Appendix F

Health Risk Assessment
Todd Cancer Institute

HUMAN HEALTH RISK ASSESSMENT
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

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GLOSSARY OF ACRONYMS/ABBREVIATIONS

ABS	Dermal Absorption Factor
AF	Soil-to-Skin Adherence Factor
AT	Averaging Time
bgs	Below Ground Surface
BW	Body Weight
CAG	Carcinogenic Assessment Group
Cal-EPA	California Environmental Protection Agency
CDC	Centers for Disease Control
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEQA	California Environmental Quality Act
CF	Conversion Factor
CFR	Code of Federal Regulations
cm	Centimeter
COC	Chain of Custody
COPCs	Chemicals of Potential Concern
C_S	Chemical Concentration in Soil
CSF	Cancer Slope Factor
DHS	California Department of Health Services
DL	Detection Limit
DTSC	California Environmental Protection Agency Department of Toxic Substances Control
ED	Exposure Duration
EF	Exposure Frequency
ELCR	Excess Lifetime Cancer Risk
EPC	Exposure Point Concentration
ES	Executive Summary
FDA	U.S. Food and Drug Administration
FI	Fraction of Ingested Chemicals
FOD	Frequency of Detection
gsf	Gross Square Feet
HEAST	Health Effects Assessment Summary Tables
HERD	Human and Ecological Risk Division
HI	Hazard Index
HQ	Hazard Quotient
HRA	Health Risk Assessment
IR	Ingestion Rate or Inhalation Rate
IRIS	Integrated Risk Information System
J&E	Johnson and Ettinger’
kg	Kilogram
km	Kilometer
LBMMC	Long Beach Memorial Medical Center
MCL	Maximum Contaminant Level
mg	Milligram
mi	Mile

NAAQS	National Ambient Air Quality Standards
MSL	Mean Sea Level
NCEA	National Center for Environmental Assessments
ND	Not Detected
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic And Atmospheric Administration
OEHHA	Office of Environmental Health Hazard Assessment
OSA	Office of Scientific Affairs
PEF	Particulate Emission Factor
PRG	Preliminary Remediation Goal
PQL	Practical Quantification Limit
QA	Quality Assurance
QC	Quality Control
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RWQCB	Regional Water Quality Control Board
SA	Skin Surface Area
SCREEN3	EPA's screening air dispersion model
sec	Second
SCS	SCS Engineers
SQL	Sample Quantification Limit
SS	Shallow Soil
TCI	Todd Cancer Institute
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
ug	Microgram
USEPA	U. S. Environmental Protection Agency
UCL	Upper Confidence Limit
VOC	Volatile Organic Compound

HUMAN HEALTH RISK ASSESSMENT

LONG BEACH MEMORIAL MEDICAL CENTER

TODD CANCER INSTITUTE

LONG BEACH, CALIFORNIA

EXECUTIVE SUMMARY

This Human Health Risk Assessment (HRA) Report has been prepared by SCS Engineers (SCS) on behalf of Long Beach Memorial Medical Center (LBMMC) for evaluation of the potential human health risks attributable to potential contaminants present in soil at the proposed Todd Cancer Institute (TCI) Site (the "Project Site"). This HRA evaluates the potential current or baseline risks to human health prior to the construction of TCI (i.e., current conditions), as well as risks during and after construction of TCI. This HRA was prepared in accordance with State of California and Federal risk assessment guidance.

Background

The proposed project includes the construction of TCI, which would be located on the northwestern corner of LBMMC, southeast of the intersection of Long Beach Boulevard and Spring Street. The TCI facility would provide comprehensive outpatient cancer services in a single facility designed for the unique requirements of cancer patients and their families. TCI would also include the construction of an additional driveway from Pasadena Avenue to provide staff and service access. The construction of TCI would occur in two phases, the first phase providing for an 83,360 gross square feet (gsf), three-story building. Phase II would provide an additional 42,300 gsf in a new 33-foot high, two-story horizontal expansion. A Project Site location map is provided in Figure 1. Figure 2 shows the locations of proposed facilities.

According to the Phase I Site Assessment Report for 300 East Spring Street, from approximately 1925 through 1935, a gasoline service station was located at the northwest corner of this parcel. From approximately 1925 to 1950, a welding shop was located immediately west of the gas station site. An underground storage tank (UST) was installed at the welding shop in 1944; however no documentation of tank removal at either the gasoline service station or welding shop was found. A site investigation conducted in May 2004 did not indicate any evidence of remaining underground storage tanks in the area of the former gas station or welding shop. (SCS, 2004). Single-family residences were located on the southwest side of the property from prior to 1930 to 1925. Oil production facilities including oil storage tanks, wells, derricks, material and equipment storage were located along the northeast corner of the site from the 1920's to 1970's. The former residential areas and remainder of the site outside of the northwest and northeast corner of the site were occupied by a trailer park from approximately 1941 to 1985. The site has been used as a parking lot since 1985 (Signal, 2001).

HRA Methodology

Identification of Chemicals of Potential Concern

Analytical results from chemical analyses of soil and soil vapor samples collected during site investigations at the Project Site are summarized in Tables 3-1 and 3-2. To determine EPCs to be used in the HRA, data were divided into three groups: 0-5 foot soil zone, 0-25 foot soil zone, and soil vapor. Analytical data from the 0-5 foot soil zone were used to estimate risks from the direct contact pathways (incidental ingestion, dermal absorption, and fugitive dust inhalation pathways). soil samples were not collected between 5 and 20 feet bgs, the 0-5 feet soil zone was used to provide a conservative EPC for direct contact pathways (i.e., the concentrations of contaminants are expected to less deeper than 5 feet, thus using the 0-5 feet soil data only will overestimate risks).

The 0-25 foot soil zone was used to estimate risk from the inhalation of volatile chemicals in the soil vapor pathway. Soil vapor data was also used to estimate risk from the inhalation of volatile chemicals in the soil vapor pathway. Data summaries are provided in Tables 3-3 through 3-5.

Based on an evaluation of the analytical data collected from the Project Site, chemicals of potential concern (COPCs) to be included and evaluated in the HRA were selected from an overall list of detected site constituents. COPCs were determined based on the frequency of detection (FOD) of each chemical. The USEPA (1989) provides for the use of frequency of detection as a criterion for selecting COPCs, with a value of 5% the most commonly used. This approach has been used and approved by the DTSC in previous HRAs (TetraTech EM, Inc. 2000). If a chemical was detected at an FOD of 5% or greater, it was considered a COPC in the HRA, unless it was an inorganic screened out by comparison to background (see below).

Inorganic chemicals were included as COPCs if the 95 percent upper confidence limit of the mean (UCLM) from the Project Site was greater than the corresponding background value. Soils data from the 0-5 ft depth interval were used for this comparison since these are the soils individuals are most likely to come in contact with.

Background samples of inorganic compounds were not taken at the site. The site has historically been used as an oil field, much of the surface soil is comprised of artificial fill due to previous hospital construction, and other site uses. Therefore, we believe that the best assessment of background native soils for the site is comparison to the background levels for California soils developed by the Kearney Foundation (Bradford, et. al., 1996), which were developed to provide a comprehensive scientific database of representative soils. This study provides defensible data to assist in accurate evaluation and decision-making regarding site data. Background soils data obtained from Bradford et al. are summarized in Table 3-6. The background comparison is summarized in Table 3-7.

Based on the evaluation of site data, the following chemicals were considered to be COPCs and were further evaluated in the HRA. COPCs and EPCs are listed in Table 3-9.

Volatile Organic Compounds (VOCs)

- Benzene

- Bromoform
- Methylene Chloride

Inorganics:

- Selenium

Total Petroleum Hydrocarbons (TPH)

- TPH (C5-C12)
- TPH (C10-C12)
- TPH (C13-C15)
- TPH (C16-C22)
- TPH (C23-C32)
- TPH (>C32)

Exposure Assessment

The populations and exposure pathways considered to be potentially exposed under current and project scenarios are detailed in Section 4.0.

The following populations were considered to be potentially exposed under a **current** land use scenario, prior to the construction of proposed additional facilities at the site. The Project Site was considered to be the area for the proposed TCI development, while all other areas were considered to be "off-site." In the HRA, "off-site" receptors were considered to be the nearest residents who live in the vicinity of the proposed TCI development and hospital patients and commercial/industrial/hospital workers considered to be located at the LBMMC main building.

- **Off-site populations:**
  - Residents (adult and child)
  - Hospital Patients (adult and child)
  - Commercial/Industrial/Hospital Workers

The following populations were considered to be potentially exposed under a **project** land use scenario, during and after construction of proposed TCI facility.

- **On-site populations:**
  - Construction Workers
  - Hospital Patients (adult and child)

- Commercial/Industrial/Hospital Workers.

- **Off-site populations:**
  - Residents (adult and child).
  - Hospital Patients (adult and child)
  - Commercial/Industrial/Hospital Workers

For the surface soil pathways, the EPCs in soil were assumed to be equal to the EPCs. In the inputs and results of the various EPC calculations are presented in Tables 4-1 through 4-9.

The EPCs for the various COPC were combined with exposure parameters for each exposure pathway to develop estimates of the chronic daily intake (CDI) for each chemical within each exposure pathway. This was completed for all receptor scenarios and is presented in Table 4-10.

Toxicity Assessment

As detailed in Section 5, for risk assessment purposes, chemicals are separated into two categories of toxicity, depending on whether they are carcinogenic and/or non-carcinogenic. For chemicals exhibiting non-carcinogenic effects, the Hazard Index (HI) is calculated summing the ratios of the CDI and the reference dose (RfD) for each of the COPCs. An HI equal to or less than 1 indicates that there are not likely to be any adverse health effects from the exposure while an HI greater than 1 indicates that there is a potential health hazard.

For chemicals exhibiting carcinogenic effects, a cancer slope factor (CSF) is used to determine how potent the chemical is in causing cancer. The CSF is an expression of the cancer-causing potential of a particular contaminant; the larger the CSF, the greater the potential for that contaminant to cause cancer. To determine the lifetime cancer risk for a particular chemical contaminant, CSFs are multiplied by the CDI of the contaminant under consideration. The total lifetime cancer risk for a site is determined by summing all the individualized cancer risks for the various chemicals of concern. Non-carcinogenic and carcinogenic toxicity information used in this HRA is presented in Tables 5-1 and 5-2, respectively.

Risk Characterization

Under the California Environmental Quality Act (CEQA), Hazard Index levels equal to or less than 1 are **not considered significant**, and such health impacts are considered acceptable.

Based on CEQA guidelines, as stated in the South Coast Air Quality Management District's CEQA Handbook, theoretical excess lifetime cancer risks less than one in 100,000 ($1x10^{-5}$) are not considered significant, and are considered acceptable (SCAQMD, 1993).

Under California Proposition 65, the Drinking Water and Toxic Enforcement Act of 1986 ("Prop 65"), no significant risk levels (NRSLs) for carcinogens are determined to be the daily intake level calculated to result in one excess cancer in an exposed population of 100,000 (1×10^{-5}) assuming lifetime (70-year) exposure at the level in question (OEHHA, 2004b).

As summarized in Section 6.0, risk characterization results for the Project Site are presented in

Tables 6-1 through 6-17

Table ES-1. Current Scenario Risk Characterization Results

Current Scenario Receptor		Total Hazard Index (HI)	Total Theoretical Excess Lifetime Cancer Risk (ELCR)
Off-Site	Hospital Patient at LBMMC (Child)	8×10^{-7}	8×10^{-12}
	Hospital Patient at LBMMC (Adult)	2×10^{-7}	2×10^{-12}
	Commercial/Industrial/Hospital Worker at LBMMC	2×10^{-5}	6×10^{-9}
	Resident (child)	1×10^{-9}	6×10^{-13}
	Resident (adult)	5×10^{-10}	

Table ES-2. Project Scenario Risk Characterization Results

Project Scenario Receptor		Total Hazard Index (HI)	Total Theoretical Excess Lifetime Cancer Risk (ELCR)
Off-Site	Hospital Patient at LBMMC (Child)	8×10^{-7}	8×10^{-12}
	Hospital Patient at LBMMC (Adult)	2×10^{-7}	2×10^{-12}
	Commercial/Industrial/Hospital Worker at LBMMC	2×10^{-5}	6×10^{-9}
	Resident (child)	1×10^{-9}	6×10^{-13}
	Resident (adult)	5×10^{-10}	
On-Site	Construction Worker	1.1	7×10^{-6}
	Hospital Patient at TCI (Child)	0.006	3×10^{-10}
	Hospital Patient at TCI (Adult)	9×10^{-6}	1×10^{-10}
	Commercial/Industrial/Hospital Worker at TCI	2×10^{-5}	5×10^{-9}

Risks from Inorganic Lead in Soil

Based on the calculations summarized in Table 7-1, the resulting blood lead levels for all receptors are below the 10.0 µg/dl level of concern set forth by Cal-EPA; therefore, health risks due to lead are not of concern at the site and are considered significant under CEQA.

Conclusions

Non-Carcinogenic Risks:

The total hazard indices for the following on-site and off-site current and project receptors are at or below 1, and **are not considered significant** under CEQA guidelines.

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Based on the risk evaluation, the total Hazard Indices for the following receptors are above the non-carcinogenic risk threshold established for the project (HI $\leq$ 1) and are **considered significant** under CEQA guidelines:

- Current On-Site Construction Worker

The exceedance of the non-carcinogenic threshold (HI $\leq$ 1) is due to the dermal absorption and ingestion of TRPH in soil.

Theoretical Excess Lifetime Cancer Risks:

The total theoretical excess lifetime cancer risks (ELCR) for the all receptors evaluated in the HRA are at or below the carcinogenic risk threshold established for the project (ELCR = 1×10^{-5}) and are **not considered significant** under CEQA guidelines:

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Commercial/Industrial/Hospital Worker

- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)
- Project On-Site Construction Worker
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)

Risk-Based Evaluation of Site Mitigation Measures

Project Scenario On-Site Construction Worker

The non-carcinogenic risk (Hazard Index) for the project scenario on-site construction worker exceeds the established threshold based on CEQA guidelines (HI $\leq$ 1). The majority of the non-carcinogenic risk is due to ingestion and dermal contact with the various TPH hydrocarbon fractions in soil. Implementing any of the following risk-based mitigation measures can minimize potential exposures to COPCs in soil at the Project Site:

a. Use of personal protective equipment (PPE) during construction/remediation activities.

b. Monitoring of worker exposure to COPCs during on-site construction/remediation activities.

c. Adherence to health and safety protocols as provided for in a site health and safety plan (e.g. no eating in construction/remediation areas).

HUMAN HEALTH RISK ASSESSMENT

LONG BEACH MEMORIAL MEDICAL CENTER

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1.0 INTRODUCTION

This Human Health Risk Assessment (HRA) Report has been prepared by SCS Engineers (SCS) on behalf of Long Beach Memorial Medical Center (LBMMC) for evaluation of the potential human health risks attributable to potential contaminants present in soil at the proposed Todd Cancer Institute (TCI) Site (the "Project Site"). This HRA evaluates the potential current or baseline risks to human health prior to the construction of TCI (i.e., current conditions), as well as risks during and after construction of TCI. LCMMC currently consists of two licensed hospitals, LBMMC and Miller Children's Hospital, in addition to other related facilities and infrastructure.

1.1 Objectives

The primary objective of this HRA is to provide upper bound, reasonable maximum exposure (RME), health-conservative estimates of the potential human health effects associated with exposures to chemicals detected in soil at the Project Site. The HRA estimates are based on current soil conditions beneath the site.

1.2 Methodology

The HRA contained herein followed a scope of work consistent with federal and state of California risk assessment guidelines. The HRA followed the outline presented in the U.S. Environmental Protection Agency's (USEPA's) *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual* (USEPA, 1989a) as supplemented by the California Environmental Protection Agency's Department of Toxic Substances Control's (DTSC) *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996).

2.0 SITE BACKGROUND

The proposed project includes the construction of TCI, which would be located on the northwestern corner of LBMMC, southeast of the intersection of Long Beach Boulevard and Spring Street. The TCI facility would provide comprehensive outpatient cancer services in a single facility designed for the unique requirements of cancer patients and their families. TCI would also include the construction of an additional driveway from Pasadena Avenue to provide staff and service access. The construction of TCI would occur in two phases, the first phase providing for an 83,360 gross square feet (gsf), three-story building. Phase II would provide an additional 42,300 gsf in a new 33-foot high, two-story horizontal expansion.

A Project Site location map is provided in Figure 1. Figure 2 shows the locations of proposed facilities.

According to the Phase I Site Assessment Report for 300 East Spring Street, from approximately 1925 through 1935, a gasoline service station was located at the northwest corner of this parcel. From approximately 1925 to 1950, a welding shop was located immediately west of the gas station site. An underground storage tank (UST) was installed at the welding shop in 1944; however no documentation of tank removal at either the gasoline service station or welding shop was found. A site investigation conducted in May 2004 did not indicate any evidence of remaining underground storage tanks in the area of the former gas station or welding shop. (SCS, 2004). Single-family residences were located on the southwest side of the property from prior to 1930 to 1925. Oil production facilities including oil storage tanks, wells, derricks, material and equipment storage were located along the northeast corner of the site from the 1920's to 1970's. The former residential areas and remainder of the site outside of the northwest and northeast corner of the site were occupied by a trailer park from approximately 1941 to 1985. The site has been used as a parking lot since 1985 (Signal, 2001).

2.0.1 Topography and Surface Hydrology

Surface elevation at the Project Site is approximately 35 and 50 above mean sea level (msl). The site generally slopes to the southwest, but there are no steep slopes. The investigation area is located on the western flank of the Signal Hill uplift, approximately 1 mile east of the Los Angeles River and approximately 3 miles north of the Long Beach shoreline. Surficial geologic materials in the area consist of Pleistocene and recent non-marine and marine units, predominantly sand, silty sand, sandy silt, silt and clay. Undisturbed soil at the Project Site is not considered significantly erodable. In addition to native materials and engineered fill placed in connection with construction activities, an unknown volume of unclassified fill, including gravel, debris, and waste oil field material was used to bring a former on-site ravine up to grade prior to use of the site for hospital activities.

The uppermost regional aquifer in this area is anticipated to be the Gage (California Department of Water Resources, 1961), located at a depth of approximately 200 to 250 feet below ground surface (bgs). Uppermost groundwater beneath most of the area occurs at a depth estimated at 50 feet bgs within sands of the Lakewood Formation. However, a thin, perched zone of groundwater was encountered as shallow as 15 feet bgs in the northern portion of the expansion area.

2.0.2 Geology and Hydrogeology

Geologically, the Project Site is located in the southwestern portion of the Los Angeles Basin. The basin formed because basement (older) rocks were structurally downwarped allowing a thick sequence of Upper Cretaceous through Recent age (approximately 100 million years ago to present) sedimentary units to accumulate. The sedimentary basin fill in the project area is estimated to be 12,000 feet thick (Yerkes, et al, 1965). The basin fill in the project area consists predominantly of marine origin sandstone, siltstone, and shale of Middle Miocene to Pliocene age (approximately 16 to 1.8 million years ago) overlain by predominantly marine sand and silt of Pleistocene to Recent age (approximately 1.8 million years ago to present).

The rocks of the basin are cut by numerous faults, many of which are strike-slip faults of generally northwest-southeast orientation. Of these, the Newport-Inglewood fault zone is located closest to the Project Site, within approximately 1,000 feet northeast. The Newport-Inglewood zone extends from the Baldwin Hills to Newport Bay and is considered active.

Surficial geologic materials in the area consist of Pleistocene and Recent non-marine and marine units, predominantly san, silty sand, sandy silt, silt, and clay. In addition to native materials and engineered fill placed in connection with construction activities, and unknown volume of unclassified fill, including gravel, debris, and waste oil field material, was used to bring a former on-site ravine up to grade prior to use of the site for hospital facilities. Groundwater has been encountered at depths of 40 to 50 feet bgs in the project area. Approximately 10 to 15% of the Project Site overlies an area potentially susceptible to liquefaction, as indicated on the California State Seismic Maps. A portion of the site, extending from near the intersection of Columbia Street and Atlantic Avenue in the northeast to the intersection of Patterson Avenue and Long Beach Boulevard on the west is susceptible to liquefaction. A thin, perched zone of groundwater was encountered at a depth of 15 feet bgs in the northern portion of the Project Site. The perched water may be seasonal.

2.0.3 Meteorology

Climatic data compiled by the National Oceanic and Atmospheric Administration (NOAA, 2004) for the City of Long Beach indicated an average annual precipitation rate of 12.94 inches, and an average annual temperature of 65.3 degrees Fahrenheit (°F). The average annual wind speed in the City of Long Beach is 6.2 miles per hour (mph).

2.0.4 Demographics

The City of Long Beach is located within Los Angeles County in Southern California and is the fifth largest city in California, and is the second largest in Los Angeles County.

As of the census of 2000, there are 461,522 people, 163,088 households, and 99,646 families residing in the city. The population density is 3,532.8/km² (9,149.8/mi²). There are 171,632 housing units at an average density of 1,313.8/km² (3,402.6/mi²). The racial makeup of the city is 45.16% White, 14.87% African-American, 0.84% Native American, 12.05% Asian, 1.21% Pacific Islander 20.61% from other races, and 5.27% from two or more races. 35.77% of the population is Hispanic or Latino of any race (U.S. Census Bureau, 2000).

2.0.5 Land Use and Zoning

The Project Site is located within the Central Long Beach Redevelopment Area. The proposed land uses are consistent with the existing land use designations (LUD) No. 7 Mixed Use District General Plan land use designation, and the Institutional zoning. It is anticipated that land owned by LBMMC between 29th Street and Spring Street with the Planning Development and Regional Highway District land use zoning designations would be rezoned Institutional. Similarly, the land owned by LBMMC between 27th Street and Willow Street with the Regional Highway District and Community Automobile-Oriented designation would be rezoned to Institutional. The Master Plan of Land Uses provides for reorganization of the six existing land uses: Inpatient, Outpatient, Mixed Use, Utility, Parking, and Circulation.

2.1 Report Organization

Section 1.0 presents introductory material and the objectives for the HRA. Section 2.0 provides site background information. Section 3.0 provides an evaluation of analytical data. The exposure assessment is provided in Section 4.0, including identification of potentially exposed populations, identification of exposure pathways, and estimation of exposure point concentrations (EPCs), and also describes the procedures through which chronic daily intakes (CDIs) of the chemicals of concern were estimated. Toxicity information for carcinogens and non-carcinogens is discussed in Section 5.0. Risk characterization is summarized in Section 6.0. An evaluation of potential risks from inorganic lead in soil is presented in Section 7.0. Conclusions are discussed in Section 8.0. Section 9.0 describes the uncertainties inherent in the HRA process and Section 10.0 describes the limitations of a baseline HRA of this type. References are presented in Section 11.0. This report also includes an Executive Summary, prior to Section 1.0.

Tables and Figures are attached to the HRA document immediately following Section 11.0. Appendices immediately following the figures section and include additional information and documentation pertaining to the HRA.

3.0 DATA EVALUATION

3.1 Summary of Analytical Results

USEPA-approved analytical methods were utilized during the site investigations. These included:

- USEPA Method 8260B for analysis of soil and soil vapor samples for VOCs.
- USEPA Method 8015(M) for analysis of total petroleum hydrocarbons.
- USEPA Method 3050B/6010B for analysis of metals.

Analyses were performed at laboratories certified by the State of California Department of Health Services (DHS). The use of these USEPA-approved analytical methods and DHS-certified laboratories ensures that, at a minimum, certain laboratory data quality objectives have been met.

Analytical results from chemical analyses of soil samples collected during previous investigations at the Project Site are summarized in Tables 3-1 and 3-2. These tables and the data they present are listed below:

- Table 3-1: Summary of Analytical Results for Soil Samples
- Table 3-2: Summary of Soil Vapor Survey Analytical Results

Soil and soil vapor sampling locations are shown on Figure 3.

A total of 2 VOCs were detected in soil samples collected from the Project Site and were considered as part of this HRA. These include:

- Bromoform
- Methylene Chloride

Inorganic selenium was detected above established background levels in soil samples collected from the Project Site and were considered as COPCs for the HRA.

Total Petroleum Hydrocarbons (TPH) were detected at the site and were considered as a part of this HRA. These include:

- TPH (C5-C12)
- TPH (C10-C12)
- TPH (C13-C15)
- TPH (C16-C22)
- TPH (C23-C32)

- TPH (>C32)

Benzene was detected in soil vapor samples collected at the site and was considered as a part of this HRA.

3.2 Data Evaluation

Quality Assurance/Quality Control (QA/QC) documentation for samples, where available, was reviewed. This review was conducted to determine whether the recent site analytical data could meet the data quality objectives recommended by EPA for use in risk assessments (EPA, 1990).

The following parameters were the focus of this review of the QA/QC data where available:

- Compliance with QA/AC Procedures
- Chain-of-Custody Documentation
- Sample Holding Times
- Method Blanks
- Recovery Limits
- Surrogates

The QA/QC documentation appeared to be adequate. Analytical detection limits (DLs) for most samples were maintained at minimum levels in order to yield acceptable sample results. Sample dilution prior to analysis (to minimize contamination of analytical equipment) was only necessary for only a small proportion of samples. In those analyses where dilution was necessary, it is not anticipated that these instances of sample dilution affected the quality of the data for use in the HRA since their elimination could serve to underestimate exposure point concentrations (EPCs)

Based on the review of QA/QC data, it was determined that soil and soil vapor samples collected from the site would be used in HRA. Estimated concentrations (flagged as "J") were also included in the HRA since their elimination could serve to underestimate risks.

Data summaries of the samples collected at the site are presented in Table 3-3 (0-5 feet soil zone data), Table 3-4 (0-25 feet soil zone data), and Table 3-5 (soil vapor data). In addition to the data summaries, Tables 3-3, 3-4, and 3-5 also present frequency of detection (number of detected concentrations of compound per total number of samples), the range of concentrations, the sampling location and depth of maximum detection, and upper confidence limits (UCLs) for each compound in each medium.

When a particular analyte was reported to be present below the method detection limit, a value of ½ the detection limit was used to represent a hypothetical concentration of a given contaminant in order to perform the statistical calculations. In addition, the "estimated" concentration of a contaminant (i.e. a concentration reported in laboratory reports at levels lower than the method detection limit) was used in lieu of ½ of the method detection limit, where available. This procedure is consistent

with HRA guidelines.

Moreover, it was assumed that EPCs of the chemicals considered for the HRA were present at a concentration equal to the lower of its maximum detection or its upper confidence limit (UCL) value. The use of maximum or UCL contaminant concentrations is a health-conservative approach and is consistent with HRA guidelines. Statistical analyses were completed for all the remaining chemicals. The EPCs are also listed on Tables 3-3, 3-4, and 3-5.

3.3 Data Selection and Identification of Chemicals of Potential Concern

3.3.1 Data Selection

For evaluation of risks at the proposed TCI site, available soil analytical data was separated into two "media" for the HRA. Soil data from 0-5 feet bgs was used to evaluate potential exposure to "surface" soil, including 1) soil ingestion, 2) dermal absorption, and 3) fugitive dust inhalation pathways. Soil data were not available for depths between 5-20 feet, therefore the 0-5 foot soil zone interval, rather than the 0-10 foot soil zone to evaluate potential exposures from the pathways listed previously. Soil data from 0-25 feet bgs were used to evaluate potential exposures through inhalation of VOCs via the vapor intrusion pathway. The 0-25 foot soil interval was chosen for this evaluation to be consistent with the HRA prepared for Miller Children's Hospital and available soil data from the Project Site were not collected between the intervals of 35-50 feet; therefore the 0-25 feet soil interval was used in the HRA. Soil vapor data collected from the proposed TCI site were used to estimate risks through the inhalation of VOCs. The inhalation of VOCs from soil pathway was conservatively evaluated using both soil data and soil vapor data.

The 0 - 5-foot soil data interval was used to provide a conservative EPC of chemical exposure for direct contact pathways (i.e., soil ingestion, dermal absorption, and fugitive dust inhalation) for the project on-site construction worker. While construction workers could typically be exposed to soils as deep as 10 feet bgs during trenching or utility work, because available soil samples were not collected between 5 and 20 feet bgs, the 0-5 feet soil zone was used to provide a conservative EPC for direct contact pathways (i.e., the concentrations of contaminants are expected to less deeper than 5 feet, thus using the 0-5 feet soil data only will overestimate risks).

In order to determine the EPCs for each soil zone (0-5 feet and 0-25 feet), the cumulative soil data were filtered based on sample depth to create inclusive data sets for the 0-5 and 0-25 foot intervals.

Although many of the chemicals were detected in only a fraction of the total number of samples and the detections represent only a portion (i.e., area) of the site, we assumed that the contaminant was present spatially across the TCI site, at the EPC.

3.3.2 Identification of Chemicals of Potential Concern

Based on an evaluation of the analytical data collected from the Project Site, chemicals of potential concern (COPCs) to be included and evaluated in the HRA were selected from an overall list of detected site constituents. COPCs were determined based on the frequency of detection (FOD) of each chemical. The USEPA (1989) provides for the use of frequency of detection as a criterion for selecting COPCs, with a value of 5% the most commonly used. This approach has been used and approved by the DTSC in previous HRAs (TetraTech EM, Inc. 2000). If a chemical was detected at

an FOD of 5% or greater, it was considered a COPC in the HRA, unless it was an inorganic screened out by comparison to background (see below).

Inorganic chemicals were included as COPCs if the 95 percent upper confidence limit of the mean (UCLM) from the Project Site was greater than the corresponding background value. Soils data from the 0-5 foot depth interval were used for this comparison since these are the soils individuals are most likely to come in contact with.

Background samples of inorganic compounds were not taken at the site. The site has historically been used as an oil field and much of the surface soil is comprised of artificial fill due to previous hospital construction and other site uses. Therefore, we believe that the best assessment of background native soils for the site is comparison to the background levels for California soils developed by the Kearney Foundation (Bradford, et. al., 1996), which were developed to provide a comprehensive scientific database of representative soils. This study provides defensible data to assist in accurate evaluation and decision-making regarding site data.

EPCs of inorganic compounds detected at the site were compared to the 95% UCLM concentrations of benchmark soil samples selected from throughout the state. Background soils data obtained from Bradford et al. are summarized in Table 3-6. The background comparison is summarized in Table 3-7.

The following chemicals have been identified as COPCs at the Project Site and were evaluated in the HRA:

VOCs

- Benzene
- Bromoform
- Methylene Chloride

Inorganics:

- Selenium

4.0 EXPOSURE ASSESSMENT

The exposure assessment identifies and describes potentially exposed human receptors, develops exposure pathways, and estimates the chemical concentration at the point where a human receptor could potentially come into contact with COPCs in various environmental media (i.e., soil groundwater, air).

4.1 Conceptual Site Model

A conceptual site model (CSM) was developed to provide the framework for the exposure assessment. The potential for risk from chemical stressors is assessed by considering complete exposure pathways as defined by four elements that make up a CSM: (1) source, (2) fate and transport mechanisms, (3) exposure routes, and (4) receptors. The CSM schematically presents the relationship between chemical sources and receptors at the site, and identifies potentially complete and significant pathways through which receptors may be exposed to COPCs. The CSM for the current exposure scenario is presented in Figure 4a. The CSM for the project exposure scenario is presented in Figure 4b.

4.1.1 Sources of Potential Release and Potential Transport Mechanisms

The sources of potential chemical release consist of the areas associated with the historical uses of the site. According to a Phase I Site Assessment Report for 300 East Spring Street (Signal, 2001), from approximately 1925 through 1935, a gasoline service station was located at the proposed TCI site location. From approximately 1925 to 1950, a welding shop was located immediately west of the gas station site. Historical records indicate that an underground storage tank (UST) was installed at the welding shop in 1944, however, no documentation of tank removal at either the gasoline service station or the welding shop was found. A site investigation did not result in any evidence of remaining USTs (SCS, 2004). Single-family residences were located on the southwest side of the property from prior to 1930 to 1925. Oil production facilities including oil storage tanks, wells, derricks, material and equipment storage were located along the northeast corner of the site from the 1920's to 1970's. The former residential areas and remainder of the site outside of the northwest and northeast corner of the site were occupied by a trailer park from approximately 1941 to 1985. The site has been used as a parking lot since 1985 (Signal, 2001).

Chemicals released to the surface from soil could be dispersed into the air via dust-borne particulates. Volatile chemicals could likewise release emissions into the air. Through the process of infiltration, chemicals in surface soil could eventually be transported to the subsurface soil.

4.1.2 Potential Human Receptors and Potential Exposure Pathways

An exposure pathway is the mechanism by which a human receptor is exposed to chemicals from a source. The four elements of a complete exposure pathway are:

- A source of chemical release,
- A mechanism of release through a transport medium (e.g., release of chemicals in the

soil through indoor air or dust-particles),

- A point of contact between the potential receptor and the transport medium (e.g., ingestion of soil)

- A potential receptor (e.g., an on-site commercial/industrial/hospital worker)

If any of these four components is not present, then a potential exposure pathway is considered incomplete and is not evaluated further in a risk assessment.

4.1.2.1 Current Scenario

Current potential exposure pathways are those that exist as a result of the current extent of contamination, combined with existing land use and human activity patterns.

The Project Site was considered to be the area for the proposed TCI development, while all other areas were considered to be "off-site." In the HRA, "off-site" receptors were considered to be nearest residents who live in the vicinity of the proposed TCI development and hospital patients and commercial/industrial/hospital workers considered to be located at the LBMMC main building.

The following populations were considered to be potentially exposed under a **current** land use scenario, prior to the construction of proposed additional facilities at the site:

- **Off-site populations:**
  - Residents (adult and children)
  - Hospital Patients (adults and children)
  - Commercial/Industrial/Hospital Workers

The exposure pathways by which these potential receptors are expected to be exposed to chemicals at the proposed Todd Cancer Institute are presented below.

Current Off-Site Residents (adult and children)

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

Current Off-Site Hospital Patients (adult and child):

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

Current Off-Site Commercial/Industrial/Hospital Workers:

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

Off-site populations were assumed to be located at the LBMMC main building. Therefore, only the inhalation of VOCs from soil and soil vapor pathway was considered complete for the current off-

site commercial/industrial/hospital worker scenario, hospital patient, and resident (child and adult) scenario. Off-site receptors will not come in direct contact with impacted site soils, since the site is currently paved or occupied by structures with landscaped areas. As such, the inhalation of chemicals adhered to dust pathway is considered incomplete for these receptors. Off-site hospital patients and commercial/industrial/hospital workers were considered to be located at the LBMMC main building, which is located approximately 1,162 feet from the center of the proposed TCI facility. The nearest off-site residents are located approximately 800 feet from the proposed TCI facility (VSA, 2004).

4.1.2.2 Project Scenario

The following populations were considered to be potentially exposed under a **project** land use scenario, during and after construction of proposed additional facilities at the site. Project exposure pathways include pathways that have a reasonable probability of completion based on projected land use and predicted human activity at the Project Site.

- **On-site populations:**
  - Construction Workers
  - Hospital Patients (adults and child)
  - Commercial/Industrial/Hospital Workers.
- **Off-site populations:**
  - Residents (adult and child).
  - Hospital Patients (adult and child)
  - Commercial/Industrial/Hospital Workers

Project exposure pathways include pathways that are expected to be complete based on projected land use and predicted human activity at the Project Site. The exposure pathways by which these potential receptors are expected to be exposed to chemicals at the proposed Todd Cancer Institute are presented below.

<u>Project On-Site Construction Worker:</u>

- Inhalation of Volatile Chemicals in Outdoor (Ambient) Air from Soil and Soil Vapor
- Inhalation of Contaminants in Fugitive Dust
- Incidental Ingestion of Soil
- Dermal Contact with Soil

The "project scenario on-site construction worker" evaluation includes the assumption that

construction-related work (e.g., demolition, environmental site investigation/remediation activities, trenching, construction, etc.) will be conducted at the site on a short-term basis. The on-site construction worker will be exposed to contaminants through contact with impacted soil (dermal and incidental ingestion) and through inhalation of contaminants adhered to dust. The direct contact pathways were considered complete for the on-site construction worker since it was assumed that the construction work would cause direct exposure to on-site soils. In addition, the current on-site construction worker will be exposed to contaminants through inhalation of volatile chemicals originating from soil at the TCI site.

The uppermost aquifer at the site is found at approximately 45 to 50 feet below ground surface (bgs). Although we believe that the groundwater in this aquifer is of poor quality, we do not have chemical data to demonstrate that it would be considered non-potable. Therefore, we must assume that the water is potable. Deeper, regional aquifers do exist under the site and are used for municipal purposes, however these aquifers are separated from the shallow aquifer by clay layers. No well survey of the area has been conducted to the best of our knowledge.

The uppermost aquifer is not currently used as a groundwater supply. Potable water for the site is supplied by the City of Long Beach, through the Long Beach water supply system. The Long Beach water supply system is comprised of three sources: 50% purchased water from the Metropolitan Water District of Southern California, with water supplies from the Colorado River and the Sacramento River/San Joaquin Delta through the State Water Project; 8% tertiary treated reclaimed water; and 42% from local groundwater sources in the City of Long Beach extracted from Department-owned wells, most of which exceed 1,000 feet in depth. Local groundwater undergoes a multi-stage treatment process in the Groundwater Treatment Plant, including aeration, settling and chemical disinfection. Water quality of the Long Beach water supply is tested by the City Water Department for chemical, physical, radioactive and bacteriological parameters and is evaluated against current and proposed Federal and State water quality health based standards.

The Regional Water Quality Control Board has not designated beneficial uses for the uppermost aquifer at the site, which is not a regional aquifer. The Basin Plan designates existing beneficial uses of the West Coast Basin (Los Angeles Coastal Plain) groundwater as municipal and domestic, industrial service, industrial process and agricultural.

Therefore, direct contact (that is, ingestion and/or dermal contact) with impacted groundwater, was considered to be incomplete since groundwater has not been discovered at a depth less than approximately 50 feet below the ground surface, as well as a thin perched zone of groundwater encountered at 15 feet bgs in the northern portion of the expansion area. The construction worker is not anticipated to come in contact with impacted groundwater during normal grading, excavation, and/or trenching operations. In addition, groundwater at the site is highly unlikely to be used as a source of potable water.

Project On-Site Hospital Patients (adult and child):

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

The "project on-site hospital patient" receptor scenario includes the assumption that the hospital patients spend 100% of their time indoors within facilities at TCI during the duration of their visits.

In addition, it was conservatively assumed that TCI patients would visit the facility 5 days a week for a duration of one year. The on-site hospital patient will be exposed to contaminants through inhalation of VOCs originating from soil and soil vapor.

Project On-Site Commercial/Industrial/Hospital Workers:

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

The "on-site commercial/industrial/hospital worker" receptor scenario includes the fact that the site is anticipated to be used as an active medical facility and commercial, industrial and hospital workers are on-site on a daily basis. The on-site commercial/industrial/hospital worker will be exposed to contaminants through inhalation of VOCs originating from soil. Because the Project Site where receptors are present will be paved or occupied by building structures, exposure pathways, which require direct contact with site soils or exposed soils (e.g., dermal contact, incidental ingestion, and fugitive dust inhalation), were considered incomplete.

Project Off-Site Hospital Patients (adult and child):

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

Project Off-Site Commercial/Industrial/Hospital Workers:

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

Project Off-Site Residents (adult and child)

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Soil Vapor

Off-site populations were assumed to be exposed to contaminants that can be transported from the site to off-site locations. Therefore, only the inhalation of VOCs from soil and soil vapor pathway was considered complete for the project off-site receptor scenarios. Off-site workers, hospital patients, and residents will not come in direct contact with impacted site soils, since the site is anticipated to be paved or occupied by structures with landscaped areas. Therefore, the inhalation of chemicals adhered to dust pathway is considered incomplete.

Off-site hospital patients were considered to be inpatients at the LBMMC main building, which is located approximately 1,162 feet from the center of the proposed TCI facility. The nearest off-site residents are located approximately 800 feet from the proposed TCI facility (VSA, 2004).

Risks to the project off-site receptors were assumed to be the same as for the current off-site receptors because the project is not expected to significantly affect the relevant exposure pathway for these populations, specifically, inhalation of volatile chemicals from soil.

4.2 Calculation of Exposure Point Concentrations

Exposure point concentrations (EPCs) are the concentrations of chemical in soil, water, or air that are used to calculate human health risks. Consistent with USEPA risk assessment guidance (USEPA 1989), the EPC for a chemical was the lesser of the 95 percent upper confidence limit of the

arithmetic mean (95UCLM) or the maximum concentration. For the purposes of the EPC calculation, non-detect values were assigned a value of one-half the sample quantitation limit (SQL), or the practical quantitation limit (PQL) if the SQL was equal to the PQL. These decision rules are consistent with the DTSC guideline document, *Use of Soil Concentration Data in Exposure Assessments* (DTSC 1996).

4.2.1 Soil Exposure Point Concentrations

EPCs for soil were used as input in fate and transport models in the risk calculations for the direct contact pathways. The on-site construction worker can potentially become exposed to contaminants in soil during construction and/or trenching activities conducted at the site. Calculation of the soil EPCs usually requires specifying the depth interval from which soil concentrations will be used to calculate the EPCs. The 0-5 ft depth was used to develop exposure point concentrations more representative of the surface soils to which most individuals would actually be exposed. The 0-5 ft depth was used specifically to account for mixing due to land disturbance (grading) expected on the site. Soil EPCs are presented on Table 3-9.

4.2.2 Air Exposure Point Concentrations

Ambient (outdoor) air EPCs were calculated for volatile soil COPCs. The EPCs were calculated using a mathematical model that converts the soil concentration to an emission rate. The emission rates were then used as inputs in a simple "box" or single compartment model to calculate on- and off-site ambient air concentrations. This simple method for estimated ambient are concentrations is recommended by both CARB (1992) and DTSC (1984). The resulting ambient air concentrations were used to estimate health risks to the on-site construction worker and off-site receptors. Default parameters and sample calculations for the air pathways are presented in Appendix A.

Calculation of Volatile Emission Rates---

Volatile COPC emission rates from soil into outdoor air were calculated using the Farmer Equation, as presented in the California Site Mitigation Decision Tree Manual (DHS, 1986) and the Superfund Exposure Assessment Manual (USEPA, 1988). The Farmer Equation is based on Fick's Law of Diffusion and was used to calculate the diffusion of vapors through soil-gas. Emission rates were approximated using the contaminant flux estimation method, which is presented below:

$$Q = D_i(p_a^{10/3}/p_T^2)(P_iM_iW_i/RT)/L$$

Where:

Q = Volatilization emission flux (g/cm^2-sec).

D_i = Air diffusion coefficient of chemical i (cm^2/sec).

p_a = Air filled porosity (dimensionless).

p_T = Total soil porosity (dimensionless).

P_i = Vapor pressure of i at the temperature T (mmHg).

M_i = Molecular weight of i (g/mole).

W_i = Weight fraction of i in the soil (mg/mg).

R = Universal gas constant.

T = Temperature (K).

L = Average depth of deeper soil strata samples (cm).

Pertinent chemical properties for site COPCs, which were used in the Farmer Equation calculations, are presented in Table 4-1. The results of the Farmer Equation calculations (on-site outdoor emission fluxes for VOCs) are presented in Table 4-2a. The weight fraction of each chemical in soil was calculated using the 0-25 foot soil data presented in Table 3-9. As with the surface soil data, the lower of the maximum detected or UCL concentration for the 0-25 feet soil zone profile was utilized (i.e. the EPC).

The outdoor air concentrations were used to assess health risks to the on-site construction worker and the off-site residential receptors. For the off-site residential scenario, the site was assumed to be paved, therefore a slab attenuation was assumed (Table 4-2a). For the construction worker scenario, the site was assumed to be unpaved so no slab attenuation was assumed (Table 4-2b). Example calculations for the Farmer Equation are provided in Appendix A.

Note that the above is a very conservative form of the Farmer Equation (because it assumes that each chemical is present in a pure form in soil-vapor rather than a mixture with air) and should tend toward overestimation of outdoor air concentrations and assumes the site to be unpaved in future scenarios.

On-Site Outdoor Airborne Concentrations of COPCs---

To calculate outdoor on-site airborne concentrations of VOCs and indoor and outdoor contaminants in fugitive dust, a "Box" Model was utilized as recommended by the California Air Resources Board (CARB, 1992). A box model is a simple mass-balance equation that uses the concept of a theoretically enclosed space (i.e., box) over the impacted area. The model assumes that emissions of contaminants into a box, with their removal based on wind speed. The EPC within the box is calculated by the following equation:

$$B = QA/(u)(h)(l) \times CF$$

Where:

B = Box concentration, EPC (ug/m^3)

Q = Emission flux (g/cm^2-sec).

A = Emitting area of site (cm^2)

u = Wind speed (cm/sec)

h = Height of box (cm)

l = Length of box (cm)

CF = Conversion factor, 10^{12} (ug-cm^3/g-m^3)

The results of the Box Model calculations (on-site outdoor airborne chemical concentrations) are presented in Table 4-3. The EPCs from the Box Model were used for the on-site construction worker scenario. Example calculations for the Box Model are provided in Appendix B.

Particulates Adhered to Dust---

Dust emissions by wind erosion were calculated using a Particulate Emission Factor (PEF) method developed by the USEPA, and included as part of the Preliminary Remediation Goals (PRG) published by USEPA Region 9 (USEPA, 2000). The PEF converts the EPC in surface soil to an on-site concentration using the following equation:

$$C_{air} = C_{soil}/PEF \times CF$$

Where:

C_{air} = On-site airborne concentration, EPC (ug/m^3)

C_{soil} = EPC in surface soil (mg/kg)

PEF = Particulate emission factor (m^3/kg)

CF = Conversion factor (1000 ug/mg)

A summary of the fugitive dust calculations is presented in Table 4-4. The concentration for each chemical in soil was calculated using EPCs for surface soil presented in Table 3-3. The fugitive dust calculations were used to estimate non-VOC concentrations in outdoor air for the project on-site construction worker.

