.00
Exp. Frequency Soil (events/year)	40.00
Exp. Duration Soil (years)	9.00
Absorption Adjustment Factor for Ingestion of Soil (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0
Soil Bioavailability (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0
DERMAL CONTACT WITH SOIL	
Fraction Skin Exposed to Soil (-)	0.11
Adherence Factor for Soil (mg/cm^2)	0.20
Exposure Freq. Soil (events/year)	40.00
Exposure Duration Soil (years)	9.00
Absorption Adjustment Factor for Dermal Exposure to Soil (-)	
Benzene	0.50
Ethylbenzene	0.50
Toluene	0.50
Xylenes (mixed)	0.50
Soil Bioavailability (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0

Xylenes (mixed)	1.0

INHALATION OF OUTDOOR AIR

Inhalation rate (m^3/hr)	0.83
Time outdoors (hours/day)	1.10
Lung Retention Factor (-)	1.00
Exp. Freq. Outdoor Air (events/yr)	350.00
Exp. Duration Outdoor Air (yr)	9.00
Absorption Adjustment Factor for Inhalation (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0

INHALATION OF INDOOR AIR

Inhalation rate (m^3/hr)	0.62
Time indoors (hours/day)	16.00
Lung Retention Factor (-)	1.00
Exp. Freq. Indoor Air (events/yr)	350.00
Exp. Duration Indoor Air (yr)	9.00
Absorption Adjustment Factor for Inhalation (-)	
Benzene	1.0
Ethylbenzene	1.0
Toluene	1.0
Xylenes (mixed)	1.0

MEDIA CONCENTRATIONS

Concentration in Outdoor Air (mg/m^3)
Obtained from Fate and Transport output
AVERAGE Concentration (over exposure duration)
(used to calculate carcinogenic risk)

Exposure Duration (years)	9.0
Benzene	8.27E-04
Ethylbenzene	3.12E-04
Toluene	1.96E-03
Xylenes (mixed)	1.02E-03

Concentration used to calculate hazard index
(Minimum of 7 years or exposure duration)

Exposure Duration (years)	7.0
Benzene	8.50E-04
Ethylbenzene	3.13E-04
Toluene	1.97E-03
Xylenes (mixed)	1.02E-03

Concentration in Soil (mg/kg)
Used in calculating carcinogenic risk and hazard index

Benzene	65.
Ethylbenzene	2.56E+02
Toluene	4.70E+02
Xylenes (mixed)	8.54E+02

Concentration in Indoor Air (mg/m^3)
Obtained from Fate and Transport output
AVERAGE Concentration (over exposure duration)
(used to calculate carcinogenic risk)

Exposure Duration (years)	9.0
Benzene	0.44
Ethylbenzene	0.17

Toluene	0.[redacted]
Xylenes (mixed)	0.[redacted]

Concentration used to calculate hazard index
(Minimum of 7 years or exposure duration)

Exposure Duration (years)	7.0
Benzene	0.44
Ethylbenzene	0.17
Toluene	0.97
Xylenes (mixed)	0.59

SLOPE FACTORS AND REFERENCE DOSES

Ingestion Slope Factor [1/(mg/kg-day)]

Benzene	2.90E-02
Ethylbenzene	ND
Toluene	ND
Xylenes (mixed)	ND

Ingestion Reference Dose (mg/kg-day)

Benzene	ND
Ethylbenzene	0.10
Toluene	0.20
Xylenes (mixed)	2.0

Inhalation Slope Factor [1/(mg/kg-day)]

Benzene	2.90E-02
Ethylbenzene	ND
Toluene	ND
Xylenes (mixed)	ND

Inhalation Reference Dose (mg/kg-day)

Benzene	ND
Ethylbenzene	0.29
Toluene	0.11
Xylenes (mixed)	0.20

Dermal Slope Factor [1/(mg/kg-day)]

Benzene	2.90E-02
Ethylbenzene	ND
Toluene	ND
Xylenes (mixed)	ND

Dermal Reference Dose (mg/kg-day)

Benzene	ND
Ethylbenzene	0.10
Toluene	0.20
Xylenes (mixed)	2.0

SUMMARY OF RESULTS

INGESTION OF SOIL

Benzene

CDI (mg/kg-day)	4.07E-06
LADD (mg/kg-day)	5.23E-07
Cancer Risk (-)	1.52E-08

Hazard Index (-)	0.00E+00
Ethylbenzene	
CDI (mg/kg-day)	1.60E-05
LADD (mg/kg-day)	2.06E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	1.60E-04
Toluene	
CDI (mg/kg-day)	2.94E-05
LADD (mg/kg-day)	3.78E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	1.47E-04
Xylenes (mixed)	
CDI (mg/kg-day)	5.35E-05
LADD (mg/kg-day)	6.88E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	2.67E-05

DERMAL CONTACT WITH SOIL

Benzene	
CDI (mg/kg-day)	2.06E-05
LADD (mg/kg-day)	2.65E-06
Cancer Risk (-)	7.68E-08
Hazard Index (-)	0.00E+00
Ethylbenzene	
CDI (mg/kg-day)	8.11E-05
LADD (mg/kg-day)	1.04E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	8.11E-04
Toluene	
CDI (mg/kg-day)	1.49E-04
LADD (mg/kg-day)	1.91E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	7.45E-04
Xylenes (mixed)	
CDI (mg/kg-day)	2.71E-04
LADD (mg/kg-day)	3.48E-05
Cancer Risk (-)	0.00E+00
Hazard Index (-)	1.35E-04

INHALATION OF OUTDOOR AIR

Benzene	
CDI (mg/kg-day)	1.06E-05
LADD (mg/kg-day)	1.33E-06
Cancer Risk (-)	3.86E-08
Hazard Index (-)	0.00E+00
Ethylbenzene	
CDI (mg/kg-day)	3.92E-06
LADD (mg/kg-day)	5.02E-07
Cancer Risk (-)	0.00E+00
Hazard Index (-)	1.35E-05
Toluene	
CDI (mg/kg-day)	2.47E-05
LADD (mg/kg-day)	3.15E-06

Cancer Risk (-)	0.00E+00
Hazard Index (-)	2.25E-04
Xylenes (mixed)	
CDI (mg/kg-day)	1.28E-05
LADD (mg/kg-day)	1.64E-06
Cancer Risk (-)	0.00E+00
Hazard Index (-)	6.40E-05

INHALATION OF INDOOR AIR

Benzene	
CDI (mg/kg-day)	6.09E-02
LADD (mg/kg-day)	7.83E-03
Cancer Risk (-)	2.27E-04
Hazard Index (-)	0.00E+00
Ethylbenzene	
CDI (mg/kg-day)	2.38E-02
LADD (mg/kg-day)	3.05E-03
Cancer Risk (-)	0.00E+00
Hazard Index (-)	8.19E-02
Toluene	
CDI (mg/kg-day)	1.34E-01
LADD (mg/kg-day)	1.72E-02
Cancer Risk (-)	0.00E+00
Hazard Index (-)	1.21E+00
Xylenes (mixed)	
CDI (mg/kg-day)	8.06E-02
LADD (mg/kg-day)	1.04E-02
Cancer Risk (-)	0.00E+00
Hazard Index (-)	4.03E-01

Vadose zone model used to estimate outdoor air concentration

Title: Lea County, New Mexico Spill

Simulation time (years)..... 50

Vadose Zone Source Parameters

Thickness of contamination (m).....	5.00
Depth to top of contamination (m).....	.000
Length of source (m).....	20.0
Width of source (m).....	20.0

Unsaturated Zone Properties

Total Porosity in vadose zone (cm3/cm3)	.300
Residual water content (cm3/cm3).....	5.000E-02
Fraction organic carbon (g oc/g soil)...	2.000E-03
Soil bulk density (g/cm3).....	1.70
Infiltration Rate (cm/yr).....	5.00
Saturated conductivity (m/d).....	5.00
Van Genuchten"s N.....	2.68
Thickness of vadose zone (m).....	20.0

OUTDOOR AIR PARAMETERS

Height of box (breathing zone) (m).....	2.00
Width of box (m).....	20.0
Wind speed (m/s).....	5.00

TPH Data for Unsaturated Zone Source

Concentration of TPH in soil (mg/kg)....	8.535E+03
Molecular weight of TPH (g/mol).....	100.

CHEMICAL DATA INPUT: Benzene

Diffusion coeff. in air (cm2/s).....	8.800E-02
Diffusion coeff. in water (cm2/s)...	9.800E-06
Solubility (mg/l).....	1.750E+03
KOC (ml/g).....	58.9
Henry"s Law Coefficient (-).....	.228
Molecular Weight (g/mol).....	78.0
Density of chemical (g/cm3).....	.877
Degradation rate sat. zone (1/d)....	.000
Degradation rate unsat. zone (1/d)..	2.000E-03

Source Concentrations: Benzene

Source Conc. for unsaturated zone model (mg/kg)... 65.0

CHEMICAL DATA INPUT: Ethylbenzene

Diffusion coeff. in air (cm2/s)	7.500E-02
Diffusion coeff. in water (cm2/s)	7.800E-06
Solubility (mg/l)	169.
KOC (ml/g)	363.
Henry"s Law Coefficient (-)	.323
Molecular Weight (g/mol)	106.
Density of chemical (g/cm3)	.867
Degradation rate sat. zone (1/d)	.000
Degradation rate unsat. zone (1/d)	3.000E-03

Source Concentrations: Ethylbenzene

Source Conc. for unsaturated zone model (mg/kg)... 256.

CHEMICAL DATA INPUT: Toluene

Diffusion coeff. in air (cm2/s)	8.700E-02
Diffusion coeff. in water (cm2/s)	8.600E-06
Solubility (mg/l)	526.
KOC (ml/g)	182.
Henry"s Law Coefficient (-)	.272
Molecular Weight (g/mol)	92.1
Density of chemical (g/cm3)	.867
Degradation rate sat. zone (1/d)	.000
Degradation rate unsat. zone (1/d)	3.300E-03

Source Concentrations: Toluene

Source Conc. for unsaturated zone model (mg/kg)... 470.

CHEMICAL DATA INPUT: Xylenes (mixed)

Diffusion coeff. in air (cm2/s)	7.200E-02
Diffusion coeff. in water (cm2/s)	8.500E-06
Solubility (mg/l)	185.
KOC (ml/g)	386.
Henry"s Law Coefficient (-)	.301
Molecular Weight (g/mol)	106.
Density of chemical (g/cm3)	.870
Degradation rate sat. zone (1/d)	.000
Degradation rate unsat. zone (1/d)	2.000E-03

Source Concentrations: Xylenes (mixed)

Source Conc. for unsaturated zone model (mg/kg)... 854.

PHILIP SERVICES CORP.

DATE: Febuary 20, 1998 **PAGES:** 8

TO: Neil Gaetz

COMPANY: Conoco

FAX #: 686-5780 **PHONE #:** _____

FROM: Jeff Kindley

PHILIP SERVICES CORPORATION
7904 INTERSTATE 20 WEST, MIDLAND, TX 79706
TELEPHONE:(915) 563-0118 FAX (915) 563-9526

MESSAGE:

APPENDIX F
COMMON ORGANIC SOLVENTS AND GASES DATA SHEET

CHEMICAL MATERIALS	F.W. (G/MOLE)	DENSITY (G/ML)	BP (°C)*	I.P. (EV)**	TWA (PPM)*
Acetaldehyde	44.05	0.788	21	10.21	200
Acetamide	59.07	1.159	221	9.77	
Acetic Acid	60.05	1.049	116-117	10.37	10
Acetic Anhydride	102.1	1.10	138-117	9.88	5
Acetone	58.1	0.79	56	9.69	1000
Acetonitrile	41.1	0.79	82	12.22	40 cell
Acetophenone	120.15	1.033	202	9.27	
Acetyl Bromide	122.96	1.52	75-75	10.55	
Acetyl Chloride	78.50	1.104	52	11.02	
Acetylene	26.02	0.90		11.41	
Acrolein	56.06	0.8389	53	10.10	0.1
Acrylonitrile	53.06	0.8004	77	10.91	10
Allyl Alcohol	58.1	0.85	96-98	9.67	2
Allyl Chloride	76.5	0.94	44-46	9.9	1
Aniline	93.1	1.02	184	7.70	5
Anisole	108.13	0.9956	154	8.22	
Ammonia	17.03	gas		10.15	
Arsine	77.9	gas			0.05
Benzaldelyde	106.12	1.053	178-185	9.53	
Benzene	78.1	0.88	80	9.25	1
Benzonitrile	103.12	1.010	188	9.71	
Benzotriflouride	146.11	1.1886	102	9.68	
Benzyl Chloride	126.6	1.10	177-181	9.14	1
Biphenyl	154.21	0.992	255		
Bromine	159.81	3.1023	58.8	10.55	0.1
Bromobenzene	157.02	1.495	156	8.98	
1-Bromobutene	137.03	1.276	100-04	10.13	
2-Bromobutene	137.03	1.255	91	9.98	
1-Bromo-2-Chlorethene	143.42	1.723	106-07	10.63	
Bromochloromethane	129.39	1.991	68	10.77	
1-Bromo-2-Flourobenzene	175.01	1.593	150	8.99	
Bromoform	252.8	2.9	150-01	10.47	0.5
1-Bromo-2-methyl propane	137.03	1.260	90-92	10.09	
2-Bromo-2-methyl propane	137.03	1.189	72-74	9.89	
1-Bromopentane	151.05	1.218	130	10.10	
2-Bromopropane	123.00	1.354	71	10.18	
2-Bromopropene	123.00	1.310	59	10.08	
1-Bromopropene	120.98	1.413	58-63	9.30	
3-Bromopropene	120.98	1.398	70-71	9.70	
2-Bromothiophene	163.04	1.684	149-151	8.63	
M-Bromotoluene	171.04	1.4099	183.7	8.81	
O-Bromotoluene	171.04	1.431	58.60	8.79	
P-Bromotoluene	171.04	1.431	184	8.67	
1,3-Butadiene	54.1	gas	9.07		1000
Butane	58.12	gas	10.63		
	90.19	.842	9.14		

* BP - Boiling Point Degrees Centigrade
** IP - Ionization Potential
*** TWA - Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W. (G/MOLE)	DENSITY (G/ML)	BP (°C)*	I.P. (EV)**	TWA (PPM)***
2-Butanone	72.1	0.81	80	9.53	200
1-Butene	56.10	0.6255		9.58	
N-Butyl Acetate	116.2	0.88	124-26	10.01	150
S-Butyl Acetate	116.2	0.88	111-12	9.91	150
N-Butyl Alcohol	74.1	0.81	117.7	10.04	100
N-Butyl Amine	73.1	0.73	73	78	5
S-Butyl Amine	73.1	0.73	63	8.70	5
T-Butyl Amine	73.1	0.73	46	8.64	5
N-Butyl Benzene	134.21	0.8604	183	8.69	
S-Butyl Benzene	134.21	0.8604	173-04	8.68	
T-Butyl Benzene	134.21	0.8669	169	8.68	
N-Butyraldehyde	72.10	0.8016	75	9.86	
N-Butyric Acid	88.10	0.959	162	10.16	
N-Butyronitrile	69.10	0.7954	115-17	11.67	
Camphor	152.2	0.99	204	8.76	2 mg/m
Carbon Dioxide	44.01	gas		13.79	5000
Carbon Monoxide	28.01	gas		14.01	50
Carbon Tetrachloride	153.8	1.59	77	11.47	10
Chlorine	70.90	gas		11.48	1 cell
Chlorobenzene	112.6	1.10	132	9.07	75
Chloroform	119.4	1.48	60.5-61.5	11.37	50 cell
1-Chloro-2-Methylpropane	92.57	.883	68-69	10.66	
2-Chloro-2-Methylpropane	101.64	.851	51-52	10.61	
1-Chloropropane	78.54	.892	46-47	10.82	
2-Chloropropane	78.54	.859	34-36	10.78	
3-Chloropropane	76.53	.939	44-46	10.04	
2-Chlorothiophene	118.59	1.286	127-29	8.68	
M-Chlorotoluene	126.58	1.076	160-162	8.83	
O-Chlorotoluene	126.58	1.0826	157-159	8.83	
P-Chlorotoluene	126.58	1.0697	162	8.70	
M-Cresol	108.1	1.034	203	8.52	5 cell
O-Cresol	108.1	1.048	191	8.50	5 cell
P-Cresol	108.1	1.034	202	8.38	5 cell
Crotonaldehyde	70.09	0.853	104	9.73	2
Cumene	120.2	0.86	152-154	8.75	50
Cyanogen	52.04	0.9537		13.80	
Cyclohexane	84.2	0.81	80.7-81	9.98	300
Cyclohexane	100.2	0.96	160-161	10.0	50
Cyclohexanone	98.1	0.95	155	9.14	50
Cyclohexene	82.1	0.81	83	8.95	300
Cyclo-Octatetraene	104.15	0.925	142-43	7.99	
Cyclopentane	70.13	0.7460	50	10.53	
Cyclopentanone	84.11	1.4366	130-131	9.26	
Cyclopentene	68.12	0.744	44	9.01	
Cyclopropane	42.08	gas		9.91	
Diborane	27.68	gas		11.00	
Diazomethane	42.0	gas		9.0	0.2

* BP - Boiling Point Degrees Centigrade
** IP - Ionization Potential
*** TWA - Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W. (G/MOLE)	DENSITY (G/ML)	BP (°C)*	I.P. (EV)**	TWA (PPM)*
Dibromodiflouromethane	209.83	2.297	22-23	11.07	
1,2-Dibromoethane	187.87	2.180	131-32	9.45	
1,3-Dibromopropane	201.90	1.937	167	10.07	
Dibutylphthlate	278.3	1.04	340		5 mg/m
M-Dichlorobenzene	147.01	1.288	172-73	9.12	50
O-Dichlorobenzene	147.01	1.306	179-180	9.07	50
P-Dichlorobenzene	147.01	1.241	173	8.94	75
1,1-Dichlorethane	99.0	1.18	57	11.06	100
1,2-Dichlorethane	98.96	1.256	83	11.12	
1,2-Dichlorethylene	97.0	1.28	46-60	9.66	200
Dichloromethane	84.93	1.325	39.8-40	11.35	
1,2-Dichloropropane	112.99	1.156	95-96	10.87	
1,3-Dichloropropane	112.99	1.190	120-22	10.85	
2,3-Dichloropropane	110.97	1.204	94	9.82	
N,N-Diethyl Acetamide	115.18	0.925	182-86	8.60	
Diethylamine	73.1	0.71	55	8.01	25
Diethyl Ether	74.12	0.7134	34.6	9.53	
N.N-Diethyl Formamide	101.15	0.908	176-77	8.89	
Diethyl Ketone	86.13	0.816	102	9.32	
Diethyl Sulfide	90.19	.837		8.43	
Diethyl Sulfite	138.19	1.883	158-60	9.68	
Dihydropyran	84.12	0.922	86	8.34	
Diisopropylamine	101.2	0.72	84	7.73	5
1,1-Dimethoxyethane	90.12	0.863	64	9.65	
N,N-Dimethyl Acetamide	87.12	0.937	164.5-66	8.81	10
Dimethyl Amine	45.1	0.68		8.24	10
N,N-Dimethyl Aniline	122.2	0.96	193-94	7.13	
2,2-Dimethyl Butane	86.18	0.649	50	10.06	
2,3-Dimethyl Butane	86.18	0.662	50	10.02	
3,3-Dimethyl Butanone	100.16	0.801	106	9.17	
N,N-Dimethyl Formamide	73.09	0.9445	153	9.12	10
Dimethlyl Sulfide	63.13	0.846	38	8.69	
P-Dioxane	88.1	1.03	100-102	9.13	100
Dipropyl Amine	101.19	0.738	105-110	7.84	
Durene	134.12	0.84	80-82	8.03	
Epichlorohydrin	92.5	1.18	115-117		5
Ethane	30.07	gas		11.65	
Ethanethiol	62.13	0.8315	35	9.29	
Ethyl Acetate	88.1	0.90	76.5-77.5	10.11	400
Ethyl Alcohol	46.1	0.80	78	10.48	1000
Ethyl Amine	45.1	0.69	19.20	8.86	10
Ethyl Benzene	106.2	0.87	136	8.76	100
Ethyl Bromide	109.0	1.45	37-40	10.29	200
Ethyl Butyl Ketone	114.2	0.82	146-49	9.02	50
Ethyl Chloride	64.52	0.9214		10.98	1000
Ethyl Disulfide	122.25	0.993	153	8.27	
Ethylene Dibromide	187.9	2.17	131-132	10.52	20
Ethylene Dichloride	99.0	1.26	83	11.32	50

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*** TWA - Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W. (G/MOLE)	DENSITY (G/ML)	BP (°C)*	I.P. (EV)**
Ethyl Ether	74.1	0.73	34.6	9.59
Ethyl Formate	74.1	0.92	52-54	10.61
Ethyl Iodide	155.98	1.950	67-73	9.33
Ethyl Isothiocyanate	87.15	1.003	60	9.14
Ethyl Methyl Sulfide	76.16	0.842	66-67	8.55
Ethyl Nitrate	75.07	0.90	112	11.22
Ethyl Propionate	102.13	0.891	99	10.00
Ethyl Thiocyanate	87.14	1.007		9.89
Ethynylbenzene	102.13	0.9300	142-44	8.82
Fluorine	37.99	gas		15.70
Flourobenzene	96.10	1.024	85	9.20
O-Fluorophenol	112.10	1.256	172-74	8.95
M-Fluorotoluene	110.13	0.997	178	8.92
O-Fluorotoluene	110.13	1.004	172-172	8.92
P-Fluorotoluene	110.13	1.001	185	8.79
Formaldehyde	30.03	1.083		10.87
Formahide	45.04	1.1334	210	10.25
Formic Acid	46.02	1.220	110-101	11.05
2-Furaldehyde	96.09	1.160	182	9.21
Furan	68.07	0.9371		8.89
Heptane	100.2	0.68	98	10.08
2-Heptanone	114.18	0.8068	149-50	9.33
Hexane	86.2	0.66	68-69	10.18
1-Hexane	84.16	0.673	64	9.46
Hexone	100.2	0.80		9.53
Hydrogen	2.017	gas		15.43
Hydrogen Bromide	80.92	gas		11.62
Hydrogen Chloride	36.47	gas		12.74
Hydrogen Cyanide	27.03	0.687		13.91
Hydrogen Flouride	20.01	gas		15.77
Hydrogen Iodide	127.93	gas		10.38
Hydrogen Selenide	80.98	gas		9.38
Hydrogen Sulfide	34.08	gas		10.46
Hydrogen Telluride	129.63	gas		9.14
Iodine	253.81	4.93		9.28
Iodobenzene	204.02	1.8384	188	8.73
1-Iodobutene	184.02	1.617	130-31	9.21
2-Iodobutene	184.02	1.4991	119-120	9.09
1-Iodo-2-Methylpropane	184.02	1.599	120-21	9.18
1-Iodopentane	198.05	1.517	154-55	9.19
1-Iodopropane	169.99	1.743	101-02	9.26
2-Iodopropane	169.99	1.703	88-90	9.17
O-Iodotoluene	218.04	1.713	211	8.62
M-Iodotoluene	218.04	1.698		8.61
P-Odotoluene	218.04		211-5	8.50
Isoamyl Acetate	130.2	0.88	142	9.04
Isoamyl Alcohol	88.2	0.81	130-1	10.42