VOCs from Soil and Soil Vapor into Indoor Air---

To calculate on-site VOC concentrations in indoor air due to volatilization from soil and soil vapor, the Johnson and Ettinger Model was used (USEPA 2003). The Johnson and Ettinger Model was used in the advanced mode. The advanced mode allows for greater use of site-specific parameters. In cases where site-specific information was not available, the model defaults were used. A list of non-default parameters used in the Model is presented in Table 4-5.

The VOC contribution from soil was added to the contribution from soil vapor (Table to derive final indoor air concentrations. Table 4-6a and 4-6b pertain to the proposed TCI building, while Table 4-7a and 4-7b pertains to the LBMMC main building. Documentation pertaining to the Johnson & Ettinger calculations is provided in Appendix B.

Off-Site Airborne Concentrations of COPCs---

To calculate off-site atmospheric concentrations of VOCs, the USEPA-approved SCREEN3 screening air dispersion model was utilized. SCREEN3 was used to calculate EPCs for the chemicals of concern at points representing pertinent off-site populations, including the nearest residential populations under the current and project exposure scenarios.

Under the current and project exposure scenarios, the nearest off-site residential population is located be located directly approximately 800 feet from the center of the proposed TCI building.

Table 4-9 presents the results of SCREEN3 modeling in tabular form for the off-site resident receptors. The nearest off-site resident receptors are located approximately 800 feet from the proposed TCI facility. A summary of the air dispersion modeling, including the various assumptions and default parameters utilized, is presented in Appendix C.

Full meteorology was used in the SCREEN3 model in which the model examines a series of wind stability classes and their associated wind speeds to identify the "worst case" meteorological conditions (i.e., the combination of wind speed and stability that results in the maximum ground-level concentrations).

4.3 Estimation of Chemical Intake

The chronic daily intake (CDI) is a measure of the average daily intake of each COPC for each identified human receptor via a specific exposure pathway. Equations for specific exposure pathways that were used to calculate CDIs for the on-site and off-site populations from the COPCs are shown below.

4.3.1 Incidental Soil Ingestion

$$CDI = \frac{CS \times IR \times EF \times ED \times CF \times FI}{BW \times AT} = (mg/kg\text{-}day)$$

Where:

CS = Chemical concentration (Exposure Point Concentration [EPC]) in soil to a depth of 5 feet (mg/kg); Table 3-3.

IR = Ingestion Rate (mg soil/day) = refer to Table 4-10.

EF = Exposure Frequency (days/year) = refer to Table 4-10.

ED = Exposure Duration (years) = refer to Table Table 4-10.

CF = Conversion Factor (10^{-6} kg/mg).

BW = Body weight (kg) = Refer to Table 4-10.

AT = Averaging Time (days) = Refer to Table Table 4-10.

FI = Fraction of ingested chemicals which are absorbed, assumed to be 100% for most chemicals.

4.3.2 Dermal Absorption of Chemicals in Soil

$$CDI = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} = (mg/kg\text{-}day)$$

Where:

CS = Chemical concentration (EPC) in soil to a depth of 5 feet bgs (mg/kg) = refer to Table 3-3

CF = Conversion Factor (10^{-6} mg/kg).

SA = Skin Surface Area Available for Contact (cm^2/day) = refer to Table 4-10.

AF = Soil-to-Skin Adherence Factor (mg/cm^2) = refer to Table 4-10.

ABS = Dermal Absorption Factor Specific for Each Contaminant (unitless): 10% for organics; 0.1% for cadmium, 1% for other metals; (DTSC, 1994).

EF = Exposure Frequency (days/year) = refer to Table 4-10.

ED = Exposure Duration (years) = refer to Table 4-10.

BW = Body Weight (kg) = refer to Table 4-10.

AT = Averaging Time (days) = refer to Table 4-10.

The fraction of chemical dermally absorbed, ABS is the fraction of chemical adhering to the skin that is expected to be absorbed across the skin into the body. Chemical-specific ABS values were obtained from DTSC (1994), using a default value of 0.01 or 1% for inorganic chemicals and 0.1 or 10% for organic chemicals (DTSC, 1994).

4.3.3 Inhalation of Chemicals in Soil-Vapor and Fugitive Dust

$$CDI = \frac{CA \times CF \times IR \times EF \times ED}{BW \times AT} = (mg/kg\text{-}day)$$

Where:

CA = Chemical concentration in air (ug/m^3).

CF = Conversion Factor (10^{-3} mg/ug).

IR = Inhalation Rate (m^3/day) = refer to Table 4-10.

EF = Exposure Frequency (days/year) = refer to Table 4-10.

ED = Exposure Duration (years) = refer to Table 4-10.

BW = Body Weight (kg) = refer to Table 4-10.

AT = Averaging Time (days) = refer to Table 4-10.

Exposure parameters used for each receptor are listed on Table 4-10. Table 4-10 also shows a calculation result of the "CDI factor," which is a combination of all exposure parameters for a particular receptor.

5.0 TOXICITY ASSESSMENT

As part of the HRA, toxicity information, both qualitative and quantitative, was obtained, reviewed, and compiled for each COPC. This information included applicable toxicity values from the Cal-EPA and the USEPA.

For risk assessment purposes, chemicals are separated into two categories of toxicity, depending on whether they exhibit non-carcinogenic or carcinogenic effects. This distinction reflects the current scientific opinion that the mechanisms of action for each category are different. For purposes of assessing risks associated with potential carcinogens, the general risk assessment approach used by USEPA assumes that a small number of molecular events can cause changes in a single cell or a small number of cells that can lead to tumor formation. This is known as a no-threshold mechanism since there is essentially no level of exposure (i.e., threshold) to a carcinogen, which will not result in some finite possibility of causing a disease. In the case of chemicals exhibiting non-carcinogenic effects, however, it is believed that a threshold exists, and that organisms have protective mechanisms that must be overcome before toxic endpoints are manifested.

5.1 Non-Carcinogenic Toxicity Criteria

The potential for non-carcinogenic health defects is evaluated using reference doses (RfD) developed by the USEPA. The RfD, expressed in units of mg/kg/day, is an estimate of the daily exposure to human population (including sensitive sub-populations) that is likely to have no appreciable risk of deleterious effects during an entire lifetime. These RfDs are usually derived either from human studies involving work place exposure or from animal studies and are adjusted using uncertainty factors. The RfD provides a benchmark to which CDIs may be compared. When RfDs are not available for chemicals of concern, other pertinent data may be utilized. For example, for a chemical where a published RfD was not available, but a chronic reference exposure level (REL) was available, the REL was converted to the appropriate units of mg/kg-day. Available non-carcinogenic RfDs for the chemicals of concern are presented in Table 5-1.

DTSC recommends the following hierarchy for selection and use of non-carcinogenic toxicity data (i.e., RfDs) for non-carcinogens, and was used in the HRA:

(1) RfDs set forth in California regulations or derived from chronic RELs;

(2) The USEPA's Integrated Risk Information System (IRIS), (USEPA, 2004a);

(3) The most current HEASTS, (USEPA, 1997a); and

(4) Other acceptable sources.

5.2 Carcinogenic Toxicity Criteria

Cancer slope factors (CSFs) developed by the Cal-EPA's Office of the Environmental Health Hazard Assessment (OEHHA) and/or USEPA's Carcinogen Assessment Group (CAG) for potentially carcinogenic chemicals are expressed in units of $(mg/kg/day)^{-1}$. CSFs are derived from the results of

chronic animal bioassays or human epidemiological studies.

The animal studies must usually be conducted using relatively high doses in order to detect possible adverse effects. Since humans are expected to be exposed at much lower doses than those used in the animal studies, the data are adjusted by using mathematical models. The data from the animal studies are typically fit to a linearized multi-stage model to obtain a dose-response curve. The 95th percentile UCL of the slope of the dose-response curve is subjected to various health-conservative adjustments and an inter-species scaling factor is applied to derive the CSFs for humans. Thus, the actual risks, when quantitatively evaluated based on animal studies, are very conservative and not likely to exceed the risks estimated using these CSFs.

The USEPA assigns weight-of-evidence classifications to potential carcinogens. Under this system, chemicals are classified as either Group A, Group B1, Group B2, Group C, Group D, or Group E. Group A chemicals (human carcinogens) are agents for which there is sufficient evidence to support a direct cause association between exposure to the agents in humans and cancer. Groups B1 and B2 chemicals (probable human carcinogens) are agents for which there is limited (B1) or inadequate (B2) evidence of carcinogenicity from animal studies. Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals, and Group D chemicals (not classified as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available. Group E chemicals (no evidence of carcinogenicity in humans) are agents for which there is no evidence of carcinogenicity in adequate human or animal studies (USEPA, 1989a).

For the purposes of this HRA, site contaminants that have been classified by the USEPA as A (human carcinogens), B (probable human carcinogens), or C (possible carcinogens) were considered as carcinogens. Any contaminants classified by USEPA as Class D or lower were not considered for further risk analysis as part of this HRA. Available carcinogenic CSFs are presented in Table 5-2.

DTSC recommends the following hierarchy for selection and use of carcinogenic toxicity data (i.e., CSFs) for carcinogens, and was used in the HRA:

(2) Cal-EPA, OEHHA, Standards and Criteria Workgroup, most recent list of CSFs (OEHHA, 2004a);

(3) EPA's IRIS, (USEPA, 2004a);

(4) The most current HEASTs, (USEPA, 1997a); and

(5) The most recent NCEA data (NCEA, 1996).

Cancer slope factors were extrapolated from one route of exposure to another only if carcinogenicity by the other route of exposure is supported by information contained in IRIS or California risk assessment guidance.

6.0 RISK CHARACTERIZATION

This section of the HRA describes how calculated exposure doses were integrated with the toxicity criteria to yield estimates of potential health risks. Risk characterization involves the integration of health effects information, developed as a part of the dose-response assessment, with exposure estimates developed as part of the exposure assessment. The result is a quantitative estimate of chronic cancer risks and non-carcinogenic hazards based on the presumption that a threshold dose is required to elicit a response.

6.1 Non-Carcinogenic Effects

Potential risks for non-carcinogens are presented as the ratio of the CDI to the reference dose (CDI/RfD). This ratio is known as the hazard quotient (HQ). A HQ is a chemical-specific measure of potential non-carcinogenic effects on human health due to exposures of a receptor through a specific pathway. Since some individuals are exposed by more than one pathway, HQs are summed for each pathway that contributes to the exposure to the same individual in a given population. The sum of the CDI/RfD ratios (i.e., HQs) associated with multiple exposure pathways to each chemical is called the hazard index (HI). The HI is thus determined as follows:

$$HI_i = \text{sum of } (CDI)_i/(RfD)_i$$

where:

HI_i = Hazard Index for chemical "i" (unitless).

$(CDI)_i$ = Daily intake from all routes of exposure for the ith contaminant (mg/kg/day).

$(RfD)_i$ = Acceptable daily intake (reference dose) for the ith contaminant. (mg/kg/day).

If the total HI is equal or less than 1, it is believed that no threshold effects will occur. An HI of slightly higher than 1 is not necessarily an indication that health effects will occur. The summation of HQs across all chemicals and across all pathways assumed that all chronic human health effects are additive.

6.2 Carcinogenic Risk Estimates

The theoretical excess lifetime cancer risk is an estimate of the increased risk of an individual developing cancer as a result of exposure to the COPCs at specified daily dosages over a lifetime of 70 years. The excess lifetime cancer risk was estimated for each known, probable, or possible carcinogenic constituent using the following equation:

$$Risk_i = \text{sum of } CDI_i \times CSF_i$$

where:

$Risk_i$ = Individual excess lifetime cancer risk (probability) for intake of ith substance (unitless).

CDI_i = Chronic daily intake of chemical "i" (mg/kg-day).

CSF_i = Cancer slope factor of chemical "i" $(mg/kg\text{-}day)^{-1}$.

Lifetime daily intakes, using an averaging time of 70 years effectively prorate the total cumulative dose over a lifetime. This approach is based on the assumption that a high dose of carcinogens received over a short period of time, at any age is equivalent to a correspondingly low dose received over a lifetime. Note that only a single residential cancer risk was calculated for the various receptor scenarios since the risks are determined for a 70-year lifetime, which includes both childhood and adult exposures.

6.3 Risk Characterization Results

Risk characterization was utilized to derive quantitative estimates of incremental lifetime cancer risk for the detected human carcinogens and potential adverse health impacts for non-carcinogens. The results of risk characterization are summarized below and presented in Tables 6-1 through 6-17:

6.3.1 Current and Project Off-Site Hospital Patient at LBMMC

The risks for the off-site Hospital Patient for the project scenario are equal to those in the current (baseline) scenario.

The total HI for the off-site hospital patient (child) at LBMMC is **8×10^{-7}** (Table 6-1). The total HI for the off-site hospital patient (adult) is **2×10^{-7}** (Table 6-2). The total ELCR for the off-site hospital patient (child) is **8×10^{-12}** (Table 6-3). The total ELCR for the off-site hospital patient (adult) is **2×10^{-12}** (Table 6-4).

6.3.2 Current Off-Site Commercial/Industrial/Hospital Worker at LBMMC

The total HI for the current Off-Site Commercial/Industrial/Hospital Worker is **2×10^{-5}** (Table 6-5). The total ELCR for the current Off-Site Commercial/Industrial/Hospital Worker is **6×10^{-9}** (Table 6-6).

6.3.3 Current Off-Site Resident

The total HI for the current off-site resident (child) is **1×10^{-9}** (Table 6-7). The total HI for the current off-site resident (adult) is **5×10^{-10}** (Table 6-8). The total ELCR for the current off-site resident (adult and child) is **6×10^{-13}** (Table 6-9).

6.3.4 Project On-Site Construction Worker

The total HI for the project on-site construction worker is **1.1** (Table 6-10). The total ELCR for the project on-site construction worker is **7×10^{-6}** (Table 6-11).

6.3.5 Project On-Site Hospital Patient

The total HI for the project on-site hospital patient (child) is **0.006** (Table 6-12). The total HI for the project on-site hospital patient (adult) is **9×10^{-6}** (Table 6-13). The total ELCR for the project on-site hospital patient (child) is **3×10^{-10}** (Table 6-14). The total ELCR for the project on-site hospital patient (adult) is **1×10^{-10}** (Table 6-15).

6.3.6 Project On-Site Commercial/Industrial/Hospital Worker

The total HI for the project on-site commercial/industrial/hospital worker is **2×10^{-5}** (Table 6-16). The total ELCR for the project on-site commercial/industrial/hospital worker is **5×10^{-9}** (Table 6-17).

6.4 Risk Characterization Summary

Under the California Environmental Quality Act (CEQA), non-carcinogenic levels below 1 are not considered significant, and are such health impacts are considered acceptable.

Based on CEQA guidelines, as stated in the South Coast Air Quality Management District's CEQA Handbook, theoretical excess lifetime cancer risks less than one in 100,000 (1×10^{-5}) are not considered significant, and are considered acceptable (SCAQMD, 1993).

This level of "acceptable" risk is also used under California Proposition 65, the Drinking Water and Toxic Enforcement Act of 1986 ("Prop 65"). Under Prop 65, no significant risk levels (NRSLs) for carcinogens were determined to be the daily intake level calculated to result in one excess cancer in an exposed population of 100,000 (1×10^{-5}) assuming lifetime (70-year) exposure at the level in question (OEHHA, 2004b).

The total hazard indices for the following on-site and off-site current and project receptors are at or below 1, and **are not considered significant** under CEQA guidelines.

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Based on the risk evaluation, the total Hazard Indices for the following receptors are above the non-carcinogenic risk threshold established for the project ($HI \leq 1$) and are **considered significant** under CEQA guidelines:

- Current On-Site Construction Worker

The total theoretical excess lifetime cancer risks for the following current and project on-site and

off-site receptor scenarios are all at or below one in 100,000. Therefore, carcinogenic risk levels for these receptors are **not considered significant** under CEQA.

- Current/Project Off-Site Hospital Patient (Child and Adult)
- Current/Project Off-Site Commercial/Industrial/Hospital Worker
- Current/Project Off-Site Resident (Child and Adult)
- Project On-Site Construction Worker
- Project On-Site Hospital Patient (Child and Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Due to the health-conservative methodologies used in this baseline HRA, the actual probabilities of cancer formation in the populations of concern due to exposure to chemicals in soil are likely to be lower than the risks derived using the above methodology. In fact, the reasonable maximum exposure (RME) risk assessment has been designed to overestimate risks and err on the side of health protection.

7.0 ASSESSMENT OF HEALTH RISKS FROM INORGANIC LEAD IN SOILS

The assessment of health risk from inorganic lead in soils was prepared in accordance with the *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996).

Since most data of human health effects for exposure to inorganic lead are based on blood lead concentration, the DTSC documents evaluate the increased blood lead concentrations resulting from exposures to lead in soil. As set forth in the DTSC document, the Office of Scientific Affairs, Human and Ecological Risk Division (OSA, HERD) has developed a series of equations for estimating blood lead concentrations due to exposure through the five (5) pathways shown below.

- Dietary Intake
- Drinking Water Intake
- Soil Ingestion
- Inhalation of Fugitive Dust
- Dermal Contact

The blood lead concentration of concern for both children and adults is 10 micrograms (µg) of lead per deciliter (dl) of blood, as recommended by Cal-EPA, USEPA, the Centers of Disease Control (CDC), and the Food and Drug Administration (FDA). The contributions via the five (5) pathways are added to arrive at an estimate of a mean blood lead concentration resulting from the exposures. A 99% upper confidence limit (UCL) is then calculated from the mean value and compared to the 10 µg/dl threshold. If the 99% UCL value is below the threshold, then there is 99% certainty that the resulting blood lead concentration from site contamination will be within a range of acceptable risk.

In order to determine a risk screening level (i.e. maximum allowable concentration) for inorganic lead in soil at a "typical" site, the following assumptions were made:

(1) All five (5) exposure pathways are complete,

(2) The background level of lead in drinking water is equal to its maximum contaminant limit (MCL: 15 ug/L),

(3) The background level of lead in ambient air is equal to the national ambient air quality standard (NAAQS: 50 ug/m^3),

(4) 7% of the typical diet consists of ingestion of homegrown produce.

The assumptions listed are extremely conservative, and reflect the default values provided with the LEADSPREAD 7 model. The inputs for the LEADSPREAD model are summarized on Table 7-1.

Based on the calculations summarized in Table 7-1, at an EPC of 7.5 mg/kg (Table 3-3), the resulting blood lead levels for all receptors are below the 10.0 µg/dl level of concern set forth by

Cal-EPA; therefore, health risks due to lead are not of concern at the site and are not considered significant under CEQA.

8.0 CONCLUSIONS

8.1 Hazard Indices

Based on the risk evaluation, the total Hazard Indices for the following receptors are at or below the non-carcinogenic risk threshold established for the project (HI ≤ 1) and are **not considered significant** under CEQA guidelines:

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Based on the risk evaluation, the total Hazard Indices for the following receptors are above the non-carcinogenic risk threshold established for the project (HI ≤1) and are **considered significant** under CEQA guidelines:

- Current On-Site Construction Worker

The exceedance of the non-carcinogenic threshold (HI ≤ 1) is due to the dermal absorption and ingestion of TRPH in soil.

8.2 Theoretical Excess Lifetime Cancer Risks

The total theoretical excess lifetime cancer risks (ELCR) for the all receptors evaluated in the HRA are at or below the carcinogenic risk threshold established for the project (ELCR = 1×10^{-5}) and are **not considered significant** under CEQA guidelines:

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)

- Current and Project Off-Site Resident (Adult)
- Project On-Site Construction Worker
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)

8.3 Risks from Inorganic Lead in Soil

Based on the calculations summarized in Table 7-1, the resulting blood lead levels for all receptors are below the 10.0 µg/dl level of concern set forth by Cal-EPA; therefore, health risks due to lead are not of concern at the site and are not considered significant under CEQA.

9.0 RISK-BASED EVALUATION OF SITE MITIGATION MEASURES

Risk-Based Mitigation Measures

Project Scenario On-Site Construction Worker

The non-carcinogenic risk (Hazard Index) for the project scenario on-site construction worker exceeds the established threshold based on CEQA guidelines (HI ≤ 1). The majority of the non-carcinogenic risk is due to ingestion and dermal contact with TRPH in soil. Implementing any of the following risk-based mitigation measures can minimize potential exposures to COPCs in soil at the Project Site:

a. Use of personal protective equipment (PPE) during construction/remediation activities.

b. Monitoring of worker exposure to COPCs during on-site construction/remediation activities.

c. Adherence to health and safety protocols as provided for in a site health and safety plan (e.g. no eating in construction/remediation areas).

10.0 UNCERTAINTIES

There are three principal sources of assumptions and, therefore, uncertainties for this risk assessment: (1) identification and selection of COPCs and determination of EPCs, (2) exposure assessment and determination of EPCs and CDIs, and (3) toxicity assessment. These sources are further discussed below.

Risk assessment methodologies require that a number of assumptions be made throughout the HRA process. The choice of assumptions may impact the calculated risk estimates such that these estimates may overestimate or underestimate the actual potential health risk. Table 9-1 presents a summary of how the uncertainties in this HRA are judged to impact the risk estimates in this report. As indicated in the table, the assumptions used in this baseline HRA were designed, for the most part, to over-estimate the potential human health risk. This health-conservative nature of HRA methodology is recommended by the USEPA and DTSC.

The potential effects of uncertainties presented in Table 9-1 were evaluated in a qualitative fashion only. A "Low" ranking is defined as assumptions that contributed less than one order of magnitude to the sensitivity of the risk calculations. A "Medium" ranking denotes assumptions that contributed one to two orders of magnitude to the sensitivity of the risk calculations. A "High" ranking denotes assumptions that contributed over two orders of magnitude to the sensitivity of the risk calculations.

In the absence of specific information concerning the magnitude of uncertainty, the potential effects were assumed to be low. Any assumptions that were deemed to have a medium to high-risk impact on risk estimates are further discussed below.

9.1 Identification of Chemicals of Potential Concern

The potential effects of uncertainty for the identification and selection of COPCs and determination of EPCs were generally considered to be low. The following identifies potential uncertainties associated with the identification of COPCs and their ranking of uncertainty:

9.2 Exposure Assessment

The potential effects of uncertainty for the exposure assessment were generally considered to be low for most parameters used in determining EPCs and/or developing CDIs for the COPC, with the exception of the following:

Medium Potential

(1) Use of Farmer Equation to estimate emission flux from soil vapor

The form of the Farmer Equation that was used in this HRA modeled the emission flux from chemical substances assumed to be present in a pure-phase, based on their weight-fraction in soil. This assumption results in an overestimation of risks associated with both on- and off-site receptors.

(2) Use of SCREEN3 model to estimate dispersion of VOCs in particulates to off-site resident receptors

By design, the SCREEN3 model is a screening-level model that overestimates ground-level contaminant concentrations. In addition, for this HRA, the model was used to calculate maximum hourly concentrations, which are a significant over-estimate when considering long-term, chronic exposures.

(3) Use of J&E Model for estimation of indoor air concentrations from soil vapor

It is our opinion that the pressure differential assumed in the J&E model is inappropriate for buildings located in a temperate climate. As indicated by model developers, pressure differential does not account for climates in which doors and/or windows may be utilized, which would tend to equalize pressure, thereby reducing the default pressure differential.

High Potential

(1) Exposure Factors used for On- and Off-Site Hospital Patients

The exposure factors used for the on- and off-site hospital patients are extremely health conservative as the duration of time a patient is at the hospital varies greatly. An average of 4.9 days provided by the Center for Disease Control was used in the estimates for patients at the LBMMC Main Hospital Building. Since the Todd Cancer Institute is anticipated to serve as an outpatient facility, it was conservatively assumed that patients would visit the facility 5 days a week, for the duration of one year to receive medical treatment or evaluation. These assumptions have the potential to over-estimate risks.

9.3 Toxicity Assessment

The potential effects of uncertainty for the toxicity assessment were generally considered to be medium to low based on route extrapolation and CSF determination. This HRA did not consider antagonistic/synergistic effects of the various COPCs, which is estimated to have a low effect on the uncertainty on risk estimates.

Using route extrapolation from the oral to the dermal pathway tends to overestimate risks due to the fact that the oral pathway is a direct pathway for chemical entry into an organism, versus the absorption pathway.

Since animal data is limited on the carcinogenicity of USEPA Class B2 and C carcinogens, the CSFs determined for animal species are multiplied by uncertainty factors, which reflect cross-species extrapolation difficulties. In an attempt to err on the health-conservative side in the absence of human carcinogenic data, toxicologists have produced higher CSFs, which tend to overestimate risks.

9.4 Risk Characterization

As indicated previously, the non-carcinogenic hazard index of 1.1 obtained for the construction

worker is due primarily to exposure to TRPH through incidental ingestion of soil and dermal contact. There is significant uncertainty associated with this hazard index estimate for two reasons: 1) it is based on oil soils data collected in 1991 that has not been verified recently, and 2) the quantitative risk assessment of complex mixtures such as TRPH is difficult, and requires considerable assumptions and is still under development. This, there is considerable uncertainty associated with the risk assessment of TRPH. Nonetheless, a hazard index was still estimated for this chemical mixture to err on the health protective side.

11.0 LIMITATIONS AND CERTIFICATIONS

This HRA was prepared in accordance with risk assessment methodologies recommended at the present time by regulatory agencies having jurisdiction in the State of California. It should be recognized that an assessment of the human health risks associated with exposures to chemicals in the environment is a difficult and inexact science. Professional judgments leading to conclusions and recommendations are generally made with a margin of error inherent to the risk assessment process.

It is sometimes difficult to verify the adequacy or accuracy of the site investigations through which data were developed for an HRA. For this reason, we have attempted to use health-conservative assumptions wherever data or information was limited or uncertain.

12.0 REFERENCES

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TABLE 3-1
SUMMARY OF ANALYTICAL RESULTS FOR SOIL SAMPLES
LONG BEACH MEMORIAL MEDICAL CENTER - TODD CANCER INSTITUTE, LONG BEACH, CALIFORNIA

Sample Location	Date of Collection	Total Petroleum Hydrocarbons (TPH)								Volitile Organic Compounds (VOCs)		Title 22 Metals									
		EPA Method 8015B(M)								EPA Method 8260B/5035		EPA Method 3050B/6010B									
		Gasoline Range (C4 - C12)	Diesel Range (C8 - C25)	C5-C12	C10-C12	C13-C15	C16-C22	C23-C32	>C32	Bromoform	Methylene Chloride	Arsenic	Barium	Cobalt	Chromium	Copper	Nickel	Lead	Selenium	Vanadium	Zinc
		mg/Kg								µg/Kg		mg/Kg									
SB-1-5'	**9/28/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	NA	NA	**3.5**	**110**	**9.9**	**24**	**15**	**15**	**6**	**3.8**	**39**	**41**
SB-1-25'	**9/28/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	**8.3**	**28**	**5.3**	**11**	**3.7**	**7**	**2.1**	**1.9**	**23**	**24**
SB-1-35'	**9/28/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-2-5'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	NA	NA	**4.1**	**110**	**9.9**	**20**	**16**	**14**	**5**	**3.3**	**33**	**41**
SB-2-20'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	**4.5**	**120**	**11**	**24**	**18**	**16**	**5.6**	**4.6**	**32**	**52**
SB-2-35'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-2-55'	**9/27/2004**	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-3-5'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	NA	NA	**6.8**	**85**	**12**	**29**	**22**	**21**	**7.9**	**4.7**	**49**	**48**
SB-3-20'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	2.1	**16**	**3.1**	**6.3**	**2.1**	**4**	**1.2**	**1.2**	**13**	**16.0**
SB-3-35'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-4-5'	**9/28/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	NA	NA	**4.1**	**100**	**12**	**23**	**15**	**16**	**6.6**	**4**	**41**	**45**
SB-4-20'	**9/28/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	**23**	**92**	**12**	**23**	**31**	**19**	**9.1**	**4.1**	**49**	**43**
SB-4-35'	**9/28/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-4-55'	**9/28/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SB-5-5'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	NA	NA	**6.7**	**88**	**11**	**25**	**22**	**19**	**6.7**	**4.2**	**42**	**44**
SB-5-20'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	**15**	**25**	**7.8**	**55**	**4.6**	**17**	**8.4**	**6.4**	**2.7**	**1.7**	**43**	**22**
SB-5-30'	**9/27/2004**	<1.0	<10	NA	NA	NA	NA	NA	NA	ND	ND	**1.3**	**27**	**8**	**15**	**11**	**12**	**4**	**3.2**	**29**	**32**
TSB-21-5'	**10/8/2004**	NA	NA	710	710	850	690	1300	340	NA	NA	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
TSB-21-10'	**10/8/2004**	NA	NA	380	230	310	280	480	130	NA	NA	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Notes:
* = Only analytes detected in one or more samples are listed.
µg/Kg = micrograms per kilogram (or parts per billion)
mg/Kg = milligrams per kilogram (or parts per million)
NA = Not Analyzed
ND = Not Detected

TABLE 3-2
SUMMARY OF SOIL VAPOR SURVEY ANALYTICAL RESULTS
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Sample Location	Date of Collection	Volatile Organic Compounds			
		8260B			
		Freon 113	Toluene	m,p-Xylene	Benzene
		µg/L			
SV1-1V	10/7/2004	<1	<1	<2	<1
SV1-3V	10/7/2004	<1	<1	<2	<1
SV1-7V	10/7/2004	<1	<1	<2	<1
SV2-5	10/7/2004	<1	<1	<2	<1
SV3-5	10/7/2004	<1	<1	<2	<1
SV4-5	10/7/2004	<1	<1	<2	<1
SV5-5	10/7/2004	<1	<1	<2	<1
SV6-5	10/7/2004	<1	<1	<2	<1
SV7-5	10/7/2004	<1	<1	<2	<1
SV8-5	10/7/2004	<1	<1	<2	<1
SV9-5	10/7/2004	**4.4**	**2.1**	<2	<1
SV10-5	10/7/2004	<1	<1	<2	<1
SV11-5	10/7/2004	<1	<1	<2	<1
SV12-5	10/7/2004	<1	<1	<2	<1
SV13-5	10/7/2004	<1	<1	<2	<1
SV14-5	10/7/2004	<1	<1	<2	<1
SV14-5 (dup)	10/7/2004	<1	<1	<2	<1
SV15-5	10/7/2004	<1	<1	<2	<1
SV16-5	10/8/2004	<1	<1	**2.2**	<1
SV17-5	10/8/2004	<1	<1	<2	<1
SV18-5	10/8/2004	<1	<1	<2	<1
SV19-5	10/8/2004	<1	<1	<2	<1
SV20-5	10/8/2004	<1	<1	<2	<1

TABLE 3-2
SUMMARY OF SOIL VAPOR SURVEY ANALYTICAL RESULTS
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Sample Location	Date of Collection	Volatile Organic Compounds			
		8260B			
		Freon 113	Toluene	m,p-Xylene	Benzene
		µg/L			
SV21-5	**10/8/2004**	<1	<1	<2	**3.6 (S-04)**
SV22-5	**10/8/2004**	<1	<1	<2	<1
SV23-5	**10/8/2004**	<1	<1	<2	<1
SV23-5 (dup)	**10/8/2004**	<1	<1	<2	<1
SV24-5	**10/8/2004**	<1	<1	<2	<1
SV25-5	**10/8/2004**	<1	<1	<2	<1
SV26-5	**10/8/2004**	<1	<1	<2	<1
SV27-5	**10/8/2004**	<1	<1	<2	**6.8**

Notes:
* = Only analytes detected in one or more samples are listed.
S-04 = The surrogate recovery for this sample is outside of established control limits due to a sample matrix effect.
µg/Kg = micrograms per kilogram (or parts per billion)
Bold text indicates analyte detected

TABLE 3-3. DATA SUMMARY FOR 0-5 FEET SOIL SAMPLES
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Frequency of Detection			Range of Concentrations[1,2] (ug/L)			Sample Location of Maximum Detection	Sample Depth of Maximum Detection (feet bgs)	Average Concentration (mg/kg)	95% Upper Confidence Limit of the Arithmetic Mean (UCLM)[3]	Exposure Point Concentration (ug/L)[4]
	# of Detections	# of Samples	Frequency of Detection	Minimum	-	Maximum					
Arsenic	5	5	100%	3.5	-	6.8	SB-3	5.0	5.0	6.55E+00	**6.55E+00**
Barium	5	5	100%	85.0	-	110.0	SB-1 / SB-2	5.0	98.6	1.10E+02	**1.10E+02**
Cobalt	5	5	100%	9.9	-	12.0	SB-3 /SB-4	5.0	11.0	1.20E+01	**1.20E+01**
Chromium	5	5	100%	20.0	-	29.0	SB-3	5.0	24.2	2.73E+01	**2.73E+01**
Copper	5	5	100%	15.0	-	22.0	SB-3	5.0	18.0	2.15E+01	**2.15E+01**
Nickel	5	5	100%	14.0	-	21.0	SB-3	5.0	17.0	1.98E+01	**1.98E+01**
Lead	5	5	100%	5.0	-	7.9	SB-3	5.0	6.4	7.45E+00	**7.45E+00**
Selenium	5	5	100%	3.3	-	4.7	SB-3	5.0	4.0	4.49E+00	**4.49E+00**
Vanadium	5	5	100%	33.0	-	49.0	SB-3	5.0	40.8	4.63E+01	**4.63E+01**
Zinc	5	5	100%	41.0	-	48.0	SB-3	5.0	43.8	4.66E+01	**4.66E+01**
TPH (C5-C12)	1	1	100%	710	-	710	TSB-21	5.0	710	NA	**7.10E+02**
TPH (C10-C12)	1	1	100%	710	-	710	TSB-21	5.0	710	NA	**7.10E+02**
TPH (C13-C15)	1	1	100%	850	-	850	TSB-21	5.0	850	NA	**8.50E+02**
TPH (C16-C22)	1	1	100%	690	-	690	TSB-21	5.0	690	NA	**6.90E+02**
TPH (C23-C32)	1	1	100%	1,300	-	1,300	TSB-21	5.0	1,300	NA	**1.30E+03**
TPH (>C32)	1	1	100%	340	-	340	TSB-21	5.0	340	NA	**3.40E+02**

Notes:
bgs = below ground surface
mg/kg = Milligrams per kilogram
UCLM = Upper confidence limit of the arithmetic mean

[1] 1/2 detection limit values used for analytical results below detection limits. Statistical calculations utilized sample statistics rather than population statistics.
[2] Laboratory-estimated values which were below the detection limit were used
[3] Data distribution assumed normal. 95% UCLM calculated as follows: $UCL_{1-\alpha}$ = sample mean + $t_{\alpha, n-1}$ S/sqrt(n) (USEPA, 2002, Exhibit 1)
[4] Exposure Point Concentration is the lesser of the 95% UCLM or the maximum concentration and is consistent with USEPA risk assessment guidance (USEPA, 1989)

TABLE 3-4. DATA SUMMARY FOR 0-25 FEET SOIL SAMPLES
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Frequency of Detection			Range of Concentrations[1,2] (ug/L)			Sample Location of Maximum Detection	Sample Depth of Maximum Detection (feet bgs)	Average Concentration (mg/kg)	95% Upper Confidence Limit of the Arithmetic Mean (UCLM)[3]	Exposure Point Concentration (ug/L)[4]
	# of Detections	# of Samples	Frequency of Detection	Minimum	-	Maximum					
Bromoform	1	5	20%	0.0022	-	0.015	SB-5	20.0	4.94E-03	1.03E-02	**1.03E-02**
Methylene Chloride	1	5	20%	0.0022	-	0.025	SB-5	20.0	6.94E-03	1.66E-02	**1.66E-02**
Arsenic	10	10	100%	2.1	-	23.0	SB-4	20.0	7.09E+00	1.05E+01	**1.05E+01**
Barium	10	10	100%	16.0	-	120.0	SB-2	20.0	8.04E+01	1.01E+02	**1.01E+02**
Cobalt	10	10	100%	3.1	-	12.0	SB-4	5.0	9.08E+00	1.11E+01	**1.11E+01**
Chromium	10	10	100%	6.3	-	29.0	SB-3	5.0	2.02E+01	2.43E+01	**2.43E+01**
Copper	10	10	100%	2.1	-	31.0	SB-4	20.0	1.53E+01	2.04E+01	**2.04E+01**
Nickel	10	10	100%	4.0	-	21.0	SB-3	5.0	1.37E+01	1.72E+01	**1.72E+01**
Lead	10	10	100%	1.2	-	9.1	SB4-20	5.0	5.29E+00	6.78E+00	**6.78E+00**
Selenium	10	10	100%	1.2	-	4.7	SB-3	5.0	3.35E+00	4.09E+00	**4.09E+00**
Vanadium	10	10	100%	13.0	-	49.0	SB-3 / 4	5.0 / 20.0	3.64E+01	4.30E+01	**4.30E+01**
Zinc	10	10	100%	16.0	-	52.0	SB-2	20.0	3.76E+01	4.47E+01	**4.47E+01**
TPH (C5-C12)	1	1	100%	380	-	380	TSB-21	10.0	380.0	NA	**3.80E+02**
TPH (C10-C12)	1	1	100%	230	-	230	TSB-21	10.0	230.0	NA	**2.30E+02**
TPH (C13-C15)	1	1	100%	310	-	310	TSB-21	10.0	310.0	NA	**3.10E+02**
TPH (C16-C22)	1	1	100%	280	-	280	TSB-21	10.0	280.0	NA	**2.80E+02**
TPH (C23-C32)	1	1	100%	480	-	480	TSB-21	10.0	480.0	NA	**4.80E+02**
TPH (>C32)	1	1	100%	130	-	130	TSB-21	10.0	130.0	NA	**1.30E+02**

Notes:
bgs = below ground surface
mg/kg = Milligrams per kilogram
UCLM = Upper confidence limit of the arithmetic mean

[1] 1/2 detection limit values used for analytical results below detection limits. Statistical calculations utilized sample statistics rather than population statistics.
[2] Laboratory-estimated values which were below the detection limit were used
[3] Data distribution assumed normal. 95% UCLM calculated as follows: $UCL_{1-\alpha}$ = sample mean + $t_{\alpha, n-1}$ S/sqrt(n) (USEPA, 2002, Exhibit 1)
[4] Exposure Point Concentration is the lesser of the 95% UCLM or the maximum concentration and is consistent with USEPA risk assessment guidance (USEPA, 1989)

TABLE 3-5. DATA SUMMARY FOR SOIL VAPOR SAMPLES
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Frequency of Detection			Range of Concentrations[1,2] (ug/L)			Sample Location of Maximum Detection	Sample Depth of Maximum Detection (feet bgs)	Average Concentration (mg/kg)	95% Upper Confidence Limit of the Arithmetic Mean (UCLM)[3]	Exposure Point Concentration (ug/L)[4]
	# of Detections	# of Samples	Frequency of Detection	Minimum	-	Maximum					
Benzene	2	29	3%	0.5	-	6.8	SV27	5.0	0.8	1.23E+00	**1.23E+00**
Freon 113	1	29	3%	0.5	-	4.4	SV9	5.0	0.6	8.63E-01	**8.63E-01**
Toluene	1	29	3%	0.5	-	2.1	SV9	5.0	0.6	6.49E-01	**6.49E-01**
Total Xylenes	1	29	3%	1.0	-	2.2	SV16	5.0	1.0	1.11E+00	**1.11E+00**

Notes:
bgs = below ground surface
mg/kg = Milligrams per kilogram
UCLM = Upper confidence limit of the arithmetic mean

[1] 1/2 detection limit values used for analytical results below detection limits. Statistical calculations utilized sample statistics rather than population statistics.
[2] Laboratory-estimated values which were below the detection limit were used
[3] Data distribution assumed normal. 95% UCLM calculated as follows: $UCL_{1-\alpha}$ = sample mean + $t_{\alpha, n-1}$ S/sqrt(n) (USEPA, 2002, Exhibit 1)
[4] Exposure Point Concentration is the lesser of the 95% UCLM or the maximum concentration and is consistent with USEPA risk assessment guidance (USEPA, 1989)

TABLE 3-6.
BACKGROUND CONCENTRATION OF METALS IN CALIFORNIA SOILS
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Metal	Min	Max	Mean	Standard Deviation	95% Upper Confidence Limit
Arsenic	0.6	11	7.3	2.5	7.99
Barium	133	1400	509	210	567.21
Beryllium	0.25	2.7	1.28	0.52	1.42
Cadmium	0.05	1.7	0.36	0.31	0.45
Chromium	23	1579	122	223	183.81
Cobalt	2.7	46.9	14.9	9.2	17.45
Copper	9.1	96.4	28.7	19.3	34.05
Lead	12.4	97.1	23.9	13.8	27.73
Mercury	0.05	0.9	0.26	0.21	0.32
Molybdenum	0.1	9.6	1.3	1.5	1.72
Nickel	9	509	57	80	79.17
Selenium	0.015	0.43	0.058	0.084	0.08
Thallium	0.17	1.1	0.56	0.19	0.61
Vanadium	39	288	112	53	126.69
Zinc	88	236	149	32	157.87

Source: G.R. Bradford, A.C. Chang, A.L. Page, D. Bakhtar, J.A. Frampton, and H. Wright, "Background Concentrations of Trace and Major Elements in California Soils," Kerney Foundation of Soil Science Division of Agriculture and Natural Resources University of California, March 1996.

TABLE 3-7. METALS COPC DETERMINATION
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Metal	Frequency of Detection in 0-5' Soils	Exposure Point Concentration in 0-5' Soils (mg/kg)	95% UCLM from Benchmark California Soil Samples (mg/kg) [1]	Site Value Greater?	Removed from further evaluation in HRA?
Arsenic	100%	6.55E+00	7.99E+00	**FALSE**	**X**
Barium	100%	1.10E+02	5.67E+02	**FALSE**	**X**
Cobalt	100%	1.20E+01	1.75E+01	**FALSE**	**X**
Chromium	100%	2.73E+01	1.84E+02	**FALSE**	**X**
Copper	100%	2.15E+01	3.40E+01	**FALSE**	**X**
Nickel	100%	1.98E+01	7.92E+01	**FALSE**	**X**
Lead	100%	7.45E+00	2.77E+01	**FALSE**	**X**
Selenium	100%	4.49E+00	8.13E-02	**TRUE**	
Vanadium	100%	4.63E+01	1.27E+02	**FALSE**	**X**
Zinc	100%	4.66E+01	1.58E+02	**FALSE**	**X**

Notes:

UCLM = Upper confidence limit of the arithmetic mean

[1]Determined from 50 Benchmark California Soils, From "Background Concentrations of Trace and Major Elements in California Soils," Kerney Foundation of Soil Science Division of Agriculture and Natural Resources University of California, March 1996.

TABLE 3-8. CONVERSION OF SOIL VAPOR CONCENTRATIONS TO TOTAL SOIL CONCENTRATIONS
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Soil Vapor to Soil Gas Conversion		
	Benzene	
Depth	Gas	Soil
(feet)	µg/l	mg/kg
5.0	1.23E+00	**2.83E-04**

Notes:
µg/l = micrograms per liter
mg/kg = milligrams per kilogram
RWQCB = Los Angeles Regional Water Quality Control Board

Conversion formula:
$C_T = C_g*[S_w + (n-S_w)*K_H + p_b*f_{oc}*K_{oc}] / (p_b*K_H)$

where:	values:	
C_T = Total soil concentration in µg/kg	calculated	
C_g = Soil gas concentration in µg/l	1.78	(Benzene)
S_w = Soil water content (unitless)	0.075	(Benzene)
n = Soil porosity (unitless)	0.04	RWQCB Mean Value
K_H = Henry's law constant (unitless)	0.23	(Benzene)
p_b = Soil bulk density (g/ml)	1.5	RWQCB Mean Value
f_{oc} = Soil organic carbon content (unitless)	0.0014	RWQCB Mean Value
K_{oc} = Organic carbon partition coefficient (ml/g)	5.90	(Benzene)

TABLE 3-9. CHEMICALS OF POTENTIAL CONCERN
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

COPC	Exposure Point Concentration		
	0-5 Feet Soil (mg/kg)	0-25 Feet Soil (mg/kg)	Soil Vapor (ug/L)
Benzene	--	--	1.23E+00
Bromoform	--	1.03E-02	--
Methylene Chloride	--	1.66E-02	--
Selenium	4.49E+00	4.09E+00	--
TPH (C5-C12)	7.10E+02	3.80E+02	--
TPH (C10-C12)	7.10E+02	2.30E+02	--
TPH (C13-C15)	8.50E+02	3.10E+02	--
TPH (C16-C22)	6.90E+02	2.80E+02	--
TPH (C23-C32)	1.30E+03	4.80E+02	--
TPH (>C32)	3.40E+02	1.30E+02	--

TABLE 4-1. PERTINENT CHEMICAL PROPERTIES FOR VOCs (Soil)
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Vapor Pressure	Molecular Weight	Henry's Law Constant	Air Diffusion Coefficient	Water Diffusion Coef.	Organic Carbon/Water Partition Coef.	Soil/Water Partition Coef.[1]	Weight Fraction in Soil
	mm Hg @ 25° C	g/mol		cm^2/sec		ml/g		mg/mg
Benzene	1.19E+01	7.80E+01	2.30E-01	8.80E-02	9.80E-06	5.90E+00	5.90E-02	2.83E-10
Bromoform	5.00E+00	2.53E+02	2.41E-02	1.49E-02	1.03E-05	8.71E+01	8.71E-01	1.03E-08
Methylene Chloride	3.50E+02	8.49E+01	2.18E-03	1.01E-01	1.17E-05	1.17E+01	1.17E-01	1.66E-08

[1] Calculated based on LARWQCB default values (see source #3 below).