* BP - Boiling Point Degrees Centigrade
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*** TWA - Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W. (G/MOLE)	DENSITY (G/ML)	BP (°C)*	I.P. (EV)**	TWA (PPM)***
Isobutyl Amine	73.14	0.724	64-71	8.70	
Isobutyl Formate	102.13	0.885	98.4	10.46	
Isobutylene	56.11	0.5942	-6.9	9.23	
Isobutyraldehyde	72.11	0.794	63	9.74	
Isobutyric Acid	88.11	0.950	153-54	10.02	
Isoctane	114.2	0.70	98-99	17.9	400
Isopentane	114.23	0.692	30	10.32	
Isoprene	68.12	0.681	34	8.85	
Isopropyl Acetate	102.1	0.87	85	9.99	250
Isopropyl Alcohol	60.1	0.79		10.16	400
Isopropyl Amine	59.1	0.69	33-34	8.72	5
Isopropyl Benzene	120.2	0.86	152-54	8.75	50
Isopropyl Ether	102.2	1.37	68-69	9.20	500
Isovaleraldehyde	86.13	0.785	90	9.71	
2,3-Lutidine	107.15	0.945	162-63	8.85	
2,4-Lutidine	107.15	0.927	159	8.85	
2,6-Lutidine	107.15	0.9252	143-45	8.85	
Malaic Anhydride	98.1	0.93	200	11.1	
Mesitylene	120.19	0.8637	162-64	8.40	
Mesityl Oxide	98.14	0.8592	129	9.08	
Methane	16.04	gas		12.98	
Methanethiol	48.11	0.96		9.44	
N-Methyl Acetamide	73.10	0.957	204-05	8.90	
Methyl Acetate	74.08	0.9279	57.5	10.27	
Methyl Acrylate	86.1	0.96	80	9.9	10
Methyl Amine	31.06	gas	48	8.97	
Methyl Bromide	95.0	gas		10.53	
2-Methyl-1-Butane	70.16	0.650	31	9.12	
3-Methyl-1-Butane	70.14	0.627	20	9.51	
3-Methyl-2-Butane	70.14	0.643		8.67	
Methyl Butyl Ketone	100.6	0.83	127	9.34	100
Methyl Butyrate	102.13	0.898	102-103	10.07	
Methyl Chloride	50.5			11.28	100
Methyl Cyclohexane	98.19	0.770	101	9.85	
Methyl Disulfide	94.20	1.046	109	8.46	
Methyl Ethyl Ketone	72.10	0.805	80	9.53	
Methyl Formate	60.1	1.34	34	10.815	100
2-Methyl Furan	82.10	0.827	63-66	8.39	
Methyl Iodide	142.0	2.28	41-43	9.54	5
Methyl Isobutyl Ketone	100.2	0.80	117-18	9.30	100
Methyl Isobutyrate	102.13	0.891	90	9.98	
Methyl Isopropyl Ketone	86.12	0.805	94-95	9.32	
Methyl Isothiocyanate	73.12		37-39	9.25	
Methyl Methacrylate	100.1	0.94	100	9.9	100
1-Methyl Napthalene	142.20	1.001	240-243	7.96	
2-Methyl Napthalene	142.20	1,000	241-242	7.96	
2-Methyl Pentane	86.18	0.653	62	10.12	
3-Methyl Pentane	86.18	0.664	64	10.08	
Methyl Propionate	88.11	0.915	79	10.15	

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*** TWA - Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W. (G/MOLE)	DENSITY (G/ML)	BP (^{o}C)*	I.P. (EV)**	TWA (PPM)***
Methyl Propyl Ketone	86.13	.0.809	100.01	9.38	
2-Methyl Styrene	165.4	1.068	131	10.07	
Monomethyl Aniline	107.16	0.989			
Monomethyl Hydrazine	46.1	0.87			
Morpholine	87.1	1.01	129	8.88	20
Nephthalene	93.7	1.16	217.7	8.12	10
Nitric Oxide	162.2	1.01		9.25	
P-Nitroaniline	138.1				1.0
Nitrobenzene	123.1	1.21	210-211	9.92	1.0
4-Nitrobiphenyl	199.2				
P-Nitrochlorobenzene	157.6	1.52		9.96	1.0 mg/m
Nitrogen Dioxide	46.01	1.448		9.78	
Nitroethane	75.1	1.38	112	10.81	100
Nitromethane	61.0	1.13	100.8-101	11.08	100
1-Nitropropane	89.1	0.99	131-32	10.88	25
2-Nitropropane	89.1	0.98	120	10.71	25
N-Nitrosodimethylamine	74.1	1.00	153	9.07	
Nitrotoluene	137.1	1.16	225-238	11.63	5
Oxygen	31.9988	gas		12.08	
Ozone	48.00	gas		12.08	
Pentaborane	63.17	0.61		10.40	
Pentane	72.15	0.62638	35	10.35	
2,4-Pentanedione	70.13	0.6429	140.4	8.87	
1-Pentene	70.13	0.6503	29.9-30.1	9.50	
Phenetol	122.16	0.967	169-70	8.13	
Phenol	94.1	1.07	182	8.50	5
Phenyl Hydrazine	108.1	1.1	238-41	7.86	5
Phenyl Isocyanate	119.12	1.0887	162-63	8.77	
Phenyl Isothiocyanate	135.18	1.1288	221	8.52	
Phosgene	98.9	gas		11.77	0.4 mg/m
Phosphine	34.0	gas			0.3
Phosphorous Pentachloride	208.2	1.6		10.7	1 mg/m
Phosphorous Trichloride	137.3	1.57	76	10.5	
2-Picoline	93.12	0.950	128-29	9.02	
3-Picoline	93.12	0.9613	144	9.02	
4-Picoline	93.12	0.9571	145	9.04	
Propane	44.09	gas		11.07	
1-Propanethiol	76.16	0.841	67-68	9.20	
Propiolactone	72.06	1.146	162	9.70	
Propionic Acid	74.08	0.99336	141	10.24	
Propionaldehyde	58.08	0.8071	46-50	9.98	
Propionitrile	55.08	0.7818	97	11.84	
N-Propyl Acetate	102.1	0.84	120	10.04	200
Propyl Alcohol	60.10	0.804	97	10.20	
Propyl Amine	59.11	0.719	48	8.78	
Propyl Benzene	120.20	0.862	159	8.72	
Propylene	42.08	gas		8.73	
Propylene Oxide	58.08	0.859	34	10.22	

* BP - Boiling Point Degrees Centigrade
** IP - Ionization Potential
*** TWA - Time Weighted Average = Parts Per Million

CHEMICAL MATERIALS	F.W. (G/MOLE)	DENSITY (G/ML)	BP (°C)*	I.P. (EV)**	TWA (PPM)***
Methyl Propyl Ketone	86.13	0.809	100.01	9.38	
2-Methyl Styrene	165.4	1.068	131	10.07	
Monomethyl Aniline	107.16	0.989			
Monomethyl Hydrazine	46.1	0.87			
Morpholine	87.1	1.01	129	8.88	20
Napthalene	93.7	1.16	217.7	8.12	10
Propyl Ether	102.17	0.7360	88.90	9.27	
Propyl Formate	88.10	0.901		10.54	
Pyrene	202.3	gas		7.41	
Pyridine	79.1	0.98	115	9.32	5
Pyrrole	67.09	0.9691	131	8.20	
Styrene	104.14	9.9059	145-146	8.47	
Styrene Oxide	120.2	1.054	194	9.04	
Tetrachloroethylene	165.9	1.63	121	9.32	100
Tetrahydrofuran	72.10	0.8892	67	9.54	
Tetrahydropyran	86.13	0.8814	88	9.26	
Thiophene	84.1	1.53	84	8.86	
Toluene	93.13	0.866	111	8.82	
O-Toluidine	107.2	1.01	199-200	7.44	5
Trichloroethene	131.40	1.4649	87	9.45	
Triethylamine	101.19	1.069	88.18	7.50	
Trimethyl Amine	59.11	0.636	3-4	7.82	
2,2,4-Trimethyl Pentane	114.23	0.692	98-99	9.86	
Tripropyl Amine	143.27	0.753	155-58	7.23	
Valeraldehyder	86.13	0.8095	103	9.82	
Valeric Acid	102.13	0.939	185	10.12	
Vinyl Acetate	118	0.94	72-73	9.19	10
Vinyl Bromide	106.96	1.517	16	9.80	
Vinyl Chloride	62.5	gas		10.00	1
Water	18.016	1.00	100	12.59	
M-Xylene	106.16	0.8684	138-39	8.56	100
O-Xylene	106.16	0.8801	143-45	8.56	100
P-Xylene	106.16	0.8614	138	8.45	100

* BP - Boiling Point Degrees Centigrade
** IP - Ionization Potential
*** TWA - Time Weighted Average = Parts Per Million

NEW MEXICO ENERGY, MINERALS
& NATURAL RESOURCES DEPARTMENT

OFFICE OF THE SECRETARY
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-5950

Jennifer A. Salisbury
CABINET SECRETARY

February 16, 1998

Mr. Neal Goates
Sr. Environmental Specialist
Conoco Inc.
Midland Production Division
10 Desta Drive, Suite 100 West
Midland, Tx 79705

Re: Crude Oil Spill SEMU DTB Battery UL J-Sec 15-Ts20s-R37E
Crude remaining in the ground (322-50)=272 bbls.

Dear Mr. Goates:

New Mexico Conservation Division (NMOCD) is in receipt of the C-141 and attached documentation "Apply Risk Evaluation to Limit Gross Excavation Procedure Lea County, New Mexico" for the above referenced site. (50 year Fate & Transport Model).

After careful review and resultant telephone conversations with your technical personnel the NMOCD has the following comments:

Your cover letter indicated the contamination was screened using an OVM corrected for benzene. Please provide to the NMOCD the QA/QC information pertaining to this instrument. The NMOCD normally experiences companies using calibrations for total BTEX not just benzene.

After reviewing the fate and transport model it was apparent the model was for the top five feet of the soil. However, your letter indicated this top five feet would be removed and replaced with new soils which were not identified. NMOCD's concern is that soils buried below the "zero flux plane" within the vadose zone may not have an opportunity to bio-remediate or transport either up or down. Thus, the site would just become a burial site. It is NMOCD's opinion that Conoco has not properly demonstrated the actual fate and transport at this time.

Also, Conoco did not include the actual assessment of human and ecological exposure and the associated risks at the site. It appeared the Fate & Transport model just looked at future concentration of the contaminants of selected concern.

The analyticals only provided values for TPH. The NMOCD would have liked to seen what the actual BTEX values are since your OVM meter was calibrated only on benzene.

There is also a possible site control issue in which Conoco has not demonstrated to the NMOCD the long term control (50 years model time) of this remediation project. Also, what restriction controls would be placed on this site and how would it be implemented and monitored over the next 50 years. NMOCD understands some monitoring is required to calibrate models. Another issue is the amount of contaminated soil remaining might exceed 1400 cu yds and may trigger a 711 permit.

Therefore your request as presented is hereby denied and the NMOCD will require the following actions in order for Conoco to receive an approved closure;

Conoco shall remove and/or treat all contaminated soils in excess of 5000 ppm TPH (by method 418.1 or 8015-M) and demonstrate that all soils are below the 50 ppm level for BTEX (method 8020) all pursuant to the attached "OCD APPROVAL CONDITIONS".

Conoco shall provide a closure report pursuant to the attached OCD approval conditions and satisfy the above condition action items for this site within one year of receipt of this letter. Conoco may be granted more time for good cause shown.

Conoco shall start removal and/or treatment within 30 days receipt of this letter. Please notify the NMOCD within 48 hours of start of project.

If you require any further information or assistance please do not hesitate to call or write this office.

Sincerely Yours,

Wayne Price-Environmental Engineer

cc: Chris Williams-NMOCD District I Supervisor
Roger Anderson-Environmental Bureau Chief, Santa Fe, NM
Bill Olson-Environmental Bureau-SF
Hobbs Environmental/Spill file.

file:linda/wpconoco

attachments- copy of spill report, OCD APPROVAL CONDITIONS.

OCD APPROVAL CONDITIONS
FOR
REMEDIATION OF LEAKS AND SPILLS

1. The following remedial actions will be performed in accordance with OCD's August 13, 1993 "GUIDELINES FOR REMEDIATION OF LEAKS, SPILLS AND RELEASES":

   a. Vertical and horizontal extent of contamination will be determined either prior to, during or upon completion of remedial actions.

   b. Contaminated soils will be remediated to the OCD's recommended levels or a risk assessment will be provided which shows that an alternate cleanup level is protective of surface water, ground water, human health and the environment.

   c. Final soil contaminant concentrations will be determined upon completion of remedial actions.

   d. Soil samples for verification of completion of remedial actions will be sampled and analyzed for benzene, toluene, ethylbenzene, xylene **and** total petroleum hydrocarbons.

2. All wastes removed from a specific site will be disposed of at an OCD approved facility.

3. The OCD Santa Fe Office's Environmental Bureau Chief and the OCD Hobbs District Office will be notified within 24 hours of the discovery of ground water contamination related to remedial actions.

4. Upon completion of all remedial actions, a final remedial action report containing a description and the results of all remedial actions will be submitted to the OCD for approval. The report will include the concentrations and application rates of any materials or additives used to enhance bioremediation of the contaminants and the final concentrations of any soils landfarmed onsite or the final disposition of soils removed from the site . To simplify the approval process, the OCD requests that the final remedial action report be submitted only upon completion of all remedial activities including onsite remediation or landfarming of contaminated soils.

5. All original documents will be submitted to the OCD Hobbs Office for approval with copies provided to the OCD Santa Fe Office.

6. OCD approval does not relieve you of liability should remedial activities determine that contamination exists which is beyond the scope of the work plan or if the actions fail to adequately remediate contamination related to your activities. In addition, OCD approval does not relieve you of responsibility for compliance with other federal, state or local laws and regulations.

District I (505) 393-6161
P. O. Box 1980
Hobbs, NM 88241-1980
District II - (505) 748-1283
811 South First
Artesia, NM 88210
District III - (505) 334-6178
1000 Rio Brazos Road
Aztec, NM 87410
District IV - (505) 827-7131

State of New Mexico
Energy Minerals and Natural Resources Department
Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

Form C- 141
Originated 2/13/97

Submit 2 copies to Appropriate District Office in accordance with Rule 116 on back side of form

Release Notification and Corrective Action
OPERATOR

☐ Initial Report ☒ Final Report

Name	Contact
Conoco Inc.	John Inlow
Address	**Telephone No.**
10 Desta Dr. Ste 100W, Midland, Tx. 79705-4500	505-393-0138 ext. 28
Facility Name	**Facility Type**
SEMU DTB Battery	well location

Surface Owner	Mineral Owner	Lease No.
Trent Stradly		003085

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
J	15	20S	37E					Lea

NATURE OF RELEASE

Type of Release	Volume of Release	Volume Recovered
Crude Oil	322 bbls. oil	50 bbls. oil
Source of Release	**Date and Hour of Occurrence**	**Date and Hour of Discovery**
Tank overflow due to well kick	8/27/97; 5:00 p.m.	8/28/97; 9:30 a.m.
Was Immediate Notice Given? ☒ Yes ☐ No ☐ Not Required	**If YES, To Whom?** Karen Sharp	
By Whom? John Inlow	**Date and Hour** 8/29/97; 9:30 a.m.	
Was a Watercourse Reached? ☐ Yes ☒ No	**If YES, Volume Impacting the Watercourse**	

If a Watercourse was Impacted, Describe Fully.*

Describe Cause of Problem and Remedial Action Taken.*

Cause: Well # 87 kicked causing psi to kit treater, blowing gas & fluid into tank.
Remedial Action Taken: Add high psi separation; add choke in flowline; set psi shut in at well at 150; increase plate size

Describe Area Affected and Cleanup Action Taken.*

Area Affected: under tank area & running into field with 2 pockets approx. 15' by 15'
Cleanup Action Taken: Vertical extent of contamination has been determined. Area will be excavated down to 5' depth and material removed for proper disposal. Area will be backfilled with clean top soil to allow for reseeding of natural vegetation. See attachment for assessment details.

Describe General Conditions Prevailing (Temperature, Precipitation, etc.).*

clear

I hereby certify that the information given above is true and complete to the best of my knowledge and belief.
Signature: Neal Goates/by nsl
Printed Name: Neal Goates
Title: Sr. Environmental Specialist
Date: 12/22/97 Phone (915) 686-5488

OIL CONSERVATION DIVISION

Approved by District Supervisor
Approval Date: Expiration Date:
Conditions of Approval: Attached ☐

* Attach Additional Sheets If Necessary

District I (505) 393-6161
P. O. Box 1980
Hobbs, NM 88241-1980
District II - (505) 748-1283
811 South First
Artesia, NM 88210
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State of New Mexico
Energy Minerals and Natural Resources Department
Oil Conservation Division
2040 South Pacheco Street
Santa Fe, New Mexico 87505
(505) 827-7131

Form C- 141
Originated 2/13/97

Submit 2 copies to Appropriate District Office in accordance with Rule 116 on back side of form

Release Notification and Corrective Action
OPERATOR

☒ Initial Report ☐ Final Report

Name	Contact
Conoco Inc.	John Inlow
Address	**Telephone No.**
10 Desta Dr. Ste 100W, Midland, Tx. 79705-4500	505-393-0138 ext. 28
Facility Name	**Facility Type**
SEMU DTB Battery	well location

Surface Owner	Mineral Owner	Lease No.
Trent Stradly		003085

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
J	15	20S	37E					Lea

NATURE OF RELEASE

Type of Release	Volume of Release	Volume Recovered
Crude Oil	322bbls. oil	50 bbls. oil
Source of Release	**Date and Hour of Occurrence**	**Date and Hour of Discovery**
Tank overflow due to well kick	8/27/97; 5:00p.m.	8/28/97; 9:30a.m.
Was Immediate Notice Given? ☒ Yes ☐ No ☐ Not Required	**If YES, To Whom?** Karen Sharp	
By Whom? John Inlow	**Date and Hour** 8/29/97; 9:30a.m.	
Was a Watercourse Reached? ☐ Yes ☒ No	**If YES, Volume Impacting the Watercourse**	

If a Watercourse was Impacted, Describe Fully.*

Describe Cause of Problem and Remedial Action Taken.*

Cause: Well # 87 kicked causing psi to kit treater, blowing gas & fluid into tank.
Remedial Action Taken: Add high psi seperation; add choke in flowline; set psi shut in at well at 150; increase plate size

Describe Area Affected and Cleanup Action Taken.*

Area Affected: under tank area & running into field with 2 pockets approx. 15' by 15'
Cleanup Action Taken: Scheduling investigation for determine vertical extent of contamination-remedial plan to follow.

Describe General Conditions Prevailing (Temperature, Precipitation, etc.).*

clear

I hereby certify that the information given above is true and complete to the best of my knowledge and belief.
Signature:

Printed Name: Doris A. Powers
Title: Staff Regulatory Assistant
Date: 9/8/97 Phone (915) 686-6188

OIL CONSERVATION DIVISION

Approved by District Supervisor
Approval Date: Expiration Date:
Conditions of Approval: Attached ☐

* Attach Additional Sheets If Necessary

PHILIP ENVIRONMENTAL

Environmental Services Group
Southern Region

October 15, 1997
Project Number 18626

Mr. John Inlow
Conoco Inc.
1410 NW County Road
Hobbs, New Mexico 88240

Dear Mr. Inlow,

Philip Services Corporation is pleased to submit this report of spill assessment activities of a tank battery location near Monument, New Mexico. Based on the results of this work, hydrocarbon impacted soil in the spill area appears to be limited to a depth of approximately 25 feet below ground surface (bgs), with the highest TPH concentrations in the interval from surface to approximately 10 feet bgs. Groundwater was not encountered, and no surface water bodies or water wells were observed within a one-mile radius of the site.

Based on ranking criteria established in the New Mexico Oil Conservation Division's (NMOCD) *Guidelines for Remediation of Leaks, Spills, and Releases*, the NMOCD will likely require remediation of the impacted soils to achieve a remediation action level of 5,000 parts per million (milligrams per kilogram).

Philip has enjoyed working with you on this project. If you have any questions or we can be of further assistance, please call Jeff Kindley or me at (915) 563-0118.

Sincerely,

PHILIP SERVICES CORPORATION

Sharon E. Hall

Sharon E. Hall
Operations Manager

PHILIP ENVIRONMENTAL SERVICES CORPORATION
7904 Interstate 20 West • Midland, TX 79706
(915) 563-0118 • Fax (915) 563-9526

CONOCO MONUMENT TANK BATTERY

SPILL ASSESSMENT REPORT

October, 1997

Prepared For

Conoco Inc.
Hobbs, New Mexico

Project 18626

Prepared By

PHILIP SERVICES CORPORATION
7904 Interstate 20 West
Midland, Texas 79706
(915) 563-0118

TABLE OF CONTENTS

1.0 INTRODUCTION

Philip Services Corporation (Philip) has completed a site characterization of a spill area at a Conoco Tank Battery located near Monument, New Mexico (**Figure 1**). This report details the installation and sampling of four boreholes in the subject area. The purpose of the site investigation was to delineate the vertical extent of crude oil impacts to the soil at a recent spill site, and to identify if groundwater has been impacted.

2.0 HYDROGEOLOGY

The Ogallala Formation is the principal source of groundwater in Lea County, New Mexico. Depth to groundwater in Lea County ranges from 12 feet below ground surface (bgs) to 300 feet bgs. The Ogallala consists of predominantly coarse fluvial conglomerate and sandstone and fine-grained eolian siltstone and clay. Where present in the subject area, the Ogallala unconformably overlies Triassic red-beds.

3.0 SUBSURFACE INVESTIGATION

As per Philip's Workplan dated September 9, 1997, Philip field personnel were on-site September 17, 1997 to oversee the installation of four boreholes. Three of the boreholes were drilled in the area impacted by the spill, and the fourth was drilled in a direction assumed to be down-gradient based on surface topography (**Figure 2**).

Subsurface conditions were similar in the four boreholes installed (**Appendix A** - Boring Logs). The surface material to a depth of approximately 5 feet bgs is composed of a brown fine to medium-grained sand. From approximately 5 feet bgs to approximately 43 bgs, the lithology is white to buff limestone containing fine-grained sand. A one-foot thick sandstone layer occurs at a depth of approximately 25 feet bgs in each of the boreholes.

Soil samples were collected in each of the boreholes installed within the spill area (B-1, B-2, and B-3) at five-foot intervals, and were screened in the field for volatile organic compounds (VOCs) by a Philip representative using a photoionization detector (PID). The samples were visually inspected for evidence of staining. Soil characteristics, evidence of staining, and PID readings are shown on the boring logs in **Appendix A**.

Soil samples collected from the fourth borehole (B-4) were examined for visible evidence of staining, but samples were not screened using a PID due to the borehole's downgradient location and lack of staining or odor. The purpose of installing borehole B-4 in a location outside of the spill area was to identify if shallow groundwater occurs at the site without risk of cross-contaminating the groundwater. B-4 was advanced to a depth of 45 feet bgs and terminated in red clay (red-bed). Groundwater was not encountered in this borehole.

Following installation and sampling of the boreholes, each was grouted to the surface with cement containing a minimum 5% bentonite (**Appendix B** - Site Photographs).

4.0 ANALYTICAL RESULTS

In each of the boreholes drilled in the subject spill area (B-1, B-2 and B-3) the soil sample exhibiting the highest PID reading, and the sample collected at total depth of each borehole was submitted to Trace Analysis in Lubbock, Texas for analysis of total petroleum hydrocarbons (TPH). Analytical results are summarized below in **Table 1** and are included in **Appendix C**.

Table I
Laboratory Analysis
(Samples Collected 9/19/97)

Sample	Depth	Total Petroleum Hydrocarbon
B-1	5'	11,000
B-1	30'	11.9
B-2	5'	29,700
B-2	25'	<10.0
B-3	10'	33,900
B-3	30'	<10.0

mg/kg = milligrams per kilogram

USEPA Method 418.1

TPH concentrations in surface soil samples (5-10 feet bgs) range from 11,000 milligrams per kilogram (mg/kg) to 33,900 mg/kg. TPH concentrations were below the detection limit of 10 mg/kg in samples collected at total depth of boreholes B-2 and B-3. A TPH concentration of 11.9 mg/kg was detected in the sample collected at total depth of borehole B-1.

Percent moisture and fraction organic content (FOC) were analyzed for the sample collected at 5 feet bgs in borehole B-4. The moisture content of the sample was 82%, and the FOC 2.7%.

5.0 CONCLUSIONS

Based on field observation and laboratory analysis, hydrocarbon impacted soil in the spill area appears to be limited to a depth of approximately 25 feet bgs, with the highest TPH concentrations in the interval from surface to approximately 10 feet bgs.