Sources:
1) U.S. EPA *Region 9 Preliminary Remediation Goals,* October 2002.
2) Oak Ridge National Laboratory, Risk Assessment Information System Database, http://risk.lsd.ornl.gov
3) LARWQCB, *Interim Site Assessment & Cleanup Guidebook*, May 1996.
4) NIOSH Pocket Guide to Chemical Hazards Online Version:, 2004, http://www.cdc.gov/niosh/npg/pgdstart.html

TABLE 4-2a. ON-SITE OUTDOOR EMISSIONS FLUX COMPUTATIONS (Farmer Equation).
LONG BEACH MEMORIAL MEDICAL CENTER, TODD CANCER INSTITUTE, LONG BEACH, CALIFORNIA
VOCs from Soil to Outdoor Air Pathway
(Site Paved/Slab Attenuation)-Off-Site Resident Scenario

Chemical	Air Diffusion Coefficient	Air Filled Porosity	Total Porosity	Vapor Pressure	Molecular Weight	Weight Fraction in Soil	Gas Constant	Temp.	Average Depth	Slab Attenuation Factor	Emission Flux
	cm^2/sec			mmHg	g/mol	mg/mg	mmHg-cm^3/mole-°K	°K	cm		g/m^2-sec
Benzene	8.80E-02	2.80E-01	4.34E-01	1.19E+01	7.80E+01	2.83E-10	6.24E+04	2.98E+02	6.10E+02	1.00E-02	1.56E-17
Bromoform	1.49E-02	2.80E-01	4.34E-01	5.00E+00	2.53E+02	1.03E-08	6.24E+04	2.98E+02	6.10E+02	1.00E-02	1.31E-16
Methylene Chloride	1.01E-01	2.80E-01	4.34E-01	3.50E+02	8.49E+01	1.66E-08	6.24E+04	2.98E+02	6.10E+02	1.00E-02	3.35E-14

Notes:
1. Emission Flux was multiplied by 10,000 to convert to units of g/m^2-sec.

TABLE 4-2b. ON-SITE OUTDOOR EMISSIONS FLUX COMPUTATIONS (Farmer Equation)
LONG BEACH MEMORIAL MEDICAL CENTER, TODD CANCER INSTITUTE, LONG BEACH, CALIFORNIA
VOCs from Soil to Outdoor Air Pathway
(Site assumed not paved/No slab attenuation)-On-Site Construction Worker Scenario

Chemical	Air Diffusion Coefficient	Air Filled Porosity	Total Porosity	Vapor Pressure	Molecular Weight	Weight Fraction in Soil	Gas Constant	Temp.	Average Depth	Emission Flux
	cm^2/sec			mmHg	g/mol	mg/mg	mmHg-cm^3/mole-°K	°K	cm	g/m^2-sec
Benzene	8.80E-02	2.80E-01	4.34E-01	1.19E+01	7.80E+01	2.83E-10	6.24E+04	2.98E+02	6.10E+02	1.56E-15
Bromoform	1.49E-02	2.80E-01	4.34E-01	5.00E+00	2.53E+02	1.03E-08	6.24E+04	2.98E+02	6.10E+02	1.31E-14
Methylene Chloride	1.01E-01	2.80E-01	4.34E-01	3.50E+02	8.49E+01	1.66E-08	6.24E+04	2.98E+02	6.10E+02	3.35E-12

Notes:
1. Emission Flux was multiplied by 10,000 to convert to units of g/m^2-sec.

TABLE 4-3. ON-SITE OUTDOOR EMISSION COMPUTATIONS FOR VOCs (Box Model).
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Emission Flux	Emitting Area	Wind Speed[1]	Box Height	Length of Site	Conversion Factor	On-Site Concentration
	g/cm^2-sec	cm^2	cm/s	cm	cm	$\mu g\text{-}cm^3/g\text{-}m^3$	$\mu g/m^3$
Benzene	1.56E-19	2.79E+08	277	150	18,288	1.00E+12	5.70E-08
Bromoform	1.31E-18	2.79E+08	277	150	18,288	1.00E+12	4.79E-07
Methylene Chloride	3.35E-16	2.79E+08	277	150	18,288	1.00E+12	1.23E-04

Notes:

[1] Wind speed is average annual wind speed (6.2 miles per hour), based on climatic data collected by National Oceanic and Atmospheric Administration (NOAA,2004) for the City of Long Beach.

TABLE 4-4. ON-SITE OUTDOOR EMISSION COMPUTATIONS FOR NON-VOCs (EPA Region 9 PRG Model). LONG BEACH MEMORIAL MEDICAL CENTER TODD CANCER INSTITUTE LONG BEACH, CALIFORNIA

Chemical	Concentration in Soils	Particulate Emission Factor	On-Site Concentration
	mg/kg	m^3/kg	$\mu g/m^3$
Selenium	4.09E+00	1.32E+09	3.11E-06
TPH (C5-C12)	3.80E+02	1.32E+09	2.89E-04
TPH (C10-C12)	2.30E+02	1.32E+09	1.75E-04
TPH (C13-C15)	3.10E+02	1.32E+09	2.36E-04
TPH (C16-C22)	2.80E+02	1.32E+09	2.13E-04
TPH (C23-C32)	4.80E+02	1.32E+09	3.65E-04
TPH (>C32)	1.30E+02	1.32E+09	9.88E-05

Notes:

On-site concentrations in µg/m3 were calculated by dividing the soil concentration in mg/kg by the PEF
And multiplying the result by 1000 to convert mg to µg.

TABLE 4-5. NON-DEFAULT PARAMETERS USED IN JOHNSON AND ETTINGER MODEL
TODD CANCER INSTITUTE
LONG BEACH MEMORIAL MEDICAL CENTER
LONG BEACH, CALIFORNIA

Model default parameters for the Johnson and Ettinger (J&E) Model were used with the exception of the following

Parameter	Abbreviation (units)	J&E Model Default	Assumption Used			
			Comm./Ind./Hospital Worker		On-Site Hospital Patient	
Average soil temperature	T_S (°C)	10	18		18	
Depth below grade to top of contamination	L_t (cm)	400	200		200	
Depth below grade to bottom of contamination	L_B(cm)	--	1524		1524	
Enclosed space floor length	L_b (cm)	1,000	7276 (TCI)	5603 (LBMMC)	7276 (TCI)	5603 (LBMMC)
Enclosed space floor length	W_b (cm)	1,000	7276(TCI)	5603 (LBMMC)	7276 (TCI)	5603 (LBMMC)
Indoor air exchange rate	ER (1/hr)	0.25	2			
Exposure duration	ED (years)	30	25		1	
Exposure frequency	EF (days/year)	350	250		4.6	

Notes:

1. Depth below grade to bottom of enclosed space floor was assumed to be 200 cm (model default)
Todd Cancer Institute building is expected to include one-story below grade, while Long Beach Memorial Medical Center Main Building has one-story below grade.
2. Average soil temperature is consistent with DTSC recommendations.
3. Enclosed space floor lengths shown for Todd Cancer Institute proposed building and Long Beach Memorial Medical Center main building.
4. Indoor air exchange rate was modified from model default of 0.25 to 2, which is based on personal communication with Long Beach Memorial Medical Center Construction Manager, Marion Vinton dated January 7, 2005.
5. Soil type (Stratum A, B, C SCS soil type) used in model was silt (SI). This is based on boring logs created during the drilling of soil borings created during the drilling of soil borings at the site.
6. The default exposure factors in the J&E Model are based on a residential scenario. Exposure factors were modified to reflect commercial/industrial/hospital worker and hospital patient scenarios.

TABLE 4-6a. EMISSIONS OF VOCs FROM SOIL TO INDOOR AIR [1] (J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AND HOSPITAL PATIENT
LONG BEACH, CALIFORNIA

Chemical	Initial Soil Concentration, C_R	Finite Source Building Concentration, $C_{building}$
	(µg/kg)	(µg/m^3)
Bromoform	1.03E+01	**1.41E-03**
Methylene Chloride	1.66E+01	**1.82E-02**

Assumed Building Model Variables:
Building Area = 57,000 square feet [2]

Notes:
[1] = Results Based on Soil Johnson and Ettinger Model - Advanced (SL-ADV) Version 3.0, February 2003
[2] = Estimated from Moffat and Nicholls grading plan or dimension estimates in EIR project description

TABLE 4-6b. EMISSIONS OF VOCs FROM SOIL VAPOR TO INDOOR AIR [1] (J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AND HOSPITAL PATIENT
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Initial Soil Vapor Concentration, C_R	Infinite Source Building Concentration, $C_{building}$
	($\mu g/m^3$)	($\mu g/m^3$)
Benzene	1.23E-03	**3.22E-09**

Assumed Building Model Variables:
Building Area = 57,000 square feet [2]

Notes:
[1] = Results Based on Soil Gas Johnson and Ettinger Model - Advanced (SG-ADV) Version 2.0, February 2003
[2] = Estimated from Moffat and Nicholls grading plan or dimension estimates in EIR project description

TABLE 4-7a. EMISSIONS OF VOCs FROM SOIL TO INDOOR AIR [1] (J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
OFF-SITE AT LBMMC MAIN BUILDING
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AND HOSPITAL PATIENT
LONG BEACH, CALIFORNIA

Chemical	Initial Soil Concentration, C_R	Finite Source Building Concentration, $C_{building}$
	(µg/kg)	(µg/m^3)
Bromoform	1.03E+01	**1.83E-03**
Methylene Chloride	1.66E+01	**2.36E-02**

Assumed Building Model Variables:
Building Area = 33,794 square feet [2]
Ventilation Rate = 5 exchanges/hour (Spence, 2000)

Notes:
[1] = Results Based on Soil Johnson and Ettinger Model - Advanced (SL-ADV) Version 3.0, February 2003
[2] = Estimated from site plan maps

TABLE 4-7b. EMISSIONS OF VOCs FROM SOIL VAPOR TO INDOOR AIR [1] (J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
OFF-SITE AT LBMMC MAIN BUILDING
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AND HOSPITAL PATIENT
LONG BEACH, CALIFORNIA

Chemical	Initial Soil Vapor Concentration, C_R	Infinite Source Building Concentration, $C_{building}$
	($\mu g/m^3$)	($\mu g/m^3$)
Benzene	1.23E-03	**4.18E-09**

Assumed Building Model Variables:
Building Area = 33,794 square feet
Ventilation Rate = 5 exchanges/hour (Spence, 2000)

Notes:
[1] = Results Based on Soil Gas Johnson and Ettinger Model - Advanced (SG-ADV) Version 2.0, February 2003
[2] = Estimated from site plan maps

TABLE 4-8a. SUMMARY OF INDOOR AIR MODELING CALCULATIONS LONG BEACH MEMORIAL MEDICAL CENTER TODD CANCER INSTITUTE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER AND HOSPITAL PATIENT LONG BEACH , CALIFORNIA

Chemical	Indoor Air Concentration from Soil[1]	Indoor Air Concentration from Soil Vapor[2]	Total Indoor Air Concentration
	µg/m^3	µg/m^3	µg/m^3
Benzene	Soil Vapor Only	4.18E-09	4.18E-09
Bromoform	1.41E-03	Soil Only	1.41E-03
Methylene Chloride	1.82E-02	Soil Only	1.82E-02

[1]See Johnson & Ettinger Calculations for Soil, Table 4-5b
[2]See Johnson & Ettinger Calculations for Soil Vapor, Table 4-6b

TABLE 4-8b. SUMMARY OF INDOOR AIR MODELING CALCULATIONS LONG BEACH MEMORIAL MEDICAL CENTER OFF-SITE AT LBMMC MAIN BUILDING COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER AND HOSPITAL PATIENT LONG BEACH , CALIFORNIA

Chemical	Indoor Air Concentration from Soil[1]	Indoor Air Concentration from Soil Vapor[2]	Total Indoor Air Concentration
	µg/m^3	µg/m^3	µg/m^3
Benzene	Soil Vapor Only	4.18E-09	4.18E-09
Bromoform	1.83E-03	Soil Only	1.83E-03
Methylene Chloride	2.36E-02	Soil Only	2.36E-02

[1]See Johnson & Ettinger Calculations for Soil, Table 4-5a
[2]See Johnson & Ettinger Calculations for Soil Vapor, Table 4-6a

TABLE 4-9. SUMMARY OF THE RESULTS OF
OFF-SITE AIR DISPERSION MODELING (SCREEN3 Model)
OFF-SITE RESIDENTS
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Nearest Residential Receptor
	244 meters
Benzene	5.81E-10
Bromoform	4.88E-09
Methylene Chloride	1.25E-06

TABLE 4-10.
EXPOSURE FACTORS AND CHRONIC DAILY INTAKE (CDI) FOR PROJECT-SPECIFIC RECEPTORS
LONG BEACH MEMORIAL MEDICAL CENTER, TODD CANCER INSTITUTE, LONG BEACH, CALIFORNIA

Soil Ingestion

Receptor Scenario	Ingestion Rate [1]	Exposure Frequency [2]	Exposure Duration [3]	Conversion Factor	Fraction Ingested	Body Weight[2]	Averaging Time		CDI Factor	
							Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic
	(mg/day)	(days/yr)	(years)	(kg/mg)	(%)	(kg)	(days)			
On-Site Construction Worker	480	250	1	0.000001	100%	70	365	25550	4.7E-06	6.7E-08

[1] Standard Default Exposure Factors, Supplemental Guidance to Risk Assessment Guidance for Superfund, U.S. EPA, March 1991 (USEPA, 1991)
[2] Exposure Factors Handbook, U.S. EPA, August 1997. (USEPA, 1997)
[3] Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, Cal/EPA, DTSC, July 1992 (DTSC, 1992)

Soil Dermal Contact

Receptor Scenario	Skin Surface[1]	Exposure Frequency [1,2]	Exposure Duration	Conversion Factor	Absorption Factor [3]	Body Weight [1,2]	Adherence Factor [4]	Averaging Time		CDI Factor	
								Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic
	(cm^2)	(days/yr)	(years)	(kg/mg)	(%)	(kg)	(mg/cm^2)	(days)			
On-Site Construction Worker	5700	250	1	0.000001	100%	70	0.8	365	25550	4.5E-05	6.4E-07

[1] Exposure Factors Handbook, U.S. EPA, August 1997. (USEPA, 1997)
[2] Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, Cal/EPA, DTSC, July 1992 (DTSC, 1992)
[3] Dermal Absorption Factors (AF) are chemical specific and are applied directly to the risk calculations. 10% for organics, 0.1% for cadmium, 1% for other metals. (DTSC, 1994)
[4] Supplemental Guidance Dermal Risk Assessment, Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (USEPA, 1998)

Inhalation of Volatiles from Soil and Soil Vapor

Receptor Scenario	Inhalation Rate [1]	Exposure Frequency	Exposure Duration	Conversion Factor	Body Weight[1,2]	Averaging Time		CDI Factor	
						Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic
	(m^3/day)	(days/yr)	(years)	(kg/mg)	(kg)	(days)			
On-Site Construction Worker [1]	20	250	1	0.001	70	365	25550	2.0E-04	2.8E-06
Off-Site Hospital Patient (at LBMMC) (Adult) [3,4]	9.6	4.9	1	0.001	70	365	25550	1.8E-06	2.6E-08
Off-Site Hospital Patient (at LBMMC) (Child) [3,4]	7.2	4.9	1	0.001	15	365	25550	6.4E-06	9.2E-08
On-Site Hospital Patient (at TCI) (Adult) [3,5]	9.6	260	1	0.001	70	365	25550	9.8E-05	1.4E-06
On-Site Hospital Patient (at TCI) (Child) [3,5]	7.2	260	1	0.001	15	365	25550	3.4E-04	4.9E-06
On-/Off-Site Commercial/Industrial/Hospital Worker [2]	20	250	25	0.001	70	9125	25550	2.0E-04	7.0E-05
Off-Site Resident (Adult) [2]	20	350	30	0.001	70	10950	25550	2.7E-04	1.4E-04
Off-Site Resident (Child) [2]	10	350	6	0.001	15	2190	25550	6.4E-04	

[1] Exposure Factors Handbook, U.S. EPA, August 1997. (USEPA, 1997)
[2] Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, Cal/EPA, DTSC, July 1992 (DTSC, 1992)
[3] Exposure factors for On-/Off-Site Commercial/Industrial/Hospital Worker and Off-Site Resident obtained from Cal-EPA Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, August 1996.
[4] Inhalation rates for On-/Off-Site Hospital Patient obtained from U.S. EPA Exposure Factors Handbook (USEPA, 1997), and is based on short-term inhalation rates for children and adults during rest.
[5] Exposure Frequency for On-/Off-Site Hospital Patients at LBMMC and MCH based on average length of stay in 2002 for hospital inpatient care provided by National Center for Health Statistics, Center for Diesease Control (CDC, 2004) www.cdc.gov/nchs/fastats/hospital.html

TABLE 5-1. NON-CARCINOGENIC TOXICITY INFORMATION
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Oral Reference Dose	Dermal Reference Dose[1]	Inhalation Reference Dose	Information Source
	(mg/kg/day)			
VOCs				
Benzene	4.00E-03	4.00E-03	1.70E-02	IRIS/OEHHA[3]
Bromoform	2.00E-02	2.00E-02	2.00E-02	IRIS [1,2]
Methylene Chloride	6.00E-02	6.00E-02	8.60E-01	IRIS [1,2]
Selenium	5.00E-03	5.00E-03	5.00E-03	IRIS [1,2]
TPH (C5-C12)	2.00E-01	2.00E-01	1.14E-01	AEHS [1]
TPH (C10-C12)	4.00E-02	4.00E-02	5.70E-02	AEHS [1]
TPH (C13-C15)	4.00E-02	4.00E-02	5.70E-02	AEHS [1]
TPH (C16-C22)	3.00E-02	3.00E-02	--	AEHS [1]
TPH (C23-C32)	3.00E-02	3.00E-02	--	AEHS [1]
TPH (>C32)	3.00E-02	3.00E-02	--	AEHS [1]

Notes:
No Data = No reference doses have been developed for a particular compound.
[1] Route extrapolation: Oral to Dermal
[2] Route Extrapolation: Oral to Inhalation
[3] Inhalation Reference Dose calculated from Inhalation Chronic REL from OEHHA
AEHS = Association for Environmental Health and Sciences, TPH Working Group (1997)
IRIS = U.S. EPA's Integrated Risk Management System, 2003
HEAST = U.S. EPA's Health Effects Assessment Summary Tables, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 2002
NCEA = National Center for Environmental Assessment, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 20
OEHHA = Cal-EPA Office of Environmental Health Hazard Assessment Chronic Exposure Levels Table, August 2003

TABLE 5-2. CARCINOGENIC TOXICITY INFORMATION
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

Chemical	Cancer Slope Factors			Information Source
	Oral	Dermal[1]	Inhalation	
	$(mg/kg/day)^{-1}$			
Benzene	1.00E-01	1.00E-01	1.00E-01	OEHHA[1]
Bromoform	7.90E-03	7.90E-03	3.90E-03	IRIS [1]
Methylene Chloride	1.40E-02	1.40E-02	3.50E-03	OEHHA [1]
Selenium	--	--	--	No Data
TPH (C5-C12)	NC	NC	NC	--
TPH (C10-C12)	NC	NC	NC	--
TPH (C13-C15)	NC	NC	NC	--
TPH (C16-C22)	NC	NC	NC	--
TPH (C23-C32)	NC	NC	NC	--
TPH (>C32)	NC	NC	NC	--

NC = Compound is not a carcinogen.
[1] Route Extrapolation: Oral to Dermal
[2] Route Extrapolation: Oral to Inhalation
[3] Route extrapolation: Inhalation to Oral
OEHHA = California EPA, Office of the Environmental Health Hazard Assessment, 2003
IRIS = U.S. EPA's Integrated Risk Management System, 2003
HEAST = U.S. EPA's Health Effects Assessment Summary Tables, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 2002
NCEA = National Center for Environmental Assessment, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 200

TABLE 6-1. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPITAL PATIENT (CHILD)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	4.18E-09	6.44E-06	1.70E-02	1.6E-12	<0.001%
Bromoform	1.83E-03	6.44E-06	2.00E-02	5.9E-07	77%
Methylene Chloride	2.36E-02	6.44E-06	8.60E-01	1.8E-07	23%
Inhalation Pathway Total Hazard Index =				**8E-07**	100%

Hazard Index: Current/Project Off-Site Hospital Patient (child) =	**8E-07**

TABLE 6-2. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPITAL PATIENT (ADULT)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	4.18E-09	1.84E-06	1.70E-02	4.5E-13	<0.001%
Bromoform	1.83E-03	1.84E-06	2.00E-02	1.7E-07	77%
Methylene Chloride	2.36E-02	1.84E-06	8.60E-01	5.1E-08	23%
Inhalation Pathway Total Hazard Index =				**2E-07**	100%

Hazard Index: Current/Project Off-Site Hospital Patient (adult) =	**2E-07**

TABLE 6-3. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPITAL PATIENT (CHILD)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
	µg/m^3				
Benzene	4.18E-09	9.21E-08	1.00E-01	3.8E-17	<0.001%
Bromoform	1.83E-03	9.21E-08	3.90E-03	6.6E-13	8%
Methylene Chloride	2.36E-02	9.21E-08	3.50E-03	7.6E-12	92%
			Inhalation Pathway ELCR =	**8E-12**	100%

ELCR: Current/Project Off-Site Hospital Patient (child)=	**8E-12**

TABLE 6-4. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPITAL PATIENT (ADULT)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
	µg/m^3				
Benzene	4.18E-09	2.63E-08	1.00E-01	1.1E-17	<0.001%
Bromoform	1.83E-03	2.63E-08	3.90E-03	1.9E-13	8%
Methylene Chloride	2.36E-02	2.63E-08	3.50E-03	2.2E-12	92%
		Inhalation Pathway ELCR =		**2E-12**	

ELCR: Current/Project Off-Site Hospital Patient (adult)=	**2E-12**

TABLE 6-5. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	4.18E-09	1.96E-04	1.70E-02	4.8E-11	<0.001%
Bromoform	1.83E-03	1.96E-04	2.00E-02	1.8E-05	77%
Methylene Chloride	2.36E-02	1.96E-04	8.60E-01	5.4E-06	23%
			Inhalation Pathway ELCR =	**2E-05**	100%

Hazard Index: Current/Project Off-Site Com./Ind/Hosp. Worker =	**2E-05**

TABLE 6-6. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
	$\mu g/m^3$				
Benzene	4.18E-09	6.99E-05	1.00E-01	2.9E-14	<0.001%
Bromoform	1.83E-03	6.99E-05	3.90E-03	5.0E-10	8%
Methylene Chloride	2.36E-02	6.99E-05	3.50E-03	5.8E-09	92%
			Inhalation ELCR =	**6E-09**	100%

ELCR: Current/Project Off-Site Com./Ind./Hosp. Worker =	**6E-09**

TABLE 6-7. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE RESIDENT (CHILD)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	5.81E-10	6.39E-04	1.70E-02	2.2E-11	2%
Bromoform	4.88E-09	6.39E-04	2.00E-02	1.6E-10	14%
Methylene Chloride	1.25E-06	6.39E-04	8.60E-01	9.3E-10	84%
Inhalation Pathway Total Hazard Index =				**1E-09**	100%

Hazard Index: Current/Project Off-Site Resident (child) =	**1E-09**

TABLE 6-8. HAZARD INDEX - INHALATION PATHWAY
CURRENT AND PROJECT SCENARIO
OFF-SITE RESIDENT (ADULT)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	5.81E-10	2.74E-04	1.70E-02	9.4E-12	2%
Bromoform	4.88E-09	2.74E-04	2.00E-02	6.7E-11	14%
Methylene Chloride	1.25E-06	2.74E-04	8.60E-01	4.0E-10	84%
Inhalation Pathway Total Hazard Index =				**5E-10**	100%

Hazard Index: Current/Project Off-Site Resident (adult) =	**5E-10**

TABLE 6-9. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE RESIDENT (ADULT AND CHILD)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	5.81E-10	1.41E-04	1.00E-01	8.2E-15	1%
Bromoform	4.88E-09	1.41E-04	3.90E-03	2.7E-15	0%
Methylene Chloride	1.25E-06	1.41E-04	3.50E-03	6.2E-13	98%
			Inhalation Pathway ELCR =	**6E-13**	100%

ELCR: Current/Project Off-Site Resident (adult and child) =	**6E-13**

TABLE 6-10. HAZARD INDEX
PROJECT SCENARIO
ON-SITE CONSTRUCTION WORKER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	5.70E-08	1.96E-04	1.70E-02	6.6E-10	<0.001%
Bromoform	4.79E-07	1.96E-04	2.00E-02	4.7E-09	<0.001%
Methylene Chloride	1.23E-04	1.96E-04	8.60E-01	2.8E-08	<0.001%
Selenium	3.11E-06	1.96E-04	5.00E-03	1.2E-07	<0.001%
TPH (C5-C12)	2.89E-04	1.96E-04	1.14E-01	4.9E-07	<0.001%
TPH (C10-C12)	1.75E-04	1.96E-04	5.70E-02	6.0E-07	<0.001%
TPH (C13-C15)	2.36E-04	1.96E-04	5.70E-02	8.1E-07	<0.001%
TPH (C16-C22)	2.13E-04	1.96E-04	--	--	<0.001%
TPH (C23-C32)	3.65E-04	1.96E-04	--	--	<0.001%
TPH (>C32)	9.88E-05	1.96E-04	--	--	<0.001%
Inhalation Pathway Hazard Index =				**2E-06**	0%

Soil Ingestion

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Selenium	4.49E+00	4.70E-06	5.00E-03	4.2E-03	0%
TPH (C5-C12)	7.10E+02	4.70E-06	2.00E-01	1.7E-02	2%
TPH (C10-C12)	7.10E+02	4.70E-06	4.00E-02	8.3E-02	8%
TPH (C13-C15)	8.50E+02	4.70E-06	4.00E-02	1.0E-01	9%
TPH (C16-C22)	6.90E+02	4.70E-06	3.00E-02	1.1E-01	10%
TPH (C23-C32)	1.30E+03	4.70E-06	3.00E-02	2.0E-01	18%
TPH (>C32)	3.40E+02	4.70E-06	3.00E-02	5.3E-02	5%
Soil Ingestion Pathway Hazard Index =				**0.6**	51%

Dermal Absorption of Soil

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Selenium	4.49E+00	4.46E-06	5.00E-03	4.0E-03	0%
TPH (C5-C12)	7.10E+02	4.46E-06	2.00E-01	1.6E-02	1%
TPH (C10-C12)	7.10E+02	4.46E-06	4.00E-02	7.9E-02	7%
TPH (C13-C15)	8.50E+02	4.46E-06	4.00E-02	9.5E-02	9%
TPH (C16-C22)	6.90E+02	4.46E-06	3.00E-02	1.0E-01	9%
TPH (C23-C32)	1.30E+03	4.46E-06	3.00E-02	1.9E-01	17%
TPH (>C32)	3.40E+02	4.46E-06	3.00E-02	5.1E-02	5%
Dermal Absorption of Soil Pathway Hazard Index=				**0.5**	49%

Hazard Index: Project On-Site Construction Worker =	**1.1**	100%

TABLE 6-11. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE CONSTRUCTION WORKER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	5.70E-08	1.96E-04	1.00E-01	1.1E-10	0%
Bromoform	4.79E-07	1.96E-04	3.90E-03	2.4E-08	0%
Methylene Chloride	1.23E-04	1.96E-04	3.50E-03	6.9E-06	100%
Selenium	3.11E-06	1.96E-04	--	--	<0.001%
TPH (C5-C12)	2.89E-04	1.96E-04	NC	--	<0.001%
TPH (C10-C12)	1.75E-04	1.96E-04	NC	--	<0.001%
TPH (C13-C15)	2.36E-04	1.96E-04	NC	--	<0.001%
TPH (C16-C22)	2.13E-04	1.96E-04	NC	--	<0.001%
TPH (C23-C32)	3.65E-04	1.96E-04	NC	--	<0.001%
TPH (>C32)	9.88E-05	1.96E-04	NC	--	<0.001%
			Inhalation Pathway ELCR =	**7E-06**	100%

Soil Ingestion

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Selenium	4.49E+00	4.70E-06	--	--	<0.001%
TPH (C5-C12)	7.10E+02	4.70E-06	NC	--	<0.001%
TPH (C10-C12)	7.10E+02	4.70E-06	NC	--	<0.001%
TPH (C13-C15)	8.50E+02	4.70E-06	NC	--	<0.001%
TPH (C16-C22)	6.90E+02	4.70E-06	NC	--	<0.001%
TPH (C23-C32)	1.30E+03	4.70E-06	NC	--	<0.001%
TPH (>C32)	3.40E+02	4.70E-06	NC	--	<0.001%
			Soil Ingestion Pathway ELCR =	**0E+00**	0%

Dermal Absorption of Soil

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Selenium	4.49E+00	4.46E-06	--	--	<0.001%
TPH (C5-C12)	7.10E+02	4.46E-06	NC	--	<0.001%
TPH (C10-C12)	7.10E+02	4.46E-06	NC	--	<0.001%
TPH (C13-C15)	8.50E+02	4.46E-06	NC	--	<0.001%
TPH (C16-C22)	6.90E+02	4.46E-06	NC	--	<0.001%
TPH (C23-C32)	1.30E+03	4.46E-06	NC	--	<0.001%
TPH (>C32)	3.40E+02	4.46E-06	NC	--	<0.001%
			Dermal Absorption of Soil Pathway ELCR=	**0E+00**	0%

ELCR: Project On-Site Construction Worker =	**7E-06**	100%

TABLE 6-12. HAZARD INDEX
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (CHILD)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	4.18E-09	3.42E-04	1.00E-01	1.4E-11	<0.001%
Bromoform	1.41E-03	3.42E-04	3.90E-03	1.2E-04	7%
Methylene Chloride	1.82E-02	3.42E-04	3.50E-03	1.8E-03	93%
Inhalation Pathway Total Hazard Index =				**2E-03**	100%

Hazard Index: Project On-Site Hospital Patient (child) =	**2E-03**

TABLE 6-13. HAZARD INDEX
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (ADULT)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	4.18E-09	9.77E-05	1.70E-02	2.4E-11	<0.001%
Bromoform	1.41E-03	9.77E-05	2.00E-02	6.9E-06	77%
Methylene Chloride	1.82E-02	9.77E-05	8.60E-01	2.1E-06	23%
Inhalation Pathway Total Hazard Index =				**9E-06**	100%

Hazard Index: Project On-Site Hospital Patient (adult)=	**9E-06**

TABLE 6-14. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (CHILD)

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
	µg/m^3				
Benzene	4.18E-09	4.88E-06	1.00E-01	2.0E-15	<0.001%
Bromoform	1.41E-03	4.88E-06	3.90E-03	2.7E-11	8%
Methylene Chloride	1.82E-02	4.88E-06	3.50E-03	3.1E-10	92%
			Inhalation ELCR =	**3E-10**	100%

ELCR: Project On-Site Hospital Patient (child) =	**3E-10**

TABLE 6-15. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (ADULT)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	4.18E-09	1.40E-06	1.00E-01	5.8E-16	<0.001%
Bromoform	1.41E-03	1.40E-06	3.90E-03	7.7E-12	8%
Methylene Chloride	1.82E-02	1.40E-06	3.50E-03	8.9E-11	92%
			Inhalation ELCR =	**1E-10**	100%

ELCR: Project On-Site Hospital Patient (adult)=	**1E-10**

TABLE 6-16. HAZARD INDEX
PROJECT SCENARIO
ON-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	4.18E-09	1.96E-04	1.70E-02	4.8E-11	<0.001%
Bromoform	1.41E-03	1.96E-04	2.00E-02	1.4E-05	77%
Methylene Chloride	1.82E-02	1.96E-04	8.60E-01	4.1E-06	23%
			Inhalation Pathway ELCR =	**2E-05**	100%

Hazard Index: Project On-Site Com./Ind./Hosp. Worker =	**2E-05**

TABLE 6-17. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	4.18E-09	6.99E-05	1.00E-01	2.9E-14	<0.001%
Bromoform	1.41E-03	6.99E-05	3.90E-03	3.9E-10	8%
Methylene Chloride	1.82E-02	6.99E-05	3.50E-03	4.5E-09	92%
			Inhalation ELCR =	**5.E-09**	100%

ELCR: Project On-Site Com./Ind./Hosp. Worker =	**5.E-09**

TABLE 7-1. LEADSPREAD 7 RESULTS
ON-SITE LEAD EXPOSURE
CONSTRUCTION WORKER
LONG BEACH MEMORIAL MEDICAL CENTER, TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

INPUT

MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	7.5
Lead in Water (ug/l)	15
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT

	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	1.0	1.7	2.1	2.5	**2.8**	277	421
BLOOD Pb, CHILD	1.0	1.9	2.3	2.8	**3.1**	331	511
BLOOD Pb, PICA CHILD	1.1	2.0	2.4	2.9	3.3	166	257
BLOOD Pb, OCCUPATIONAL	0.9	1.7	2.0	2.4	2.8	389	591

EXPOSURE PARAMETERS

	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	5700	
Soil adherence	ug/cm^2	800	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	480	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	0.0	
Lead in home-grown produce	ug/kg	0.0	

PATHWAYS

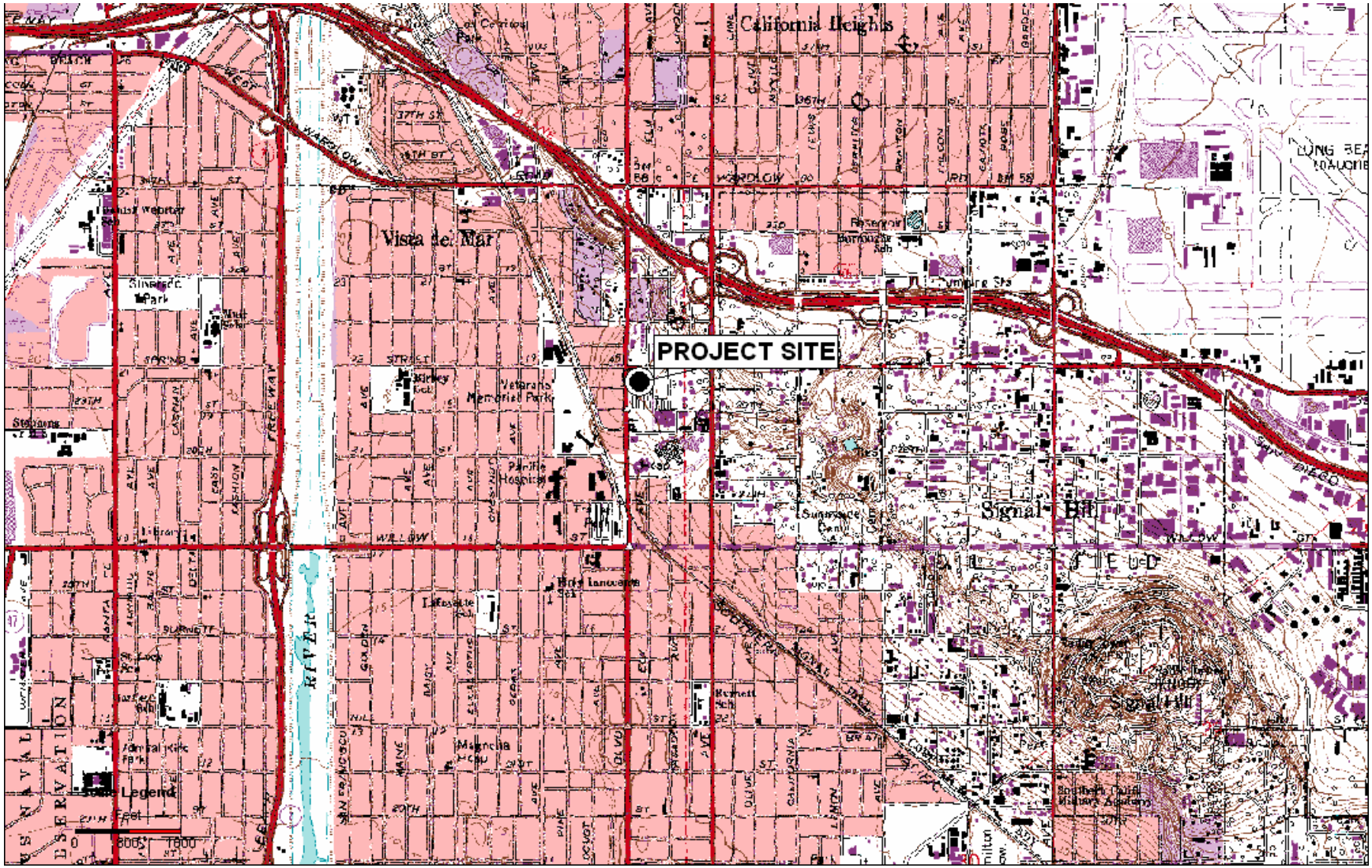
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	4.4E-4	0.00	0%	3.1E-4	0.00	0%
Soil Ingestion	8.4E-3	0.06	7%	6.0E-3	0.04	5%
Inhalation, bkgrnd		0.05	5%		0.03	4%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.84	88%		0.84	91%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.6E-5	0.00	0%		0.00	0%
Soil Ingestion	7.0E-3	0.05	5%	1.4E-2	0.10	10%
Inhalation	2.0E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.04	3%		0.04	3%
Water Ingestion		0.96	91%		0.96	87%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

TABLE 9-1. POTENTIAL EFFECTS OF UNCERTAINTY ON ESTIMATION OF RISKS
LONG BEACH MEMORIAL MEDICAL CENTER
TODD CANCER INSTITUTE
LONG BEACH, CALIFORNIA

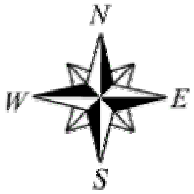
Assumption	Potential Magnitude for Over-Estimation of Risk	Potential Magnitude for Under-Estimation of Risk	Potential Magnitude for Over or Under-Estimation of Risk
IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN			
Number of samples/analyses in 0-5 foot soil zone			Low
Number of samples/analyses in 0-10 foot soil zone			Low
Number of samples/analyses of groundwater data			Low
Use of "comparison" method for evaluation of background data vs. contaminant data	Low		
Use of USEPA ProUCL recommended upper confidence limit (UCL)	Medium		
Use of UCL or maximum detected value	Low		
Use of estimated concentrations in lieu of 1/2 DL for non detect samples with estimated values			Low
QA/QC review			Low
EXPOSURE ASSESSMENT			
Identification of receptors			Low
Completeness determination for exposure pathways			Low
Elimination (dedesignation) of potable groundwater pathways		Low	
Use of Farmers Equation to estimate emission flux from soil vapor	Medium		
Use of Box model for determination of on-site outdoor air concentrations of VOCs	Low		
Use of Screen3 model to estimate dispersion of VOCs to off-site residential receptors	Medium		
Use of PEF calculation to estimate on-site concentrations of non-VOCs for inhalation pathway	Low	Low (construction workers)	
Use of dispersion-adjusted PEF calculation to estimate off-site exposure concentrations of non-VOCs for inhalation pathway	Low		
Use of J&E Model for estimation of indoor air concentrations from groundwater and soil vapor	Medium		
Exposure frequency for hospital patient receptors	High		
Exposure frequency for all other receptors	Low		Low
Exposure duration for hospital patient receptors	High		
Exposure duration for all other receptors	Low		
Soil ingestion rate	Low		
Skin surface area exposed to soil			Low
Soil to skin adherence factor	Low		
Amount of chemical absorbed through skin			Low
Inhalation rate	Low		
Body weight			Low
Averaging time		Low (carcinogenic)	Low (non-carcinogenic)
TOXICITY ASSESSMENT			
Route extrapolation from oral to dermal pathway for non-carcinogens	Low		
Route extrapolation from oral to dermal pathway for carcinogens	Medium		
Reference doses/linear cancer slope factors (CSF) for Group B2/C carcinogens based on animal data			Medium
Synergistic/antagonistic effects not considered			Low
RISK CHARACTERIZATION			
Risk assessment of TPH			Medium

FIGURES



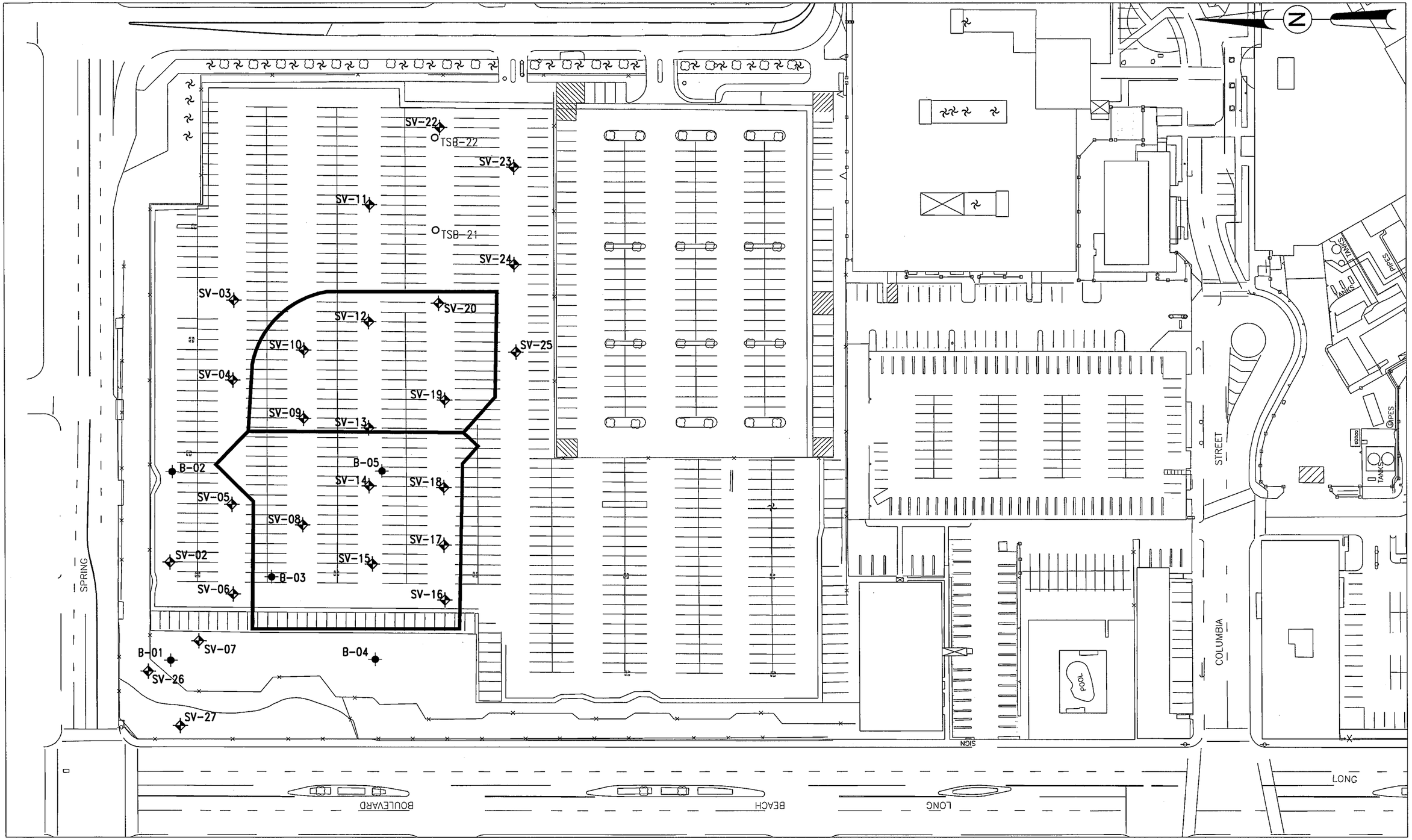
SCS ENGINEERS

Figure 1. Project Site Location, Todd Cancer Institute, Long Beach Memorial Medical Center Long Beach, California



SCS ENGINEERS

Figure 2. Proposed Project Locations, Long Beach Memorial Medical Center, Long Beach, CA



SV-01 SCS Soil Vapor (2004)

B-1 MacTec Geotechnical Boring (July 2004) – Locations Approximate

TSB-1 SCS Env. Borings (2004)

Proposed Improvement

0 80 160
SCALE IN FEET

SCS ENGINEERS
ENVIRONMENTAL CONSULTANTS
3711 LONG BEACH BLVD., 9th FLOOR
LONG BEACH, CA 90807
PH. (562) 426-9544 FAX. (562) 427-0805

Todd Cancer Institute
Long Beach Memorial Medical Center

DATE 10/26/2004
REVIEWED
REG. NO.
DESIGNED
DRAWN
CHECKED

FIGURE 3
SOIL & SOIL VAPOR SAMPLING LOCATIONS

SCALE: As Shown
SHEET NO. ----
DWG. NO. ----

Q:\2003\01203219.00 LBMMC\support\VCI 7 MCH Submittals.dwg (TCI - Soil Borings & Vapor Layout) October 26, 2004 - 2517 MEF

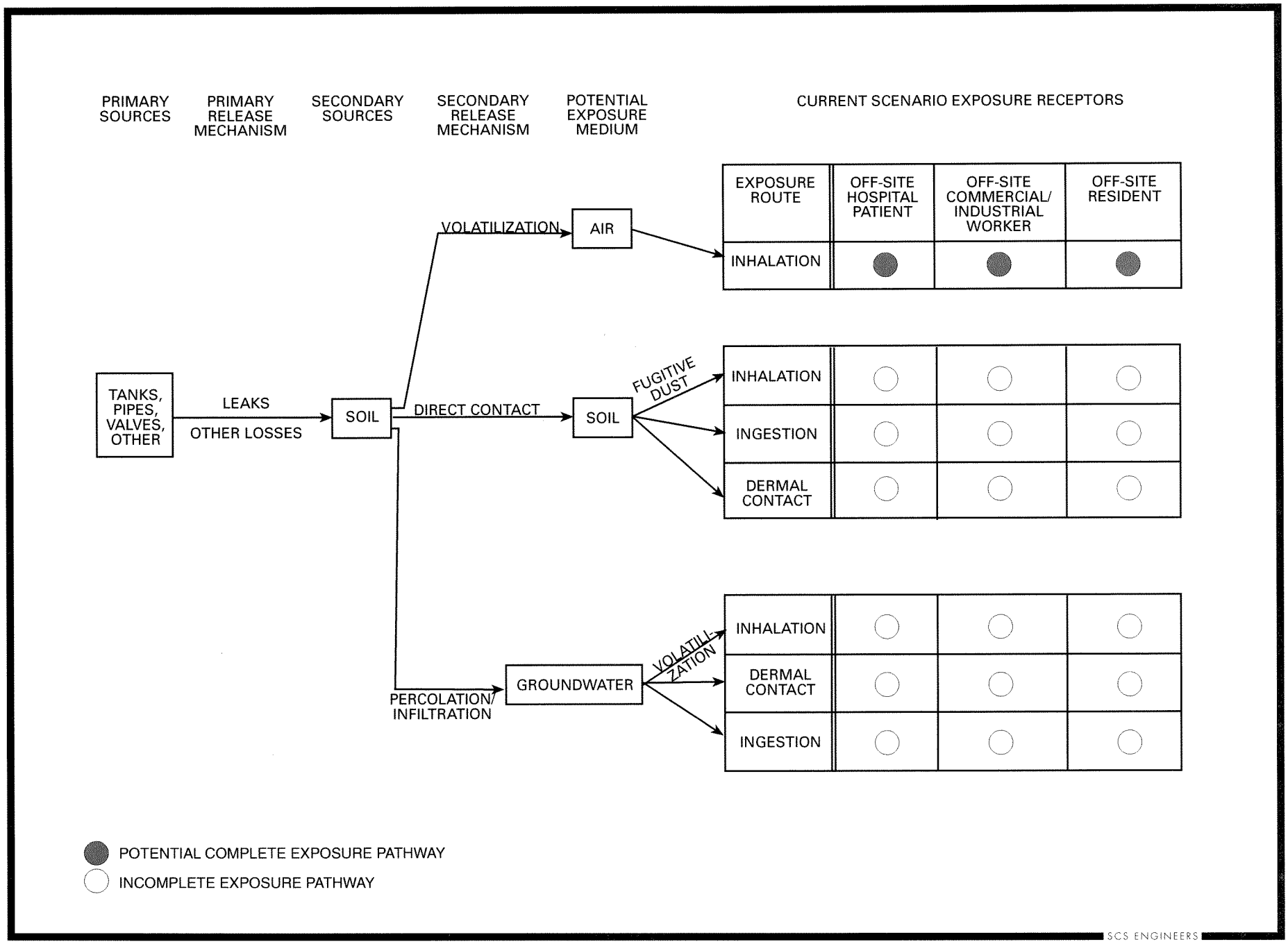


Figure 4a. Conceptual Site Model, Current Scenario, Todd Cancer Institute, Long Beach Memorial Medical Center, Long Beach, CA

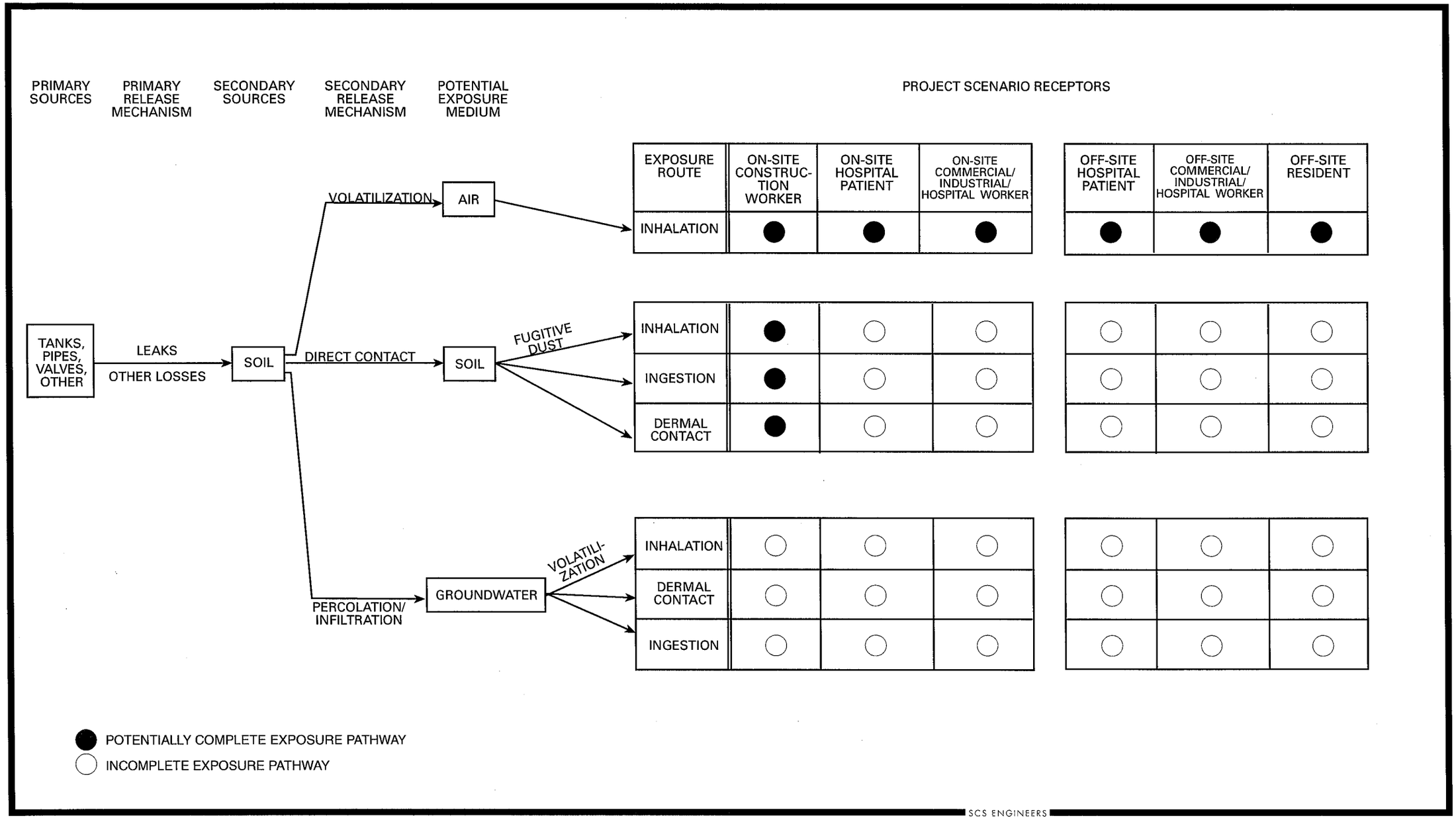


Figure 4b. Conceptual Site Model, Project Scenario, Todd Cancer Institute, Long Beach Memorial Medical Center, Long Beach, CA

APPENDICES

APPENDIX A

DEFAULT PARAMETERS AND SAMPLE CALCULATIONS FOR AIR PATHWAYS

DEFAULT PARAMETERS AND

SAMPLE CALCULATIONS FOR AIR PATHWAYS

Exposures in air were estimated for pathways, which include volatilization of chemicals from on-site soils into the breathing zone and fugitive dust.