Groundwater was not encountered at this location, and is typically encountered in this area above the Triassic red-bed. The red-bed was identified at a depth of 43 feet bgs in B-4.

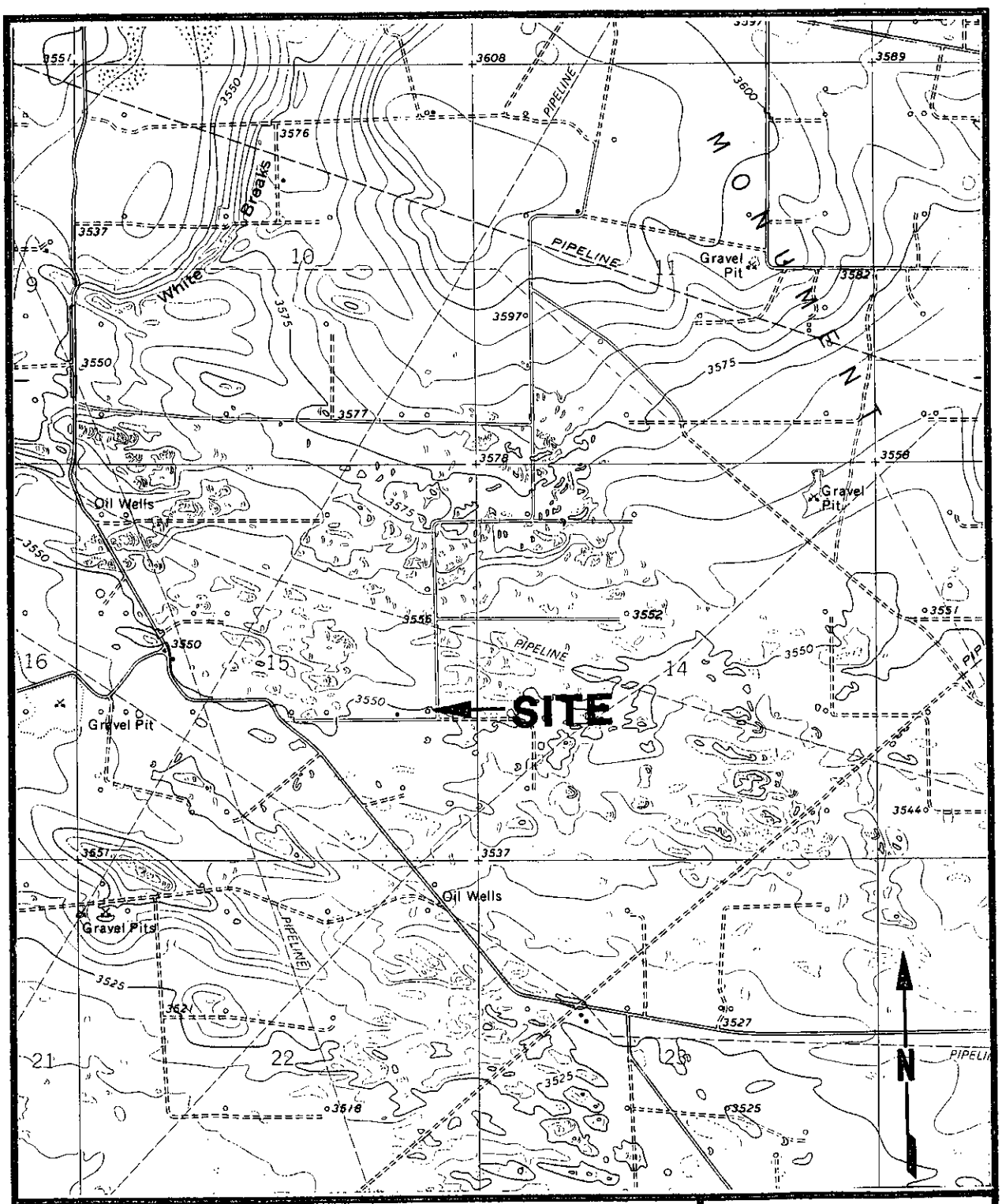
Additionally, based on a conversation with a local rancher who has attempted to drill several water wells, shallow groundwater does not occur in this area.

Based on field observation, no surface water bodies or water wells are located within a one-mile radius of the site.

6.0 REFERENCES

Hydrology and Hydrochemistry of the Ogallala Aquifer, Southern High Plains, Texas Panhandle, and Eastern New Mexico; Report Number 177; Bureau of Economic Geology; 1988

Hydrogeochemistry and Water Resources of the Lower Dockum Group in the Texas Panhandle and Eastern New Mexico; Report Number 161; Bureau of Economic Geology; 1986



PHILIP SERVICES CORP

Conoco
USGS 7.5"Quad
Hobbs SW
Lea Co. New Mexico
1969 Edition, Photorevised 1979

Figure 1
Project No. 18626
Scale 1:24,000

Soil staining around boring B-1

Drilling of boring B-1

Soil staining around boring B-1

Drilling of boring B-1

Grouting of Boring B-1

Grouted Boring B-1

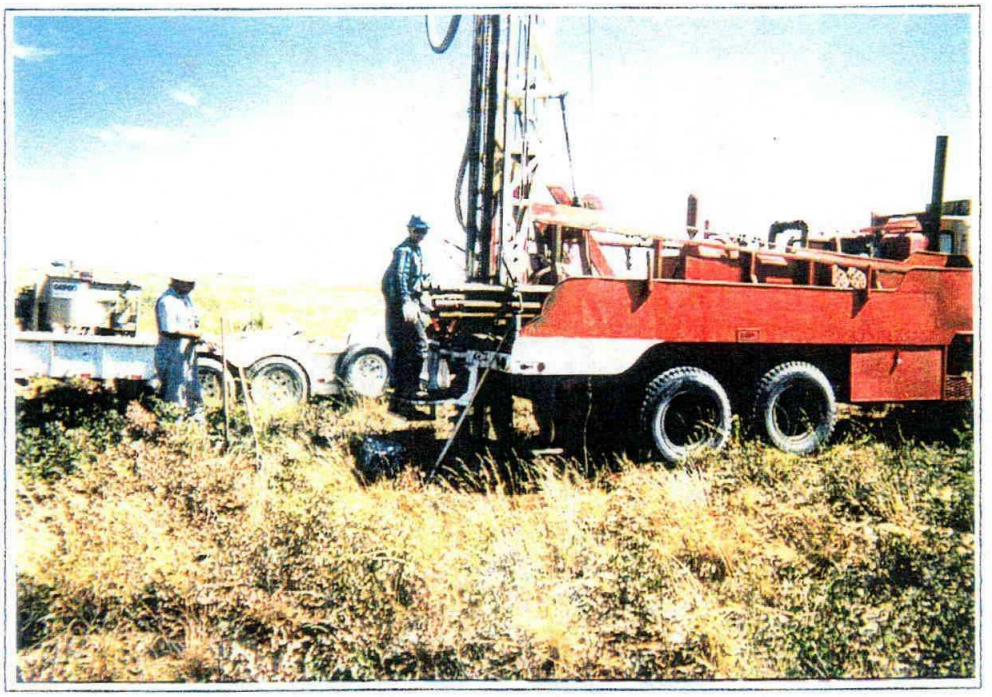
Grouting of Boring B-1

Grouted Boring B-1

Soil staining around Boring B-2

Drilling of Boring B-2

Soil staining around Boring B-2



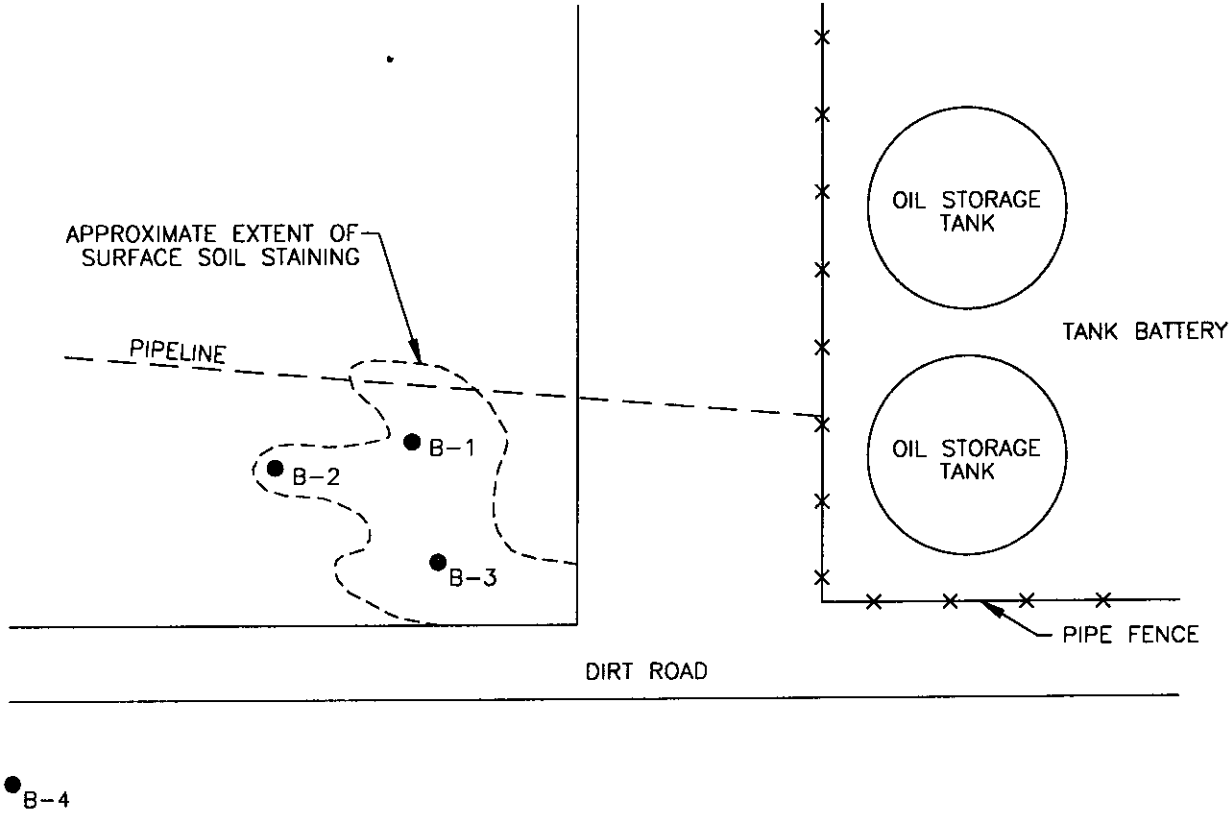
Drilling of Boring B-2

Grouting of Boring B-2

Grouted Boring B-2

Grouting of Boring B-2

Grouted Boring B-2



LEGEND

●B-1 SAMPLE LOCATION AND NUMBER

0 50
FEET

N

PHILIP SERVICES CORP

TITLE:
CONOCO TANK BATTERY MONUMENT
LEA COUNTY, NEW MEXICO

DWN:	DES.:
TMM	JK
CHKD:	APPD:
JK	JK
DATE:	REV.:
10/14/97	0

PROJECT NO.: 18626
TANK BATTERY
LEA COUNTY, NM

FIGURE 2

COL. 18626A-001

APPENDIX A

BORING/DRILLER'S LOGS

PHILIP SERVICES C.O.R.P.

RECORD OF SUBSURFACE EXPLORATION

Borehole No. B-1

Project Name: Conoco
Project No. 18626
Borehole Location: Lea Co., New Mexico
Logged By: Jeffrey Kindley
Drilled By: Scarborough Drilling
Drilling/Rig Methods: Air Rotary 8 1/4"
Date/Time Started: 09/17/97 @ 1100
Date/Time Completion(s): 09/17/97 @ 1140
Air Monitoring Type: Not Applicable
GWL Depth: Not encountered

Depth (feet)	Sample Number	Sample Interval	Sample Type	Sample Description	OVM Readings (ppm)	USCS Symbol	Comments
0-							
5	B-1	3-5	S.S.	Brown hydrocarbon stained fine-grain sand	780	SW	Dry
--10		8-10	S.S.	Brown hydrocarbon stained limestone with brown clayey silty fine-grain sand inter-mixed	620	L	Dry
--15		13-15	S.S.	White/buff limestone	244	L	Dry Hydrocarbon odor
--20		18-20	S.S.	White/buff limestone with fine-grain sand	96	L	Dry-- Slight Hydrocarbon odor-
--25		23-25	S.S.	Sandstone at 25'	174	SS	-Dry- Hydrocarbon odor
--30	B-2	28-30	S.S.	White/buff limestone with fine-grain sand Boring terminated at 30 feet	3	L	Dry-- No hydrocarbon odor-
--35							
--40							

Comments: Boring terminated at 30 feet. Samples collected at 3-5 feet and 28-30 feet.

Geologist Signature Jeffrey Kindley

PHILIP SERVICES CORP

RECORD OF SUBSURFACE EXPLORATION

Borehole No. B-2

Project Name: Conoco
Project No. 18626
Borehole Location: Lea Co., New Mexico
Logged By: Jeffrey Kindley
Drilled By: Scarborough Drilling
Drilling/Rig Methods: Air Rotary 8 1/4"
Date/Time Started: 09/17/97 @ 1218
Date/Time Completion(s): 09/17/97 @ 1310
Air Monitoring Type: Not Applicable
GWL Depth: Not encountered

Depth (feet)	Sample Number	Sample Interval	Sample Type	Sample Description	OVM Readings (ppm)	USCS Symbol	Comments
0-							
5	B-3	3-5	S.S.	Brown hydrocarbon stained fine-grain sand	489	SW	Dry Hydrocarbon odor & staining
--10		8-10	S.S.	White/Buff limestone	56	L	Dry Slight hydrocarbon odor
--15		13-15	S.S.	with small amount of fine-grain sand	16		Dry Slight hydrocarbon odor
--20		18-20	S.S.	tan fine-grain sand	72	SW	Dry-- Slight Hydrocarbon odor-
--25	B-4	23-25	S.S.	Grey sandstone at 25'	3	SS	-Dry- No hydrocarbon odor
--30				Boring terminated at 26 feet			
--35							
--40							

Comments: Boring terminated at 26 feet. Samples collected at 3-5 feet and 26 feet.

Geologist Signature Jeffrey Kindley

PHILIP SERVICES CORP

RECORD OF SUBSURFACE EXPLORATION

Borehole No. B-3

Project Name: Conoco
Project No. 18626
Borehole Location: Lea Co., New Mexico
Logged By: Jeffrey Kindley
Drilled By: Scarborough Drilling
Drilling/Rig Methods: Air Rotary 8 1/4"
Date/Time Started: 09/17/97 @ 1354
Date/Time Completion(s): 09/17/97 @ 1430
Air Monitoring Type: Not Applicable
GWL Depth: Not encountered

Depth (feet)	Sample Number	Sample Interval	Sample Type	Sample Description	OVM Readings (ppm)	USCS Symbol	Comments
0-							
5		3-5	S.S.	Brown medium-grain sand	325	SW	Dry -Hydrocarbon stained with hydrocarbon odor
--10	B-5	8-10	S.S.		532		
--15		13-15	S.S.	*Buff/White limestone*	185	L	Dry Hydrocarbon odor
--20		18-20	S.S.	with fine-grain sand intermixed	43	L	Dry-- Slight Hydrocarbon odor-
--25		23-25	S.S.		87	L	
				Sandstone at 26'		SS	Dry No hydrocarbon odor
--30	B-6	28-30	S.S.	White/buff limestone with fine-grain sand	8	L	Dry-- No hydrocarbon odor-
				Boring terminated at 30 feet			
--35							
--40							

Comments: Boring terminated at 30 feet. Samples collected at 8-10 feet and 28-30 feet.

Geologist Signature Jeffrey Kindley

PHILIP SERVICES CORP

RECORD OF SUBSURFACE EXPLORATION

Borehole No. B-4

Project Name: Conoco
Project No. 18626
Borehole Location: Lea Co., New Mexico
Logged By: Jeffrey Kindley
Drilled By: Scarborough Drilling
Drilling/Rig Methods: Air Rotary 8 1/4"
Date/Time Started: 09/17/97 @ 1445
Date/Time Completion(s): 09/17/97 @ 1549
Air Monitoring Type: Not Applicable
GWL Depth: Not encountered

Depth (feet)	Sample Number	Sample Interval	Sample Type	Sample Description	OVM Readings (ppm)	USCS Symbol	Comments
0-							
5		3-5	S.S.	Brown medium-grain sand		SW	Dry
--10		8-10	S.S.	White/buff limestone		L	
--15		13-15	S.S.				Dry
--20		18-20	S.S.	with fine-grain sand intermixed		L	Dry--
--25		23-25	S.S.	Sandstone at 25'		SS	Dry
--30		28-30	S.S.	White/buff limestone with fine-grain sand		L	Dry--
--35		33-35	S.S.				
--40							

Comments:

Geologist Signature Jeffrey Kindley

PHILIP SERVICES C.O.R.P.

RECORD OF SUBSURFACE EXPLORATION

Borehole No. B-4

Project Name: Conoco
Project No. 18626
Borehole Location: Lea Co., New Mexico
Logged By: Jeffrey Kindley
Drilled By: Scarborough Drilling
Drilling/Rig Methods: Air Rotary 8 1/4"
Date/Time Started: 09/17/97 @ 1445
Date/Time Completion(s): 09/17/97 @ 1549
Air Monitoring Type: Not Applicable
GWL Depth: Not encountered

Depth (feet)	Sample Number	Sample Interval	Sample Type	Sample Description	OVM Readings (ppm)	USCS Symbol	Comments
40-							
45		43-45	S.S.	Red clay of high plasticity		CL	Dry
				Boring terminated at 45 feet			
50							

Comments: Boring terminated at 45 feet

Geologist Signature Jeffrey Kindley

APPENDIX B

SITE PHOTOGRAPHS

APPENDIX C

LABORATORY ANALYSIS

6701 Aberdeen Avenue
Lubbock, Texas 79424
806•794•1796
FAX 806•794•1298

ANALYTICAL RESULTS FOR
Philip Environmental
Attention Jeff Kindley
7904 I-20 West
Midland TX 79706

Date: Sep 24, 1997
Date Rec: 9/19/97
Project: 18626
Proj Name: ~~Transwestern~~ Conoco
Proj Loc: ~~Monahans, Tx~~ Monument, NM.

Lab Receiving # : 9709000328
Sampling Date: 9/17/97
Sample Condition: Intact and Cool
Sample Received By: JH

TA#	Field Code	MATRIX	TRPHC (mg/Kg)
T81915	B-1 (5')	Soil	11,000
T81916	B-1 (30')	Soil	11.9
T81917	B-2 (5')	Soil	29,700
T81918	B-2 (25')	Soil	<10.0
T81919	B-3 (10')	Soil	33,900
T81920	B 3 (30')	Soil	<10.0
	Method Blank		<10.0
	Reporting Limit		10
	QC		102
	RPD		25
	% Extraction Accuracy		94
	% Instrument Accuracy		102

TEST	PREP METHOD	PREP DATE	ANALYSIS METHOD	ANALYSIS COMPLETED	CHEMIST	QC: (mg/L)	SPIKE: (mg/Kg)
TRPHC	EPA 3550	9/24/97	EPA 418.1	9/24/97	MS	100	350

BL 9-24-97

Director, Dr. Blair Leftwich Date

TRACEANALYSIS, INC.
A Laboratory for Advanced Environmental Research and Analysis

6701 Aberdeen Avenue
Lubbock, Texas 79424
806•794•1296
FAX 806•794•1298

ANALYTICAL RESULTS FOR
Philip Environmental
Attention Jeff Kindley
7904 I 20 West
Midland TX 79706

Date: Oct. 03, 1997
Date Rec: 9/19/97
Project: 18626
Proj Name: Transwestern
Proj Loc: Monahans, Tx

Lab Receiving # : 9709000328
Sampling Date: 9/17/97
Sample Condition: Intact and Cool
Sample Received By: JH

TA#	Field Code	MATRIX	FOC (%)
T81921	B-4 (5')	Soil	2.7
RPD			14

TEST	PREP METHOD	PREP DATE	ANALYSIS METHOD	ANALYSIS COMPLETED	CHEMIST
FOC	N/A	9/29/97	ASTM 2974-8	9/29/97	JS

Director Dr. Blair Leftwich

10-3-97
Date

6701 Aberdeen Avenue
Lubbock, Texas 79424
806•794•1296
FAX 806•794•1298

ANALYTICAL RESULTS FOR
PHILIP ENVIRONMENTAL
Attention: Jeff Kindley
7904 I-20 West
Midland, TX 79706

October 03, 1997
Receiving Date: 09/19/97
Sample Type: Soil
Project No: 18626
Project Location: Monument, New Mexico

Prep Date: 09/29/97
Analysis Date: 09/29/97
Sampling Date: 09/17/97
Sample Condition: Intact & Cool
Sample Received by: JH
Project Name: Conoco

TA#	FIELD CODE	% Moisture (%)
T81921	B-4 (5')	0.82
RPD		10

CHEMIST: JS

Director, Dr. Blair Leftwich

10-3-97
DATE

TraceAnalysis, Inc.

6701 Aberdeen Avenue Lubbock, Texas 79424
Tel (806) 794 1296 Fax (806) 794 1298
1 (800) 378 1296

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

Project Manager: Jeffrey Kindley
Phone #: (915) 563-0118
FAX #: (915) 563-9526

Company Name & Address: Philip Services Corporation
7904 Interstate 20 West, Midland, Tx 79706

Project #: 18626
Project Name: Conoco

Project Location: Monument, New Mexico
Sampler Signature: Jeffrey Kindley

LAB # (LAB USE ONLY)	FIELD CODE	# CONTAINERS	Volume/Amount	MATRIX: WATER	SOIL	AIR	SLUDGE	PRESERVATIVE METHOD: HCL	HNO3	ICE	NONE	SAMPLING: DATE	TIME	BTEX, MTBE	TPH	Total Metals Ag As Ba Cd Cr Pb Hg Se	TCLP Metals Ag As Ba Cd Cr Pb Hg Se	TCLP Volatiles	TCLP Semi Volatiles	RCI	8240 / 8260	8270	Fraction Organic Content (FOC)	Moisture Content	Porosity *	Intrinsic Permeability *	Turn around # of days	Fax ASAP	Hold
	B-1 (5')	1			✓						✓	09/18/97	1105		✓														
	B-1 (30')	1			✓						✓	09/18/97	1129		✓														
	B-2 (5')	1			✓						✓	09/18/97	1220		✓														
	B-2 (25')	1			✓						✓	09/18/97	1252		✓														
	B-3 (10')	1			✓						✓	09/18/97	1404		✓														
	B-3 (30')	1			✓						✓	09/18/97	1426		✓														
	B-4 (5')	1			✓						✓	09/18/97	1445									✓	✓	✓	✓				
	B-4 (10')	1			✓						✓	09/18/97	1450											✓	✓				
	B-4 (15')	1			✓						✓	09/18/97	1455											✓	✓				

Relinquished by: Jeffrey Kindley Date: September 18, 1997 Time: 3:10 PM
Received by: Helen Ahrton Date: 9/18/97 Time: 3:10PM

Relinquished by: Date: Time:
Received by: Date: Time:

Relinquished by: Date: Time:
Received at Laboratory by: Date: Time:

REMARKS
* For Porosity and Intrinsic Permeability, we need to mix (if possible) the remainder of B-4 (5') with B-4 (10') and B-4 (15') and run these analysis.

Normal Turnaround

Steve H. Danbom, Ph.D.
Sr. Consultant
Remediation Technology
RMNA

Conoco Inc.
P.O. Box 2197
Houston, TX 77252-2197
(281) 293-2636

November 24, 1997

Mr. Neal Goates
Midland Production Division
10 Desta Drive, Suite 100 West
Midland, TX 79705

Dear Neal:

The following letter report discusses fate and transport modeling results using Risk-Integrated Software for Cleanups (RISC), a product of British Petroleum that has recently been released . I have used this program to evaluate long-term effects of a spill from a tank battery in Lea County, NM. Appendix A gives a brief discussion of the scope of the computer-modeling program RISC. Appendix B provides details of Model #1 input parameters including a graph showing the 50-year predicted concentrations of benzene, ethylbenzene, and toluene in the soil for the spill assuming no remediation and using some supplied site-specific parameters. Appendix B details a second model that is identical to Model #1 except for inserting more nominal values for fraction of organic carbon in the indigenous soil and percentage of partial-water saturation in the vadose zone.