Emission Flux – VOCs from Soil to Outdoor Air

Volatilization emission rates from soil into outdoor air were calculated using the Farmer Equation, as presented in the California Site Mitigation Decision Tree Manual (DHS, 1986) and the Superfund Exposure Assessment Manual (EPA, 1988). The Farmer equation is based on Fick's Law of Diffusion and is used to calculate the diffusion of vapors through soil-gas. Emission rates were approximated using the contaminant flux estimation method, which is presented below:

$$Q = D_i(p_a^{10/3}/p_T^2)(P_iM_iW_i/RT)/L$$

Where:

Q = Volatilization emission flux (g/cm^2-sec).

D_i = Air diffusion coefficient of chemical i (cm^2/sec).

p_a = Air filled porosity (dimensionless).

p_T = Total soil porosity (dimensionless).

P_i = Vapor pressure of i at the temperature T (mmHg).

M_i = Molecular weight of i (g/mole).

W_i = Weight fraction of i in the soil (mg/mg).

R = Universal gas constant.

T = Temperature (K).

L = Average depth of deeper soil strata samples (cm).

Pertinent chemical properties for VOCs of concern, which were used in the Farmer Equation calculations, are presented in Table 4-1. The results of the Farmer Equation calculations (on-site emission fluxes) for VOCs are presented in Table 4-2a and 4-2b. The weight fraction of each chemical in soil was calculated using the 0-25 foot soil data presented in Table 3-9.

The default parameters, which were utilized to calculate volatile emission fluxes for the various contaminants of concern, are listed below:

D_i = Chemical specific (cm^2/sec); from EPA, 1988.

p_a = 0.28 (dimensionless); from EPA, 1998a.

p_T = 0.447 (dimensionless); from LARWQCB, 1996.

P_i = Chemical specific (mmHg); from NIOSH, 1990.

M_i = Chemical specific (g/mole); from DTSC, 1994.

W_i = Chemical specific (mg/mg); from 0-35 foot soil data (Table 3-4).

R = 62,361 (mmHg-cm^3/mole-K); standard.

T = 298 (K); standard.

L = 609.6(cm); calculated value; it is the mean sample depths for all VOC soil samples.

A sample calculation for **bromoform** is shown below:

The W_i values were calculated by multiplying the EPCs for each COPC (in 0-25 foot zone soil) by 1.25E-02 mg/kg (Table 3-9).

$$Q_{bromoform} = D_i(p_a^{10/3}/p_T^2)(P_iM_iW_i/RT)/L$$

$$Q_{bromoform} = 0.149(0.28^{10/3}/0.434^2)(5.0)(253)(8.08E\text{-}09)/(62{,}361)(298)/609.6*10{,}000$$

$$Q_{bromoform} = 1.31E\text{-}14\ (g/m^2\text{-sec})$$

On-Site Outdoor Concentration of VOCs

To calculate on-site airborne concentrations of VOCs, a "box" model was utilized as recommended by the California Air Resources Board (CARB, 1992). A box model is a simple mass-balance equation that uses the concept of a theoretically enclosed space (i.e., box) over the impacted area. The model assumes that emissions of contaminants into a box, with their removal based on wind speed. Airborne concentrations within the box can be calculated and used as on-site EPCs for contaminant concentrations via soil-gas and fugitive dust. The EPC within the box is calculated by the following equation:

$$B = QA/(u)(h)(l) \times CF$$

Where:

B = Box concentration, EPC (ug/m^3)

Q = Volatilization emission flux (g/cm^2-sec).

A = Emitting area of site (cm^2)

u = Wind speed (cm/sec)

h = Height of box (cm)

l = Length of box (cm)

CF = Conversion factor, 10^{12} (ug-cm^3/g-m^3)

The results of the Box Model calculations (on-site airborne chemical concentrations) are presented in Table 4-3.

The default parameters, which were utilized to calculate on-site emission concentrations for the various contaminants of concern, are listed below:

Q = Chemical specific (g/cm^2-sec); from soil flux calculations (Table 4-2b).

A = 2.79E+08 (cm^2), site area

u = 277 (cm/sec); average wind speed in the City of Long Beach.

h = 150 (cm); average height of receptor's nose and mouth.

l = 18,288 (cm)

A sample calculation for **bromoform** is shown below:

$B_{bromoform}$ = QA/(u)(h)(l) x CF

$B_{bromoform}$ = (1.31E-18)(2.79E+08)/(277)(150)(18,288) x (1.0E+12)

$B_{bromoform}$ = 4.79E-07 (ug/m^3)

On-Site Outdoor Concentration of Non-VOCs (Fugitive Dust)

Fugitive dust emissions by wind erosion were calculated using a Particulate Emission Factor (PEF) method developed by the EPA, and included as part of the Preliminary Remediation Goals (PRG) published by EPA Region 9 (EPA, 2002). The PEF converts the EPC in surface soil to an on-site concentration using the following equation:

C_{air} = C_{soil}/PEF x CF

Where:

C_{air} = On-site airborne concentration, EPC (µg/m^3)

C_{soil} = EPC in surface soil (mg/kg)

PEF = Particulate emission factor (m^3/kg)

CF = Conversion factor (1000 µg/mg)

A summary of the fugitive dust calculations is presented in Table 4-4. The concentration in soil for each chemical in soil was calculated using EPCs for surface soil (0-5 feet soil interval) presented in Table 3-9.

The default parameters, which were utilized to calculate on-site emission concentrations for the various contaminants of concern, are listed below:

C_{soil} = EPC in surface soil (mg/kg)

PEF = 1.32E+09; USEPA PRG Guidance Manual, 2002

A sample calculation for **selenium** is shown below:

$$C_{air(selenium)} = C_{soil}/PEF \times CF$$

$$C_{air(selenium)} = 4.09E+00/1.32E+09 \times 1000$$

$$C_{air(selenium)} = 3.11E-06$$

The fugitive dust calculations were used to estimate non-VOC concentrations in outdoor air for the on-site construction worker.

APPENDIX B

DOCUMENTATION FOR JOHNSON & ETTINGER MODEL RUNS

DOCUMENTATION FOR JOHNSON & ETTINGER MODEL RUNS

To calculate on-site VOC concentrations in indoor air due to volatilization from concentrations of soil and soil vapor, the Johnson and Ettinger Model was used (USEPA 2003). The Johnson and Ettinger (J&E) Model was used in the advanced mode for calculation of both soil and soil vapor chemical concentrations inside of the proposed Todd Cancer Institute Facility and the Long Beach Memorial Medical Center Main Building. Silt soils were assumed based on a review of boring logs. All of the model default settings were used with the exception of the following:

- **Depth below grade to top of contamination**

  The depth below grade to top of contamination was assumed to be 762 cm (25 feet).

- **Building Area for Todd Cancer Institute Model Run**

  For the J&E model run, the default building area was changed from the model default of 2000 square feet to 57,000 square feet of the proposed Todd Cancer Institute building footprint. The value of 57,000 square feet was estimated from the grading plan provided by Moffat and Nichol.

- **Building Area for Long Beach Memorial Medical Center Main Building**

  For the J&E model run, the default building area was changed from the model default of 2000 square feet to 33,794 square feet for the main building of the Long Beach Memorial Medical Center.

- **Soil Type Used in Model Runs**

  Soil type (Stratum A, B, C SCS soil type) used in model was silt (SI). This is based on boring logs created during the drilling of soil borings created during the drilling of soil borings at the site (SCS, 2004).

- **Ventilation Rate for Model Runs**

  The ventilation rate (i.e. indoor air exchange rate) was changed from the model default value of 0.25/hour to 2/hour. The air exchange rate of 2/hour is based on a personal communication with Marion Vinton, Construction Manager of Long Beach Memorial Medical Center/Miller Children's Hospital, dated January 7, 2005 via facsimile.

J&E SOIL-ADV MODEL WORKSHEETS

Todd Cancer Institute

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
75252	1.03E+01	Bromoform

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	1524	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	7276	7276	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.49E-02	1.03E-05	5.88E-04	25	9,479	422.35	696.00	8.71E+01	3.10E+03	1.1E-06	7.0E-02	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	29,104	1.03E+01	1.08E+07

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
5.88E+07	4.95E-05	200	10,800	3.79E-04	1.59E-02	1.78E-04	1.44E-03	0.00E+00	0.00E+00	1.44E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.74E-01	5.42E+02	0.10	2.81E+01	1.44E-03	2.91E+03	1.59E+29	NA	NA	3.00E+03	5.61E-05	8.66E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.61E-06	NA	1.41E-03	1.41E-03	1.1E-06	7.0E-02

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
75092	1.66E+01	Methylene chloride

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	7276	7276	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.01E-01	1.17E-05	2.18E-03	25	6,706	313.00	510.00	1.17E+01	1.30E+04	4.7E-07	3.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	29,104	1.66E+01	1.08E+07

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
5.88E+07	4.95E-05	200	6,949	1.65E-03	6.90E-02	1.78E-04	9.70E-03	0.00E+00	0.00E+00	9.70E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.34E-02	6.99E+03	0.10	2.81E+01	9.70E-03	2.91E+03	2.13E+04	NA	NA	2.03E+04	3.03E-03	9.14E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.61E-06	NA	1.82E-02	1.82E-02	4.7E-07	3.0E+00

END

Long Beach Memorial Medical Center Main Building

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
75252	1.03E+01	Bromoform

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.49E-02	1.03E-05	5.88E-04	25	9,479	422.35	696.00	8.71E+01	3.10E+03	1.1E-06	7.0E-02	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.03E+01	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	10,800	3.79E-04	1.59E-02	1.78E-04	1.44E-03	0.00E+00	0.00E+00	1.44E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.74E-01	5.42E+02	0.10	2.17E+01	1.44E-03	2.24E+03	1.59E+29	NA	NA	2.38E+03	5.61E-05	7.19E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	1.83E-03	1.83E-03	1.1E-06	7.0E-02

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
75092	1.66E+01	Methylene chloride

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.01E-01	1.17E-05	2.18E-03	25	6,706	313.00	510.00	1.17E+01	1.30E+04	4.7E-07	3.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.66E+01	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	6,949	1.65E-03	6.90E-02	1.78E-04	9.70E-03	0.00E+00	0.00E+00	9.70E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.34E-02	6.99E+03	0.10	2.17E+01	9.70E-03	2.24E+03	2.13E+04	NA	NA	1.61E+04	3.03E-03	7.31E+09	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	2.36E-02	2.36E-02	4.7E-07	3.0E+00

END

SOIL GAS-ADV MODEL WORKSHEETS

Todd Cancer Institute

SG-ADV
Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	1.23E-03			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
200	200	18	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	7276	7276	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	350

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	78.11	7.8E-06	0.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	29,104	1.23E-03	1.08E+07

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
5.88E+07	4.95E-05	200	8,040	3.99E-03	1.67E-01	1.78E-04	8.45E-03	0.00E+00	0.00E+00	8.45E-03	1

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.23E-03	0.10	2.81E+01	8.45E-03	2.91E+03	9.29E+04	2.61E-06	3.22E-09	7.8E-06	NA

END

Long Beach Memorial Medical Center Main Building

SG-ADV
Version 2.0; 02/03

Reset to Defaults

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	1.23E-03			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
200	200	18	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	25	25	350

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Molecular weight, MW (g/mol)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	78.11	7.8E-06	0.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.23E-03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
3.59E+07	6.25E-05	200	8,040	3.99E-03	1.67E-01	1.78E-04	8.45E-03	0.00E+00	0.00E+00	8.45E-03	1

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.23E-03	0.10	2.17E+01	8.45E-03	2.24E+03	9.29E+04	3.40E-06	4.18E-09	7.8E-06	NA

END

APPENDIX C

DEFAULT PARAMETERS AND

PROCEDURES FOR AIR DISPERSION MODELING

USING SCREEN3

SUMMARY REPORT

SCREEN3 MODELING

DEFAULT PARAMETERS AND

PROCEDURES FOR AIR DISPERSION MODELING

USING SCREEN3

To calculate off-site atmospheric concentrations of VOCs and inorganic substances in fugitive dust, the EPA-approved SCREEN3 dispersion model was utilized. SCREEN3 was used to calculate EPCs for the chemicals of concern at various distances from the Project Site, representing pertinent off-site populations, including the nearest residential populations under the current and project exposure scenarios.

The use of SCREEN3 is very health conservative since it is a screening model that calculates maximum hourly-average ground level concentrations at a particular distance from a source. SCREEN3 does not take into account wind rose data; therefore, the maximum concentration is typically in the prevailing wind direction(s).

In the current and project scenarios, the nearest residential population is assumed to be located 800 feet (244 meters) from the proposed location of the Todd Cancer Institute (TCI) facility (VSA, 2004).

SCREEN3 was utilized in regulatory default mode for the purposes of this HRA. The urban (U) terrain model was utilized since the Project Site is located in a developed urban area. Receptor terrain was assumed to be at the same elevation as the source area since the terrain is generally flat-lying. Receptors were assumed to have a height of 1.5 meters, the height at which the nose and mouth of the average person are located.

The source was designated as an "area" source in order to represent the Project Site surface. The height of the source was assumed to be zero (i.e., ground surface). The width and the length of the source for were assumed to be were assumed to be 600 feet (ft) (182.88 meters [m]) and 500 ft (500 m), respectively, the width and length of the site on which the proposed TCI facility is to be located.

Full meteorology was used in the SCREEN3 model in which the model examines a series of wind stability classes and their associated wind speeds to identify the “worst case” meteorological conditions (i.e., the combination of wind speed and stability that results in the maximum ground-level concentrations).

A unit emission rate was used in the model to arrive at unit-specific ground level concentrations. The unit-specific ground level concentrations for each receptor location were multiplied by the emission rates for the each COPC, which were obtained from the Farmer Equation calculations (Table 4-2a). Table 4-8 presents the results of SCREEN3 modeling in tabular form. A summary of SCREEN3 results for each chemical evaluated with the air dispersion model is attached as part of this appendix.

12/30/04
14:25:43

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

Todd Cancer Institute - Off-Site Resident

SIMPLE TERRAIN INPUTS:
SOURCE TYPE = AREA
EMISSION RATE (G/(S-M**2)) = 1.00000
SOURCE HEIGHT (M) = .0000
LENGTH OF LARGER SIDE (M) = 182.8800
LENGTH OF SMALLER SIDE (M) = 152.4000
RECEPTOR HEIGHT (M) = 1.5000
URBAN/RURAL OPTION = URBAN
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION

BUOY. FLUX = .000 M**4/S**3; MOM. FLUX = .000 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	MAX DIR (DEG)
100.	.2540E+08	6	1.0	1.0	10000.0	.00	36.
200.	.1329E+08	6	1.0	1.0	10000.0	.00	38.
300.	.7975E+07	6	1.0	1.0	10000.0	.00	36.
400.	.5635E+07	6	1.0	1.0	10000.0	.00	32.
500.	.4277E+07	6	1.0	1.0	10000.0	.00	25.
600.	.3389E+07	6	1.0	1.0	10000.0	.00	18.
700.	.2768E+07	6	1.0	1.0	10000.0	.00	2.
800.	.2312E+07	6	1.0	1.0	10000.0	.00	1.
900.	.1967E+07	6	1.0	1.0	10000.0	.00	2.
1000.	.1700E+07	6	1.0	1.0	10000.0	.00	2.
1100.	.1489E+07	6	1.0	1.0	10000.0	.00	0.
1200.	.1319E+07	6	1.0	1.0	10000.0	.00	1.
1300.	.1180E+07	6	1.0	1.0	10000.0	.00	1.

```
  1400.   .1065E+07    6     1.0    1.0 10000.0     .00      1.
  1500.   .9679E+06    6     1.0    1.0 10000.0     .00      1.
  1600.   .8852E+06    6     1.0    1.0 10000.0     .00      3.
  1700.   .8145E+06    6     1.0    1.0 10000.0     .00      5.
  1800.   .7536E+06    6     1.0    1.0 10000.0     .00      1.
  1900.   .7000E+06    6     1.0    1.0 10000.0     .00      4.
  2000.   .6529E+06    6     1.0    1.0 10000.0     .00      7.
  2100.   .6114E+06    6     1.0    1.0 10000.0     .00      6.
  2200.   .5745E+06    6     1.0    1.0 10000.0     .00      6.
  2300.   .5415E+06    6     1.0    1.0 10000.0     .00      4.
  2400.   .5118E+06    6     1.0    1.0 10000.0     .00      4.
  2500.   .4849E+06    6     1.0    1.0 10000.0     .00      4.
  2600.   .4604E+06    6     1.0    1.0 10000.0     .00      4.
  2700.   .4382E+06    6     1.0    1.0 10000.0     .00      4.
  2800.   .4178E+06    6     1.0    1.0 10000.0     .00      7.
  2900.   .3992E+06    6     1.0    1.0 10000.0     .00      7.
  3000.   .3820E+06    6     1.0    1.0 10000.0     .00      7.
  3500.   .3137E+06    6     1.0    1.0 10000.0     .00      4.
  4000.   .2652E+06    6     1.0    1.0 10000.0     .00      4.
  4500.   .2292E+06    6     1.0    1.0 10000.0     .00      7.
  5000.   .2015E+06    6     1.0    1.0 10000.0     .00      7.

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
   122.   .2695E+08    6     1.0    1.0 10000.0     .00     40.

*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC            U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
   244.   .1027E+08    6     1.0    1.0 10000.0     .00     37.

    ***************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ***************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      .2695E+08      122.        0.


****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
```

Appendix F

Health Risk Assessment
Miller Children's Hospital

HUMAN HEALTH RISK ASSESSMENT
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

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GLOSSARY OF ACRONYMS/ABBREVIATIONS

ABS	Dermal Absorption Factor
AF	Soil-to-Skin Adherence Factor
AT	Averaging Time
bgs	Below Ground Surface
BW	Body Weight
CAG	Carcinogenic Assessment Group
Cal-EPA	California Environmental Protection Agency
CDC	Centers for Disease Control
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEQA	California Environmental Quality Act
CF	Conversion Factor
CFR	Code of Federal Regulations
cm	Centimeter
COC	Chain of Custody
COPCs	Chemicals of Potential Concern
C_S	Chemical Concentration in Soil
CSF	Cancer Slope Factor
DHS	California Department of Health Services
DL	Detection Limit
DTSC	California Environmental Protection Agency Department of Toxic Substances Control
ED	Exposure Duration
EF	Exposure Frequency
ELCR	Excess Lifetime Cancer Risk
EPC	Exposure Point Concentration
ES	Executive Summary
FDA	U.S. Food and Drug Administration
FI	Fraction of Ingested Chemicals
FOD	Frequency of Detection
gsf	Gross Square Feet
HEAST	Health Effects Assessment Summary Tables
HERD	Human and Ecological Risk Division
HI	Hazard Index
HQ	Hazard Quotient
HRA	Health Risk Assessment
IR	Ingestion Rate or Inhalation Rate

IRIS	Integrated Risk Information System
J&E	Johnson and Ettinger’
kg	Kilogram
km	Kilometer
LBMMC	Long Beach Memorial Medical Center
mg	Milligram
mi	Mile
MCH	Miller Children’s Hospital
MCL	Maximum Contaminant Level
NAAQS	National Ambient Air Quality Standards
MSL	Mean Sea Level
NCEA	National Center for Environmental Assessments
ND	Not Detected
NIOSH	National Institute of Occupational Safety and Health
NOAA	National Oceanic And Atmospheric Administration
OEHHA	Office of Environmental Health Hazard Assessment
OSA	Office of Scientific Affairs
PEF	Particulate Emission Factor
PRG	Preliminary Remediation Goal
PQL	Practical Quantification Limit
QA	Quality Assurance
QC	Quality Control
RfD	Reference Dose
RME	Reasonable Maximum Exposure
RWQCB	Regional Water Quality Control Board
SA	Skin Surface Area
SCREEN3	EPA's screening air dispersion model
sec	Second
SCS	SCS Engineers
SQL	Sample Quantification Limit
SS	Shallow Soil
TPH	Total Petroleum Hydrocarbons
TRPH	Total Recoverable Petroleum Hydrocarbons
ug	Microgram
USEPA	U. S. Environmental Protection Agency
UCL	Upper Confidence Limit
VOC	Volatile Organic Compound

HUMAN HEALTH RISK ASSESSMENT
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA 90801

EXECUTIVE SUMMARY

This Human Health Risk Assessment (HRA) Report has been prepared by SCS Engineers (SCS) on behalf of Long Beach Memorial Medical Center (LBMMC) for evaluation of the potential human health risks attributable to potential contaminants present in soil and groundwater at the proposed Miller Children's Hospital ("MCH") Expansion Site (the "Project Site"). This HRA evaluates the potential current or baseline risks to human health prior to the expansion of MCH (i.e., current conditions), as well as risks after construction of the expansion of MCH. LBMMC currently consists of two licensed hospitals, LBMMC and Miller Children's Hospital, as well as related facilities and infrastructure.

Background

The proposed expansion of Miller Children's Hospital (MCH) through the addition of a pediatric inpatient tower would be located immediately adjacent to the existing Miller Children's Hospital, southwest of the intersection of Atlantic Avenue and Columbia Street. A parking structure currently exists at this location and would be demolished to accommodate the inpatient tower. Phase I of the expansion of MCH would provide 198,000 gross square feet of new space for pediatric surgical services, imaging, a lobby, newborn intensive care services, and general pediatric inpatient care services. Phase I would consist of a four-story building with one story below grade and three stories above grade. Phase II would provide approximately 73,500 square feet (sf) in a vertical expansion of the Phase I structure. In addition, a central plant building designed to support Phases I and II of the pediatric inpatient tower is also proposed. This HRA focuses on the Phase I expansion of MCH with the construction of the new Pediatric Inpatient Tower.

A new pediatric outpatient building is also proposed and would be located south of the existing Miller Children's Hospital, west of Atlantic Avenue and approximately midway between Patterson Street and 27th Street. The Miller Children's Hospital outpatient building would provide approximately 120,000 gross square feet (gsf).

The proposed construction involves the partial placement of the new Pediatric Inpatient Tower over a former ravine which was historically filled using petroleum impacted soil and debris. Some unclassified fill was removed and replaced with compacted fill prior to previous on-site construction. In addition, at least five oil wells have been identified as being located or formerly located in the vicinity of the MCH expansion area. Figure 1 shows the location of the Project Site, Figure 2 shows the location of the proposed MCH expansion.

HRA Methodology

Identification of Chemicals of Potential Concern

Based on an evaluation of the analytical data collected from the Project Site, chemicals of potential concern (COPCs) to be included and evaluated in the HRA were selected from an overall list of detected site constituents. COPCs were determined based on the frequency of detection (FOD) of each chemical and comparison of soil exposure point concentrations (EPC) to background.

Soil EPCs were calculated for the 0-10 feet (ft) soil interval. The 0-10 ft depth is the default or standard soil depth recommended by DTSC for most receptor populations. The 0-10 ft depth was used specifically to account for mixing due to land disturbance (grading) expected on the site. The USEPA (1989) provides for the use of frequency of detection (FOD) as a criterion for selecting COPCs, with a value of 5% the most commonly used. This approach has been used and approved by the DTSC in previous HRAs (TetraTech EM, Inc. 2000). If a chemical was detected at an FOD of 5% or greater, it was considered a COPC in the HRA, unless it was an inorganic screened out by comparison to background (see below).

Inorganic chemicals were included as COPCs if the 95 percent upper confidence limit of the mean (UCLM) from the Project Site was greater than the corresponding background value. Soils data from the 0-10 ft depth interval were used for this comparison since these are the soils individuals are most likely to come in contact with.

Background samples of inorganic compounds were not taken at the site. The site has historically been used as an oil field, much of the surface soil is comprised of artificial fill due to previous hospital construction, and other site uses. Therefore, we believe that the best assessment of background native soils for the site is comparison to the background levels for California soils developed by the Kearney Foundation (Bradford, et. al., 1996), which were developed to provide a comprehensive scientific database of representative soils. This study provides defensible data to assist in accurate evaluation and decision-making regarding site data. Background soils data obtained from Bradford et al. are summarized in Table 3-8. The background comparison is summarized in Table 3-9.

Based on the evaluation of site data, the following chemicals were considered to be COPCs and were further evaluated in the HRA. A listing of COPCs and their EPCs is also shown on Table 3-10.

VOCs

- Benzene
- Bromodichloromethane
- n-Butylbenzene
- sec-Butylbenzene
- tert-Butylbenzene

- Chloroethane
- Dibromochloromethane
- Ethylbenzene
- Isopropylbenzene
- p-Isopropyltoluene
- Methylene Chloride
- Naphthalene
- n-Propylbenzene
- Styrene
- Toluene
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Total Xylenes

Inorganics

- Cadmium
- Copper
- Lead
- Molybdenum
- Thallium
- Zinc

Total Petroleum Hydrocarbons (TPH)

- TPH as Gasoline and Light Hydrocarbons (C4-C12)
- TPH as Gasoline (C6-C16)
- TPH as Diesel (C11-C23)
- TPH as Diesel (C13-C22)

- TPH as Heavy Hydrocarbons (C23-C40)
- Fuel Mix (C6-C23)
- Total Recoverable Petroleum Hydrocarbons (TRPH)

Exposure Assessment

The populations and exposure pathways considered to be potentially exposed under current and project scenarios are detailed in Section 4.0. Conceptual site models (CSM) for the current and project exposure scenarios are presented in Figures 4a and 4b.

The following populations were considered to be potentially exposed under a **current** land use scenario, prior to the construction of proposed additional facilities at the site. The Project Site was considered to be the area for the proposed MCH expansion, while all other areas were considered to be "off-site." In the HRA, "off-site" receptors were considered to be the nearest residents who live in the vicinity of the proposed MCH expansion and hospital patients and commercial/industrial/hospital workers considered to be located at the LBMMC main building.

- **Off-site populations:**
  - Residents (adult and children)
  - Hospital Patients (adults and children)
  - Commercial/Industrial/Hospital Workers

The following populations were considered to be potentially exposed under a **project** land use scenario, during and after construction of proposed MCH expansion.

- **On-site populations:**
  - Construction Workers
  - Hospital Patients (adults and child)
  - Commercial/Industrial/Hospital Workers.
- **Off-site populations:**
  - Residents (adult and child).
  - Hospital Patients (adult and child)
  - Commercial/Industrial/Hospital Workers

The EPCs for the various COPC were combined with exposure parameters for each exposure pathway to develop estimates of the chronic daily intake (CDI) for each chemical within each exposure pathway. This was completed for all receptor scenarios and is presented in Table 4-11.

Toxicity Assessment

As detailed in Section 5.0, for risk assessment purposes, chemicals are separated into two categories of toxicity, depending on whether they are carcinogenic and/or non-carcinogenic. For chemicals exhibiting non-carcinogenic effects, the Hazard Index (HI) is calculated summing the ratios of the CDI and the reference dose (RfD) for each of the COPCs. An HI equal to or less than 1 indicates that there are not likely to be any adverse health effects from the exposure while an HI greater than 1 indicates that there is a potential health hazard.

For chemicals exhibiting carcinogenic effects, a cancer slope factor (CSF) is used to determine how potent the chemical is in causing cancer. The CSF is an expression of the cancer-causing potential of a particular contaminant; the larger the CSF, the greater the potential for that contaminant to cause cancer. To determine the lifetime cancer risk for a particular chemical contaminant, CSFs are multiplied by the CDI of the contaminant under consideration. The total lifetime cancer risk for a site is determined by summing all the individualized cancer risks for the various chemicals of concern. Non-carcinogenic and carcinogenic toxicity information used in this HRA is presented in Tables 5-1 and 5-2, respectively.

Risk Characterization

Under the California Environmental Quality Act (CEQA), Hazard Index levels equal or less than 1 are not considered significant, and such health impacts are considered acceptable.

Based on CEQA guidelines, as stated in the South Coast Air Quality Management District's CEQA Handbook, theoretical excess lifetime cancer risks less than one in 100,000 ($1x10^{-5}$) are not considered significant, and are considered acceptable (SCAQMD, 1993).

Under California Proposition 65, the Drinking Water and Toxic Enforcement Act of 1986 ("Prop 65"), no significant risk levels (NRSLs) for carcinogens are determined to be the daily intake level calculated to result in one excess cancer in an exposed population of 100,000 (1×10^{-5}) assuming lifetime (70-year) exposure at the level in question (OEHHA, 2004b).

As summarized in Section 6.0, risk characterization results for the Project Site are presented in Tables 6-1 through 6-17

Table ES-1. Current Scenario Risk Characterization Results

Current Scenario Receptor		Total Hazard Index (HI)	Total Theoretical Excess Lifetime Cancer Risk (ELCR)
Off-Site	Hospital Patient at LBMMC (Child)	0.004	4×10^{-9}
	Hospital Patient at LBMMC (Adult)	0.001	1×10^{-9}
	Commercial/Industrial/Hospital Worker at LBMMC	0.1	3×10^{-6}
	Resident (child)	8×10^{-10}	3×10^{-14}
	Resident (adult)	3×10^{-10}	

Table ES-2. Project Scenario Risk Characterization Results

Project Scenario Receptor		Total Hazard Index (HI)	Total Theoretical Excess Lifetime Cancer Risk (ELCR)
Off-Site	Hospital Patient at LBMMC (Child)	0.004	4×10^{-9}
	Hospital Patient at LBMMC (Adult)	0.001	1×10^{-9}
	Commercial/Industrial/Hospital Worker at LBMMC	0.1	3×10^{-6}
	Resident (child)	8×10^{-10}	3×10^{-14}
	Resident (adult)	3×10^{-10}	
On-Site	Construction Worker	**4**	3×10^{-8}
	Hospital Patient at MCH (Child)	0.1	4×10^{-9}
	Hospital Patient at MCH (Adult)	0.03	1×10^{-9}
	Commercial/Industrial/Hospital Worker at MCH	0.1	3×10^{-6}

*Note: **Bold** Text indicates an exceedance of non-carcinogenic risk threshold of 1 (HI ≤ 1) based on CEQA guidelines.*

Risks from Inorganic Lead in Soil

Based on the calculations summarized in Table 7-1, the resulting blood lead levels for all receptors are below the 10.0 µg/dl level of concern set forth by Cal-EPA; therefore, health risks due to lead are not of concern at the site.

Conclusions

Non-Carcinogenic Risks:

Based on the risk evaluation, the total Hazard Indices for the following receptors are below the non-carcinogenic risk threshold established for the project (HI ≤ 1) and are **not considered significant** under CEQA guidelines:

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Based on the risk evaluation, the total Hazard Indices for the following receptors are above the non-carcinogenic risk threshold established for the project (HI ≤ 1) and are **considered significant** under CEQA guidelines:

- Current On-Site Construction Worker

The exceedance of the non-carcinogenic threshold (HI ≤ 1) is due to the dermal absorption and ingestion of TRPH in soil.

Theoretical Excess Lifetime Cancer Risks:

The total theoretical excess lifetime cancer risks (ELCR) for **all receptors** evaluated in the HRA are at or below the carcinogenic risk threshold established for the project (ELCR = 1×10^{-5}) and **are not considered significant** under CEQA guidelines:

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)

- Project On-Site Construction Worker
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Risk-Based Evaluation of Site Mitigation Measures

Project Scenario On-Site Construction Worker

The non-carcinogenic risk (Hazard Index) for the project scenario on-site construction worker exceeds the established threshold based on CEQA guidelines (HI ≤ 1). The majority of the non-carcinogenic risk is due to ingestion and dermal contact with the various TPH hydrocarbon fractions in soil. Implementing any of the following risk-based mitigation measures can minimize potential exposures to COPCs in soil at the Project Site:

1) Use of personal protective equipment (PPE) during construction/remediation activities.

2) Monitoring of worker exposure to COPCs during on-site construction/remediation activities.

3) Adherence to health and safety protocols as provided for in a site health and safety plan (e.g. no eating in construction/remediation areas).

HUMAN HEALTH RISK ASSESSMENT

LONG BEACH MEMORIAL MEDICAL CENTER

MILLER CHILDREN'S HOSPITAL EXPANSION

LONG BEACH, CALIFORNIA

1.0 INTRODUCTION

This Human Health Risk Assessment (HRA) Report has been prepared by SCS Engineers (SCS) on behalf of Long Beach Memorial Medical Center (LBMMC) for evaluation of the potential human health risks attributable to potential contaminants present in soil and groundwater at the proposed Miller Children's Hospital ("MCH") Expansion Site (the "Project Site"). This HRA evaluates the potential current or baseline risks to human health prior to the expansion of MCH (i.e., current conditions), as well as risks after construction of the expansion of MCH. LBMMC currently consists of two licensed hospitals, LBMMC and Miller Children's Hospital, as well as related facilities and infrastructure.

1.1 Objectives

The primary objective of this HRA is to provide upper bound, reasonable maximum exposure (RME), health-conservative estimates of the potential human health effects associated with exposures to chemicals detected in soil at the Project Site. The HRA estimates are based on current soil conditions beneath the site.

1.2 Methodology

The HRA contained herein followed a scope of work consistent with federal and state of California risk assessment guidelines. The HRA followed the outline presented in the U.S. Environmental Protection Agency's (USEPA's) *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual* (USEPA, 1989) as supplemented by the California Environmental Protection Agency's Department of Toxic Substances Control's (DTSC) *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996).

2.0 SITE BACKGROUND

The proposed expansion of Miller Children's Hospital (MCH) through the addition of a pediatric inpatient tower would be located immediately adjacent to the existing Miller Children's Hospital, southwest of the intersection of Atlantic Avenue and Columbia Street. A parking structure currently exists at this location and would be demolished to accommodate the inpatient tower. Expansion of MCH would provide 198,000 gross square feet of new space for pediatric surgical services, imaging, a lobby, newborn intensive care services, and general pediatric inpatient care services. The MCH expansion would consist of a four-story building with one story below grade and three stories above grade. In addition, a central plant building designed to support expansion of the pediatric inpatient tower is also proposed. This HRA focuses on the construction of the new Pediatric Inpatient Tower.

A new pediatric outpatient building is also proposed and would be located south of the existing Miller Children's Hospital, west of Atlantic Avenue and approximately midway between Patterson Street and 27th Street. The Miller Children's Hospital outpatient building would provide approximately 120,000 gross square feet (gsf) and consist of an eight-story medical office building.

The proposed construction involves the partial placement of buildings over a former ravine, which with historically filled using petroleum impacted soil and debris. Some unclassified fill was removed prior to previous on-site construction. In addition, at least five oil wells have been identified as being located or formerly located in the vicinity of the MCH expansion area. Figure 1 shows the location of the Project Site, Figure 2 shows the location of the proposed MCH expansion.

2.0.1 Topography and Surface Hydrology

Surface elevation at the Project Site is approximately 35 and 50 above mean sea level (msl). The site generally slopes to the southwest, but there are no steep slopes. The investigation area is located on the western flank of the Signal Hill uplift, approximately 1 mile east of the Los Angeles River and approximately 3 miles north of the Long Beach shoreline. Surficial geologic materials in the area consist of Pleistocene and recent non-marine and marine units, predominantly sand, silty sand, sandy silt, silt and clay. Undisturbed soil at the Project Site is not considered significantly erodable. In addition to native materials and engineered fill placed in connection with construction activities, an unknown volume of unclassified fill, including gravel, debris, and waste oil field material was used to bring a former on-site ravine up to grade prior to use of the site for hospital activities.

The uppermost regional aquifer in this area is anticipated to be the Gage (California Department of Water Resources, 1961), located at a depth of approximately 200 to 250 feet below ground surface (bgs). Uppermost groundwater beneath most of the area occurs at a depth estimated at 50 feet bgs within sands of the Lakewood Formation. However, a thin, perched zone of groundwater was encountered as shallow as 15 feet bgs in the northern portion of the expansion area.

2.0.2 Geology and Hydrogeology

Geologically, the Project Site is located in the southwestern portion of the Los Angeles basin. The basin formed because basement (older) rocks were structurally down-warped allowing a thick sequence of Upper Cretaceous through Recent age (approximately 100 million years ago to present) sedimentary units to accumulate. The sedimentary basin fill in the project area is estimated to be

12,000 feet thick (Yerkes, et al, 1965). The basin fill in the project area consists predominantly of marine origin sandstone, siltstone, and shale of Middle Miocene to Pliocene age (approximately 16 to 1.8 million years ago) overlain by predominantly marine sand and silt of Pleistocene to Recent age (approximately 1.8 million years ago to present).

The rocks of the basin are cut by numerous faults, many of which are strike-slip faults of generally northwest-southeast orientation. Of these, the Newport-Inglewood fault zone is located closest to the Project Site, within approximately 1,000 feet northeast. The Newport-Inglewood zone extends from the Baldwin Hills to Newport Bay and is considered active.

Surficial geologic materials in the area consist of Pleistocene and Recent non-marine and marine units, predominantly san, silty sand, sandy silt, silt, and clay. Groundwater has been encountered at depths of 40 to 50 feet bgs in the project area. Approximately 10 to 15% of the Project Site overlies an area potentially susceptible to liquefaction, as indicated on the California State Seismic Maps. A portion of the site, extending from near the intersection of Columbia Street and Atlantic Avenue in the northeast to the intersection of Patterson Avenue and Long Beach Boulevard on the west is susceptible to liquefaction. This area is the former location of a ravine crossing the area that was backfilled with unclassified soil prior to construction of the present hospital buildings. Perched groundwater has been encountered in this fill material (SCS, 2004). The perched water may be seasonal.

2.0.3 Meteorology

Climatic data compiled by the National Oceanic and Atmospheric Administration (NOAA, 2004) for the City of Long Beach indicated an average annual precipitation rate of 12.94 inches, and an average annual temperature of 65.3 degrees Fahrenheit (°F). The average annual wind speed in the City of Long Beach is 6.2 miles per hour (mph).

2.0.4 Demographics

The City of Long Beach is located within Los Angeles County in Southern California and is the fifth largest city in California, and is the second largest in Los Angeles County.

As of the census of 2000, there are 461,522 people, 163,088 households, and 99,646 families residing in the city. The population density is 3,532.8/km² (9,149.8/mi²). There are 171,632 housing units at an average density of 1,313.8/km² (3,402.6/mi²). The racial makeup of the city is 45.16% White, 14.87% African-American, 0.84% Native American, 12.05% Asian, 1.21% Pacific Islander 20.61% from other races, and 5.27% from two or more races. 35.77% of the population is Hispanic or Latino of any race (U.S. Census Bureau, 2000).

2.0.5 Land Use and Zoning

The proposed project is located within the Central Long Beach Redevelopment Area. The proposed land uses are consistent with the existing land use designations (LUD) No. 7 Mixed Use District General Plan land use designation, and the Institutional zoning. It is anticipated that land owned by LBMMC between 29th Street and Spring Street with the Planning Development and Regional Highway District land use zoning designations would be rezoned Institutional. Similarly, the land owned by the Center between 27th Street and Willow Street with the Regional Highway District and

Community Automobile-Oriented designation would be rezoned to Institutional. The Master Plan of Land Uses provides for reorganization of the six existing land uses: Inpatient, Outpatient, Mixed Use, Utility, Parking, and Circulation.

2.1 Report Organization

Section 1.0 presents introductory material and the objectives for the HRA. Section 2.0 provides site background information. Section 3.0 provides an evaluation of analytical data. The exposure assessment is provided in Section 4.0, including identification of potentially exposed populations, identification of exposure pathways, and estimation of exposure point concentrations (EPCs), and also describes the procedures through which chronic daily intakes (CDIs) of the chemicals of concern were estimated. Toxicity information for carcinogens and non-carcinogens is discussed in Section 5.0. Risk characterization is summarized in Section 6.0. An evaluation of potential risks from inorganic lead in soil is presented in Section 7.0. Conclusions are discussed in Section 8.0. Section 9.0 describes the uncertainties inherent in the HRA process and Section 10.0 describes the limitations of a baseline HRA of this type. References are presented in Section 11.0. This report also includes an Executive Summary, prior to Section 1.0.