General Discussion

First, I want to emphasize what is obvious, that the area surrounding the site is quite remote. As a result, there are no human receptors living near this spill. The workers that encounter this site do so infrequently and are assumed to wear protective clothing consistent with work of this nature. Secondly, concerning the groundwater issue, which is almost always foremost in the thinking of professionals in the human-health risk-assessment business, this site has no established near-surface groundwater. The Ogallala Aquifer, which is underlain by Permian-aged sedimentary rock, is absent.

As a consequence of the combination of the absence of people living nearby and no near-surface groundwater or surface water, the risk to human health is nearly zero. The only potential risk, which is very small, would be for oil-field workers (this can be calculated with this same RISC program given additional information on worker exposure, etc.).

The Spill

I have done this modeling with somewhat limited information on the spill. The report, dated October 15th from Philip Environmental describing (TPH) analytical measurements for two depths at four locations around the spill was the primary source

of information. Three of the sample locations were within the spill boundary and a fourth location was taken outside this boundary for control purposes. With no speciation of the TPH information and potential exposure pathways limited to inhalation of volatiles from the lighter ends of the crude oil, it was decided to evaluate a "worst case" scenario by assuming the spill to have concentrations of commonly modeled BETX constituents (benzene, ethylbenzene, toluene, and xylene) as if the spill was predominately of the gasoline range organic variety. As a result of this conservative assumption (i.e., an assumption that would maximize the effects of volatilization in order to err on the side of human health), an available generic gasoline was used to further speciate the spill analytical data, using the mass-fraction analysis of the generic gasoline as a guide. The modeling also shows the amount of BETX that remains at the site over time as well; this information is graphically displayed in Appendices B and C to estimate site conditions in the future.

For Both Models

The estimation for the spill (200 bbl) was converted into 2.9 X 10^{10} milligrams by common physical constants. The spill dimensions, chosen by examining the information of the Philips report, are 20m X 20m X 5m which converts into 3.4 X 10^{6} kilograms of affected soil. This gives an average concentration of 8535 mg/kg (ppm) in the soil, which is consistent with specific, point measurements reported in the Phillips report. The mass fractions of 0.076, 0.03, 0.055, and 0.010 for benzene, ethylbenzene, toluene, and xylene respectively, are from the generic gasoline model.

Other specific parameters listed in Appendices B and C are appropriate for the site's geology, hydrogeology, and climatic conditions. It should be stressed that the modeling did not assume any contaminant degradation due to intrinsic bioremediation (the commonly observed phenomenon due to local soil microbial communities). This is because the model has no provisions to account for intrinsic bioremediation in the vadose zone, only for the saturated zone. There is a lack of refereed papers on the subject of vadose-zone bioremediation from which one could extract meaningful constants of decay.

Model #1

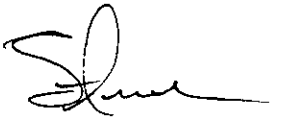
The input data for Model #1 and the graph showing model predictions for residual contamination over time for three of the BETX compounds is included as Appendix B (xylene was omitted due to graphical limitations of the program). Two of the input values, that of fraction of organic carbon for the indigenous soil (taken from sample #4 that is out of the spill area) and partial water saturation in the vadose zone are questionable. Due to the near-desert conditions in the area, fraction of organic carbon might be expected to range from 0.001 to 0.01. The value of 0.027 that was measured for sample #4 is outside the expected range. Similarly, the value of 82 percent for partial-water saturation in the vadose zone is very high considering the local soil type and the limited rainfall for the region. This first model would predict very little hydrocarbon loss over the next fifty years, even for these lighter ends in this crude oil

spill. Whereas this would render human-health risk for an oil-field worker to an insignificant value, it would probably not be the best prediction for the site, as one would normally expect the lighter ends of the spill to volatilize somewhat rapidly due to the fact that the spill is currently neither excavated nor capped.

Model #2

Model #2 is identical to Model #1 except for changing the fraction of organic carbon and partial water saturation to values more normal for this area. As expected, Model #2 predicts a greater volatilization into the atmosphere over time, leaving less residual hydrocarbon saturation at the site for the same fifty years modeled.

Sincerely,



Steve H. Danbom, Ph.D.
Senior Consultant
Remediation Technology

APPENDIX A

1.0
OVERVIEW AND GETTING STARTED

1.1 INTRODUCTION

1.1.1 Background

British Petroleum's (BP's) Risk-Integrated Software for Cleanups (RISC) has been developed to assist in the evaluation of potential human health risks from contaminated sites. RISC is a Windows® based software program that can be used to estimate the potential for adverse human health impacts (both carcinogenic and non-carcinogenic) from up to nine exposure pathways; additional pathways and other non-human health impacts may be considered in future revisions. The software contains vadose zone, saturated zone, and air fate and transport models for estimating receptor point concentrations.

The reader should note that through out this document the term "risk" will be used to refer to the estimated potential for adverse human health impacts, for both carcinogenic and non-carcinogenic compounds. For some, this is a departure from the more rigorous use of the term "risk", where it is sometimes only used to refer to the probability of developing cancer as a result of exposure to a chemical or group of chemicals.

1.1.2 Uses of this Software

There are at least three broad applications for the RISC software. RISC can be used to (1) estimate human health risk from exposure to contaminated media, (2) estimate risk-based clean-up levels in various media, and (3) perform simple fate and transport modeling. These three different applications are discussed in the following sections.

1.1.2.1 Human Health Risk Assessment

Human health risk assessment can be defined as the characterization of the potential adverse effects on human life or health. Calculating risk is sometimes called the "forward calculation" whereas calculating clean-up levels is called the "back calculation". US EPA's Risk Assessment Guidance for Superfund, or the "RAGS" manual (US EPA, 1989), characterize the risk assessment process by dividing it into four basic steps:

The RISC software is a powerful, flexible tool that can be used for any of the above objectives. The reader is referred to the RAGS manual (US EPA, 1989) for more detailed information on each step of the risk assessment process.

1.1.2.2 Risk-Based Corrective Action

Risk-Based Corrective Action (RBCA) is a decision-making process for assessment and response to subsurface contamination, and is based on protection of human health and environmental resources. One of the steps in RBCA is to calculate clean-up levels, or concentrations of contaminants that pose an acceptable risk left in place (the back-calculation). The guidelines for RBCA are published in ASTM E1739-95, Standard Guide for Risk-based Corrective Action Applied at Petroleum Release Sites.

- The RBCA process was developed as a way to allocate limited resources (time, money, regulatory oversight, etc.) to multiple release sites in a way that allows innovative and cost-effective decision making while ensuring that human health and environmental resources are protected. In order to meet that goal, the process emphasizes the following:
- it integrates site assessment, remedial action selection and site monitoring so the approach is streamlined, targeted and consistent;
- site assessment activities are focused on collecting information needed to make risk-based corrective action decisions; and
- these corrective action decisions are based on site-specific factors and compliance points directed toward cost-effective alternatives that have a high probability of achieving an appropriate reduction in risk.

The RBCA process involves a tiered approach to data collection and evaluation. In general, Tier 1 of the RBCA process involves an initial site assessment and classification of the site based on conservative risk-based screening levels (RBSLs) that are not site specific. Tiers 2 and 3 involve evaluating the site using more site-specific information (e.g., depth to groundwater, infiltration rate, etc.) and/or evaluating alternate compliance points (locations of exposure). Tier 3 is likely to involve more complex analysis such as detailed site assessment, probabilistic evaluations, and sophisticated chemical fate and transport models.

- Dispersion, advection, and degradation of groundwater as it moves in an aquifer;
- Saturated soil source at the water table impacting groundwater;
- Emissions from soil to outdoor and indoor air; and
- Emissions from groundwater to indoor air.

The models listed above may be linked together as well. For example, the saturated soil source model (at the water table) can be linked with the groundwater model and then used to estimate volatile emissions to indoor air.

1.1.3 Overview of Features

1. The RISC software includes many features to assist in performing and presenting risk assessments or the results of fate and transport models. Version 3.0 of RISC allows the user to:

    - follow the ASTM tiered approach by utilizing a spreadsheet based on the ASTM algorithms for Tier 1, the embedded fate and transport models in RISC for Tier 2, and the Monte Carlo option in RISC for Tier 3;
    - choose chemicals of concern from a standard library of 86 chemicals; users may also add or delete chemicals from the library and alter the physical, chemical, and toxicological properties of each;
    - perform calculations for two different exposure scenarios (with up to nine exposure pathways each) simultaneously (e.g. calculations for both residential and industrial scenarios can be performed at the same time);
    - determine cumulative risks from two different exposure scenarios, as might be the case when the user wants to sum the risks for the scenario where a resident is exposed during both childhood and adulthood;
    - estimate exposure point water and air (both indoor and outdoor) concentrations using predictive chemical fate and transport models;
    - allow for additivity of pathways and compounds for either a forward calculation of risk or back calculation of cleanup levels
    - use a Word® template to write a risk-based closure report for regulatory submission;
    - use an embedded tool to estimate average, 95th UCL, and weight-averaged concentrations for a set of parameter values; and

APPENDIX B

Vadose zone model used to estimate outdoor air concentration

Title: Lea County, New Mexico Spill

Simulation time (years)..... 50

Vadose Zone Source Parameters

Thickness of contamination (m).....	5.00
Depth to top of contamination (m).....	.000
Length of source (m).....	20.0
Width of source (m).....	20.0

Unsaturated Zone Properties

Total Porosity in vadose zone (cm3/cm3)	.300
Residual water content (cm3/cm3).....	.250
Fraction organic carbon (g oc/g soil)...	2.700E-02
Soil bulk density (g/cm3).....	1.70
Infiltration Rate (cm/yr).....	5.00
Saturated conductivity (m/d).....	5.00
Van Genuchten"s N.....	2.68
Thickness of vadose zone (m).....	20.0

OUTDOOR AIR PARAMETERS

Height of box (breathing zone) (m).....	2.00
Width of box (m).....	20.0
Wind speed (m/s).....	5.00

TPH Data for Unsaturated Zone Source

Concentration of TPH in soil (mg/kg)....	8.535E+03
Molecular weight of TPH (g/mol).....	100.

CHEMICAL DATA INPUT: Benzene

Diffusion coeff. in air (cm2/s).....	8.800E-02
Diffusion coeff. in water (cm2/s)...	9.800E-06
Solubility (mg/l).....	1.750E+03
KOC (ml/g).....	58.9
Henry"s Law Coefficient (-).....	.228
Molecular Weight (g/mol).....	78.0
Density of chemical (g/cm3).....	.877
Degradation rate sat. zone (1/d)....	.000
Degradation rate unsat. zone (1/d)..	2.000E-03

Source Concentrations: Benzene

Source Conc. for unsaturated zone model (mg/kg)... 65.0

CHEMICAL DATA INPUT: Ethylbenzene

Diffusion coeff. in air (cm2/s).....	7.500E-02
Diffusion coeff. in water (cm2/s)...	7.800E-06
Solubility (mg/l).....	169.
KOC (ml/g).....	363.
Henry"s Law Coefficient (-).....	.323
Molecular Weight (g/mol).....	106.
Density of chemical (g/cm3).....	.867
Degradation rate sat. zone (1/d)....	.000
Degradation rate unsat. zone (1/d)..	3.000E-03

Source Concentrations: Ethylbenzene

Source Conc. for unsaturated zone model (mg/kg)... 256.

CHEMICAL DATA INPUT: Toluene

Diffusion coeff. in air (cm2/s).....	8.700E-02
Diffusion coeff. in water (cm2/s)...	8.600E-06

Solubility (mg/l)	526.
KOC (ml/g)	182.
Henry"s Law Coefficient (-)	.272
Molecular Weight (g/mol)	92.1
Density of chemical (g/cm3)	.867
Degradation rate sat. zone (1/d)	.000
Degradation rate unsat. zone (1/d)	3.300E-03

Source Concentrations: Toluene

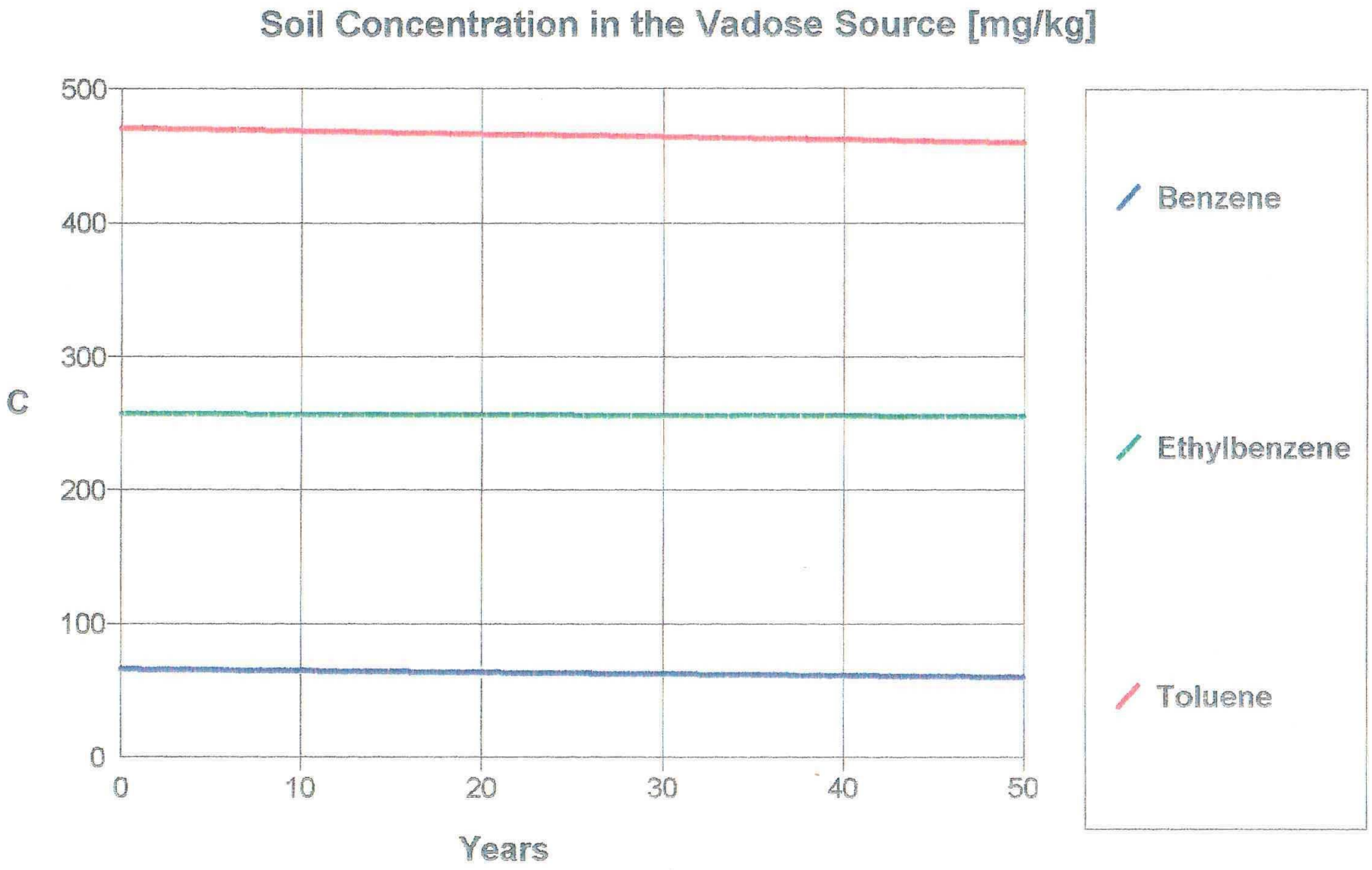
Source Conc. for unsaturated zone model (mg/kg)... 470.

CHEMICAL DATA INPUT: Xylenes (mixed)

Diffusion coeff. in air (cm2/s)	7.200E-02
Diffusion coeff. in water (cm2/s)	8.500E-06
Solubility (mg/l)	185.
KOC (ml/g)	386.
Henry"s Law Coefficient (-)	.301
Molecular Weight (g/mol)	106.
Density of chemical (g/cm3)	.870
Degradation rate sat. zone (1/d)	.000
Degradation rate unsat. zone (1/d)	2.000E-03

Source Concentrations: Xylenes (mixed)

Source Conc. for unsaturated zone model (mg/kg)... 854.


Soil Concentration in the Vadose Source [mg/kg]
C
500
400
300
200
100
0
0
10
20
30
40
50
Years
Benzene
Ethylbenzene
Toluene

APPENDIX C

Vadose zone model used to estimate outdoor air concentration

Title: Lea County, New Mexico Spill

Simulation time (years)..... 50

Vadose Zone Source Parameters

Thickness of contamination (m).....	5.00
Depth to top of contamination (m).....	.000
Length of source (m).....	20.0
Width of source (m).....	20.0

Unsaturated Zone Properties

Total Porosity in vadose zone (cm3/cm3)	.300
Residual water content (cm3/cm3).....	5.000E-02
Fraction organic carbon (g oc/g soil)...	2.000E-03
Soil bulk density (g/cm3).....	1.70
Infiltration Rate (cm/yr).....	5.00
Saturated conductivity (m/d).....	5.00
Van Genuchten"s N.....	2.68
Thickness of vadose zone (m).....	20.0

OUTDOOR AIR PARAMETERS

Height of box (breathing zone) (m).....	2.00
Width of box (m).....	20.0
Wind speed (m/s).....	5.00

TPH Data for Unsaturated Zone Source

Concentration of TPH in soil (mg/kg)....	8.535E+03
Molecular weight of TPH (g/mol).....	100.

CHEMICAL DATA INPUT: Benzene

Diffusion coeff. in air (cm2/s).....	8.800E-02
Diffusion coeff. in water (cm2/s)...	9.800E-06
Solubility (mg/l).....	1.750E+03
KOC (ml/g).....	58.9
Henry"s Law Coefficient (-).....	.228
Molecular Weight (g/mol).....	78.0
Density of chemical (g/cm3).....	.877
Degradation rate sat. zone (1/d)....	.000
Degradation rate unsat. zone (1/d)..	2.000E-03

Source Concentrations: Benzene

Source Conc. for unsaturated zone model (mg/kg)... 65.0

CHEMICAL DATA INPUT: Ethylbenzene

Diffusion coeff. in air (cm2/s).....	7.500E-02
Diffusion coeff. in water (cm2/s)...	7.800E-06
Solubility (mg/l).....	169.
KOC (ml/g).....	363.
Henry"s Law Coefficient (-).....	.323
Molecular Weight (g/mol).....	106.
Density of chemical (g/cm3).....	.867
Degradation rate sat. zone (1/d)....	.000
Degradation rate unsat. zone (1/d)..	3.000E-03

Source Concentrations: Ethylbenzene

Source Conc. for unsaturated zone model (mg/kg)... 256.

CHEMICAL DATA INPUT: Toluene

Diffusion coeff. in air (cm2/s).....	8.700E-02
Diffusion coeff. in water (cm2/s)...	8.600E-06

Solubility (mg/l)	526.
KOC (ml/g)	182.
Henry"s Law Coefficient (-)	.272
Molecular Weight (g/mol)	92.1
Density of chemical (g/cm3)	.867
Degradation rate sat. zone (1/d)	.000
Degradation rate unsat. zone (1/d)	3.300E-03

Source Concentrations: Toluene

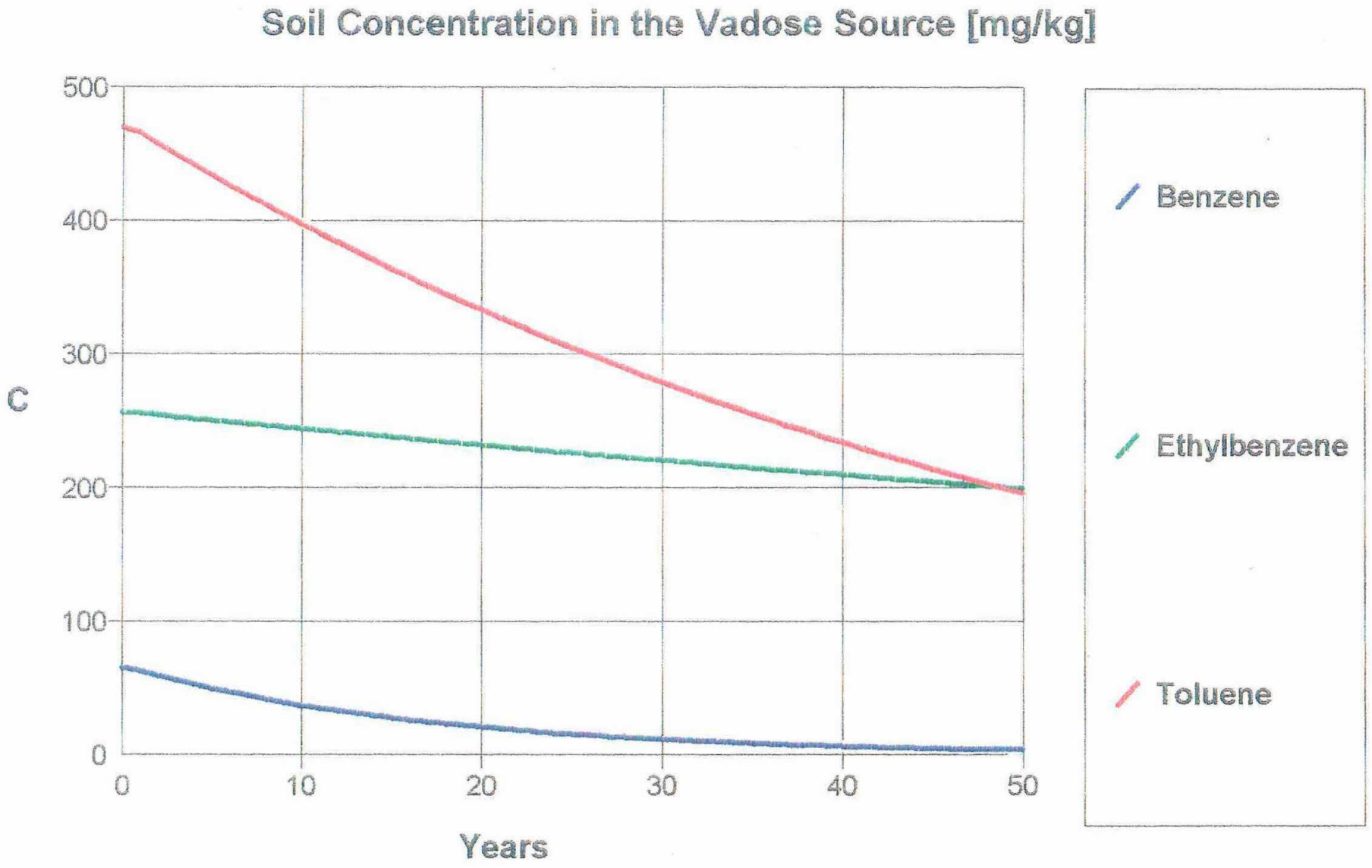
Source Conc. for unsaturated zone model (mg/kg)... 470.

CHEMICAL DATA INPUT: Xylenes (mixed)

Diffusion coeff. in air (cm2/s)	7.200E-02
Diffusion coeff. in water (cm2/s)	8.500E-06
Solubility (mg/l)	185.
KOC (ml/g)	386.
Henry"s Law Coefficient (-)	.301
Molecular Weight (g/mol)	106.
Density of chemical (g/cm3)	.870
Degradation rate sat. zone (1/d)	.000
Degradation rate unsat. zone (1/d)	2.000E-03

Source Concentrations: Xylenes (mixed)

Source Conc. for unsaturated zone model (mg/kg)... 854.


Soil Concentration in the Vadose Source [mg/kg]
500
400
300
200
100
0
C
0
10
20
30
40
50
Years
Benzene
Ethylbenzene
Toluene