Tables and Figures are attached to the HRA document immediately following Section 11.0. Appendices immediately follow the figures section and include additional information and documentation pertaining to the HRA.

3.0 DATA EVALUATION

3.1 Summary of Analytical Results

Twelve USEPA-approved analytical methods or method series and one standard method were utilized during the site investigations. These included:

- USEPA Method 8260B for analysis of soil and groundwater samples for Volatile Organic Compounds (VOCs)
- USEPA Method 8015 (gas chromatograph/flame ionization detector) for analysis of soil samples for Total Petroleum Hydrocarbons (TPH) as Diesel and/or Heavy Hydrocarbons
- USEPA Method 8015 (gas chromatograph/flame ionization detector) for analysis of soil samples for TPH as Gasoline and/or Light Hydrocarbons
- USEPA Method 418.1 for analysis of soil samples for Total Recoverable Petroleum Hydrocarbons (TRPH)
- USEPA Method 6010B/7000 series (atomic absorption; flame or furnace) for analysis of soil samples for trace metals.

Analyses were performed at laboratories certified by the State of California Department of Health Services (DHS). The use of these USEPA-approved analytical methods and DHS-certified laboratories ensures that, at a minimum, certain laboratory data quality objectives have been met.

Analytical results from chemical analyses of soil and groundwater samples collected during previous investigations at the Project Site are summarized in Table Numbers 3-1 through 3-4. These tables and the data they present are listed below:

- Table 3-1 Summary of Analytical Results for Soil Samples – VOCs
- Table 3-2 Summary of Analytical Results for Soil Samples – Inorganic Elements (Metals)
- Table 3-3 Summary of Analytical Results for Soil Samples – Total Petroleum Hydrocarbons
- Table 3-4 Summary of Analytical Results for Groundwater – VOCs

Soil and groundwater sampling locations are shown on Figure 3.

A total of 17 VOCs were detected in soil and groundwater samples collected from the Project Site and were considered as part of this HRA. These include:

- Benzene
- Bromodichloromethane

- n-Butylbenzene
- sec-Butylbenzene
- tert-Butylbenzene
- Chloroethane
- Dibromochloromethane
- Ethylbenzene
- Isopropylbenzene
- p-Isopropyltoluene
- Methylene Chloride
- Naphthalene
- n-Propylbenzene
- Styrene
- Toluene
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Total Xylenes

A total of 14 separate inorganic substances were detected in soil samples collected from the Project Site and were considered in the HRA. These substances were:

- Arsenic
- Barium
- Beryllium
- Cadmium
- Chromium
- Cobalt
- Copper

- Lead
- Mercury
- Molybdenum
- Nickel
- Thallium
- Vanadium
- Zinc

TPH were also detected at the site and include:

- TPH as Gasoline and Light Hydrocarbons (C4-C12)
- TPH as Gasoline (C6-C16)
- TPH as Diesel (C11-C23)
- TPH as Diesel (C13-C22)
- TPH as Heavy Hydrocarbons (C23-C40)
- Fuel Mix (C6-C23)
- TPRH

3.2 Data Evaluation

As part of the HRA, SCS performed a data quality review for the analytical data used herein. As part of this review, Quality Assurance/Quality Control (QA/QC) documentation for the samples, where available, was reviewed. This review was conducted to determine whether the recent site analytical data could meet the data quality objectives recommended by EPA for use in risk assessments (EPA, 1990).

The following parameters were the focus of this review of the QA/QC data where available:

- Compliance with QA/AC Procedures
- Chain-of-Custody Documentation
- Sample Holding Times
- Method Blanks

- Recovery Limits
- Surrogates

In general, the QA/QC documentation appeared to be adequate, although full QA/QC reports were available for only a limited number of samples. QA/QC procedures outlined in the Workplan(s) were generally followed. Analytical method detection limits for most samples were maintained at minimum levels in order to yield acceptable sample results. Sample dilution prior to analysis (to minimize contamination of analytical equipment) was only necessary for only a small proportion of samples. In those analyses where dilution was necessary, it is not anticipated that these instances of sample dilution affected the quality of the data for use in the HRA.

Based on the review of QA/QC data, soil and groundwater samples collected from the site were used in HRA. Estimated concentrations (flagged as "J") were also included in the HRA since their elimination could serve to underestimate risks.

Data summaries of the samples collected at the site are presented in Table 3-5 (0-10 foot soil zone data). Table 3-6 (0-25 feet soil zone data) and Table 3-7 (groundwater). In addition to the data summaries, Tables 3-5 through 3-7 also present frequency of detection (number of detected concentrations of compound per total number of samples), the range of concentrations, the sampling location and depth of maximum detection, the average concentrations and upper confidence limits of the mean (UCLMs) for each compound in each medium.

3.3 Data Selection and Identification of Chemicals of Potential Concern

3.3.1 Data Selection

Analytical data for the soil profile were separated into two "media" for the purposes of this HRA: soil data from 0 to 10 feet bgs, and soil data from 0-25 feet bgs. The 0-10 foot soil data intervals were utilized to evaluate potential exposures to "surface" soils including: a) soil ingestion, b) dermal absorption, and c) fugitive dust inhalation pathways for the on-site construction worker receptor. For the evaluation of potential exposures through the inhalation of VOCs via the vapor intrusion pathway, the soil data from 0-25 feet were utilized. It was assumed that volatile chemicals in deeper soils could migrate vertically toward the surface. Groundwater data collected from the vicinity of MCH was used to evaluate the volatilization of VOCs from groundwater toward the surface into indoor air.

3.3.2 Identification of Chemicals of Potential Concern

Based on an evaluation of the analytical data collected from the Project Site, chemicals of potential concern (COPCs) to be included and evaluated in the HRA were selected from an overall list of detected site constituents. COPCs were determined based on the frequency of detection (FOD) of each chemical. The USEPA (1989) provides for the use of frequency of detection as a criterion for selecting COPCs, with a value of 5% the most commonly used. This approach has been used and approved by the DTSC in previous HRAs (TetraTech EM, Inc. 2000). If a chemical was detected at an FOD of 5% or greater, it was considered a COPC in the HRA, unless it was an inorganic screened out by comparison to background (see below).

Inorganic chemicals were included as COPCs if the 95 percent upper confidence limit of the mean (UCLM) from the Project Site was greater than the corresponding background value. Soils data from the 0-10 ft depth interval were used for this comparison since these are the soils individuals are most likely to come in contact with.

Background samples of inorganic compounds were not taken at the site. The site has historically been used as an oil field, much of the surface soil is comprised of artificial fill due to previous hospital construction, and other site uses. Therefore, we believe that the best assessment of background native soils for the site is comparison to the background levels for California soils developed by the Kearney Foundation (Bradford, et. al., 1996), which were developed to provide a comprehensive scientific database of representative soils. This study provides defensible data to assist in accurate evaluation and decision-making regarding site data. EPCs of inorganic compounds detected at the site were compared to the 95% UCLM concentrations of benchmark soil samples selected from throughout the state. Background soils data obtained from Bradford et al. are summarized in Table 3-6. The background comparison is summarized in Table 3-7.

The following chemicals have been identified as COPCs at the Project Site and were evaluated in the HRA:

VOCs

- Benzene
- Bromodichloromethane
- n-Butylbenzene
- sec-Butylbenzene
- tert-Butylbenzene
- Chloroethane
- Dibromochloromethane
- Ethylbenzene
- Isopropylbenzene
- p-Isopropyltoluene
- Methylene Chloride
- Naphthalene
- n-Propylbenzene
- Styrene

- Toluene
- 1,2,4-Trimethylbenzene
- 1,3,5-Trimethylbenzene
- Total Xylenes

Inorganics

- Cadmium
- Copper
- Lead
- Molybdenum
- Thallium
- Zinc

TPH

- TPH as Gasoline and Light Hydrocarbons (C4-C12)
- TPH as Gasoline (C6-C16)
- TPH as Diesel (C11-C23)
- TPH as Diesel (C13-C22)
- TPH as Heavy Hydrocarbons (C23-C40)
- Fuel Mix (C6-C23)
- Total Recoverable Petroleum Hydrocarbons (TRPH)

The following chemicals were eliminated from consideration in the HRA due to frequency of detection and/or background comparisons:

Inorganics

- Arsenic
- Barium
- Beryllium

- Chromium
- Cobalt
- Mercury
- Nickel
- Vanadium

4.0 EXPOSURE ASSESSMENT

The exposure assessment identifies and describes potentially exposed human receptors, develops exposure pathways, and estimates the chemical concentration at the point where a human receptor could potentially come into contact with COPCs in soil and groundwater at the site, as well as COPCs in air.

4.1 Conceptual Site Model

A conceptual site model (CSM) was developed to provide the framework for the exposure assessment. The potential for risk from chemical stressors is assessed by considering complete exposure pathways as defined by four elements that make up a CSM: (1) source, (2) fate and transport mechanisms, (3) exposure routes, and (4) receptors. The CSM schematically presents the relationship between chemical sources and receptors at the site, and identifies potentially complete and significant pathways through which receptors may be exposed to COPCs. The CSM for the current exposure scenario is presented in Figure 4a. The CSM for the project exposure scenario is presented in Figure 4b.

4.1.1 Sources of Potential Release and Potential Transport Mechanisms

The sources of potential chemical release consist of the areas associated with the historical uses of the site. Portions of the LBMMC were constructed over a former ravine reportedly filled with petroleum containing soil and miscellaneous oil field and other debris. Some unclassified fill was removed prior to construction on-site. At least five oil wells have been identified as being located or formerly located in the vicinity of the MCH expansion area (SCS, 2004).

Chemicals released to the surface from soil and groundwater could be dispersed into the air via dust-borne particulates. Volatile chemicals could likewise release emissions into the air. Through the process of infiltration, chemicals in surface soil could eventually be transported to the subsurface soil.

4.1.2 Potential Human Receptors and Potential Exposure Pathways

An exposure pathway is the mechanism by which a human receptor is exposed to chemicals from a source. The four elements of a complete exposure pathway are:

- A source of chemical release,
- A mechanism of release through a transport medium (e.g., release of chemicals in the soil through indoor air or dust-particles),
- A point of contact between the potential receptor and the transport medium (e.g., ingestion of soil)
- A potential receptor (e.g., an on-site commercial/industrial/hospital worker)

If any of these four components is not present, then a potential exposure pathway is considered

incomplete and is not evaluated further in a risk assessment.

4.1.2.1 Current Scenario

Current potential exposure pathways are those that exist as a result of the current extent of contamination, combined with existing land use and human activity patterns.

The Project Site was considered to be the area for the proposed MCH development, while all other areas were considered to be "off-site." In the HRA, "off-site" receptors were considered to be nearest residents who live in the vicinity of the proposed MCH development and hospital patients and commercial/industrial/hospital workers considered to be located at the LBMMC main building.

The following populations were considered to be potentially exposed under a **current** land use scenario, prior to the construction of proposed additional facilities at the site:

- **Off-site populations:**
  - Residents (adult and child)
  - Hospital Patients (adult and child)
  - Commercial/Industrial/Hospital Workers

The exposure pathways by which these potential receptors are expected to be exposed to chemicals at the proposed Miller Children's Hospital Expansion are presented below.

Current Off-Site Residents (adult and child)

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

Current Off-Site Hospital Patients (adult and child):

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

Current Off-Site Commercial/Industrial/Hospital Workers:

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

Off-site populations were assumed to be located in the LBMMC main building. Therefore, only the inhalation of volatile chemicals in indoor air from soil and groundwater was considered complete for the current off-site commercial/industrial/hospital worker scenario, hospital patient, and resident (child and adult) scenario. Off-site receptors will not come in direct contact with impacted site soils, since the site is currently paved or occupied by structures with landscaped areas. As such, the inhalation of chemicals adhered to dust pathway is considered incomplete for these receptors. Off-site hospital patients and commercial/industrial/hospital workers were considered to be located at the LBMMC main building which is located approximately 413 feet from the center of the new pediatric inpatient tower (phase I). Much of this building is expected to be built over a portion of the former ravine, and was thus used in the HRA. The nearest off-site residents are located approximately

1,162 feet from the proposed Expansion (VSA, 2004).

The uppermost aquifer at the site is found at approximately 45 to 50 feet below ground surface (bgs). Although we believe that the groundwater in this aquifer is of poor quality, we do not have chemical data to demonstrate that it would be considered non-potable. Therefore, we must assume that the water is potable. Deeper, regional aquifers do exist under the site and are used for municipal purposes, however these aquifers are separated from the shallow aquifer by clay layers. No well survey of the area has been conducted to the best of our knowledge.

The uppermost aquifer is not currently used as a groundwater supply. Potable water for the site is supplied by the City of Long Beach, through the Long Beach water supply system. The Long Beach water supply system is comprised of three sources: 50% purchased water from the Metropolitan Water District of Southern California, with water supplies from the Colorado River and the Sacramento River/San Joaquin Delta through the State Water Project; 8% tertiary treated reclaimed water; and 42% from local groundwater sources in the City of Long Beach extracted from Department-owned wells, most of which exceed 1,000 feet in depth. Local groundwater undergoes a multi-stage treatment process in the Groundwater Treatment Plant, including aeration, settling and chemical disinfection. Water quality of the Long Beach water supply is tested by the City Water Department for chemical, physical, radioactive and bacteriological parameters and is evaluated against current and proposed Federal and State water quality health based standards.

The Regional Water Quality Control Board has not designated beneficial uses for the uppermost aquifer at the site, which is not a regional aquifer. The Basin Plan designates existing beneficial uses of the West Coast Basin (Los Angeles Coastal Plain) groundwater as municipal and domestic, industrial service, industrial process and agricultural.

Direct contact (that is, ingestion and/or dermal contact) with impacted groundwater, was considered to be incomplete since groundwater has not been discovered at a depth less than approximately 50 feet below the ground surface. The construction worker is not anticipated to come in contact with impacted groundwater during normal grading, excavation, and/or trenching operations. In addition, groundwater at the site is highly unlikely to be used as a source of potable water.

4.1.2.2 Project Scenario

The following populations were considered to be potentially exposed under a **project** land use scenario, during and after construction of proposed additional facilities at the site.

- **On-site populations:**
  - Construction Workers
  - Hospital Patients (adult and child)
  - Commercial/Industrial/Hospital Workers.

- **Off-site populations:**
  - Residents (adult and child).
  - Hospital Patients (adult and child)
  - Commercial/Industrial/Hospital Workers

Project exposure pathways include pathways that are expected to be complete based on projected land use and predicted human activity at the Project Site. The exposure pathways by which these potential receptors are expected to be exposed to chemicals at the proposed Miller Children's Hospital Expansion are presented below.

Project On-Site Construction Worker:

- Inhalation of Volatile Chemicals from Soil in Outdoor (Ambient) Air
- Inhalation of Contaminants in Fugitive Dust
- Incidental Ingestion of Soil
- Dermal Contact with Soil

The "project scenario on-site construction worker" evaluation includes the assumption that construction-related work (e.g., demolition, environmental site investigation/remediation activities, trenching, construction, etc.) will be conducted at the site on a short-term basis. The on-site construction worker will be exposed to contaminants through contact with impacted soil (dermal and incidental ingestion) and through inhalation of contaminants adhered to dust. The direct contact pathways were considered complete for the on-site construction worker since it was assumed that the construction work would cause direct exposure to on-site soils. The 0-10 feet soil interval was used to assess risks to the on-site construction worker since this receptor could potentially come in contact with soils during soil invasive activities. In addition, the current on-site construction worker will be exposed to contaminants through inhalation of volatile chemicals in outdoor air originating from soil at the MCH site.

Project On-Site Hospital Patients (adult and child):

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

The "project on-site hospital patient" receptor scenario includes the assumption that the hospital patients spend 100% of their time indoors within the pediatric inpatient tower during the duration of their visit. In addition, it was conservatively assumed that MCH patients stay in the hospital 4.9 days, which is the national average length of hospital stays in the United States based on statistics provided by the Center for Disease Control (CDC, 2002). The on-site hospital patient will be exposed to contaminants through inhalation of volatile chemicals in indoor air originating from soil and groundwater.

Project On-Site Commercial/Industrial/Hospital Workers:

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

The "on-site commercial/industrial/hospital worker" receptor scenario includes the fact that the site is anticipated to be used as an active medical facility and commercial, industrial and hospital workers are on-site on a daily basis. The on-site commercial/industrial/hospital worker will be exposed to contaminants through inhalation of volatile chemicals in indoor air originating from soil and groundwater. Because the Project Site where receptors are present will be paved or occupied by building structures, exposure pathways, which require direct contact with site soils or exposed soils (e.g., dermal contact, incidental ingestion, and fugitive dust inhalation), were considered incomplete.

Project Off-Site Hospital Patients (adult and child):

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

Project Off-Site Commercial/Industrial/Hospital Workers:

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

Project Off-Site Residents (adult and child)

- Inhalation of Volatile Chemicals in Indoor Air from Soil and Groundwater

Off-site populations were assumed to be exposed to contaminants that can be transported from the site to off-site locations. Therefore, only the inhalation of volatile chemicals in indoor air originating from soil and groundwater pathway was considered complete for the project off-site receptor scenarios. Off-site workers, hospital patients, and residents will not come in direct contact with impacted site soils, since the site is anticipated to be paved or occupied by structures with landscaped areas. Therefore, the inhalation of chemicals adhered to dust pathway is considered incomplete.

Off-site hospital patients were considered to be inpatients at the LBMMC main building, which is located approximately 413 feet from the center of the proposed MCH pediatric inpatient tower. The nearest off-site residents are located approximately 5,500 feet from the proposed MCH pediatric inpatient tower. Distances to the nearest off-site residents were provided in a telephone conversation by Dr. Mahabir Atwal of VSA n Associates (VSA, 2004).

Risks to the project off-site receptors were assumed to be the same as for the current off-site receptors because the project is not expected to significantly affect the relevant exposure pathway for these populations, specifically, inhalation of volatile chemicals from soil.

4.2 Calculation of Exposure Point Concentrations

Exposure point concentrations (EPCs) are the concentrations of chemical in soil, water, or air that are used to calculate human health risks. Consistent with USEPA risk assessment guidance (USEPA 1989), the EPC for a chemical was the lesser of the 95 percent upper confidence limit of the arithmetic mean (95UCLM) or the maximum concentration. For the purposes of the EPC calculation, non-detect values were assigned a value of one-half the sample quantitation limit (SQL), or the practical quantitation limit (PQL) if the SQL was equal to the PQL. These decision rules are

consistent with the DTSC guideline document, *Use of Soil Concentration Data in Exposure Assessments* (DTSC 1996).

4.2.1 Soil Exposure Point Concentrations

EPCs for soil were used as input in fate and transport models in the risk calculations for the direct contact pathways. The on-site construction worker can potentially become exposed to contaminants in soil during construction and/or trenching activities conducted at the site. Calculation of the soil EPCs usually requires specifying the depth interval from which soil concentrations will be used to calculate the EPCs. The 0-10 ft depth is the default or standard soil depth recommended by DTSC for most receptor populations. The 0-10 ft depth was also used to develop EPCs more representative of the surface soils to which most on-site construction workers would actually be exposed. All other receptors evaluated in the HRA are not anticipated to come in direct contact with soil, since the site is paved or covered with buildings. The 0-10 ft depth was used specifically to account for mixing due to land disturbance (grading) and trenching expected on the site by the on-site construction worker. Soil EPCs are presented on Table 3-10

4.2.2 Groundwater Exposure Point Concentrations

EPCs for groundwater were used in fate and transport models to assess exposure through the inhalation of volatiles chemicals originating from groundwater pathway. Groundwater data used were collected from observation wells installed by Law/Crandall, Inc. in 1991 (Law/Crandall, 1991). Groundwater EPCs were estimated as described in Section 4.2 and are presented on Table 3-10.

4.2.3 Air Exposure Point Concentrations

Ambient (outdoor) air EPCs were calculated for volatile soil COPCs. The EPCs were calculated using a mathematical model that converts the soil concentration to an emission rate. The emission rates were then used as inputs in a simple "box" or single compartment model to calculate on- and off-site ambient air concentrations. This simple method for estimating ambient air concentrations is recommended by both CARB (1992) and DTSC (1984). The resulting ambient air concentrations were used to estimate health risks to the on-site construction worker and off-site receptors.

Calculation of Volatile Emission Rates---

Volatile COPC emission rates from soil into outdoor air were calculated using the Farmer Equation, as presented in the California Site Mitigation Decision Tree Manual (DHS, 1986) and the Superfund Exposure Assessment Manual (USEPA, 1988). The Farmer Equation is based on Fick's Law of Diffusion and was used to calculate the diffusion of vapors through soil-gas. Emission rates were estimated as follows:

$$Q = D_i(p_a^{10/3}/p_T^2)(P_iM_iW_i/RT)/L$$

Where:

Q = Volatilization emission flux (g/cm^2-sec).

D_i = Air diffusion coefficient of chemical i (cm^2/sec).

p_a = Air filled porosity (dimensionless).

p_T = Total soil porosity (dimensionless).

P_i = Vapor pressure of i at the temperature T (mmHg).

M_i = Molecular weight of i (g/mole).

W_i = Weight fraction of i in the soil (mg/mg).

R = Universal gas constant.

T = Temperature (K).

L = Average depth of deeper soil strata samples (cm).

Pertinent chemical properties for site COPCs, which were used in the Farmer Equation calculations, are presented in Table 4-1. The results of the Farmer Equation calculations (on-site outdoor emission fluxes for VOCs) are presented in Tables 4-2a and 4-2b. The weight fraction of each chemical in soil was calculated using the 0-25 foot soil zone data presented in Table 3-7. As described in Section 4.2, the lower of the maximum detected or UCLM concentration (EPC) for the 0-25 feet soil zone profile was utilized

The outdoor air concentrations were used to assess health risks to the on-site construction worker and the off-site residential receptors. For the off-site residential scenario, the site was assumed to be paved, therefore slab attenuation was assumed (Table 4-2a). For the construction worker scenario, the site was assumed to be unpaved so no slab attenuation was assumed (Table 4-2b). Example calculations for the Farmer Equation are provided in Appendix A.

Note that the above is a very conservative form of the Farmer Equation, (because it assumes that each chemical is present in a pure form in soil-vapor rather than a mixture with air), and should tend toward overestimation of outdoor air concentrations and assumes the site to be unpaved in future scenarios.

On-Site Outdoor Airborne Concentrations of COPCs ---

To calculate outdoor on-site airborne concentrations of VOCs and indoor and outdoor contaminants in fugitive dust, a "Box" Model was utilized as recommended by the California Air Resources Board (CARB, 1992). A box model is a simple mass-balance equation that uses the concept of a theoretically enclosed space (i.e., box) over the impacted area. The model assumes that emissions of contaminants into a box, with their removal based on wind speed. The EPC within the box is calculated by the following equation:

$$B = QA/(u)(h)(l) \times CF$$

Where:

B = Box concentration, EPC (ug/m^3)

Q	=	Emission flux (g/cm^2-sec).
A	=	Emitting area of site (cm^2)
u	=	Wind speed (cm/sec)
h	=	Height of box (cm)
l	=	Length of box (cm)
CF	=	Conversion factor, 10^{12} ($ug\text{-}cm^3/g\text{-}m^3$)

The results of the Box Model calculations (on-site outdoor airborne chemical concentrations) are presented in Table 4-3. The EPCs from the Box Model were used for the on-site construction worker scenario.

Particulates Adhered to Fugitive Dust---

Dust emissions by wind erosion were calculated using a Particulate Emission Factor (PEF) method developed by the USEPA, and included as part of the Preliminary Remediation Goals (PRG) published by USEPA Region 9 (USEPA, 2000). The PEF converts the EPC in surface soil to an on-site concentration using the following equation:

$$C_{air} = C_{soil}/PEF \times CF$$

Where:

C_{air}	=	On-site airborne concentration, EPC (ug/m^3)
C_{soil}	=	EPC in surface soil (mg/kg)
PEF	=	Particulate emission factor (m^3/kg)
CF	=	Conversion factor (1000 ug/mg)

A summary of the fugitive dust calculations is presented in Table 4-4. The concentration for each chemical in soil was calculated using EPCs for "surface" soil (0-10 feet bgs) presented in Table 3-10. The fugitive dust calculations were used to estimate non-VOC concentrations in outdoor air for certain receptors, including the project on-site construction worker and all off-site resident receptors.

VOCs from Soil and Groundwater into Indoor Air---

To calculate on-site VOC concentrations in indoor air due to volatilization from soil and groundwater, the Johnson and Ettinger Model was used (USEPA, 2003). The Johnson and Ettinger Model was used in the advanced mode. The advanced mode allows for greater use of site-specific parameters. In cases where site-specific information was not available, the model defaults were used. A list of non-default parameters used in the Model is presented in Table 4-5.

The soil-vapor contribution from soil (Table 4-6a or 4-7a) was added to the contribution from groundwater (Table 4-6b and 4-7b) to derive final indoor air concentrations. Tables 4-8a and 4-8b show the final indoor air concentrations determined by the J&E Model for the MCH Pediatric Inpatient Tower and LBMMC main building, respectively. Documentation pertaining to the Johnson & Ettinger calculations is provided in Appendix B.

Off-Site Airborne Concentrations of COPCs---

To calculate off-site atmospheric concentrations of VOCs, the USEPA-approved SCREEN3 screening air dispersion model was utilized. SCREEN3 was used to calculate EPCs for the chemicals of concern at points representing pertinent off-site populations, including the nearest residential and commercial/industrial worker populations under the current and project exposure scenarios.

Under the current and project exposure scenario, the nearest off-site residential population is located be located directly approximately 5,500 feet from the MCH Expansion area (VSA, 2004) All receptors were considered "flagpole" receptors and were given a height of 1.5 meters, the approximate height at which the nose and mouth are located on an average person.

Table 4-9 presents the off-site volatile COPC EPCs for the off-site resident receptors based on SCREEN3 modeling. A summary of the air dispersion modeling, including the various assumptions and default parameters utilized, is presented in Appendix C.

Full meteorology was used in the SCREEN3 model in which the model examines a series of wind stability classes and their associated wind speeds to identify the “worst case” meteorological conditions (i.e., the combination of wind speed and stability that results in the maximum ground-level concentrations).

4.3 Estimation of Chemical Intake

The chronic daily intake (CDI) is a measure of the average daily intake of each COPC for each identified human receptor via a specific exposure pathway. Equations for specific exposure pathways that were used to calculate CDIs for the on-site and off-site populations from the COPCs are shown below.

4.3.1 Incidental Soil Ingestion

$$CDI = \frac{CS \times IR \times EF \times ED \times CF \times FI}{BW \times AT} = (mg/kg\text{-}day)$$

Where:

EPC = Chemical concentration (Exposure Point Concentration [EPC]) in soil to a depth of 10 feet (mg/kg); Table 3-10.

IR = Ingestion Rate (mg soil/day) = refer to Table 4-10.

EF = Exposure Frequency (days/year) = refer to Table 4-10.

ED = Exposure Duration (years) = refer to Table 4-10.

CF = Conversion Factor (10^{-6} kg/mg).

BW = Body weight (kg) = Refer to Table 4-10.

AT = Averaging Time (days) = Refer to Table 4-10.

FI = Fraction of ingested chemicals which are absorbed, assumed to be 100% for most chemicals.

4.3.2 Dermal Absorption of Chemicals in Soil

$$CDI = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} = (mg/kg\text{-}day)$$

Where:

CS = Chemical concentration (EPC) in soil to a depth of 10 feet (mg/kg); Table 3-10.

CF = Conversion Factor (10^{-6} mg/kg).

SA = Skin Surface Area Available for Contact (cm^2/day) = refer to Table 4-10.

AF = Soil-to-Skin Adherence Factor (mg/cm^2) = refer to Table 4-10.

ABS = Dermal Absorption Factor Specific for Each Contaminant (unitless): 10% for organics; 0.1% for cadmium, 1% for other metals (DTSC, 1994).

EF = Exposure Frequency (days/year) = refer to Table 4-10.

ED = Exposure Duration (years) = refer to Table 4-10.

BW = Body Weight (kg) = refer to Table 4-10.

AT = Averaging Time (days) = refer to Table 4-10.

The fraction of chemical dermally absorbed, ABS, is the fraction of chemical adhering to the skin that is expected to be absorbed across the skin into the body. Chemical-specific ABS values were obtained from DTSC (1994), if available, otherwise a default value of 0.01 or 1% was assumed for inorganic chemicals and 0.1 or 10% for organic chemicals (DTSC, 1994)

4.3.3 Inhalation of Chemicals in Soil-Vapor and Fugitive Dust

$$CDI = \frac{CA \times CF \times IR \times EF \times ED}{BW \times AT} = (mg/kg\text{-}day)$$

Where:

CA = Chemical concentration in air (ug/m^3).

CF = Conversion Factor (10^{-3} mg/ug).

IR = Inhalation Rate (m^3/day) = refer to Table 4-10.

EF = Exposure Frequency (days/year) = refer to Table 4-10.

ED = Exposure Duration (years) = refer to Table 4-10.

BW = Body Weight (kg) = refer to Table 4-10.

AT = Averaging Time (days) = refer to Table 4-10.

Exposure parameters used for each receptor are listed on Table 4-10. Table 4-10 also shows a calculation result of the "CDI factor," which is a combination of all exposure parameters for a particular receptor.

5.0 TOXICITY ASSESSMENT

As part of the HRA, toxicity information, both qualitative and quantitative, was obtained, reviewed, and compiled for each COPC. This information included applicable toxicity values from the Cal-EPA and the USEPA.

For risk assessment purposes, chemicals are separated into two categories of toxicity, depending on whether they exhibit non-carcinogenic or carcinogenic effects. This distinction reflects the current scientific opinion that the mechanisms of action for each category are different. For purposes of assessing risks associated with potential carcinogens, the general risk assessment approach used by USEPA assumes that a small number of molecular events can cause changes in a single cell or a small number of cells that can lead to tumor formation. This is known as a no-threshold mechanism since there is essentially no level of exposure (i.e., threshold) to a carcinogen, which will not result in some finite possibility of causing a disease. In the case of chemicals exhibiting non-carcinogenic effects, however, it is believed that a threshold exists, and that organisms have protective mechanisms that must be overcome before toxic endpoints are manifested.

5.1 Non-Carcinogenic Toxicity Criteria

The potential for non-carcinogenic health defects is evaluated using reference doses (RfD) developed by the USEPA. The RfD, expressed in units of mg/kg/day, is an estimate of the daily exposure to human population (including sensitive sub-populations) that is likely to have no appreciable risk of deleterious effects during an entire lifetime. These RfDs are usually derived either from human studies involving work place exposure or from animal studies and are adjusted using uncertainty factors. The RfD provides a benchmark to which CDIs may be compared. When RfDs are not available for chemicals of concern, other pertinent data may be utilized. For example, for a chemical where a published RfD was not available, but a chronic reference exposure level (REL) was available, the REL was converted to the appropriate units of mg/kg-day. Available non-carcinogenic RfDs for the chemicals of concern are presented in Table 5-1.

DTSC recommends the following hierarchy for selection and use of non-carcinogenic toxicity data (i.e., RfDs) for non-carcinogens, and was used in the HRA:

(1) RfDs set forth in California regulations or derived from chronic RELs;

(2) The USEPA's Integrated Risk Information System (IRIS), (USEPA, 2004a),

(3) The most current HEASTS, (USEPA, 1997a), and

(4) Other acceptable sources.

5.2 Carcinogenic Toxicity Criteria

Cancer slope factors (CSFs) developed by the Cal-EPA's Office of the Environmental Health Hazard Assessment (OEHHA) and/or USEPA's Carcinogen Assessment Group (CAG) for potentially carcinogenic chemicals are expressed in units of $(mg/kg/day)^{-1}$. CSFs are derived from the results of

chronic animal bioassays or human epidemiological studies.

The animal studies must usually be conducted using relatively high doses in order to detect possible adverse effects. Since humans are expected to be exposed at much lower doses than those used in the animal studies, the data are adjusted by using mathematical models. The data from the animal studies are typically fit to a linearized multi-stage model to obtain a dose-response curve. The 95th percentile UCL of the slope of the dose-response curve is subjected to various health-conservative adjustments and an inter-species scaling factor is applied to derive the CSFs for humans. Thus, the actual risks, when quantitatively evaluated based on animal studies, are very conservative and not likely to exceed the risks estimated using these CSFs.

The USEPA assigns weight-of-evidence classifications to potential carcinogens. Under this system, chemicals are classified as either Group A, Group B1, Group B2, Group C, Group D, or Group E. Group A chemicals (human carcinogens) are agents for which there is sufficient evidence to support a direct cause association between exposure to the agents in humans and cancer. Groups B1 and B2 chemicals (probable human carcinogens) are agents for which there is limited (B1) or inadequate (B2) evidence of carcinogenicity from animal studies. Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals, and Group D chemicals (not classified as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available. Group E chemicals (no evidence of carcinogenicity in humans) are agents for which there is no evidence of carcinogenicity in adequate human or animal studies (USEPA, 1989).

For the purposes of this HRA, site contaminants that have been classified by the USEPA as A (human carcinogens), B (probable human carcinogens), or C (possible carcinogens) were considered as carcinogens. Any contaminants classified by USEPA as Class D or lower were not considered for further risk analysis as part of this HRA. Available carcinogenic CSFs are presented in Table 5-2.

DTSC recommends the following hierarchy for selection and use of carcinogenic toxicity data (i.e., CSFs) for carcinogens, and was used in the preparation of this HRA:

(1) Cal-EPA, OEHHA, Standards and Criteria Workgroup, most recent list of CSFs (OEHHA, 2004);

(2) EPA's IRIS, (USEPA, 2004a);

(3) The most current HEASTs, (USEPA, 1997a); and

(4) The most recent NCEA data (NCEA, 1996).

Cancer slope factors were extrapolated from one route of exposure to another only if carcinogenicity by the other route of exposure is supported by information contained in IRIS or California risk assessment guidance.

6.0 RISK CHARACTERIZATION

This section of the HRA describes how calculated exposure doses were integrated with the toxicity criteria to yield estimates of potential health risks. Risk characterization involves the integration of health effects information, developed as a part of the dose-response assessment, with exposure estimates developed as part of the exposure assessment. The result is a quantitative estimate of chronic cancer risk and non-carcinogenic hazards based on the presumption that a threshold dose is required to elicit a response.

6.1 Non-Carcinogenic Effects

Potential risks for non-carcinogens are presented as the ratio of the CDI to the reference dose (CDI/RfD). This ratio is known as the hazard quotient (HQ). A HQ is a chemical-specific measure of potential non-carcinogenic effects on human health due to exposures of a receptor through a specific pathway. Since some individuals are exposed by more than one pathway, HQs are summed for each pathway that contributes to the exposure to the same individual in a given population. The sum of the CDI/RfD ratios (i.e., HQs) associated with multiple exposure pathways to each chemical is called the hazard index (HI). The HI is thus determined as follows:

$$HI_i = \text{sum of } (CDI)_i/(RfD)_i$$

where:

HI_i = Hazard Index for chemical "i" (unitless).

$(CDI)_i$ = Daily intake from all routes of exposure for the ith contaminant (mg/kg/day).

$(RfD)_i$ = Acceptable daily intake (reference dose) for the ith contaminant. (mg/kg/day).

If the total HI is equal or less than 1, it is believed that no threshold effects will occur. An HI of slightly higher than 1 is not necessarily an indication that health effects will occur. The summation of HQs across all chemicals and across all pathways assumed that all chronic human health effects are additive.

6.2 Carcinogenic Risk Estimates

The theoretical excess lifetime cancer risk is an estimate of the increased risk of an individual developing cancer as a result of exposure to the COPCs at specified daily dosages over a lifetime of 70 years. The excess lifetime cancer risk was estimated for each known, probable, or possible carcinogenic constituent using the following equation:

$$Risk_i = \text{sum of } CDI_i \times CSF_i$$

where:

$Risk_i$ = Individual excess lifetime cancer risk (probability) for intake of ith substance (unitless).

CDI_i = Chronic daily intake of chemical "i" (mg/kg-day).

CSF_i = Cancer slope factor of chemical "i" $(mg/kg\text{-}day)^{-1}$.

Lifetime daily intakes, using an averaging time of 70 years effectively prorate the total cumulative dose over a lifetime. This approach is based on the assumption that a high dose of carcinogens received over a short period of time, at any age is equivalent to a correspondingly low dose received over a lifetime. Note that only a single residential cancer risk was calculated for the various receptor scenarios since the risks are determined for a 70-year lifetime, which includes both childhood and adult exposures.

6.3 Risk Characterization Results

Risk characterization was utilized to derive quantitative estimates of incremental lifetime cancer risk for the detected human carcinogens and potential adverse health impacts for non-carcinogens. The results of risk characterization are summarized below:

6.3.1 Current and Project Off-Site Hospital Patient at LBMMC

The risks for the off-site Hospital Patient for the project scenario are equal to those in the current scenario.

The total HI for the off-site hospital patient (child) at LBMMC is **0.004** (Table 6-1). The total HI for the off-site hospital patient (adult) is **0.001** (Table 6-2). The total ELCR for the off-site hospital patient (child) is $\mathbf{4 \times 10^{-9}}$ (Table 6-3). The total ELCR for the off-site hospital patient (adult) is $\mathbf{1 \times 10^{-9}}$ (Table 6-4).

6.3.2 Current and Project Off-Site Commercial/Industrial/Hospital Worker at LBMMC

The total HI for the current Off-Site Commercial/Industrial/Hospital Worker is **0.1** (Table 6-5). The total ELCR for the current Off-Site Commercial/Industrial/Hospital Worker is $\mathbf{3 \times 10^{-6}}$ (Table 6-6).

6.3.3 Current and Project Off-Site Resident

The total HI for the current off-site resident (child) is $\mathbf{8 \times 10^{-10}}$ (Table 6-7). The total HI for the current off-site resident (adult) is $\mathbf{3 \times 10^{-10}}$ (Table 6-8). The total ELCR for the current off-site resident (adult and child) is $\mathbf{3 \times 10^{-14}}$ (Table 6-9).

6.3.4 Project On-Site Construction Worker

The total HI for the project on-site construction worker is **4** (Table 6-10). The total ELCR for the project on-site construction worker is $\mathbf{3 \times 10^{-8}}$ (Table 6-11).

6.3.5 Project On-Site Hospital Patient

The total HI for the project on-site hospital patient (child) is **0.1** (Table 6-12). The total HI for the project on-site hospital patient (adult) is **0.03** (Table 6-13). The total ELCR for the project on-site hospital patient (child) is $\mathbf{4 \times 10^{-9}}$ (Table 6-14). The total ELCR for the project on-site hospital patient (adult) is $\mathbf{1 \times 10^{-9}}$ (Table 6-15).

6.3.6 Project On-Site Commercial/Industrial/Hospital Worker

The total HI for the project on-site commercial/industrial/hospital worker is **0.1** (Table 6-16). The total ELCR for the project on-site commercial/industrial/hospital worker is **3×10^{-6}** (Table 6-17).

6.4 Risk Characterization Summary

Under the California Environmental Quality Act (CEQA), non-carcinogenic levels equal to or below 1 are not considered significant, and are considered acceptable.

Based on CEQA guidelines, as stated in the South Coast Air Quality Management District's CEQA Handbook, theoretical excess lifetime cancer risks less than one in 100,000 (1×10^{-5}) are not considered significant, and are considered acceptable (SCAQMD, 1993).

This level of "acceptable" risk is also used under California Proposition 65, the Drinking Water and Toxic Enforcement Act of 1986 ("Prop 65"). Under Prop 65, no significant risk levels (NRSLs) for carcinogens were determined to be the daily intake level calculated to result in one excess cancer in an exposed population of 100,000 (1×10^{-5}) assuming lifetime (70-year) exposure at the level in question (OEHHA, 2004b).

The total hazard indices for the following on-site and off-site current and project receptors are at or below 1, and **are not considered significant** under CEQA guidelines.

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Based on the risk evaluation, the total Hazard Indices for the following receptors are above the non-carcinogenic risk threshold established for the project ($HI \leq 1$) and are **considered significant** under CEQA guidelines:

- Current On-Site Construction Worker

The total theoretical excess lifetime cancer risks for the following current and project on-site and off-site receptor scenarios are all at or below one in 100,000. Therefore, carcinogenic risk levels for these receptors are **not considered significant** under CEQA.

- Current/Project Off-Site Hospital Patient (Child and Adult)
- Current/Project Off-Site Commercial/Industrial/Hospital Worker
- Current/Project Off-Site Resident (Child and Adult)
- Project On-Site Construction Worker
- Project On-Site Hospital Patient (Child and Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Due to the health-conservative methodologies used in this baseline HRA, the actual probabilities of cancer formation in the populations of concern due to exposure to chemicals in soil are likely to be lower than the risks derived using the above methodology. In fact, the reasonable maximum exposure (RME) risk assessment has been designed to overestimate risks and err on the side of health protection.

7.0 ASSESSMENT OF HEALTH RISKS FROM INORGANIC LEAD IN SOILS

The assessment of health risk from inorganic lead in soils was prepared in accordance with the *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (DTSC, 1996).

Since most data of human health effects for exposure to inorganic lead are based on blood lead concentration, the DTSC documents evaluate the increased blood lead concentrations resulting from exposures to lead in soil. As set forth in the DTSC document, the Office of Scientific Affairs, Human and Ecological Risk Division (OSA, HERD) has developed a series of equations for estimating blood lead concentrations due to exposure through the five (5) pathways shown below.

- Dietary Intake
- Drinking Water Intake
- Soil Ingestion
- Inhalation of Fugitive Dust
- Dermal Contact

The blood lead concentration of concern for both children and adults is 10 micrograms (µg) of lead per deciliter (dl) of blood, as recommended by Cal-EPA, USEPA, the Centers of Disease Control (CDC), and the Food and Drug Administration (FDA). The contributions via the five (5) pathways are added to arrive at an estimate of a mean blood lead concentration resulting from the exposures. A 99% upper confidence limit (UCL) is then calculated from the mean value and compared to the 10 µg/dl threshold. If the 99% UCL value is below the threshold, then there is 99% certainty that the resulting blood lead concentration from site contamination will be within a range of acceptable risk.

In order to determine a risk screening level (i.e. maximum allowable concentration) for inorganic lead in soil at a "typical" site, the following assumptions were made:

(1) All five (5) exposure pathways are complete,

(2) The background level of lead in drinking water is equal to its maximum contaminant limit (MCL: 15 ug/L),

(3) The background level of lead in ambient air is equal to the national ambient air quality standard (NAAQS: 50 ug/m^3),

(4) 7% of the typical diet consists of ingestion of homegrown produce.

The assumptions listed are extremely conservative, and reflect the default values provided with the LEADSPREAD 7 model. The inputs for the LEADSPREAD model are summarized on Table 7-1.

Based on the calculations summarized in Table 7-1, at an EPC of 31.2 mg/kg (Table 3-5), the resulting blood lead levels for all receptors are below the 10.0 µg/dl level of concern set forth by

Cal-EPA; therefore, health risks due to lead are not of concern at the site and are less than significant under CEQA.

8.0 CONCLUSIONS

8.1 Hazard Indices

Based on the risk evaluation, the total Hazard Indices for the following receptors are at or below the non-carcinogenic risk threshold established for the project (HI ≤ 1) and are **not considered significant** under CEQA guidelines:

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)
- Current and Project Off-Site Resident (Adult)
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

Based on the risk evaluation, the total Hazard Indices for the following receptors are above the non-carcinogenic risk threshold established for the project (HI ≤1) and are **considered significant** under CEQA guidelines:

- Current On-Site Construction Worker

The exceedance of the non-carcinogenic threshold (HI ≤ 1) is due to the dermal absorption and ingestion of TRPH in soil.

8.2 Theoretical Excess Lifetime Cancer Risks

The total theoretical excess lifetime cancer risks (ELCR) for **all receptors** evaluated in the HRA are at or below the carcinogenic risk threshold established for the project (ELCR = 1×10^{-5}) and **are not considered significant** under CEQA guidelines:

- Current and Project Off-Site Hospital Patient (Child)
- Current and Project Off-Site Hospital Patient (Adult)
- Current and Project Off-Site Commercial/Industrial/Hospital Worker
- Current and Project Off-Site Resident (Child)

- Current and Project Off-Site Resident (Adult)
- Project On-Site Construction Worker
- Project On-Site Hospital Patient (Child)
- Project On-Site Hospital Patient (Adult)
- Project On-Site Commercial/Industrial/Hospital Worker

8.3 Risks from Inorganic Lead in Soil

Based on the calculations summarized in Table 7-1, the resulting blood lead levels for all receptors are below the 10.0 µg/dl level of concern set forth by Cal-EPA; therefore, health risks due to lead are not of concern at the site and are **not considered significant** under CEQA.

9.0 RISK-BASED EVALUATION OF SITE MITIGATION MEASURES

9.1 Risk-Based Mitigation Measures

9.1.1 Project Scenario On-Site Construction Worker

The non-carcinogenic risk (Hazard Index) for the project scenario on-site construction worker exceeds the established threshold based on CEQA guidelines (HI $\leq$ 1). The majority of the non-carcinogenic risk is due to ingestion and dermal contact with the various TPH hydrocarbon fractions in soil. Implementing any of the following risk-based mitigation measures can minimize potential exposures to COPCs in soil at the Project Site:

1) Use of personal protective equipment (PPE) during construction/remediation activities.

2) Monitoring of worker exposure to COPCs during on-site construction/remediation activities.

3) Adherence to health and safety protocols as provided for in a site health and safety plan (e.g. no eating in construction/remediation areas).

10.0 UNCERTAINTIES

There are three principal sources of assumptions and, therefore, uncertainties for this risk assessment: (1) identification and selection of COPCs and determination of EPCs, (2) exposure assessment and determination of EPCs and CDIs, and (3) toxicity assessment. These sources are further discussed below.

Risk assessment methodologies require that a number of assumptions be made throughout the HRA process. The choice of assumptions may impact the calculated risk estimates such that these estimates may overestimate or underestimate the actual potential health risk. Table 9-1 presents a summary of how the uncertainties in this HRA are judged to impact the risk estimates in this report. As indicated in the table, the assumptions used in this baseline HRA were designed, for the most part, to over-estimate the potential human health risk. This health-conservative nature of HRA methodology is recommended by the USEPA and DTSC.

The potential effects of uncertainties presented in Table 9-1 were evaluated in a qualitative fashion only. A "Low" ranking is defined as assumptions that contributed less than one order of magnitude to the sensitivity of the risk calculations. A "Medium" ranking denotes assumptions that contributed one to two orders of magnitude to the sensitivity of the risk calculations. A "High" ranking denotes assumptions that contributed over two orders of magnitude to the sensitivity of the risk calculations.

In the absence of specific information concerning the magnitude of uncertainty, the potential effects were assumed to be low.

10.1 Identification of Chemicals of Potential Concern

The potential effects of uncertainty for the identification and selection of COPCs and determination of EPCs were generally considered to be low.

(1) Use of groundwater VOC data

Groundwater data collected from monitoring wells in 1991 was used in the HRA. The groundwater monitoring well have since been destroyed, therefore recent sampling was not possible. There has been no alteration in site use over the past 13 years that would cause a significant change of constituent concentrations over time.

10.2 Exposure Assessment

The potential effects of uncertainty for the exposure assessment were generally considered to be low for most parameters used in determining EPCs and/or developing CDIs for the COPC, with the exception of the following:

(1) Use of Farmer Equation to estimate emission flux from soil vapor

The form of the Farmer Equation that was used in this HRA modeled the emission flux from chemical substances assumed to be present in a pure-phase, based on their weight-fraction in soil. This assumption results in an overestimation of risks associated with

both on- and off-site receptors.

(2) Use of VOC groundwater data to evaluate risks from inhalation of volatiles in indoor air

Groundwater monitoring wells installed and sampled in 1991 have since been destroyed and recent groundwater sampling was not possible. It is a conservative approach to evaluate this pathway, such that volatilization of chemicals from groundwater is often negligible.

(3) Use of SCREEN3 model to estimate dispersion of VOCs in particulates to off-site receptors

By design, the SCREEN3 model is a screening-level model that overestimates ground-level contaminant concentrations. In addition, for this HRA, the model was used to calculate maximum hourly concentrations, which are a significant over-estimate when considering long-term, chronic exposures.

(3) Use of J&E Model for estimation of indoor air concentrations from groundwater and soil vapor

The J&E model assumes a size and number of cracks present in a typical residential building foundation that are not (or likely) to be present in a new development. This tends to overestimate the vapor intrusion rate, which is directly linked to the resulting indoor air concentration.

In addition, it is our opinion that the pressure differential assumed in the J&E model is inappropriate for buildings located in a temperate climate. As indicated by model developers, pressure differential does not account for climates in which doors and/or windows may be utilized, which would tend to equalize pressure, thereby reducing the default pressure differential.

10.3 Toxicity Assessment

The potential effects of uncertainty for the toxicity assessment were generally considered to be medium to low based on route extrapolation and CSF determination. This HRA did not consider antagonistic/synergistic effects of the various COPCs, which is estimated to have a low effect on the uncertainty on risk estimates.

Using route extrapolation from the oral to the dermal pathway tends to overestimate risks due to the fact that the oral pathway is a direct pathway for chemical entry into an organism, versus the absorption pathway, and would therefore tend to overestimate risks.

Since animal data is limited on the carcinogenicity of USEPA Class B2 and C carcinogens, the CSFs determined for animal species are multiplied by uncertainty factors, which reflect cross-species extrapolation difficulties. In an attempt to err on the health-conservative side in the absence of human carcinogenic data, toxicologists have produced higher CSFs, which tend to overestimate risks.

10.4 Risk Characterization

As indicated previously, the non-carcinogenic hazard index of 4 obtained for the construction worker is due primarily to exposure to various hydrocarbon fractions of TPH through incidental ingestion of soil and dermal contact. There is significant uncertainty associated with this hazard index estimate for two reasons: 1) it is based on oil soils data collected in 1991 that has not been verified recently, and 2) the quantitative risk assessment of complex mixtures such as TPH is difficult, and requires considerable assumptions and is still under development. This, there is considerable uncertainty associated with the risk assessment of TPH. Nonetheless, a hazard index was still estimated for this chemical mixture to err on the health protective side.

11.0 LIMITATIONS AND CERTIFICATIONS

This HRA was prepared in accordance with risk assessment methodologies recommended at the present time by regulatory agencies having jurisdiction in the State of California. It should be recognized that an assessment of the human health risks associated with exposures to chemicals in the environment is a difficult and inexact science. Professional judgments leading to conclusions and recommendations are generally made with a margin of error inherent to the risk assessment process.

It is sometimes difficult to verify the adequacy or accuracy of the site investigations through which data were developed for an HRA. For this reason, we have attempted to use health-conservative assumptions wherever data or information was limited or uncertain. Also, the final recommendations presented in this document are meant to reduce the uncertainties associated with past site investigative work and minimize any potential health risks.

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VSA, 2004, Telephone conversation with Mahabir Atwal, Ph.D., Tuesday, October 12, 2004. Re: Distances to nearest residential receptors. VSA Associates.

TABLES

TABLE 3-1. SUMMARY OF ANALYTICAL RESULTS- VOLATILE ORGANIC COMPOUNDS (VOCs)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Sample ID	Sample Depth	Sample Date	Benzene	n-Butylbenzene	sec-Butylbenzene	tert-Butylbenzene	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene	Methylene chloride (DCM)	Naphthalene	n-Propylbenzene	Styrene	Toluene (Methyl benzene)	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Total Xylenes
	feet		ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg
B-1	4.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-1	7.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	**6.6**
B-1	10.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-1	19.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-1	39.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-1	54.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-2	5.5	9/5/1991	<200	NA	NA	NA	<200	NA	NA	NA	NA	NA	NA	<200	NA	NA	<200
B-2	10.5	9/5/1991	**82**	NA	NA	NA	**3700**	NA	NA	NA	NA	NA	NA	**450**	NA	NA	**2800**
B-2	24.5	9/5/1991	**110**	NA	NA	NA	**8200**	NA	NA	NA	NA	NA	NA	**930**	NA	NA	**5800**
B-2	34.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	7.6
B-2	44.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	6.5
B-2	59.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-3	8.5	9/5/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-3	25.5	9/4/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-3	45.5	9/4/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-3	60	9/4/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-4	6.5	9/4/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-4	29.5	9/4/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
B-4	54.5	9/4/1991	<5	NA	NA	NA	<5	NA	NA	NA	NA	NA	NA	<5	NA	NA	<5
EB-1	5	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-1	10	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-1	15	3/10/2004	<2.0	<5.0	**7.7 J**	<5.0	<2.0	**16.8**	<5.0	NA	**51.9**	**23.1**	**NA**	<2.0	<5.0	NA	NA
EB-1	20	3/10/2004	**1690**	**3480**	**3080**	**259**	**3930**	**3670**	**3830**	**NA**	**14200**	**5950**	**NA**	**416**	**6780**	**NA**	**1428**
EB-1	25	3/10/2004	<10	**401**	**639**	**45.9 J**	**168**	**599**	**420**	**NA**	**2330**	**933**	**NA**	**131**	**660**	**NA**	**100.5**
EB-1	30	3/10/2004	<2.0	**17**	**30.5**	<5.0	**3.2 J**	**34.3**	**12.6**	**NA**	**55.5**	**55.2**	**NA**	<2.0	**40.5**	**NA**	**6.9**
EB-1	40	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-1	45	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-2	5	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-2	10	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-2	20	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-3	5	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-3	10	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA

TABLE 3-1. SUMMARY OF ANALYTICAL RESULTS- VOLATILE ORGANIC COMPOUNDS (VOCs)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Sample ID	Sample Depth	Sample Date	Benzene	n-Butylbenzene	sec-Butylbenzene	tert-Butylbenzene	Ethylbenzene	Isopropylbenzene	p-Isopropyltoluene	Methylene chloride (DCM)	Naphthalene	n-Propylbenzene	Styrene	Toluene (Methyl benzene)	1,2,4-Trimethylbenzene	1,3,5-Trimethylbenzene	Total Xylenes
	feet		ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg	ug/Kg
EB-3	20	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-4	5	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-4	10	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-4	15	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-4	20	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-4	30	3/11/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-5	5	3/10/2004	<2.0	**5.3 J**	**12.1**	<5.0	**7.7 J**	**25.3**	**7.3 J**	**NA**	**25.8**	**32.9**	**NA**	<2.0	**28.2**	**NA**	**4.3**
EB-5	10	3/10/2004	<2.0	**225**	**605**	**60**	**149**	**516**	**407**	**NA**	**1250**	**703**	**NA**	**165**	**1070**	**NA**	**126**
EB-5	15	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-5	25	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-5	40	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-6	5	3/9/2004	**2.7 J**	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-6	10	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-6	15	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-6	30	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-6	50	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-7	5	3/9/2004	**15**	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	**3.9 J**	<5.0	NA	NA
EB-7	10	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-7	20	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-7	30	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-7	50	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-8	5	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-8	10	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-8	20	3/9/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-9	5	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-9	10	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-9	20	3/10/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	NA	<5.0	<5.0	NA	<2.0	<5.0	NA	NA
EB-10	5	10/7/2004	<2.0	<5.0	<5.0	<5.0	<2.0	<5.0	<5.0	<25	<5.0	<5.0	<5.0	NA	<5.0	<5.0	NA
EB-10	15	10/7/2004	**41.5J**	**92.5**	**210**	<25	**31.5J**	**165**	<25	**1,110**	**177**	**181**	<25	NA	<25	<25	NA
EB-10	25	10/7/2004	**1,690**	<45	**1,870**	**108**	**3,470**	**2,620**	**1,690**	<225	**1,840**	**9,080**	**4,150**	NA	**10,500**	**1,120**	**3,500**
EB-10	30	10/7/2004	**160**	<60	**2,560**	**150**	**759**	**3,280**	**2,950**	**2,420**	**12,100**	**5,000**	<60	NA	**16,200**	**3,130**	**5,900**
EB-10	40	10/7/2004	**317**	<25	**677**	**40.5J**	**1,180**	**875**	**807**	**1,080**	**2,370**	**1,360**	<25	NA	**3,950**	**996**	**2,522**

Notes:

"<" = Analyte not detected at or above detection limit

"J" = Laboratory qualifier, laboratory estimated value

NA = Analyte not analyzed for

Bold text indicates analyte detected

Source of 1991 data: Law/Crandall Associates

Only detected analytes shown

TABLE 3-2. SUMMARY OF ANALYTICAL RESULTS- INORGANIC ELEMENTS (METALS)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Sample ID	Sample Depth	Sample Date	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Thallium	Vanadium	Zinc
			mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
B-1	4.5	9/5/1991	2	75	0.35	<0.4	14	7.3	16	18	<0.2	<0.8	14	11	24	57
B-1	30	12/4/2003	<5.0	30.2	<1.3	<0.4	6.45	3.5	7.65	3.05	<0.1	<2.5	NA	<5.0	13.3	17
B-1	35	12/4/2003	<5.0	93.5	<1.3	<1.3	17.3	8.35	22.5	6.75	<0.1	<2.5	NA	<5.0	29.6	42.8
B-2	1	12/4/2003	<5.0	43.5	<1.3	<1.3	8.05	4.35	8.65	7.35	<0.1	<2.5	NA	<5.0	15.9	26.8
B-2	5.5	9/5/1991	1.7	81	0.17	<0.4	8.4	6.1	18	25	<0.2	<0.8	13	6	16	57
B-2	24.5	9/5/1991	0.9	46	0.18	<0.4	8	4.2	9.5	7.5	<0.2	<0.8	9.9	5	16	26
B-2	44.5	9/5/1991	3.6	90	0.5	<0.4	27	11	19	20	<0.2	<0.8	21	6	37	68
B-2	44.5	9/5/1991	3.6	90	0.5	<0.4	27	11	19	20	<0.2	<0.8	21	6	37	68
B-2	59.5	9/5/1991	4.3	57	0.48	<0.4	20	10	57	13	<0.2	<0.8	13	<2.0	24	64
B-3	1	12/4/2003	<5.0	68.5	<1.3	<1.3	7.5	4.85	29.2	3.3	<0.1	<2.5	NA	<5.0	17.8	22.4
B-3	45.5	9/4/1991	2.8	59	0.34	<0.4	18	8.9	17	11	<0.2	<0.8	17	3	28	48
B-3	45.5	9/4/1991	2.8	59	0.34	<0.4	18	8.9	17	11	<0.2	<0.8	17	3	28	48
B-4	1	12/4/2003	<5.0	90	<1.3	<1.3	14.1	8	15.4	10.7	<0.1	<2.5	NA	<5.0	29.2	48.2
B-4	29.5	9/4/1991	3.2	76	0.39	<0.4	20	7.9	21	14	<0.2	<0.8	21	<2.0	34	54
B-4A	1	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	65
B-4B	1	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	145
B-4C	1	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	57
B-4D	5	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	19.2
B-4D	10	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	25.1
B-5	1	12/4/2003	<5.0	87	<1.3	<1.3	14	8.15	29.3	7.8	<0.1	<2.5	NA	<5.0	29.1	114
B-5A	1	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	76.5
B-5B	1	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	230
B-5C	1	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1520
B-5D	5	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28.6
B-5D	10	1/7/2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.4
B-6	1	12/4/2003	<5.0	57	<1.3	<1.3	9.75	5.65	60	7.2	<0.1	<2.5	NA	<5.0	20.9	37.5
B-7	1	12/4/2003	<5.0	73.5	<1.3	<1.3	12.9	7.8	27.6	6.9	<0.1	<2.5	NA	<5.0	27.4	39.2
B-7	5	12/4/2003	<5.0	69	<1.3	<1.3	9.4	6.25	12.4	3.85	<0.1	<2.5	NA	<5.0	23.4	30.5
B-7	10	12/4/2003	<5.0	28.4	<1.3	<1.3	4.05	3	4.55	<2.5	<0.1	<2.5	NA	<5.0	10.1	14.6
B-7	15	12/4/2003	<5.0	32.5	<1.3	<1.3	4.7	3.4	5.7	<5.0	<0.1	<2.5	NA	<5.0	13.1	15.6
B-7	20	12/4/2003	<5.0	22.5	<1.3	<1.3	3.55	<5.0	4.6	<5.0	<0.1	<2.5	NA	<5.0	9.1	13.5
B-7	25	12/4/2003	<5.0	36.3	<1.3	<1.3	6.6	3.85	7.25	<5.0	<0.1	<2.5	NA	<5.0	14.5	20.4
B-7	30	12/4/2003	<5.0	45.2	<1.3	<1.3	8.4	4.65	11.1	3.05	<0.1	<2.5	NA	<5.0	17.9	23.9
B-7	35	12/4/2003	<5.0	123	<1.3	<1.3	16	8.8	25.6	9.15	<0.1	<2.5	NA	<5.0	31.4	38.5
B-7	39	12/4/2003	<5.0	49	<1.3	<1.3	5.6	4.1	9.75	<5.0	<0.1	<2.5	NA	<5.0	15	22.5
B-8	1	12/5/2003	<5.0	103	<1.3	1.4	16.2	9.6	22.2	10.8	<0.1	3.15	NA	<5.0	34.7	51
B-8	5	12/5/2003	<5.0	43.8	<1.3	<1.3	6.9	4.6	8.9	3.9	<0.1	<2.5	NA	<5.0	17.1	22
B-8	10	12/5/2003	<5.0	35.2	<1.3	<1.3	5.6	3.9	6.95	2.6	<0.1	<2.5	NA	<5.0	16	19.4
B-8	15	12/5/2003	<5.0	24.3	<1.3	<1.3	4.65	2.75	4.85	<5.0	<0.1	<2.5	NA	<5.0	10	13.3
B-8	20	12/5/2003	<5.0	33.2	<1.3	<1.3	6.1	4	7.2	<5.0	<0.1	<2.5	NA	<5.0	15.1	18.3
B-8	25	12/5/2003	<5.0	95	<1.3	<1.3	19.2	9.65	24.7	7.65	<0.1	<2.5	NA	<5.0	33.3	40.5

TABLE 3-2. SUMMARY OF ANALYTICAL RESULTS- INORGANIC ELEMENTS (METALS)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Sample ID	Sample Depth	Sample Date	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Thallium	Vanadium	Zinc
			mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
B-8	30	12/5/2003	<5.0	27.7	<1.3	<1.3	3.8	<5.0	5.3	<5.0	<0.1	<2.5	NA	<5.0	10.7	12.9
B-8	35	12/5/2003	<5.0	29.4	<1.3	<1.3	4.2	3	6.1	<5.0	<0.1	<2.5	NA	<5.0	15.4	11.7
B-8	40	12/5/2003	<5.0	103	<1.3	<1.3	3.9	5	7.45	2.95	<0.1	<2.5	NA	<5.0	20.2	27.9
B-9	1	12/5/2003	<5.0	80	<1.3	<1.3	11.8	7.35	15.1	5.3	<0.1	<2.5	NA	<5.0	27.2	34.9
B-10	1	12/5/2003	<5.0	88.5	<1.3	<1.3	13	7.95	17.2	6.85	<0.1	<2.5	NA	<5.0	28.9	40.6
B-11	1	12/5/2003	<5.0	93	<1.3	<1.3	14.1	8.35	18.8	6.65	<0.1	<2.5	NA	<5.0	30.6	42.9
B-12	1	12/5/2003	<5.0	51	<1.3	<1.3	7.5	4.75	9.35	3.35	<0.1	<2.5	NA	<5.0	18.2	24.2
B-13	1	12/5/2003	<5.0	35.2	<1.3	<1.3	5.2	3.45	6.2	<5.0	<0.1	<2.5	NA	<5.0	13.2	17
B-14	1	12/5/2003	<5.0	84.5	<1.3	<1.3	12.8	7.85	17.4	4.3	<0.1	<2.5	NA	<5.0	29.2	39.3
B-15	1	12/5/2003	<5.0	58.5	<1.3	<1.3	9	5.3	12.3	14.6	<0.1	<2.5	NA	<5.0	19.9	45
B-16	1	12/5/2003	<5.0	41.3	<1.3	<1.3	6.15	4.45	7.65	<5.0	<0.1	<2.5	NA	<5.0	15.4	20.8
B-16	5	12/5/2003	<5.0	26.9	<1.3	<1.3	4.9	2.55	4.5	<5.0	<0.1	<2.5	NA	<5.0	9.05	13.5
B-16	10	12/5/2003	<5.0	98	<1.3	<1.3	14.3	6.8	17.5	6.25	<0.1	<2.5	NA	<5.0	24	29.9
B-16	15	12/5/2003	<5.0	23.8	<1.3	<1.3	4	2.65	4.25	<5.0	<0.1	<2.5	NA	<5.0	12	13.6
B-16	20	12/5/2003	<5.0	28.7	<1.3	<1.3	5.85	3.8	7.8	2.85	<0.1	<2.5	NA	<5.0	14.8	18.1
B-16	25	12/5/2003	<5.0	43.1	<1.3	<1.3	10.2	4.6	9.8	4.4	<0.1	<2.5	NA	<5.0	15.6	23.2
B-16	30	12/5/2003	<5.0	34.8	<1.3	<1.3	4.05	2.55	5.95	3.3	<0.1	<2.5	NA	<5.0	10.3	13.4
B-16	35	12/5/2003	<5.0	48.7	<1.3	<1.3	4.8	5.9	20.2	<5.0	<0.1	<2.5	NA	<5.0	20.2	28.9
EB-1	5	3/10/2004	<1.0	62	<1.3	<1.3	12.7	5.95	14.2	7.45	<0.1	<2.5	10.5	<1.0	25.3	29.9
EB-1	10	3/10/2004	<1.0	68	<1.3	<1.3	13.5	5.45	9.15	9.45	<0.1	<2.5	8.2	<1.0	24.6	26.1
EB-1	15	3/10/2004	26	164	<1.3	<1.3	9.5	3.8	18.6	176	0.8	<2.5	8.4	<1.0	14	233
EB-2	5	3/10/2004	<1.0	131	<1.3	<1.3	25.5	10.3	32.7	12.4	<0.1	2.85	21.9	<1.0	53.5	49.6
EB-2	10	3/10/2004	<1.0	22.5	<1.3	<1.3	6.4	2.85	7.1	5.2	<0.1	<2.5	5.85	<1.0	16.4	15.1
EB-3	5	3/11/2004	<1.0	86	<1.3	<1.3	17	7.65	19.1	17.8	<0.1	<2.5	13.8	<1.0	28.2	54
EB-3	10	3/11/2004	<1.0	107	<1.3	1.3	19.2	8	20.3	19.5	<0.1	<2.5	14.9	<1.0	31.6	57
EB-4	5	3/11/2004	<1.0	115	<1.3	1.4	20.4	8.75	25.3	9.2	<0.1	<2.5	17.1	<1.0	43.5	48.2
EB-4	10	3/11/2004	3.7	77	<1.3	1.35	20.4	9.6	25.6	12.3	<0.1	<2.5	17.1	<1.0	41.7	51
EB-4	15	3/11/2004	26.8	62	<1.3	1.5	64	11.4	22.3	11.8	<0.1	2.7	21.9	<1.0	42.9	44.6
EB-5	5	3/10/2004	7.05	93.5	<1.3	<1.3	15.5	5	17.8	68.5	<0.1	3.2	13.1	<1.0	20.8	71.5
EB-5	10	3/10/2004	<1.0	97.5	<1.3	<1.3	11.7	4.7	14	44.5	<0.1	<2.5	9.95	<1.0	21.1	120
EB-5	15	3/10/2004	<1.0	43.5	<1.3	<1.3	10.7	5.05	12.5	5.3	<0.1	<2.5	8.6	<1.0	21.5	22.7
EB-6	5	3/9/2004	<1.0	105	<1.3	<1.3	19.7	7.05	21.8	165	1.05	<2.5	11.2	<1.0	24.8	95
EB-6	10	3/9/2004	<1.0	37.5	<1.3	<1.3	13.6	6.75	14.7	5.4	<0.1	<2.5	12.8	<1.0	27.8	45
EB-6	15	3/9/2004	<1.0	41.5	<1.3	<1.3	11.3	5.65	15.4	5.3	<0.1	<2.5	13.1	<1.0	27.7	27
EB-7	5	3/9/2004	1.75	118	<1.3	3.7	43.8	6.8	379	202	0.15	8.6	21.3	<1.0	23.4	2850
EB-7	10	3/9/2004	<1.0	46.4	<1.3	<1.3	19.8	6.5	19.3	7	<0.1	<2.5	13.4	<1.0	42.3	36.7
EB-7	15	3/9/2004	<1.0	48.8	<1.3	<1.3	18.3	8.55	19.1	8.6	<0.1	<2.5	14.6	<1.0	43	42.8
EB-8	5	3/9/2004	<1.0	238	<1.3	1.45	19.3	9.15	16.4	9.7	<0.1	<2.5	13.5	<1.0	36	36.8
EB-8	10	3/9/2004	<1.0	35.3	<1.3	<1.3	13.1	8.9	13.2	6.75	<0.1	<2.5	11.6	<1.0	29.1	34.4
EB-9	5	3/10/2004	<1.0	61.5	<1.3	<1.3	18.3	10.2	15.9	7.1	<0.1	<2.5	13.6	<1.0	34.7	36
EB-9	10	3/10/2004	<1.0	97	<1.3	<1.3	14	7.3	18.2	6.7	<0.1	<2.5	11.2	<1.0	24.1	35.5

TABLE 3-2. SUMMARY OF ANALYTICAL RESULTS- INORGANIC ELEMENTS (METALS)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Sample ID	Sample Depth	Sample Date	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Mercury	Molybdenum	Nickel	Thallium	Vanadium	Zinc
			mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
EB-10	5	10/7/2004	**7.15**	**124**	<1.3	**5.5**	**74**	**5.15**	**67**	**87.5**	<0.1	<2.5	**14.7**	<1.0	**18.6**	**429**
EB-10	15	10/7/2004	**4.2**	**108**	<1.3	**8.45**	**20.6**	**18.5**	**79**	**71.5**	<0.1	<2.5	**22.8**	<1.0	**15.5**	**1,280**
EB-10	25	10/7/2004	**3.25**	**58.5**	<1.3	**1.65**	**12.5**	**8.25**	**13.4**	**11.2**	<0.1	<2.5	**13.5**	<1.0	**16.2**	**46.7**

Notes:

"<" = Analyte not detected at or above detection limit

"J" = Laboratory qualifier, laboratory estimated value

NA = Analyte not analyzed for

Bold text indicates analyte detected

Source of 1991 data: Law/Crandall Associates

Only detected analytes shown

TABLE 3-3
SUMMARY OF ANALYTICAL RESULTS - TOTAL PETROLEUM HYDROCARBONS
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Sample ID	Sample Depth	Sample Date	TPH as Gasoline and Light HC	TPH as Gasoline	TPH as Diesel	TPH as Diesel	TPH as Heavy Hydrocarbons	Fuel mix	TRPH
			(C4-C12)	(C6-C16)	(C11-C23)	(C13-C22)	(C23-C40)	(C6-C23)	
			mg/Kg	mg/kg	mg/kg	mg/Kg	mg/Kg	mg/kg	
B-1	4.5	9/5/1991	NA	**23**	NA	NA	NA	NA	**730**
B-1	7.5	9/5/1991	NA	NA	NA	NA	NA	**270**	**6,300**
B-1	10.5	9/5/1991	NA	NA	**5,500**	NA	NA	NA	**540**
B-1	19.5	9/5/1991	NA	NA	NA	NA	NA	NA	**18**
B-1	39.5	9/5/1991	NA	NA	NA	NA	NA	NA	<10
B-1	54.5	9/5/1991	NA	NA	NA	NA	NA	NA	<10
B-2	5.5	9/5/1991	NA	NA	**190,000**	NA	NA	NA	**11,000**
B-2	10.5	9/5/1991	NA	NA	NA	NA	NA	**19,000**	**16,000**
B-2	24.5	9/5/1991	NA	NA	NA	NA	NA	**41,000**	**34,000**
B-2	34.5	9/5/1991	NA	NA	**3,100**	NA	NA	NA	**220**
B-2	44.5	9/5/1991	NA	NA	**3,400**	NA	NA	NA	**43**
B-2	59.5	9/5/1991	NA	NA	**3,200**	NA	NA	NA	**63**
B-3	8.5	9/4/1991	NA	NA	NA	NA	NA	NA	**12**
B-3	25.5	9/4/1991	NA	NA	NA	NA	NA	NA	<10
B-3	45.5	9/4/1991	NA	NA	NA	NA	NA	NA	**36**
B-3	60	9/4/1991	NA	NA	NA	NA	NA	NA	<10
B-4	6.5	9/4/1991	NA	NA	NA	NA	NA	NA	<10
B-4	29.5	9/4/1991	NA	NA	NA	NA	NA	NA	**14**
EB-1	5	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-1	10	3/10/2004	<0.500	NA	NA	49	232	NA	NA
EB-1	15	3/10/2004	<0.500	NA	NA	359	1,190	NA	NA
EB-1	20	3/10/2004	**2,380**	NA	NA	**25,200**	**24,500**	NA	NA
EB-1	25	3/10/2004	371	NA	NA	527	490	NA	NA
EB-1	30	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-1	40	3/10/2004	<0.500	NA	NA	<5.0	11	NA	NA
EB-1	45	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-2	5	3/10/2004	<0.500	NA	NA	<5.0	74	NA	NA
EB-2	10	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-2	20	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-3	5	3/11/2004	<0.500	NA	NA	220	460	NA	NA
EB-3	10	3/11/2004	<0.500	NA	NA	144	341	NA	NA
EB-3	20	3/11/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-4	5	3/11/2004	<0.500	NA	NA	97	96	NA	NA
EB-4	10	3/11/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-4	15	3/11/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-4	20	3/11/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-4	30	3/11/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-5	5	3/10/2004	5	NA	NA	304	811	NA	NA
EB-5	10	3/10/2004	423	NA	NA	6,940	7,960	NA	NA
EB-5	15	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-5	25	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-5	40	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-6	5	3/9/2004	<0.500	NA	NA	89	473	NA	NA
EB-6	10	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-6	15	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-6	20	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-6	30	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-6	40	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-6	50	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-7	5	3/9/2004	<0.500	NA	NA	30	106	NA	NA
EB-7	10	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-7	15	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-7	20	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA

TABLE 3-3
SUMMARY OF ANALYTICAL RESULTS - TOTAL PETROLEUM HYDROCARBONS
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Sample ID	Sample Depth	Sample Date	TPH as Gasoline and Light HC	TPH as Gasoline	TPH as Diesel	TPH as Diesel	TPH as Heavy Hydrocarbons	Fuel mix	TRPH
			(C4-C12)	(C6-C16)	(C11-C23)	(C13-C22)	(C23-C40)	(C6-C23)	
			mg/Kg	mg/kg	mg/kg	mg/Kg	mg/Kg	mg/kg	
EB-7	30	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-7	40	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-7	50	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-8	5	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-8	10	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-8	15	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-8	20	3/9/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-9	5	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-9	10	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-9	20	3/10/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-10	5	10/7/2004	**1**	NA	NA	**228**	**711**	NA	NA
EB-10	15	10/7/2004	**378**	NA	NA	**197**	**149**	NA	NA
EB-10	25	10/7/2004	**1,260**	NA	NA	**571**	**369**	NA	NA
EB-10	30	10/7/2004	**1,890**	NA	NA	**13,800**	**7,320**	NA	NA
EB-10	40	10/7/2004	**1,030**	NA	NA	**205**	**158**	NA	NA
EB-10	50	10/7/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-11	5	10/7/2004	**405**	NA	NA	**4,930**	**3,650**	NA	NA
EB-11	10	10/7/2004	**1,160**	NA	NA	**331**	**452**	NA	NA
EB-11	15	10/7/2004	**854**	NA	NA	**812**	**423**	NA	NA
EB-11	20	10/7/2004	**770**	NA	NA	**714**	**524**	NA	NA
EB-11	25	10/7/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-11	40	10/7/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA
EB-11	50	10/7/2004	<0.500	NA	NA	<5.0	<5.0	NA	NA

Notes:
"<" Analyte not detected at or above detection limit
"NA" Analyte not Analyzed
Bold text indicates analyte detected
HC = Hydrocarbon
TPH = Total Petroleum Hydrocarbon
Only detected analytes shown

TABLE 3-4. SUMMARY OF GROUNDWATER ANALYTICAL DATA
VOLATILE ORGANIC COMPOUNDS
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Location or Type	Sample ID	Sample Date	Bromodichloromethane	Chloroethane	Dibromochloromethane	Toluene	Xylenes
			ug/L				
Monitoring Wells	MW-1	9/6/1991	6.8	40	1.4	<0.5	<0.5
	MW-2	9/6/1991	5.1	18	1.7	1.2	8.1
	MW-3	9/6/1991	1.3	2.3	1	<0.5	<0.5

Notes:

Source: Law/Crandall, 1991

"<" Analyte not detected at or above detection limit

TABLE 3-5. DATA SUMMARY FOR 0-10 FEET SOIL SAMPLES
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Chemical	Frequency of Detection			Range of Concentrations[1,2] (mg/kg)			Sample Location of Maximum Detection	Sample Depth of Maximum Detection (feet bgs)	Average Concentration (mg/kg)	95% Upper Confidence Limit of the Arithmetic Mean (UCLM)[3]	Exposure Point Concentration [4] (mg/kg)
	# of Detections	# of Samples	Frequency of Detection	Minimum	-	Maximum					
Benzene	2	24	8.3%	0.001	-	0.015	EB-7	5	0.006	1.31E-02	**1.31E-02**
n-Butylbenzene	2	19	10.5%	0.0025	-	0.225	EB-5	10	0.014	3.47E-02	**3.47E-02**
sec-Butylbenzene	2	19	10.5%	0.0025	-	0.605	EB-5	10	0.035	8.97E-02	**8.97E-02**
tert-Butylbenzene	1	19	5.3%	0.003	-	0.060	EB-5	10.0	0.006	1.08E-02	**1.08E-02**
Ethylbenzene	2	24	8.3%	0.001	-	0.149	EB-5	10.0	0.012	2.42E-02	**2.42E-02**
Isopropylbenzene	2	19	10.5%	0.003	-	0.516	EB-5	10.0	0.031	7.75E-02	**7.75E-02**
p-Isopropyltoluene	2	19	10.5%	0.003	-	0.407	EB-5	10.0	0.024	6.09E-02	**6.09E-02**
Methylene chloride (DCM)	0	1	0.0%	0.013	-	0.000	--	--	0.013	NA	**NA**
Naphthalene	2	19	10.5%	0.003	-	1.25	EB-5	10.0	0.069	1.83E-01	**1.83E-01**
n-Propylbenzene	2	19	10.5%	0.003	-	0.703	EB-5	10.0	0.041	1.05E-01	**1.05E-01**
Styrene	0	1	0.0%	0.003	-	0.000	--	--	0.003	NA	**NA**
Toluene (Methyl benzene)	2	23	8.7%	0.001	-	0.165	EB-5	10.0	0.013	2.68E-02	**2.68E-02**
1,2,4-Trimethylbenzene	2	19	10.5%	0.003	-	1.07	EB-5	10.0	0.060	1.57E-01	**1.57E-01**
1,3,5-Trimethylbenzene	0	1	0.0%	0.003	-	0.000	--	--	0.003	NA	**NA**
Total Xylenes	3	7	42.9%	0.003	-	0.126	EB-5	10.0	0.035	7.45E-02	**7.45E-02**
Arsenic	6	42	14.3%	0.50	-	7.15	EB-10	5.0	2.0	2.38E+00	**2.38E+00**
Barium	42	42	100.0%	22.50	-	238	EB-8	5.0	77.0	8.69E+01	**8.69E+01**
Beryllium	2	42	4.8%	0.17	-	0.35	B-1	4.5	0.6	6.54E-01	**3.50E-01**
Cadmium	7	42	16.7%	0.20	-	5.50	EB-10	5.0	0.9	1.14E+00	**1.14E+00**
Chromium	42	42	100.0%	4.05	-	74	EB-10	5.0	14.9	1.80E+01	**1.80E+01**
Cobalt	42	42	100.0%	2.55	-	10.3	EB-2	5.0	6.5	7.06E+00	**7.06E+00**
Copper	42	42	100.0%	4.50	-	379	EB-7	5.0	27.0	4.18E+01	**4.18E+01**
Lead	38	42	90.5%	1.25	-	202	EB-7	5.0	20.6	3.12E+01	**3.12E+01**
Mercury	2	42	4.8%	0.05	-	1.05	EB-6	5.0	0.1	1.19E-01	**1.19E-01**
Molybdenum	4	42	9.5%	0.40	-	8.6	EB-7	5.0	1.5	1.83E+00	**1.83E+00**
Nickel	21	21	100.0%	5.85	-	21.9	EB-2	5.0	13.5	1.49E+01	**1.49E+01**
Thallium	2	42	4.8%	0.50	-	11	B-1	4.5	1.9	2.37E+00	**2.37E+00**
Vanadium	42	42	100.0%	9.05	-	53.5	EB-2	5.0	25.4	2.78E+01	**2.78E+01**
Zinc	52	52	100.0%	12.40	-	2,850	EB-7	5.0	137.4	2.39E+02	**2.39E+02**
TPH as Gasoline and Light HC. (C4-C12)	5	21	23.8%	0.25	-	1,160.00	EB-11	10.0	95.1	1.98E+02	**1.98E+02**
TPH as Gasoline (C6-C16)	1	1	100.0%	23.0	-	23	B-1	4.5	23.0	NA	**2.30E+01**
TPH as Diesel (C11-C23)	1	1	100.0%	190000.0	-	190,000	B-2	5.5	190000.0	NA	**1.90E+05**
TPH as Diesel (C13-C22)	11	21	52.4%	2.5	-	6,940	EB-5	10.0	637.4	1.31E+03	**1.31E+03**
TPH as Heavy Hydrocarbons (C23-C40)	12	21	57.1%	2.5	-	7,960	EB-5	10.0	732.8	1.42E+03	**1.42E+03**
Fuel mix (C6-23)	1	1	100.0%	270.0	-	270	B-1	7.5	270.0	NA	**2.70E+02**
TRPH	4	5	80.0%	5.0	-	11,000	B-2	5.5	3609.4	8.28E+03	**8.28E+03**

Notes:

bgs = below ground surface
HC = Hydrocarbons
mg/kg = Milligrams per kilogram
VOCs = Volatile Organic Compounds

NA = Not applicable. Too few observations to calculate UCLM
TPH = Total Petroleum Hydrocarbons
TRPH = Total Recoverable Petroleum Hydrocarbons
UCLM= Upper Confidence Limit of the Arithmetic Mean

Bold cells indicate carcinogenic compounds.

[1] 1/2 detection limit values used for analytical results below detection limits. Statistical calculations utilized sample statistics rather than population statistics.

[2] Laboratory-estimated values which were below the detection limit were used

[3] Data distribution assumed normal. 95% UCLM calculated as follows: $UCL_{1-\alpha}$ = sample mean + $t_{\alpha, n-1}$ S/sqrt(n) (USEPA, 2002, Exhibit 1)

[4] Exposure Point Concentration is the lesser of the 95% UCLM or the maximum concentration and is consistent with USEPA risk assessment guidance (USEPA, 1989)

TABLE 3-6. DATA SUMMARY FOR 0-25 FEET SOIL SAMPLES
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Chemical	Frequency of Detection			Range of Concentrations[1,2] (mg/kg)			Sample Location of Maximum Detection	Sample Depth of Maximum Detection (feet bgs)	Average Concentration (mg/kg)	95% Upper Confidence Limit of the Arithmetic Mean (UCLM)[3]	Exposure Point Concentration [4] (mg/kg)
	# of Detections	# of Samples	Frequency of Detection	Minimum	-	Maximum					
Benzene	7	43	16.3%	0.001	-	1.690	EB-1	20	0.088	1.80E-01	**1.80E-01**
n-Butylbenzene	5	34	14.7%	0.0025	-	3.480	EB-1	20	0.126	3.00E-01	**3.00E-01**
sec-Butylbenzene	7	34	20.6%	0.0025	-	3.080	EB-1	20	0.191	3.70E-01	**3.70E-01**
tert-Butylbenzene	4	34	11.8%	0.003	-	0.259	EB-1	20.0	0.016	3.03E-02	**3.03E-02**
Ethylbenzene	8	43	18.6%	0.001	-	8.200	B2	24.5	0.460	8.55E-01	**8.55E-01**
Isopropylbenzene	7	34	20.6%	0.003	-	3.670	EB-1	20.0	0.226	4.48E-01	**4.48E-01**
p-Isopropyltoluene	5	34	14.7%	0.003	-	3.830	EB-1	20.0	0.189	3.95E-01	**3.95E-01**
Methylene chloride (DCM)	1	3	33.3%	0.013	-	1.110	EB-10	40.0	0.412	1.43E+00	**1.11E+00**
Naphthalene	7	34	20.6%	0.003	-	14.20	EB-1	20.0	0.587	1.30E+00	**1.30E+00**
n-Propylbenzene	7	34	20.6%	0.003	-	9.080	EB-10	25.0	0.499	1.03E+00	**1.03E+00**
Styrene	1	3	33.3%	0.003	-	4.150	EB-10	25.0	1.388	5.42E+00	**4.15E+00**
Toluene (Methyl benzene)	6	40	15.0%	0.001	-	0.930	B-2	24.5	0.056	1.02E-01	**1.02E-01**
1,2,4-Trimethylbenzene	5	34	14.7%	0.003	-	10.50	EB-10	25.0	0.562	1.18E+00	**1.18E+00**
1,3,5-Trimethylbenzene	1	3	33.3%	0.003	-	1.120	EB-10	25.0	0.378	1.46E+00	**1.12E+00**
Total Xylenes	8	14	57.1%	0.003	-	5.800	B-2	24.5	0.991	1.84E+00	**1.84E+00**
Arsenic	11	59	18.6%	0.50	-	26.80	EB-4	15.0	2.9	3.87E+00	**3.87E+00**
Barium	59	59	100.0%	22.50	-	238	EB-8	5.0	70.3	7.88E+01	**7.88E+01**
Beryllium	3	59	5.1%	0.17	-	0.35	B-1	4.5	0.6	6.49E-01	**3.50E-01**
Cadmium	10	59	16.9%	0.20	-	8.45	EB-10	15.0	1.0	1.26E+00	**1.26E+00**
Chromium	59	59	100.0%	3.55	-	74	EB-10	5.0	14.4	1.70E+01	**1.70E+01**
Cobalt	58	59	98.3%	2.50	-	18.5	EB-10	15.0	6.4	7.00E+00	**7.00E+00**
Copper	59	59	100.0%	4.25	-	379	EB-7	5.0	23.8	3.44E+01	**3.44E+01**
Lead	49	59	83.1%	1.25	-	202	EB-7	5.0	20.2	2.92E+01	**2.92E+01**
Mercury	3	59	5.1%	0.05	-	1.05	EB-6	5.0	0.1	1.19E-01	**1.19E-01**
Molybdenum	5	59	8.5%	0.40	-	8.6	EB-7	5.0	1.4	1.68E+00	**1.68E+00**
Nickel	29	29	100.0%	5.85	-	22.8	EB-10	15.0	13.6	1.50E+01	**1.50E+01**
Thallium	3	59	5.1%	0.50	-	11	B-1	4.5	1.9	2.24E+00	**2.24E+00**
Vanadium	59	59	100.0%	9.05	-	53.5	EB-2	5.0	23.7	2.59E+01	**2.59E+01**
Zinc	69	69	100.0%	12.40	-	2,850	EB-7	5.0	131.1	2.13E+02	**2.13E+02**
TPH as Gasoline and Light HC. (C4-C12)	11	42	26.2%	0.25	-	2,380.00	EB-1	20.0	190.8	3.13E+02	**3.13E+02**
TPH as Gasoline (C6-C16)	1	1	100.0%	23.0	-	23	B-1	4.5	23.0	NA	**2.30E+01**
TPH as Diesel (C11-C23)	2	2	100.0%	5500.0	-	190,000	B-2	5.5	97750.0	6.80E+05	**1.90E+05**
TPH as Diesel (C13-C22)	18	42	42.9%	2.5	-	25,200	EB-1	20.0	995.3	2.04E+03	**2.04E+03**
TPH as Heavy Hydrocarbons (C23-C40)	19	42	45.2%	2.5	-	24,500	EB-1	20.0	1025.4	2.05E+03	**2.05E+03**
Fuel mix (C6-23)	3	3	100.0%	270.0	-	41,000	B-2	24.5	20090.0	5.45E+04	**4.10E+04**
TRPH	8	9	88.9%	5.0	-	34,000	B-2	24.5	7622.8	1.47E+04	**1.47E+04**

Notes:

bgs = below ground surface
HC = Hydrocarbons
mg/kg = Milligrams per kilogram
VOCs = Volatile Organic Compounds

NA = Not applicable. Too few observations to calculate UCLM
TPH = Total Petroleum Hydrocarbons
TRPH = Total Recoverable Petroleum Hydrocarbons
UCLM= Upper Confidence Limit of the Arithmetic Mean

Bold cells indicate carcinogenic compounds.

[1] 1/2 detection limit values used for analytical results below detection limits. Statistical calculations utilized sample statistics rather than population statistics.

[2] Laboratory-estimated values which were below the detection limit were used

[3] Data distribution assumed normal. 95% UCLM calculated as follows: $UCL_{1-\alpha}$ = sample mean + $t_{\alpha, n-1}$ S/sqrt(n) (USEPA, 2002, Exhibit 1)

[4] Exposure Point Concentration is the lesser of the 95% UCLM or the maximum concentration and is consistent with USEPA risk assessment guidance (USEPA, 1989)

TABLE 3-7. DATA SUMMARY FOR GROUNDWATER SAMPLES (VOCs)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Chemical	Frequency of Detection			Range of Concentrations[1,2] (ug/L)			Sample Location of Maximum Detection	Average Concentration (ug/L)	95% Upper Confidence Limit of the Arithmetic Mean (UCLM)[3]	Exposure Point Concentration (ug/L)[4]
	# of Detections	# of Samples	Frequency of Detection	Minimum	-	Maximum				
Bromodichloromethane	3	3	100.0%	1.300	-	6.8	Boring #1	4.40	NA	**6.80E+00**
Chloroethane	3	3	100.0%	2.300	-	40	Boring #1	20.1	NA	**4.00E+01**
Dibromochloromethane	3	3	100.0%	1.000	-	1.7	Boring #2	1.37	NA	**1.70E+00**
Toluene	1	3	33.3%	0.250	-	1.2	Boring #2	0.57	NA	**1.20E+00**
Total Xylenes	1	3	33.3%	0.250	-	8.1	Boring #2	2.87	NA	**8.10E+00**

Notes:

ug/L = Micrograms per liter

VOCs = Volatile Organic Compounds

NA = Not applicable. Too few observations to calculate UCLM

UCLM = Upper Confidence Limit of the Arithmetic Mean

[1] 1/2 detection limit values used for analytical results below detection limits. Statistical calculations utilized sample statistics rather than population statistics.

[2] Laboratory-estimated values which were below the detection limit were used

[3] Data distribution assumed normal. 95% UCLM calculated as follows: $UCL_{1-\alpha}$ = sample mean + $t_{\alpha, n-1}$ S/sqrt(n) (USEPA, 2002, Exhibit 1)

[4] Exposure Point Concentration is the lesser of the 95% UCLM or the maximum concentration and is consistent with USEPA risk assessment guidance (USEPA, 1989)

TABLE 3-8.
BACKGROUND CONCENTRATIONS OF METALS IN CALIFORNIA SOILS
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Metal	Min	Max	Mean	Standard Deviation	95% UCLM
Arsenic	0.6	11	7.3	2.5	7.99
Barium	133	1400	509	210	567.21
Beryllium	0.25	2.7	1.28	0.52	1.42
Cadmium	0.05	1.7	0.36	0.31	0.45
Chromium	23	1579	122	223	183.81
Cobalt	2.7	46.9	14.9	9.2	17.45
Copper	9.1	96.4	28.7	19.3	34.05
Lead	12.4	97.1	23.9	13.8	27.73
Mercury	0.05	0.9	0.26	0.21	0.32
Molybdenum	0.1	9.6	1.3	1.5	1.72
Nickel	9	509	57	80	79.17
Thallium	0.17	1.1	0.56	0.19	0.61
Vanadium	39	288	112	53	126.69
Zinc	88	236	149	32	157.87

Notes:
UCLM = Upper confidence limit of the arithmetic mean.
Source: G.R. Bradford, A.C. Chang, A.L. Page, D. Bakhtar, J.A. Frampton, and H. Wright, "Background Concentrations of Trace and Major Elements in California Soils," Kerney Foundation of Soil Science Division of Agriculture and Natural Resources University of California, March 1996.

TABLE 3-9. METALS COPC DETERMINATION
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Metal	Frequency of Detection in 0-10 feet Soils	Exposure Point Concentration in 0-10 feet Soils (mg/kg)	95% UCLM from Benchmark California Soil Samples (mg/kg) [1]	Site Value Greater?	Removed from further evaluation in HRA?
Arsenic	14.3%	2.38E+00	7.99E+00	**FALSE**	**X**
Barium	100.0%	8.69E+01	5.67E+02	**FALSE**	**X**
Beryllium	4.8%	3.50E-01	1.42E+00	**FALSE**	**X**
Cadmium	16.7%	1.14E+00	4.46E-01	**TRUE**	
Chromium	100.0%	1.80E+01	1.84E+02	**FALSE**	**X**
Cobalt	100.0%	7.06E+00	1.75E+01	**FALSE**	**X**
Copper	100.0%	4.18E+01	3.40E+01	**TRUE**	
Lead	90.5%	3.12E+01	2.77E+01	**TRUE**	
Mercury	4.8%	1.19E-01	3.18E-01	**FALSE**	**X**
Molybdenum	9.5%	1.83E+00	1.72E+00	**TRUE**	
Nickel	100.0%	1.49E+01	7.92E+01	**FALSE**	**X**
Thallium	4.8%	2.37E+00	6.13E-01	**TRUE**	
Vanadium	100.0%	2.78E+01	1.27E+02	**FALSE**	**X**
Zinc	100.0%	2.39E+02	1.58E+02	**TRUE**	

Notes:
UCLM = Upper confidence limit of the arithmetic mean
[1]Determined from 50 Benchmark California Soils, From "Background Concentrations of Trace and Major Elements in California Soils," Kerney Foundation of Soil Science Division of Agriculture and Natural Resources University of California, March 1996.

TABLE 3-10. CHEMICALS OF POTENTIAL CONCERN
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

COPC	Exposure Point Concentrations		
	0-10 Feet Soil (mg/kg)	0-25 Feet Soil (mg/kg)	Groundwater (ug/L)
	Direct Contact/Fugitive Dust	Volatilization from Soil	Volatilization from GW
Benzene	1.31E-02	1.80E-01	--
Bromodichloromethane	--	--	6.80E+00
n-Butylbenzene	3.47E-02	3.00E-01	--
sec-Butylbenzene	8.97E-02	3.70E-01	--
tert-Butylbenzene	1.08E-02	3.03E-02	--
Chloroethane	--	--	4.00E+01
Dibromochloromethane	--	--	1.70E+00
Ethylbenzene	2.42E-02	8.55E-01	--
Isopropylbenzene	7.75E-02	4.48E-01	--
p-Isopropyltoluene	6.09E-02	3.95E-01	--
Methylene chloride (DCM)	--	1.11E+00	--
Naphthalene	1.83E-01	1.30E+00	--
n-Propylbenzene	1.05E-01	1.03E+00	--
Styrene	--	4.15E+00	--
Toluene (Methyl benzene)	2.68E-02	1.02E-01	--
1,2,4-Trimethylbenzene	1.57E-01	1.18E+00	--
1,3,5-Trimethylbenzene	NA	1.12E+00	--
Total Xylenes	7.45E-02	1.84E+00	8.10E+00
Cadmium	1.14E+00	1.26E+00	--
Copper	4.18E+01	3.44E+01	--
Lead	3.12E+01	2.92E+01	--
Molybdenum	1.83E+00	1.68E+00	--
Thallium	2.37E+00	2.24E+00	--
Zinc	2.39E+02	2.13E+02	--
TPH as Gasoline and Light HC. (C4-C12)	1.98E+02	3.13E+02	--
TPH as Gasoline (C6-C16)	2.30E+01	2.30E+01	--
TPH as Diesel (C11-C23)	1.90E+05	1.90E+05	--
TPH as Diesel (C13-C22)	1.31E+03	2.04E+03	--
TPH as Heavy Hydrocarbons (C23-C40)	1.42E+03	2.05E+03	--
Fuel mix (C6-23)	2.70E+02	4.10E+04	--
TRPH	8.28E+03	1.47E+04	--

TABLE 4-1. PERTINENT CHEMICAL PROPERTIES FOR VOCs (Soil)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Chemical	Vapor Pressure	Molecular Weight	Henry's Law Constant	Air Diffusion Coefficient	Water Diffusion Coef.	Organic Carbon/Water Partition Coef.	Soil/Water Partition Coef.[1]	Weight Fraction in Soil
	mm Hg @ 25° C	g/mol		cm^2/sec		ml/g		mg/mg
Benzene	1.19E+01	7.80E+01	2.30E-01	8.80E-02	9.80E-06	5.90E+00	5.90E-02	1.80E-07
n-Butylbenzene	1.41E+02	1.34E+02	5.38E-01	5.70E-02	8.12E-06	7.80E-06	7.80E-08	3.00E-07
sec-Butylbenzene	2.10E+00	1.34E+02	5.68E-01	5.70E-02	8.12E-06	7.80E-06	7.80E-08	3.70E-07
tert-Butylbenzene	2.10E+00	1.34E+02	4.87E-01	5.65E-02	8.02E-06	7.80E-06	7.80E-08	3.03E-08
Ethylbenzene	9.60E+00	1.06E+02	3.22E-01	7.50E-02	7.80E-06	5.18E+02	5.18E+00	8.55E-07
Isopropylbenzene	8.00E+00	1.20E+02	4.70E-01	6.50E-02	7.10E-06	8.17E+02	8.17E+00	4.48E-07
p-Isopropyltoluene	1.50E+00	1.34E+02	9.30E-03	6.00E-02	7.10E-06	8.17E+02	8.17E+00	3.95E-07
Methylene chloride (DCM)	4.35E+02	8.49E+01	8.98E-02	1.01E-01	1.17E-05	1.17E+01	1.17E-01	1.11E-06
Naphthalene	8.50E-02	1.28E+02	1.80E-02	5.90E-02	7.50E-06	1.84E+03	1.84E+01	1.30E-06
n-Propylbenzene	1.20E+02	1.20E+02	4.37E-01	6.01E-02	7.83E-06	7.80E-06	7.80E-08	1.03E-06
Styrene	5.00E+00	1.00E+02	1.10E-01	7.10E-02	8.00E-06	7.80E+02	7.80E+00	4.15E-06
Toluene (Methyl benzene)	2.84E+01	9.20E+01	2.72E-01	8.70E-02	8.60E-06	1.80E+02	1.80E+00	1.02E-07
1,2,4-Trimethylbenzene	2.10E+00	1.28E+02	2.52E-01	6.44E-02	7.92E-06	7.18E+02	7.18E+00	1.18E-06
1,3,5-Trimethylbenzene	2.10E+00	1.20E+02	3.59E-01	6.02E-02	8.67E-06	7.03E+02	7.03E+00	1.12E-06
Total Xylenes	7.99E+00	1.06E+02	2.13E-01	7.00E-02	7.80E-06	4.10E+02	4.10E+00	1.84E-06

[1] Calculated based on LARWQCB default values (see source #3 below).
Lowest Xylene isomer values used.

Sources:
1) U.S. EPA *Region 9 Preliminary Remediation Goals,* October 2002.
2) Oak Ridge National Laboratory, Risk Assessment Information System Database, http://risk.lsd.ornl.gov
3) LARWQCB, *Interim Site Assessment & Cleanup Guidebook*, May 1996.
4) NIOSH Pocket Guide to Chemical Hazards Online Version http://www.cdc.gov/niosh/npg/pgdstart.html

TABLE 4-2a. ON-SITE OUTDOOR EMISSIONS FLUX COMPUTATIONS (Farmer Equation).
LONG BEACH MEMORIAL MEDICAL CENTER, MILLER CHILDREN'S HOSPITAL
VOCs from Soil to Outdoor Air Pathway
(Site Paved)-Off-Site Resident Scenario

Chemical	Air Diffusion Coefficient	Air Filled Porosity	Total Porosity	Vapor Pressure	Molecular Weight	Weight Fraction in Soil	Gas Constant	Temp.	Average Depth	Slab Attenuation Factor	Emission Flux
	cm^2/sec			mmHg	g/mol	mg/mg	mmHg-cm^3/mole-°K	°K	cm		g/m^2-sec
Benzene	8.80E-02	2.80E-01	4.34E-01	1.19E+01	7.80E+01	1.80E-07	6.24E+04	2.98E+02	6.10E+02	1.00E-02	9.89E-15
n-Butylbenzene	5.70E-02	2.80E-01	4.34E-01	1.41E+02	1.34E+02	3.00E-07	6.24E+04	2.98E+02	6.10E+02	1.00E-02	2.18E-13
sec-Butylbenzene	5.70E-02	2.80E-01	4.34E-01	2.10E+00	1.34E+02	3.70E-07	6.24E+04	2.98E+02	6.10E+02	1.00E-02	4.00E-15
tert-Butylbenzene	5.65E-02	2.80E-01	4.34E-01	2.10E+00	1.34E+02	3.03E-08	6.24E+04	2.98E+02	6.10E+02	1.00E-02	3.25E-16
Ethylbenzene	7.50E-02	2.80E-01	4.34E-01	9.60E+00	1.06E+02	8.55E-07	6.24E+04	2.98E+02	6.10E+02	1.00E-02	4.40E-14
Isopropylbenzene	7.10E-06	2.80E-01	4.34E-01	8.00E+00	1.20E+02	4.48E-07	6.24E+04	2.98E+02	6.10E+02	1.00E-02	2.06E-18
p-Isopropyltoluene	6.00E-02	2.80E-01	4.34E-01	1.50E+00	1.34E+02	3.95E-07	6.24E+04	2.98E+02	6.10E+02	1.00E-02	3.22E-15
Methylene chloride (DCM)	1.01E-01	2.80E-01	1.43E+00	4.35E+02	8.49E+01	1.11E-06	6.24E+04	2.98E+02	6.10E+02	1.00E-02	2.55E-13
Naphthalene	5.90E-02	2.80E-01	2.43E+00	8.50E-02	1.28E+02	1.30E-06	6.24E+04	2.98E+02	6.10E+02	1.00E-02	1.79E-17
n-Propylbenzene	6.01E-02	2.80E-01	3.43E+00	1.20E+02	1.20E+02	1.03E-06	6.24E+04	2.98E+02	6.10E+02	1.00E-02	9.62E-15
Styrene	7.10E-02	2.80E-01	4.43E+00	5.00E+00	1.00E+02	4.15E-06	6.24E+04	2.98E+02	6.10E+02	1.00E-02	9.50E-16
Toluene (Methyl benzene)	8.70E-02	2.80E-01	5.43E+00	2.84E+01	9.20E+01	1.02E-07	6.24E+04	2.98E+02	6.10E+02	1.00E-02	9.96E-17
1,2,4-Trimethylbenzene	6.44E-02	2.80E-01	6.43E+00	2.10E+00	1.28E+02	1.18E-06	6.24E+04	2.98E+02	6.10E+02	1.00E-02	6.24E-17
1,3,5-Trimethylbenzene	6.02E-02	2.80E-01	7.43E+00	2.10E+00	1.20E+02	1.12E-06	6.24E+04	2.98E+02	6.10E+02	1.00E-02	3.90E-17
Total Xylenes	7.00E-02	2.80E-01	4.34E-01	7.99E+00	1.06E+02	1.84E-06	6.24E+04	2.98E+02	6.10E+02	1.00E-02	7.35E-14

Notes:
1. Emission Flux was multiplied by 10,000 to convert to units of g/m ^{2}-sec.

TABLE 4-2b. ON-SITE OUTDOOR EMISSIONS FLUX COMPUTATIONS (Farmer Equation)
LONG BEACH MEMORIAL MEDICAL CENTER, MILLER CHILDREN'S HOSPITAL EXPANSION
VOCs from Soil to Outdoor Air Pathway
(Site assumed not paved/No slab attenuation)-On-Site Construction Worker Scenario

Chemical	Air Diffusion Coefficient	Air Filled Porosity	Total Porosity	Vapor Pressure	Molecular Weight	Weight Fraction in Soil	Gas Constant	Temp.	Average Depth	Emission Flux
	cm^2/sec			mmHg	g/mol	mg/mg	mmHg-cm^3/mole-°K	°K	cm	g/m^2-sec
Benzene	8.80E-02	2.80E-01	4.34E-01	1.19E+01	7.80E+01	1.80E-07	6.24E+04	2.98E+02	6.10E+02	9.89E-13
n-Butylbenzene	5.70E-02	2.80E-01	4.34E-01	1.41E+02	1.34E+02	3.00E-07	6.24E+04	2.98E+02	6.10E+02	2.18E-11
sec-Butylbenzene	5.70E-02	2.80E-01	4.34E-01	2.10E+00	1.34E+02	3.70E-07	6.24E+04	2.98E+02	6.10E+02	4.00E-13
tert-Butylbenzene	5.65E-02	2.80E-01	4.34E-01	2.10E+00	1.34E+02	3.03E-08	6.24E+04	2.98E+02	6.10E+02	3.25E-14
Ethylbenzene	7.50E-02	2.80E-01	4.34E-01	9.60E+00	1.06E+02	8.55E-07	6.24E+04	2.98E+02	6.10E+02	4.40E-12
Isopropylbenzene	7.10E-06	2.80E-01	4.34E-01	8.00E+00	1.20E+02	4.48E-07	6.24E+04	2.98E+02	6.10E+02	2.06E-16
p-Isopropyltoluene	6.00E-02	2.80E-01	4.34E-01	1.50E+00	1.34E+02	3.95E-07	6.24E+04	2.98E+02	6.10E+02	3.22E-13
Methylene chloride (DCM)	1.01E-01	2.80E-01	4.34E-01	4.35E+02	8.49E+01	1.11E-06	6.24E+04	2.98E+02	6.10E+02	2.79E-10
Naphthalene	5.90E-02	2.80E-01	4.34E-01	8.50E-02	1.28E+02	1.30E-06	6.24E+04	2.98E+02	6.10E+02	5.63E-14
n-Propylbenzene	6.01E-02	2.80E-01	4.34E-01	1.20E+02	1.20E+02	1.03E-06	6.24E+04	2.98E+02	6.10E+02	6.02E-11
Styrene	7.10E-02	2.80E-01	4.34E-01	5.00E+00	1.00E+02	4.15E-06	6.24E+04	2.98E+02	6.10E+02	9.92E-12
Toluene (Methyl benzene)	8.70E-02	2.80E-01	4.34E-01	2.84E+01	9.20E+01	1.02E-07	6.24E+04	2.98E+02	6.10E+02	1.56E-12
1,2,4-Trimethylbenzene	6.44E-02	2.80E-01	4.34E-01	2.10E+00	1.28E+02	1.18E-06	6.24E+04	2.98E+02	6.10E+02	1.37E-12
1,3,5-Trimethylbenzene	6.02E-02	2.80E-01	4.34E-01	2.10E+00	1.20E+02	1.12E-06	6.24E+04	2.98E+02	6.10E+02	1.15E-12
Total Xylenes	7.00E-02	2.80E-01	4.34E-01	9.60E+00	1.06E+02	8.55E-07	6.24E+04	2.98E+02	6.10E+02	4.10E-12

Notes:
1. Emission Flux was multiplied by 10,000 to convert to units of g/m ^{2}-sec.

TABLE 4-3. ON-SITE OUTDOOR EMISSION COMPUTATIONS FOR VOCs (Box Model).
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Chemical	Emission Flux	Emitting Area	Wind Speed[1]	Box Height	Length of Site	Conversion Factor	On-Site Concentration
	g/cm^2-sec	cm^2	cm/s	cm	cm	$\mu g\text{-}cm^3/g\text{-}m^3$	$\mu g/m^3$
Benzene	9.89E-17	3.78E+08	277	150	24,079	1.00E+12	3.74E-05
n-Butylbenzene	2.18E-15	3.78E+08	277	150	24,080	1.00E+12	8.23E-04
sec-Butylbenzene	4.00E-17	3.78E+08	277	150	24,081	1.00E+12	1.51E-05
tert-Butylbenzene	3.25E-18	3.78E+08	277	150	24,082	1.00E+12	1.23E-06
Ethylbenzene	4.40E-16	3.78E+08	277	150	24,083	1.00E+12	1.66E-04
Isopropylbenzene	2.06E-20	3.78E+08	277	150	24,084	1.00E+12	7.77E-09
p-Isopropyltoluene	3.22E-17	3.78E+08	277	150	24,085	1.00E+12	1.22E-05
Methylene chloride (DCM)	2.79E-14	3.78E+08	277	150	24,086	1.00E+12	1.05E-02
Naphthalene	5.63E-18	3.78E+08	277	150	24,087	1.00E+12	2.13E-06
n-Propylbenzene	6.02E-15	3.78E+08	277	150	24,088	1.00E+12	2.28E-03
Styrene	9.92E-16	3.78E+08	277	150	24,089	1.00E+12	3.75E-04
Toluene (Methyl benzene)	1.56E-16	3.78E+08	277	150	24,090	1.00E+12	5.90E-05
1,2,4-Trimethylbenzene	1.37E-16	3.78E+08	277	150	24,091	1.00E+12	5.18E-05
1,3,5-Trimethylbenzene	1.15E-16	3.78E+08	277	150	24,092	1.00E+12	4.33E-05
Total Xylenes	4.10E-16	3.78E+08	277	150	24,093	1.00E+12	1.55E-04

Notes:

[1] Wind speed is average annual wind speed (6.2 miles per hour), based on climatic data collected by National Oceanic and Atmospheric Administration (NOAA), 2004.

TABLE 4-4. ON-SITE OUTDOOR EMISSION COMPUTATIONS FOR NON-VOCs (EPA Region 9 PRG Model). LONG BEACH MEMORIAL MEDICAL CENTER MILLER CHILDREN'S HOSPITAL EXPANSION LONG BEACH, CALIFORNIA

Chemical	Concentration in Soils	Particulate Emission Factor	On-Site Concentration
	mg/kg	m^3/kg	$\mu g/m^3$
Cadmium	1.14E+00	1.32E+09	8.64E-07
Copper	4.18E+01	1.32E+09	3.18E-05
Lead	3.12E+01	1.32E+09	2.37E-05
Molybdenum	1.83E+00	1.32E+09	1.39E-06
Thallium	2.37E+00	1.32E+09	1.80E-06
Zinc	2.39E+02	1.32E+09	1.82E-04
TPH as Gasoline and Light HC. (C4-C12)	1.98E+02	1.32E+09	1.51E-04
TPH as Gasoline (C6-C16)	2.30E+01	1.32E+09	1.75E-05
TPH as Diesel (C11-C23)	1.90E+05	1.32E+09	1.44E-01
TPH as Diesel (C13-C22)	1.31E+03	1.32E+09	9.97E-04
TPH as Heavy Hydrocarbons (C23-C40)	1.42E+03	1.32E+09	1.08E-03
Fuel mix (C6-23)	2.70E+02	1.32E+09	2.05E-04
TRPH	8.28E+03	1.32E+09	6.29E-03

Notes:

On-site concentrations in µg/m3 were calculated by dividing the soil concentration in mg/kg by the PEF

And multiplying the result by 1000 to convert mg to µg.

TABLE 4-5. NON-DEFAULT PARAMETERS USED IN JOHNSON AND ETTINGER MODEL
MILLER CHILDREN'S HOSPITAL
LONG BEACH MEMORIAL MEDICAL CENTER
LONG BEACH, CALIFORNIA

Model default parameters for the Johnson and Ettinger (J&E) Model were used with the exception of the following

Parameter	Abbreviation (units)	J&E Model Default	Assumption Used			
			Comm./Ind./Hospital Worker		On-Site Hospital Patient	
Average soil temperature	T_S (°C)	10	18		18	
Depth below grade to top of contamination	L_t (cm)	400	200		200	
Depth below grade to bottom of contamination	L_B(cm)	--	1524		1524	
Enclosed space floor length	L_b (cm)	1,000	5944 (MCH)	5603 (LBMMC)	5944 (MCH)	5603 (LBMMC)
Enclosed space floor length	W_b (cm)	1,000	5944 (MCH)	5603 (LBMMC)	5944 (MCH)	5603 (LBMMC)
Indoor air exchange rate	ER (1/hr)	0.25	2			
Exposure duration	ED (years)	30	25		1	
Exposure frequency	EF (days/year)	350	250		4.6	

Notes:

1. Depth below grade to bottom of enclosed space floor was assumed to be 200 cm (model default)
Miller Children's Hospital Phase I Inpatient Tower is expected to include one-story below grade, whicle Long Beach Memorial Medical Center Main Building has one-story below grade.
2. Average soil temperature is consistent with DTSC recommendations.
3. Enclosed space floor lengths shown for Todd Cancer Institute proposed building and Long Beach Memorial Medical Center main building.
4. Indoor air exchange rate was modified from model default of 0.25 to 2, which is based on personal communication with Long Beach Memorial Medical Center Construction Manager, Marion Vinton dated January 7, 2005.
5. Soil type (Stratum A, B, C SCS soil type) used in model was silt (SI). This is based on boring logs created during the drilling of soil borings created during the drilling of soil borings at the site.
6. The default exposure factors in the J&E Model are based on a residential scenario. Exposure factors were modified to reflect commercial/industrial/hospital worker and hospital patient scenarios.

TABLE 4-6a. EMISSIONS OF VOCs FROM SOIL TO INDOOR AIR [1] (J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AND HOSPITAL PATIENT SCENARIOS
PEDIATRIC INPATIENT TOWER
LONG BEACH, CALIFORNIA

Chemical	Initial Soil Concentration, C_R	Finite Source Building Concentration, $C_{building}$
	(µg/kg)	(µg/m^3)
Benzene	1.80E+02	3.40E-01
n-Butylbenzene	3.00E+02	1.34E-01
sec-Butylbenzene	3.70E+02	1.79E-02
tert-Butylbenzene	3.03E+01	1.87E-02
Ethylbenzene	8.55E+02	6.61E-01
Isopropylbenzene	4.48E+02	4.92E+00
p-Isopropyltoluene [2]	3.95E+02	4.53E-01
Methylene chloride (DCM)	1.11E+03	1.49E+00
Naphthalene	1.30E+03	1.21E-02
n-Propylbenzene	1.03E+03	7.06E-01
Styrene	4.15E+03	5.91E-01
Toluene (Methyl benzene)	1.02E+02	1.17E-01
1,2,4-Trimethylbenzene	1.18E+03	2.11E-01
1,3,5-Trimethylbenzene	1.12E+03	1.92E-01
Total Xylenes [3]	1.84E+03	1.31E+00

Assumed Building Model Variables:
Building Area = 38,000 square feet (Phase I Pediatric Inpatient Tower)[4]

Notes:
[1] = Results Based on Soil Johnson and Ettinger Model - Advanced (SL-ADV) Version 3.0, February 2003
[2] = Toluene used as a surrogate
[3] = para-xylene chemical properties used

TABLE 4-6b. EMISSIONS OF VOCs FROM GROUNDWATER TO INDOOR AIR [1] (J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AND HOSPITAL PATIENT SCENARIOS
LONG BEACH, CALIFORNIA

Chemical	Initial Groundwater Concentration, C_R	Infinite Source Building Concentration, $C_{building}$
	(µg/L)	(µg/m^3)
Bromodichloromethane	6.80E+00	4.96E-04
Chloroethane	4.00E+01	3.27E-02
Dibromochloromethane [2]	1.70E+00	1.24E-04
Toluene	1.20E+00	4.92E-04
Total Xylenes[3]	8.10E+00	3.51E-03

Assumed Building Model Variables:
Building Area = 38,000 square feet (Phase I Inpatient Tower) [4]

Notes:
[1] = Results Based on Groundwater Johnson and Ettinger Model - Advanced (GW-ADV) Version 3.0, February 2003
[2] = Bromodichloromethane used as a surrogate
[3] = para-xylene chemical properties used
[4] = Estimated from Moffat and Nicholls grading plan or dimension estimates in EIR project description

TABLE 4-7a. EMISSIONS OF VOCs FROM SOIL TO INDOOR AIR [1] (J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
OFF-SITE AT LBMMC MAIN BUILDING
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKERS
AND HOSPITAL PATIENT SCENARIOS
LONG BEACH, CALIFORNIA

Chemical	Initial Soil Concentration, C_R	Finite Source Building Concentration, $C_{building}$
	(µg/kg)	(µg/m^3)
Benzene	1.80E+02	3.60E-01
n-Butylbenzene	3.00E+02	1.43E-01
sec-Butylbenzene	3.70E+02	4.56E-03
tert-Butylbenzene	3.03E+01	1.99E-02
Ethylbenzene	8.55E+02	7.01E-01
Isopropylbenzene	4.48E+02	2.16E+01
p-Isopropyltoluene [2]	3.95E+02	4.81E-01
Methylene chloride (DCM)	1.11E+03	1.58E+00
Naphthalene	1.30E+03	1.28E-02
n-Propylbenzene	1.03E+03	7.48E-01
Styrene	4.15E+03	6.27E-01
Toluene (Methyl benzene)	1.02E+02	1.24E-01
1,2,4-Trimethylbenzene	1.18E+03	2.23E-01
1,3,5-Trimethylbenzene [3]	1.12E+03	2.04E-01
Total Xylenes [4]	1.84E+03	1.39E+00

Assumed Building Model Variables:
Building Area = 33,794 square feet (area of LBMMC Main Building)

Notes:
[1] = Results Based on Soil Johnson and Ettinger Model - Advanced (SL-ADV) Version 3.0, February 2003
[2] = Toluene used as a surrogate
[3] = 1,2,4-Trimethylbenzene used as a surrogate
[4] = para-xylene chemical properties used

TABLE 4-7b. EMISSIONS OF VOCs FROM GROUNDWATER TO INDOOR AIR [1]
(J&E Model)
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
OFF-SITE AT LBMMC MAIN BUILDING
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AND HOSPITAL PATIENT SCENARIOS
LONG BEACH, CALIFORNIA

Chemical	Initial Groundwater Concentration, C_R	Infinite Source Building Concentration, $C_{building}$
	(µg/L)	(µg/m^3)
Bromodichloromethane	6.80E+00	5.12E-04
Chloroethane	4.00E+01	3.44E-02
Dibromochloromethane [2]	1.70E+00	1.28E-04
Toluene	1.20E+00	5.12E-04
Total Xylenes [3]	8.10E+00	3.65E-03

Assumed Building Model Variables:
Building Area = 33,794 square feet (area of LBMMC Main Building)

Notes:
[1] = Results Based on Groundwater Johnson and Ettinger Model - Advanced (GW-ADV) Version 3.0, February 2003
[2] Bromodichloromethane used as a surrogate

TABLE 4-8a. SUMMARY OF INDOOR AIR MODELING CALCULATIONS
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
COMMERCIAL/INDUSTRIAL WORKER AND HOSPITAL PATIENT SCENARIOS
PEDIATRIC INPATIENT TOWER
LONG BEACH, CALIFORNIA

Chemical	Indoor Air Concentration from Soil[1]	Indoor Air Concentration GW[2]	**Total Indoor Air Concentration**
	µg/m^3	µg/m^3	**µg/m^3**
Benzene	3.40E-01	Soil Only	**3.40E-01**
Bromodichloromethane	Groundwater Only	4.96E-04	**4.96E-04**
n-Butylbenzene	1.34E-01	Soil Only	**1.34E-01**
sec-Butylbenzene	1.79E-02	Soil Only	**1.79E-02**
tert-Butylbenzene	1.87E-02	Soil Only	**1.87E-02**
Chloroethane	Groundwater Only	3.27E-02	**3.27E-02**
Dibromochloromethane	Groundwater Only	1.24E-04	**1.24E-04**
Ethylbenzene	6.61E-01	Soil Only	**6.61E-01**
Isopropylbenzene	4.92E+00	Soil Only	**4.92E+00**
p-Isopropyltoluene	4.53E-01	Soil Only	**4.53E-01**
Methylene Chloride (DCM)	1.49E+00	Soil Only	**1.49E+00**
Naphthalene	1.21E-02	Soil Only	**1.21E-02**
n-Propylbenzene	7.06E-01	Soil Only	**7.06E-01**
Styrene	5.91E-01	Soil Only	**5.91E-01**
Toluene (Methyl benzene)	1.17E-01	4.92E-04	**1.18E-01**
1,2,4-Trimethylbenzene	1.17E-01	Soil Only	**1.17E-01**
1,3,5-Trimethylbenzene	1.92E-01	Soil Only	**1.92E-01**
Total Xylenes	1.31E+00	3.51E-03	**1.31E+00**

[1]See Johnson & Ettinger Calculations for Soil, Table 4-7a
[2]See Johnson & Ettinger Calculations for Groundwater, Table 4-7b

TABLE 4-8b. SUMMARY OF INDOOR AIR MODELING CALCULATIONS
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
OFF-SITE AT LBMMC MAIN BUILDING
COMMERCIAL/INDUSTRIAL/HOSPITAL WORKERS
AND HOSPITAL PATIENT SCENARIOS
LONG BEACH, CALIFORNIA

Chemical	Indoor Air Concentration from Soil[1]	Indoor Air Concentration GW[2]	**Total Indoor Air Concentration**
	µg/m^3	µg/m^3	**µg/m^3**
Benzene	3.60E-01	Soil Only	**3.60E-01**
Bromodichloromethane	Groundwater Only	5.12E-04	**5.12E-04**
n-Butylbenzene	1.43E-01	Soil Only	**1.43E-01**
sec-Butylbenzene	4.56E-03	Soil Only	**4.56E-03**
tert-Butylbenzene	1.99E-02	Soil Only	**1.99E-02**
Chloroethane	Groundwater Only	3.44E-02	**3.44E-02**
Dibromochloromethane	Groundwater Only	1.28E-04	**1.28E-04**
Ethylbenzene	Groundwater Only	7.01E-01	**7.01E-01**
Isopropylbenzene	2.16E+01	Soil Only	**2.16E+01**
p-Isopropyltoluene	4.81E-01	Soil Only	**4.81E-01**
Methylene Chloride (DCM)	1.58E+00	Soil Only	**1.58E+00**
Naphthalene	1.28E-02	Soil Only	**1.28E-02**
n-Propylbenzene	7.48E-01	Soil Only	**7.48E-01**
Styrene	6.27E-01	Soil Only	**6.27E-01**
Toluene (Methyl benzene)	1.24E-01	5.12E-04	**1.24E-01**
1,2,4-Trimethylbenzene	2.23E-01	Soil Only	**2.23E-01**
1,3,5-Trimethylbenzene	2.04E-01	Soil Only	**2.04E-01**
Total Xylenes	1.39E+00	3.65E-03	**1.39E+00**

[1]See Johnson & Ettinger Calculations for Soil, Table 4-8a
[2]See Johnson & Ettinger Calculations for Groundwater, Table 4-8b

TABLE 4-9. SUMMARY OF THE RESULTS OF OFF-SITE AIR DISPERSION MODELING (SCREEN3 Model) LONG BEACH MEMORIAL MEDICAL CENTER MILLER CHILDREN'S HOSPITAL EXPANSION LONG BEACH, CALIFORNIA

Chemical	Off-Site Concentrations at Nearest Residential 1676 meters µg/m^3
Benzene	1.07E-09
n-Butylbenzene	2.35E-08
sec-Butylbenzene	4.32E-10
tert-Butylbenzene	3.51E-11
Ethylbenzene	4.75E-09
Isopropylbenzene	2.22E-13
p-Isopropyltoluene	3.48E-10
Methylene chloride (DCM)	2.76E-08
Naphthalene	1.94E-12
n-Propylbenzene	1.04E-09
Styrene	1.03E-10
Toluene (Methyl benzene)	1.08E-11
1,2,4-Trimethylbenzene	6.74E-12
1,3,5-Trimethylbenzene	4.22E-12
Total Xylenes	7.95E-09

TABLE 4-10.
EXPOSURE FACTORS AND CHRONIC DAILY INTAKE (CDI) FOR PROJECT-SPECIFIC RECEPTORS
LONG BEACH MEMORIAL MEDICAL CENTER, MILLER CHILDREN'S HOSPITAL EXPANSION, LONG BEACH, CALIFORNIA

Soil Ingestion

Receptor Scenario	Ingestion Rate [1]	Exposure Frequency [2,3]	Exposure Duration	Conversion Factor	Fraction Ingested	Body Weight [2,3]	Averaging Time		CDI Factor	
							Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic
	(mg/day)	(days/yr)	(years)	(kg/mg)	(%)	(kg)	(days)			
On-Site Construction Worker	480	250	1	0.000001	100%	70	365	25550	4.70E-06	6.71E-08

[1] Standard Default Exposure Factors, Supplemental Guidance to Risk Assessment Guidance for Superfund, U.S. EPA, March 1991 (USEPA, 1991)
[2] Exposure Factors Handbook, U.S. EPA, August 1997. (USEPA, 1997)
[3] Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, Cal/EPA, DTSC, July 1992 (DTSC, 1992)

Soil Dermal Contact

Receptor Scenario	Skin Surface[1]	Exposure Frequency [1,2]	Exposure Duration	Conversion Factor	Absorption Factor [3]	Body Weight [1,2]	Adherence Factor [4]	Averaging Time		CDI Factor	
								Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic
	(cm^2)	(days/yr)	(years)	(kg/mg)	(%)	(kg)	(mg/cm^2)	(days)			
On-Site Construction Worker	5700	250	1	0.000001	Chemical-Specific	70	0.8	365	25550	4.46E-05	6.37E-07

[1] Exposure Factors Handbook, U.S. EPA, August 1997. (USEPA, 1997)
[2] Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, Cal/EPA, DTSC, July 1992 (DTSC, 1992)
[3] Dermal Absorption Factors (AF) are chemical specific and are applied directly to the risk calculations. 10% for organics, 0.1% for cadmium, 1% for other metals. (DTSC, 1994)
[4] Supplemental Guidance Dermal Risk Assessment, Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (USEPA, 1998)

Inhalation of Volatiles from Soil and Groundwater

Receptor Scenario	Inhalation Rate [1]	Exposure Frequency	Exposure Duration	Conversion Factor	Body Weight[1,2]	Averaging Time		CDI Factor	
						Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic
	(m^3/day)	(days/yr)	(years)	(kg/mg)	(kg)	(days)			
On-Site Construction Worker	20	250	1	0.001	70	365	25550	1.96E-04	2.80E-06
Off-Site Hospital Patient (at LBMMC) (Adult) [3,4]	9.6	4.9	1	0.001	70	365	25550	1.84E-06	2.63E-08
Off-Site Hospital Patient (at LBMMC) (Child) [3,4]	7.2	4.9	1	0.001	15	365	25550	6.44E-06	9.21E-08
On-Site Hospital Patient (at MCH) (Adult) [3,4]	9.6	4.9	1	0.001	70	365	25550	9.77E-05	2.63E-08
On-Site Hospital Patient (at MCH) (Child) [3,4]	7.2	4.9	1	0.001	15	365	25550	3.42E-04	9.21E-08
On-/Off-Site Commercial/Industrial/Hospital Worker [2]	20	250	25	0.001	70	9125	25550	1.96E-04	6.99E-05
Off-Site Resident (Adult) [1, 2]	20	350	30	0.001	70	10950	25550	2.74E-04	1.41E-04
Off-Site Resident (Child) [1,2]	10	350	6	0.001	15	2190	25550	6.39E-04	

[1] Exposure Factors Handbook, U.S. EPA, August 1997. (USEPA, 1997)
[2] Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, Cal/EPA, DTSC, July 1992 (DTSC, 1992)
[3] Exposure factors for On-/Off-Site Commercial/Industrial/Hospital Worker and Off-Site Resident obtained from Cal-EPA Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities, August 1996.
[4] Inhalation rates for On-/Off-Site Hospital Patient obtained from U.S. EPA Exposure Factors Handbook (USEPA, 1997), and is based on short-term inhalation rates for children and adults during rest.
[5] Exposure Frequency for On-/Off-Site Hospital Patients at LBMMC and MCH based on average length of stay in 2002 for hospital inpatient care provided by National Center for Health Statistics, Center for Diesease Control (CDC, 2004) www.cdc.gov/nchs/fastats/hospital.html

TABLE 5-1. NON-CARCINOGENIC TOXICITY INFORMATION
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Chemical	Oral Reference Dose	Dermal Reference Dose	Inhalation Reference Dose	Information Source
	(mg/kg/day)			
VOCs				
Benzene	4.00E-03	4.00E-03	1.70E-02	IRIS [1]/ OEHHA [5]
n-Butylbenzene	4.00E-02	4.00E-02	4.00E-02	NCEA [1]
sec-Butylbenzene	4.00E-02	4.00E-02	4.00E-02	NCEA [1]
tert-Butylbenzene	4.00E-02	4.00E-02	4.00E-02	NCEA [1]
Bromodichloromethane	2.00E-02	2.00E-02	2.00E-02	IRIS [1,2]
Chloroethane	4.00E-01	4.00E-01	2.90E+00	IRIS [1]
Dibromochloromethane	2.00E-02	2.00E-02	2.00E-02	IRIS [1,2]
Ethylbenzene	1.00E-01	1.00E-01	2.90E-01	IRIS [1]
Isopropylbenzene	1.00E-01	1.00E-01	1.10E-01	IRIS [1]
p-Isopropyltoluene	--	--	--	No Data
Methylene chloride (DCM)	6.00E-02	6.00E-02	1.10E-01	IRIS [1]/ OEHHA [4]
Naphthalene	2.00E-02	2.00E-02	8.60E-04	IRIS[1]
n-Propylbenzene	4.00E-02	4.00E-02	4.00E-02	NCEA [1,2]
Toluene (Methyl benzene)	2.00E-01	2.00E-01	8.60E-02	IRIS [1]/ OEHHA [4]
1,2,4-Trimethylbenzene	5.00E-02	5.00E-02	1.70E-03	PPRTV
1,3,5-Trimethylbenzene	5.00E-02	5.00E-02	1.70E-03	PPRTV
Styrene	2.00E-01	2.00E-01	2.60E-01	IRIS [1]/ OEHHA [4]
Total Xylenes	2.00E-01	2.00E-01	2.90E-02	IRIS [1]
Cadmium	5.00E-04	5.00E-04	5.00E-04	IRIS [2]
Copper	4.00E-02	4.00E-02	4.00E-02	IRIS/HEAST [1,2]
Lead	See Note 3			
Molybdenum	5.00E-03	5.00E-03	5.00E-03	IRIS [1,2]
Thallium	6.60E-05	6.60E-05	6.60E-05	IRIS [1,2]
Zinc	3.00E-01	3.00E-01	3.00E-01	IRIS [1,2]
TPH as Gasoline and Light HC. (C4-C12)	2.00E-01	2.00E-01	1.14E-01	AEHS
TPH as Gasoline (C6-C16)	4.00E-02	4.00E-02	5.70E-02	AEHS
TPH as Diesel (C11-C23)	4.00E-02	4.00E-02	5.70E-02	AEHS
TPH as Diesel (C13-C22)	3.00E-02	3.00E-02	5.70E-02	AEHS
TPH as Heavy Hydrocarbons (C23-C40)	3.00E-02	3.00E-02	--	AEHS
Fuel mix (C6-23)	3.00E-02	3.00E-02	--	AEHS
TRPH	3.00E-02	3.00E-02	--	AEHS

Notes:
No Data = No reference doses have been developed for a particular compound.
[1] Route extrapolation: Oral to Dermal
[2] Route Extrapolation: Oral to Inhalation
[3] Risk from inorganic lead in soil was evaluated separately using DTSC Lead Risk Assessment Spreadsheet (Leadspread) (DTSC, 1999)
[4] Inhalation Reference Dose calculated from Inhalation Chronic REL from OEHHA
AEHS = Association for Environmental Health and Sciences, TPH Working Group (1997)
IRIS = U.S. EPA's Integrated Risk Management System, 2004
HEAST = U.S. EPA's Health Effects Assessment Summary Tables, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 2004
NCEA = National Center for Environmental Assessment, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 2004
OEHHA = Cal-EPA Office of Environmental Health Hazard Assessment Chronic Exposure Levels Table, September 2004
PPRTV = Provisional Peer Review Toxicity Value, IRIS, 2004

TABLE 5-2. CARCINOGENIC TOXICITY INFORMATION
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

Chemical	Cancer Slope Factors			Information Source
	Oral	Dermal	Inhalation	
	$(mg/kg/day)^{-1}$			
Benzene	1.00E-01	1.00E-01	1.00E-01	OEHHA[1]
n-Butylbenzene	NC	NC	NC	--
sec-Butylbenzene	NC	NC	NC	--
tert-Butylbenzene	NC	NC	NC	--
Bromodichloromethane	1.30E-01	1.30E-01	1.30E-01	OEHHA[1]
Chloroethane	2.90E-03	2.90E-03	2.90E-03	NCEA[1]
Dibromochloromethane	8.40E-02	8.40E-02	8.40E-02	IRIS [1,2]
Ethylbenzene	--	--	--	No Data
Isopropylbenzene	NC	NC	NC	--
p-Isopropyltoluene	--	--	--	No Data
Methylene chloride (DCM)	1.40E-02	1.40E-02	3.50E-03	OEHHA[1]
Naphthalene	NC	NC	NC	--
n-Propylbenzene	--	--	--	No Data
Toluene (Methyl benzene)	NC	NC	NC	--
1,2,4-Trimethylbenzene	NC	NC	NC	--
1,3,5-Trimethylbenzene	NC	NC	NC	--
Styrene	NC	NC	NC	--
Total Xylenes	NC	NC	NC	--
Cadmium	3.80E-01	3.80E-01	1.50E+01	OEHHA [1]
Copper	NC	NC	NC	--
Lead	See Note 4			
Molybdenum	NC	NC	NC	--
Thallium	NC	NC	NC	--
Zinc	NC	NC	NC	--
TPH as Gasoline and Light HC. (C4-C12)	NC	NC	NC	--
TPH as Gasoline (C6-C16)	NC	NC	NC	--
TPH as Diesel (C11-C23)	NC	NC	NC	--
TPH as Diesel (C13-C22)	NC	NC	NC	--
TPH as Heavy Hydrocarbons (C23-C40)	NC	NC	NC	--
Fuel mix (C6-23)	NC	NC	NC	--
TRPH	NC	NC	NC	--

Notes:
NC = Compound is not a carcinogen.
[1] Route Extrapolation: Oral to Dermal
[2] Route Extrapolation: Oral to Inhalation
[3] Risk from inorganic lead in soil was evaluated separately using DTSC Lead Risk Assessment Spreadsheet (Leadspread) (DTSC, 1999)
OEHHA = California EPA, Office of the Environmental Health Hazard Assessment, 2004
IRIS = U.S. EPA's Integrated Risk Management System, 2004
HEAST = U.S. EPA's Health Effects Assessment Summary Tables, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 2004
NCEA = National Center for Environmental Assessment, from U.S. EPA Region 9, Preliminary Remediation Goals (PRG) Table, October 2004

TABLE 6-1. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPITAL PATIENT (CHILD)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	3.60E-01	6.44E-06	1.70E-02	1.E-04	3.7%
Bromodichloromethane	5.12E-04	6.44E-06	2.00E-02	2.E-07	0.0%
n-Butylbenzene	1.43E-01	6.44E-06	4.00E-02	2.E-05	0.6%
sec-Butylbenzene	4.56E-03	6.44E-06	4.00E-02	7.E-07	0.0%
tert-Butylbenzene	1.99E-02	6.44E-06	4.00E-02	3.E-06	0.1%
Chloroethane	3.44E-02	6.44E-06	2.90E+00	8.E-08	0.0%
Dibromochloromethane	1.28E-04	6.44E-06	2.00E-02	--	<0.001%
Ethylbenzene	7.01E-01	6.44E-06	2.90E-01	2.E-05	0.4%
Isopropylbenzene	2.16E+01	6.44E-06	1.10E-01	1.E-03	34.2%
p-Isopropyltoluene	4.81E-01	6.44E-06	--	--	<0.001%
Methylene Chloride (DCM)	1.58E+00	6.44E-06	1.10E-01	9.E-05	2.5%
Naphthalene	1.28E-02	6.44E-06	8.60E-04	1.E-04	2.6%
n-Propylbenzene	7.48E-01	6.44E-06	4.00E-02	1.E-04	3.2%
Styrene	6.27E-01	6.44E-06	2.60E-01	2.E-05	0.4%
Toluene (Methyl benzene)	1.24E-01	6.44E-06	8.60E-02	9.E-06	0.3%
1,2,4-Trimethylbenzene	2.23E-01	6.44E-06	1.70E-03	8.E-04	22.8%
1,3,5-Trimethylbenzene	2.04E-01	6.44E-06	1.70E-03	8.E-04	20.8%
Total Xylenes	1.39E+00	6.44E-06	2.90E-02	3.E-04	8.3%
Inhalation Pathway Total Hazard Index =				**0.004**	100%

Hazard Index: Current/Project Off-Site Hospital Patient (child) =	**0.004**

TABLE 6-2. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPITAL PATIENT (ADULT)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	3.60E-01	1.84E-06	1.70E-02	4.E-05	4%
Bromodichloromethane	5.12E-04	1.84E-06	2.00E-02	5.E-08	0%
n-Butylbenzene	1.43E-01	1.84E-06	4.00E-02	7.E-06	1%
sec-Butylbenzene	4.56E-03	1.84E-06	4.00E-02	2.E-07	0%
tert-Butylbenzene	1.99E-02	1.84E-06	4.00E-02	9.E-07	0%
Chloroethane	3.44E-02	1.84E-06	2.90E+00	2.E-08	0%
Dibromochloromethane	1.28E-04	1.84E-06	2.00E-02	1.E-08	0%
Ethylbenzene	7.01E-01	1.84E-06	2.90E-01	4.E-06	0%
Isopropylbenzene	2.16E+01	1.84E-06	1.10E-01	4.E-04	34%
p-Isopropyltoluene	4.81E-01	1.84E-06	--	--	<0.001%
Methylene Chloride (DCM)	1.58E+00	1.84E-06	1.10E-01	3.E-05	2%
Naphthalene	1.28E-02	1.84E-06	8.60E-04	3.E-05	3%
n-Propylbenzene	7.48E-01	1.84E-06	4.00E-02	3.E-05	3%
Styrene	6.27E-01	1.84E-06	2.60E-01	4.E-06	0%
Toluene (Methyl benzene)	1.24E-01	1.84E-06	8.60E-02	3.E-06	0%
1,2,4-Trimethylbenzene	2.23E-01	1.84E-06	1.70E-03	2.E-04	23%
1,3,5-Trimethylbenzene	2.04E-01	1.84E-06	1.70E-03	2.E-04	21%
Total Xylenes	1.39E+00	1.84E-06	2.90E-02	9.E-05	8%
	Inhalation Pathway Total Hazard Index =			**0.001**	100%

Hazard Index: Current/Project Off-Site Hospital Patient (adult) =	**0.001**

TABLE 6-3. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPITAL PATIENT (CHILD)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	3.60E-01	9.21E-08	1.00E-01	3.E-09	86%
Bromodichloromethane	5.12E-04	9.21E-08	1.30E-01	6.E-12	0%
n-Butylbenzene	1.43E-01	9.21E-08	NC	0.E+00	<0.001%
sec-Butylbenzene	4.56E-03	9.21E-08	NC	0.E+00	<0.001%
tert-Butylbenzene	1.99E-02	9.21E-08	NC	0.E+00	<0.001%
Chloroethane	3.44E-02	9.21E-08	2.90E-03	9.E-12	0%
Dibromochloromethane	1.28E-04	9.21E-08	8.40E-02	1.E-12	0%
Ethylbenzene	7.01E-01	9.21E-08	--	0.E+00	<0.001%
Isopropylbenzene	2.16E+01	9.21E-08	NC	0.E+00	<0.001%
p-Isopropyltoluene	4.81E-01	9.21E-08	--	0.E+00	<0.001%
Methylene Chloride (DCM)	1.58E+00	9.21E-08	3.50E-03	5.E-10	13%
Naphthalene	1.28E-02	9.21E-08	NC	0.E+00	<0.001%
n-Propylbenzene	7.48E-01	9.21E-08	--	0.E+00	<0.001%
Styrene	6.27E-01	9.21E-08	NC	0.E+00	<0.001%
Toluene (Methyl benzene)	1.24E-01	9.21E-08	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	2.23E-01	9.21E-08	NC	0.E+00	<0.001%
1,3,5-Trimethylbenzene	2.04E-01	9.21E-08	NC	0.E+00	<0.001%
Total Xylenes	1.39E+00	9.21E-08	NC	0.E+00	<0.001%
			Inhalation Pathway ELCR =	**4E-09**	100%

ELCR: Current/Project Off-Site Hospital Patient (child)= 4E-09

TABLE 6-4. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE HOSPTIAL PATIENT (ADULT)
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	3.60E-01	2.63E-08	1.00E-01	9.E-10	86%
Bromodichloromethane	5.12E-04	2.63E-08	1.30E-01	2.E-12	0%
n-Butylbenzene	1.43E-01	2.63E-08	NC	0.E+00	<0.001%
sec-Butylbenzene	4.56E-03	2.63E-08	NC	0.E+00	<0.001%
tert-Butylbenzene	1.99E-02	2.63E-08	NC	0.E+00	<0.001%
Chloroethane	3.44E-02	2.63E-08	2.90E-03	3.E-12	0%
Dibromochloromethane	1.28E-04	2.63E-08	8.40E-02	3.E-13	0%
Ethylbenzene	7.01E-01	2.63E-08	--	0.E+00	<0.001%
Isopropylbenzene	2.16E+01	2.63E-08	NC	0.E+00	<0.001%
p-Isopropyltoluene	4.81E-01	2.63E-08	--	0.E+00	<0.001%
Methylene Chloride (DCM)	1.58E+00	2.63E-08	3.50E-03	1.E-10	13%
Naphthalene	1.28E-02	2.63E-08	NC	0.E+00	<0.001%
n-Propylbenzene	7.48E-01	2.63E-08	--	0.E+00	<0.001%
Styrene	6.27E-01	2.63E-08	NC	0.E+00	<0.001%
Toluene (Methyl benzene)	1.24E-01	2.63E-08	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	2.23E-01	2.63E-08	NC	0.E+00	<0.001%
1,3,5-Trimethylbenzene	2.04E-01	2.63E-08	NC	0.E+00	<0.001%
Total Xylenes	1.39E+00	2.63E-08	NC	0.E+00	<0.001%
		Inhalation Pathway ELCR =		**1E-09**	100%

ELCR: Current/Project Off-Site Hospital Patient (adult) = 1E-09

TABLE 6-5. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
	µg/m^3				
Benzene	3.60E-01	1.96E-04	1.70E-02	4.E-03	4%
Bromodichloromethane	5.12E-04	1.96E-04	2.00E-02	5.E-06	0%
n-Butylbenzene	1.43E-01	1.96E-04	4.00E-02	7.E-04	1%
sec-Butylbenzene	4.56E-03	1.96E-04	4.00E-02	2.E-05	0%
tert-Butylbenzene	1.99E-02	1.96E-04	4.00E-02	1.E-04	0%
Chloroethane	3.44E-02	1.96E-04	2.90E+00	2.E-06	0%
Dibromochloromethane	1.28E-04	1.96E-04	2.00E-02	1.E-06	0%
Ethylbenzene	7.01E-01	1.96E-04	2.90E-01	5.E-04	0%
Isopropylbenzene	2.16E+01	1.96E-04	1.10E-01	4.E-02	34%
p-Isopropyltoluene	4.81E-01	1.96E-04	--	--	<0.001%
Methylene Chloride (DCM)	1.58E+00	1.96E-04	1.10E-01	3.E-03	2%
Naphthalene	1.28E-02	1.96E-04	8.60E-04	3.E-03	3%
n-Propylbenzene	7.48E-01	1.96E-04	4.00E-02	4.E-03	3%
Styrene	6.27E-01	1.96E-04	2.60E-01	5.E-04	0%
Toluene (Methyl benzene)	1.24E-01	1.96E-04	8.60E-02	3.E-04	0%
1,2,4-Trimethylbenzene	2.23E-01	1.96E-04	1.70E-03	3.E-02	23%
1,3,5-Trimethylbenzene	2.04E-01	1.96E-04	1.70E-03	2.E-02	21%
Total Xylenes	1.39E+00	1.96E-04	2.9E-02	9.E-03	8%
		Inhalation Pathway ELCR =		**0.1**	100%

Hazard Index: Current/Project Off-Site Com./Ind./Hosp. Worker =	**0.1**

TABLE 6-6. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AT LONG BEACH MEMORIAL MEDICAL CENTER MAIN BUILDING

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
	µg/m^3				
Benzene	3.60E-01	6.99E-05	1.00E-01	3.E-06	86%
Bromodichloromethane	5.12E-04	6.99E-05	1.30E-01	5.E-09	0%
n-Butylbenzene	1.43E-01	6.99E-05	NC	0.E+00	<0.001%
sec-Butylbenzene	4.56E-03	6.99E-05	NC	0.E+00	<0.001%
tert-Butylbenzene	1.99E-02	6.99E-05	NC	0.E+00	<0.001%
Chloroethane	3.44E-02	6.99E-05	2.90E-03	7.E-09	0%
Dibromochloromethane	1.28E-04	6.99E-05	8.40E-02	8.E-10	0%
Ethylbenzene	7.01E-01	6.99E-05	--	0.E+00	<0.001%
Isopropylbenzene	2.16E+01	6.99E-05	NC	0.E+00	<0.001%
p-Isopropyltoluene	4.81E-01	6.99E-05	--	0.E+00	<0.001%
Methylene Chloride (DCM)	1.58E+00	6.99E-05	3.50E-03	4.E-07	13%
Naphthalene	1.28E-02	6.99E-05	NC	0.E+00	<0.001%
n-Propylbenzene	7.48E-01	6.99E-05	--	0.E+00	<0.001%
Styrene	6.27E-01	6.99E-05	NC	0.E+00	<0.001%
Toluene (Methyl benzene)	1.24E-01	6.99E-05	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	2.23E-01	6.99E-05	NC	0.E+00	<0.001%
1,3,5-Trimethylbenzene	2.04E-01	6.99E-05	NC	0.E+00	<0.001%
Total Xylenes	1.39E+00	6.99E-05	NC	0.E+00	<0.001%
			Inhalation ELCR =	**3E-06**	100%

ELCR: Current/Project Off-Site Com./Ind./Hosp. Worker = 3E-06

TABLE 6-7. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE RESIDENT (CHILD)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	1.07E-09	6.39E-04	1.70E-02	4.E-11	5%
n-Butylbenzene	2.35E-08	6.39E-04	4.00E-02	4.E-10	48%
sec-Butylbenzene	4.32E-10	6.39E-04	4.00E-02	7.E-12	1%
tert-Butylbenzene	3.51E-11	6.39E-04	4.00E-02	6.E-13	0%
Ethylbenzene	4.75E-09	6.39E-04	2.90E-01	1.E-11	1%
Isopropylbenzene	2.22E-13	6.39E-04	1.10E-01	1.E-15	<0.001%
p-Isopropyltoluene	3.48E-10	6.39E-04	--	--	<0.001%
Methylene chloride (DCM)	2.76E-08	6.39E-04	1.10E-01	2.E-10	21%
Naphthalene	1.94E-12	6.39E-04	8.60E-04	1.E-12	0%
n-Propylbenzene	1.04E-09	6.39E-04	4.00E-02	--	<0.001%
Styrene	1.03E-10	6.39E-04	2.60E-01	3.E-13	0%
Toluene (Methyl benzene)	1.08E-11	6.39E-04	8.60E-02	8.E-14	0%
1,2,4-Trimethylbenzene	6.74E-12	6.39E-04	1.70E-03	3.E-12	0%
1,3,5-Trimethylbenzene	4.22E-12	6.39E-04	1.70E-03	2.E-12	0%
Total Xylenes	7.95E-09	6.39E-04	2.90E-02	2.E-10	23%
Inhalation Pathway Total Hazard Index =				**8E-10**	100%

Hazard Index: Current/Project Off-Site Resident Child = 8E-10

TABLE 6-8. HAZARD INDEX
CURRENT AND PROJECT SCENARIO
OFF-SITE RESIDENT (ADULT)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	1.07E-09	2.74E-04	1.70E-02	2.E-11	5%
n-Butylbenzene	2.35E-08	2.74E-04	4.00E-02	2.E-10	48%
sec-Butylbenzene	4.32E-10	2.74E-04	4.00E-02	3.E-12	1%
tert-Butylbenzene	3.51E-11	2.74E-04	4.00E-02	2.E-13	0%
Ethylbenzene	4.75E-09	2.74E-04	2.90E-01	4.E-12	1%
Isopropylbenzene	2.22E-13	2.74E-04	1.10E-01	6.E-16	<0.001%
p-Isopropyltoluene	3.48E-10	2.74E-04	--	--	<0.001%
Methylene chloride (DCM)	2.76E-08	2.74E-04	1.10E-01	7.E-11	21%
Naphthalene	1.94E-12	2.74E-04	8.60E-04	6.E-13	0%
n-Propylbenzene	1.04E-09	2.74E-04	4.00E-02	--	<0.001%
Styrene	1.03E-10	2.74E-04	2.60E-01	1.E-13	0%
Toluene (Methyl benzene)	1.08E-11	2.74E-04	8.60E-02	3.E-14	0%
1,2,4-Trimethylbenzene	6.74E-12	2.74E-04	1.70E-03	1.E-12	0%
1,3,5-Trimethylbenzene	4.22E-12	2.74E-04	1.70E-03	7.E-13	0%
Total Xylenes	7.95E-09	2.74E-04	2.90E-02	8.E-11	23%
Inhalation Pathway Total Hazard Index =				**3E-10**	100%

Hazard Index: Current/Project Off-Site Resident Adult =	**3E-10**

TABLE 6-9. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
CURRENT AND PROJECT SCENARIO
OFF-SITE RESIDENT (ADULT AND CHILD)

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	1.07E-09	1.41E-04	1.00E-01	2.E-14	53%
n-Butylbenzene	2.35E-08	1.41E-04	NC	0.E+00	<0.001%
sec-Butylbenzene	4.32E-10	1.41E-04	NC	0.E+00	<0.001%
tert-Butylbenzene	3.51E-11	1.41E-04	NC	0.E+00	<0.001%
Ethylbenzene	4.75E-09	1.41E-04	--	0.E+00	<0.001%
Isopropylbenzene	2.22E-13	1.41E-04	NC	0.E+00	<0.001%
p-Isopropyltoluene	3.48E-10	1.41E-04	--	0.E+00	<0.001%
Methylene chloride (DCM)	2.76E-08	1.41E-04	3.50E-03	1.E-14	47%
Naphthalene	1.94E-12	1.41E-04	NC	0.E+00	<0.001%
n-Propylbenzene	1.04E-09	1.41E-04	--	0.E+00	<0.001%
Styrene	1.03E-10	1.41E-04	NC	0.E+00	<0.001%
Toluene (Methyl benzene)	1.08E-11	1.41E-04	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	6.74E-12	1.41E-04	NC	0.E+00	<0.001%
1,3,5-Trimethylbenzene	4.22E-12	1.41E-04	NC	0.E+00	<0.001%
Total Xylenes	7.95E-09	1.41E-04	NC	0.E+00	<0.001%
			Inhalation Pathway ELCR =	**3E-14**	100%

ELCR: Current/Project Off-Site Resident (Adult and Child) =	**3E-14**

TABLE 6-10. HAZARD INDEX
PROJECT SCENARIO
ON-SITE CONSTRUCTION WORKER
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	3.74E-05	1.96E-04	1.70E-02	4.E-07	<0.001%
n-Butylbenzene	8.23E-04	1.96E-04	4.00E-02	4.E-06	<0.001%
sec-Butylbenzene	1.51E-05	1.96E-04	4.00E-02	7.E-08	<0.001%
tert-Butylbenzene	1.23E-06	1.96E-04	4.00E-02	6.E-09	<0.001%
Ethylbenzene	1.66E-04	1.96E-04	2.90E-01	1.E-07	<0.001%
Isopropylbenzene	7.77E-09	1.96E-04	1.10E-01	1.E-11	<0.001%
p-Isopropyltoluene	1.22E-05	1.96E-04	--	--	<0.001%
Naphthalene	2.13E-06	1.96E-04	8.60E-04	5.E-07	<0.001%
n-Propylbenzene	2.28E-03	1.96E-04	4.00E-02	1.E-05	<0.001%
Toluene (Methyl benzene)	5.90E-05	1.96E-04	8.60E-02	1.E-07	<0.001%
1,2,4-Trimethylbenzene	5.18E-05	1.96E-04	1.70E-03	6.E-06	<0.001%
Total Xylenes	1.55E-04	1.96E-04	2.90E-02	1.E-06	<0.001%
Cadmium	8.64E-07	1.96E-04	5.00E-04	3.E-07	<0.001%
Copper	3.18E-05	1.96E-04	4.00E-02	2.E-07	<0.001%
Molybdenum	1.39E-06	1.96E-04	5.00E-03	5.E-08	<0.001%
Thallium	1.80E-06	1.96E-04	6.60E-05	5.E-06	<0.001%
Zinc	1.82E-04	1.96E-04	3.00E-01	1.E-07	<0.001%
TPH as Gasoline and Light HC. (C4-C12)	1.51E-04	1.96E-04	1.14E-01	3.E-07	<0.001%
TPH as Gasoline (C6-C16)	1.75E-05	1.96E-04	5.70E-02	6.E-08	<0.001%
TPH as Diesel (C13-C22)	9.97E-04	1.96E-04	5.70E-02	3.E-06	<0.001%
TPH as Heavy Hydrocarbons (C23-C40)	1.08E-03	1.96E-04	--	--	<0.001%
Fuel mix (C6-23)	2.05E-04	1.96E-04	--	--	<0.001%
TRPH	6.29E-03	1.96E-04	--	--	<0.001%
			Inhalation Pathway Hazard Index =	**3E-05**	0%

Soil Ingestion

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	1.31E-02	4.70E-06	4.00E-03	2.E-05	<0.001%
n-Butylbenzene	3.47E-02	4.70E-06	4.00E-02	4.E-06	<0.001%
sec-Butylbenzene	8.97E-02	4.70E-06	4.00E-02	1.E-05	<0.001%
tert-Butylbenzene	1.08E-02	4.70E-06	4.00E-02	1.E-06	<0.001%
Ethylbenzene	2.42E-02	4.70E-06	1.00E-01	1.E-06	<0.001%
Isopropylbenzene	7.75E-02	4.70E-06	1.00E-01	4.E-06	<0.001%
p-Isopropyltoluene	6.09E-02	4.70E-06	--	--	<0.001%
Naphthalene	1.83E-01	4.70E-06	2.00E-02	4.E-05	0%
n-Propylbenzene	1.05E-01	4.70E-06	4.00E-02	1.E-05	<0.001%
Toluene (Methyl benzene)	2.68E-02	4.70E-06	2.00E-01	6.E-07	<0.001%
1,2,4-Trimethylbenzene	1.57E-01	4.70E-06	5.00E-02	1.E-05	<0.001%
Total Xylenes	7.45E-02	4.70E-06	2.00E-01	2.E-06	<0.001%
Cadmium	1.14E+00	4.70E-06	5.00E-04	1.E-02	0%
Copper	4.18E+01	4.70E-06	4.00E-02	5.E-03	0%
Molybdenum	1.83E+00	4.70E-06	5.00E-03	2.E-03	0%
Thallium	2.37E+00	4.70E-06	6.60E-05	2.E-01	5%
Zinc	2.39E+02	4.70E-06	3.00E-01	4.E-03	0%
TPH as Gasoline and Light HC. (C4-C12)	1.98E+02	4.70E-06	2.00E-01	5.E-03	0%
TPH as Gasoline (C6-C16)	NA	4.70E-06	4.00E-02	0.E+00	<0.001%
TPH as Diesel (C13-C22)	1.31E+03	4.70E-06	3.00E-02	2.E-01	6%
TPH as Heavy Hydrocarbons (C23-C40)	1.42E+03	4.70E-06	3.00E-02	2.E-01	6%
Fuel mix (C6-23)	NA	4.70E-06	3.00E-02	0.E+00	<0.001%
TRPH	8.28E+03	4.70E-06	3.00E-02	1.E+00	36%
			Soil Ingestion Pathway Hazard Index =	**2**	54%

Dermal Absorption of Soil

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	1.31E-02	4.46E-06	4.00E-03	1.E-05	<0.001%
n-Butylbenzene	3.47E-02	4.46E-06	4.00E-02	4.E-06	<0.001%
sec-Butylbenzene	8.97E-02	4.46E-06	4.00E-02	1.E-05	<0.001%
tert-Butylbenzene	1.08E-02	4.46E-06	4.00E-02	1.E-06	<0.001%
Ethylbenzene	2.42E-02	4.46E-06	1.00E-01	1.E-06	<0.001%
Isopropylbenzene	7.75E-02	4.46E-06	1.00E-01	3.E-06	<0.001%
p-Isopropyltoluene	6.09E-02	4.46E-06	--	--	<0.001%
Naphthalene	1.83E-01	4.46E-06	2.00E-02	4.E-05	0%
n-Propylbenzene	1.05E-01	4.46E-06	4.00E-02	1.E-05	<0.001%
Toluene (Methyl benzene)	2.68E-02	4.46E-06	2.00E-01	6.E-07	<0.001%
1,2,4-Trimethylbenzene	1.57E-01	4.46E-06	5.00E-02	1.E-05	<0.001%
Total Xylenes	7.45E-02	4.46E-06	2.00E-01	2.E-06	<0.001%
Cadmium	1.14E+00	4.46E-08	5.00E-04	1.E-04	0%
Copper	4.18E+01	4.46E-07	4.00E-02	5.E-04	0%
Molybdenum	1.83E+00	4.46E-07	5.00E-03	2.E-04	0%
Thallium	2.37E+00	4.46E-07	6.60E-05	2.E-02	0%
Zinc	2.39E+02	4.46E-07	3.00E-01	4.E-04	0%
TPH as Gasoline and Light HC. (C4-C12)	1.98E+02	4.46E-06	2.00E-01	4.E-03	0%
TPH as Gasoline (C6-C16)	NA	4.46E-06	4.00E-02	0.E+00	<0.001%
TPH as Diesel (C13-C22)	1.31E+03	4.46E-06	3.00E-02	2.E-01	5%
TPH as Heavy Hydrocarbons (C23-C40)	1.42E+03	4.46E-06	3.00E-02	2.E-01	6%
Fuel mix (C6-23)	NA	4.46E-06	3.00E-02	0.E+00	<0.001%
TRPH	8.28E+03	4.46E-06	3.00E-02	1.E+00	34%
			Dermal Absorption of Soil Pathway Hazard Index=	**2**	46%

Hazard Index: Project On-Site Construction Worker =	**4**	100%

TABLE 6-11. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE CONSTRUCTION WORKER
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	3.74E-05	2.80E-06	1.00E-01	1.E-11	0%
n-Butylbenzene	8.23E-04	2.80E-06	NC	0.E+00	<0.001%
sec-Butylbenzene	1.51E-05	2.80E-06	NC	0.E+00	<0.001%
tert-Butylbenzene	1.23E-06	2.80E-06	NC	0.E+00	<0.001%
Ethylbenzene	1.66E-04	2.80E-06	--	0.E+00	<0.001%
Isopropylbenzene	7.77E-09	2.80E-06	NC	0.E+00	<0.001%
p-Isopropyltoluene	1.22E-05	2.80E-06	--	0.E+00	<0.001%
Naphthalene	2.13E-06	2.80E-06	NC	0.E+00	<0.001%
n-Propylbenzene	2.28E-03	2.80E-06	--	0.E+00	<0.001%
Toluene (Methyl benzene)	5.90E-05	2.80E-06	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	5.18E-05	2.80E-06	NC	0.E+00	<0.001%
Total Xylenes	1.55E-04	2.80E-06	NC	0.E+00	<0.001%
Cadmium	8.64E-07	2.80E-06	1.50E+01	4.E-11	0%
Copper	3.18E-05	2.80E-06	NC	0.E+00	<0.001%
Molybdenum	1.39E-06	2.80E-06	NC	0.E+00	<0.001%
Thallium	1.80E-06	2.80E-06	NC	0.E+00	<0.001%
Zinc	1.82E-04	2.80E-06	NC	0.E+00	<0.001%
TPH as Gasoline and Light HC. (C4-C12)	1.51E-04	2.80E-06	NC	0.E+00	<0.001%
TPH as Gasoline (C6-C16)	1.75E-05	2.80E-06	NC	0.E+00	<0.001%
TPH as Diesel (C13-C22)	9.97E-04	2.80E-06	NC	0.E+00	<0.001%
TPH as Heavy Hydrocarbons (C23-C40)	1.08E-03	2.80E-06	NC	0.E+00	<0.001%
Fuel mix (C6-23)	2.05E-04	2.80E-06	NC	0.E+00	<0.001%
TRPH	6.29E-03	2.80E-06	--	0.E+00	<0.001%
			Inhalation Pathway ELCR =	**5E-11**	0%

Soil Ingestion

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	1.31E-02	6.71E-08	1.00E-01	9.E-11	0%
n-Butylbenzene	3.47E-02	6.71E-08	NC	0.E+00	<0.001%
sec-Butylbenzene	8.97E-02	6.71E-08	NC	0.E+00	<0.001%
tert-Butylbenzene	1.08E-02	6.71E-08	NC	0.E+00	<0.001%
Ethylbenzene	2.42E-02	6.71E-08	--	0.E+00	<0.001%
Isopropylbenzene	7.75E-02	6.71E-08	NC	0.E+00	<0.001%
p-Isopropyltoluene	6.09E-02	6.71E-08	--	0.E+00	<0.001%
Naphthalene	1.83E-01	6.71E-08	NC	0.E+00	<0.001%
n-Propylbenzene	1.05E-01	6.71E-08	--	0.E+00	<0.001%
Toluene (Methyl benzene)	2.68E-02	6.71E-08	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	1.57E-01	6.71E-08	NC	0.E+00	<0.001%
Total Xylenes	7.45E-02	6.71E-08	NC	0.E+00	<0.001%
Cadmium	1.14E+00	6.71E-08	3.80E-01	3.E-08	98%
Copper	4.18E+01	6.71E-08	NC	0.E+00	<0.001%
Molybdenum	1.83E+00	6.71E-08	NC	0.E+00	<0.001%
Thallium	2.37E+00	6.71E-08	NC	0.E+00	<0.001%
Zinc	2.39E+02	6.71E-08	NC	0.E+00	<0.001%
TPH as Gasoline and Light HC. (C4-C12)	1.98E+02	6.71E-08	NC	0.E+00	<0.001%
TPH as Gasoline (C6-C16)	NA	6.71E-08	NC	0.E+00	<0.001%
TPH as Diesel (C13-C22)	1.31E+03	6.71E-08	NC	0.E+00	<0.001%
TPH as Heavy Hydrocarbons (C23-C40)	1.42E+03	6.71E-08	NC	0.E+00	<0.001%
Fuel mix (C6-23)	NA	6.71E-08	NC	0.E+00	<0.001%
TRPH	8.28E+03	6.71E-08	NC	0.E+00	<0.001%
			Soil Ingestion Pathway ELCR =	**3E-08**	99%

Dermal Absorption of Soil

Chemical	Concentration mg/kg	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	1.31E-02	6.37E-08	1.00E-01	8.E-11	0%
n-Butylbenzene	3.47E-02	6.37E-08	NC	--	<0.001%
sec-Butylbenzene	8.97E-02	6.37E-08	NC	--	<0.001%
tert-Butylbenzene	1.08E-02	6.37E-08	NC	--	<0.001%
Ethylbenzene	2.42E-02	6.37E-08	--	0.E+00	<0.001%
Isopropylbenzene	7.75E-02	6.37E-08	NC	--	<0.001%
p-Isopropyltoluene	6.09E-02	6.37E-08	--	--	<0.001%
Naphthalene	1.83E-01	9.56E-08	NC	--	<0.001%
n-Propylbenzene	1.05E-01	6.37E-08	--	--	<0.001%
Toluene (Methyl benzene)	2.68E-02	6.37E-08	NC	--	<0.001%
1,2,4-Trimethylbenzene	1.57E-01	6.37E-08	NC	--	<0.001%
Total Xylenes	7.45E-02	6.37E-08	NC	--	<0.001%
Cadmium	1.14E+00	6.37E-10	3.80E-01	3.E-10	1%
Copper	4.18E+01	6.37E-09	NC	--	<0.001%
Molybdenum	1.83E+00	6.37E-09	NC	--	<0.001%
Thallium	2.37E+00	6.37E-09	NC	--	<0.001%
Zinc	2.39E+02	6.37E-09	NC	--	<0.001%
TPH as Gasoline and Light HC. (C4-C12)	1.98E+02	6.37E-08	NC	--	<0.001%
TPH as Gasoline (C6-C16)	NA	6.37E-08	NC	--	<0.001%
TPH as Diesel (C13-C22)	1.31E+03	6.37E-08	NC	--	<0.001%
TPH as Heavy Hydrocarbons (C23-C40)	1.42E+03	6.37E-08	NC	--	<0.001%
Fuel mix (C6-23)	NA	6.37E-08	NC	--	<0.001%
TRPH	8.28E+03	6.37E-08	NC	--	<0.001%
			Dermal Absorption of Soil Pathway ELCR=	**4E-10**	1%

ELCR = Project On-Site Construction Worker =	**3E-08**	100%

TABLE 6-12. HAZARD INDEX
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (CHILD)
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	3.40E-01	3.42E-04	1.70E-02	7.E-03	6%
Bromodichloromethane	4.96E-04	3.42E-04	2.00E-02	8.E-06	0%
n-Butylbenzene	1.34E-01	3.42E-04	4.00E-02	1.E-03	1%
sec-Butylbenzene	1.79E-02	3.42E-04	4.00E-02	2.E-04	0%
tert-Butylbenzene	1.87E-02	3.42E-04	4.00E-02	2.E-04	0%
Chloroethane	3.27E-02	3.42E-04	2.90E+00	4.E-06	0%
Dibromochloromethane	1.24E-04	3.42E-04	2.00E-02	2.E-06	0%
Ethylbenzene	6.61E-01	3.42E-04	2.90E-01	8.E-04	1%
Isopropylbenzene	4.92E+00	3.42E-04	1.10E-01	2.E-02	13%
p-Isopropyltoluene	4.53E-01	3.42E-04	--	--	<0.001%
Methylene Chloride (DCM)	1.49E+00	3.42E-04	1.10E-01	5.E-03	4%
Naphthalene	1.21E-02	3.42E-04	8.60E-04	5.E-03	4%
n-Propylbenzene	7.06E-01	3.42E-04	4.00E-02	6.E-03	5%
Styrene	5.91E-01	3.42E-04	2.60E-01	8.E-04	1%
Toluene (Methyl benzene)	1.18E-01	3.42E-04	8.60E-02	5.E-04	0%
1,2,4-Trimethylbenzene	1.17E-01	3.42E-04	1.70E-03	2.E-02	20%
1,3,5-Trimethylbenzene	1.92E-01	3.42E-04	1.70E-03	4.E-02	33%
Total Xylenes	1.31E+00	3.42E-04	2.90E-02	2.E-02	13%
Inhalation Pathway Total Hazard Index =				**0.1**	100%

Hazard Index: Project On-site Hospital Patient (child)=	**0.1**

TABLE 6-13. HAZARD INDEX
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (ADULT)
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	3.40E-01	9.77E-05	1.70E-02	2.E-03	6%
Bromodichloromethane	4.96E-04	9.77E-05	2.00E-02	2.E-06	0%
n-Butylbenzene	1.34E-01	9.77E-05	4.00E-02	3.E-04	1%
sec-Butylbenzene	1.79E-02	9.77E-05	4.00E-02	4.E-05	0%
tert-Butylbenzene	1.87E-02	9.77E-05	4.00E-02	5.E-05	0%
Chloroethane	3.27E-02	9.77E-05	2.90E+00	1.E-06	0%
Dibromochloromethane	1.24E-04	9.77E-05	2.00E-02	6.E-07	0%
Ethylbenzene	6.61E-01	9.77E-05	2.90E-01	2.E-04	1%
Isopropylbenzene	4.92E+00	9.77E-05	1.10E-01	4.E-03	13%
p-Isopropyltoluene	4.53E-01	9.77E-05	--	--	<0.001%
Methylene Chloride (DCM)	1.49E+00	9.77E-05	1.10E-01	1.E-03	4%
Naphthalene	1.21E-02	9.77E-05	8.60E-04	1.E-03	4%
n-Propylbenzene	7.06E-01	9.77E-05	4.00E-02	2.E-03	5%
Styrene	5.91E-01	9.77E-05	2.60E-01	2.E-04	1%
Toluene (Methyl benzene)	1.18E-01	9.77E-05	8.60E-02	1.E-04	0%
1,2,4-Trimethylbenzene	1.17E-01	9.77E-05	1.70E-03	7.E-03	20%
1,3,5-Trimethylbenzene	1.92E-01	9.77E-05	1.70E-03	1.E-02	33%
Total Xylenes	1.31E+00	9.77E-05	2.9E-02	4.E-03	13%
Inhalation Pathway Total Hazard Index =				**0.03**	100%

Hazard Index: Project On-Site Hospital Patient (adult) =	**0.03**

TABLE 6-14. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (CHILD)
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
	µg/m^3				
Benzene	3.40E-01	9.21E-08	1.00E-01	3.E-09	86%
Bromodichloromethane	4.96E-04	9.21E-08	1.30E-01	6.E-12	0%
n-Butylbenzene	1.34E-01	9.21E-08	NC	0.E+00	<0.001%
sec-Butylbenzene	1.79E-02	9.21E-08	NC	0.E+00	<0.001%
tert-Butylbenzene	1.87E-02	9.21E-08	NC	0.E+00	<0.001%
Chloroethane	3.27E-02	9.21E-08	2.90E-03	9.E-12	0%
Dibromochloromethane	1.24E-04	9.21E-08	8.40E-02	1.E-12	0%
Ethylbenzene	6.61E-01	9.21E-08	--	0.E+00	<0.001%
Isopropylbenzene	4.92E+00	9.21E-08	NC	0.E+00	<0.001%
p-Isopropyltoluene	4.53E-01	9.21E-08	--	0.E+00	<0.001%
Methylene Chloride (DCM)	1.49E+00	9.21E-08	3.50E-03	5.E-10	13%
Naphthalene	1.21E-02	9.21E-08	NC	0.E+00	<0.001%
n-Propylbenzene	7.06E-01	9.21E-08	--	0.E+00	<0.001%
Styrene	5.91E-01	9.21E-08	NC	0.E+00	<0.001%
Toluene (Methyl benzene)	1.18E-01	9.21E-08	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	1.17E-01	9.21E-08	NC	0.E+00	<0.001%
1,3,5-Trimethylbenzene	1.92E-01	9.21E-08	NC	0.E+00	<0.001%
Total Xylenes	1.31E+00	9.21E-08	NC	0.E+00	<0.001%
			Inhalation ELCR =	**4E-09**	100%

ELCR: Project On-Site Hospital Patient (child)= 4E-09

TABLE 6-15. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE HOSPITAL PATIENT (ADULT)
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
Benzene	3.40E-01	2.63E-08	1.00E-01	9.E-10	86%
Bromodichloromethane	4.96E-04	2.63E-08	1.30E-01	2.E-12	0%
n-Butylbenzene	1.34E-01	2.63E-08	NC	0.E+00	<0.001%
sec-Butylbenzene	1.79E-02	2.63E-08	NC	0.E+00	<0.001%
tert-Butylbenzene	1.87E-02	2.63E-08	NC	0.E+00	<0.001%
Chloroethane	3.27E-02	2.63E-08	2.90E-03	2.E-12	0%
Dibromochloromethane	1.24E-04	2.63E-08	8.40E-02	3.E-13	0%
Ethylbenzene	6.61E-01	2.63E-08	--	0.E+00	<0.001%
Isopropylbenzene	4.92E+00	2.63E-08	NC	0.E+00	<0.001%
p-Isopropyltoluene	4.53E-01	2.63E-08	--	0.E+00	<0.001%
Methylene Chloride (DCM)	1.49E+00	2.63E-08	3.50E-03	1.E-10	13%
Naphthalene	1.21E-02	2.63E-08	NC	0.E+00	<0.001%
n-Propylbenzene	7.06E-01	2.63E-08	--	0.E+00	<0.001%
Styrene	5.91E-01	2.63E-08	NC	0.E+00	<0.001%
Toluene (Methyl benzene)	1.18E-01	2.63E-08	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	1.17E-01	2.63E-08	NC	0.E+00	<0.001%
1,3,5-Trimethylbenzene	1.92E-01	2.63E-08	NC	0.E+00	<0.001%
Total Xylenes	1.31E+00	2.63E-08	NC	0.E+00	<0.001%
			Inhalation Pathway ELCR =	**1E-09**	100%

ELCR: Project On-Site Hospital Patient (adult)= 1E-09

TABLE 6-16. HAZARD INDEX
PROJECT SCENARIO
ON-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration µg/m^3	Chronic Daily Intake Factor	Reference Dose	Hazard Quotient	Percent Total HI
Benzene	3.40E-01	1.96E-04	1.70E-02	4.E-03	6%
Bromodichloromethane	4.96E-04	1.96E-04	2.00E-02	5.E-06	0%
n-Butylbenzene	1.34E-01	1.96E-04	4.00E-02	7.E-04	1%
sec-Butylbenzene	1.79E-02	1.96E-04	4.00E-02	9.E-05	0%
tert-Butylbenzene	1.87E-02	1.96E-04	4.00E-02	9.E-05	0%
Chloroethane	3.27E-02	1.96E-04	2.90E+00	2.E-06	0%
Dibromochloromethane	1.24E-04	1.96E-04	2.00E-02	1.E-06	0%
Ethylbenzene	6.61E-01	1.96E-04	2.90E-01	4.E-04	1%
Isopropylbenzene	4.92E+00	1.96E-04	1.10E-01	9.E-03	13%
p-Isopropyltoluene	4.53E-01	1.96E-04	--	--	<0.001%
Methylene Chloride (DCM)	1.49E+00	1.96E-04	1.10E-01	3.E-03	4%
Naphthalene	1.21E-02	1.96E-04	8.60E-04	3.E-03	4%
n-Propylbenzene	7.06E-01	1.96E-04	4.00E-02	3.E-03	5%
Styrene	5.91E-01	1.96E-04	2.60E-01	4.E-04	1%
Toluene (Methyl benzene)	1.18E-01	1.96E-04	8.60E-02	3.E-04	0%
1,2,4-Trimethylbenzene	1.17E-01	1.96E-04	1.70E-03	1.E-02	20%
1,3,5-Trimethylbenzene	1.92E-01	1.96E-04	1.70E-03	2.E-02	33%
Total Xylenes	1.31E+00	1.96E-04	2.90E-02	9.E-03	13%
Inhalation Pathway Total Hazard Index =				**0.1**	100%

Hazard Index: Current Off-Site Com./Ind./Hospital Worker =	**0.1**

TABLE 6-17. THEORETICAL EXCESS LIFETIME CANCER RISK (ELCR)
PROJECT SCENARIO
ON-SITE COMMERCIAL/INDUSTRIAL/HOSPITAL WORKER
AT MILLER CHILDREN'S HOSPITAL INPATIENT TOWER

Inhalation

Chemical	Concentration	Chronic Daily Intake Factor	Cancer Slope Factor	ELCR	Percent Total ELCR
	µg/m^3				
Benzene	3.40E-01	6.99E-05	1.00E-01	2.E-06	86%
Bromodichloromethane	4.96E-04	6.99E-05	1.30E-01	5.E-09	0%
n-Butylbenzene	1.34E-01	6.99E-05	NC	0.E+00	<0.001%
sec-Butylbenzene	1.79E-02	6.99E-05	NC	0.E+00	<0.001%
tert-Butylbenzene	1.87E-02	6.99E-05	NC	0.E+00	<0.001%
Chloroethane	3.27E-02	6.99E-05	2.90E-03	7.E-09	0%
Dibromochloromethane	1.24E-04	6.99E-05	8.40E-02	7.E-10	0%
Ethylbenzene	6.61E-01	6.99E-05	--	0.E+00	<0.001%
Isopropylbenzene	4.92E+00	6.99E-05	NC	0.E+00	<0.001%
p-Isopropyltoluene	4.53E-01	6.99E-05	--	0.E+00	<0.001%
Methylene Chloride (DCM)	1.49E+00	6.99E-05	3.50E-03	4.E-07	13%
Naphthalene	1.21E-02	6.99E-05	NC	0.E+00	<0.001%
n-Propylbenzene	7.06E-01	6.99E-05	--	0.E+00	<0.001%
Styrene	5.91E-01	6.99E-05	NC	0.E+00	<0.001%
Toluene (Methyl benzene)	1.18E-01	6.99E-05	NC	0.E+00	<0.001%
1,2,4-Trimethylbenzene	1.17E-01	6.99E-05	NC	0.E+00	<0.001%
1,3,5-Trimethylbenzene	1.92E-01	6.99E-05	NC	0.E+00	<0.001%
Total Xylenes	1.31E+00	6.99E-05	NC	0.E+00	<0.001%
		Inhalation Pathway ELCR =		**3E-06**	100%

ELCR: Project On-Site Com./Ind./Hosp. Worker =	**3E-06**

TABLE 7-1. LEADSPREAD 7 RESULTS
ON-SITE LEAD EXPOSURE
CONSTRUCTION WORKER
LONG BEACH MEMORIAL MEDICAL CENTER, MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

INPUT

MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	31.2
Lead in Water (ug/l)	15
% Home-grown Produce	0%
Respirable Dust (ug/m^3)	1.5

OUTPUT

	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g)
BLOOD Pb, ADULT	1.2	2.1	2.5	3.1	**3.5**	277	421
BLOOD Pb, CHILD	1.2	2.2	2.6	3.2	**3.6**	331	511
BLOOD Pb, PICA CHILD	1.4	2.6	3.1	3.8	4.3	166	257
BLOOD Pb, OCCUPATIONAL	1.1	2.0	2.3	2.8	3.2	389	591

EXPOSURE PARAMETERS

	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	5700	
Soil adherence	ug/cm^2	800	200
Dermal uptake constant	(ug/dl)/(ug/day)	0.0001	
Soil ingestion	mg/day	480	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/day)	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/day)	0.082	0.192
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	0.0	
Lead in home-grown produce	ug/kg	0.0	

PATHWAYS

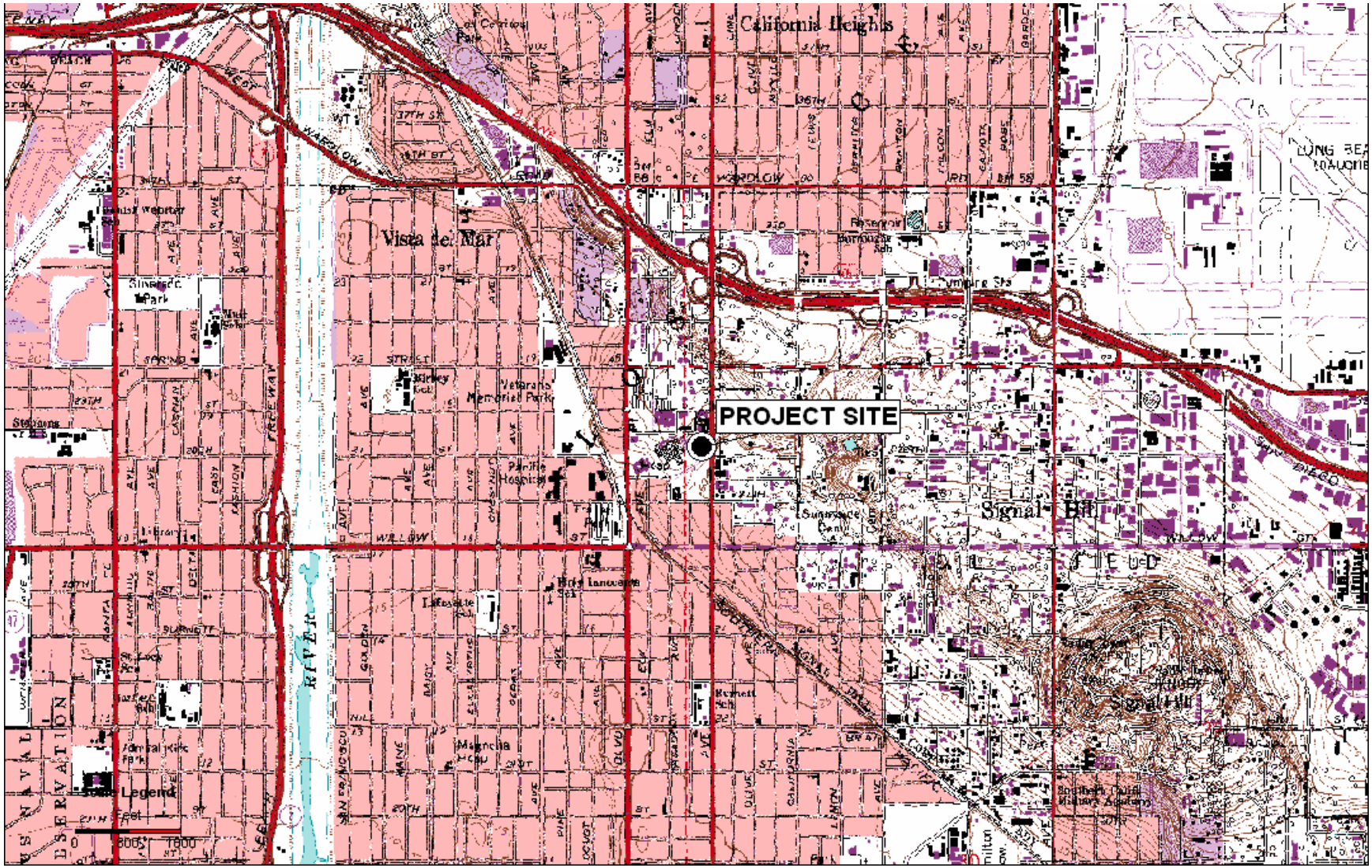
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	4.4E-4	0.01	1%	3.1E-4	0.01	1%
Soil Ingestion	8.4E-3	0.26	23%	6.0E-3	0.19	18%
Inhalation, bkgrnd		0.05	4%		0.03	3%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.84	72%		0.84	78%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.6E-5	0.00	0%		0.00	0%
Soil Ingestion	7.0E-3	0.22	18%	1.4E-2	0.44	31%
Inhalation	2.0E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.04	3%		0.04	3%
Water Ingestion		0.96	79%		0.96	67%
Food Ingestion, bkgrnd		0.00	0%		0.00	0%
Food Ingestion	0.0E+0	0.00	0%		0.00	0%

TABLE 9-1. POTENTIAL EFFECTS OF UNCERTAINTY ON ESTIMATION OF RISKS
LONG BEACH MEMORIAL MEDICAL CENTER
MILLER CHILDREN'S HOSPITAL EXPANSION
LONG BEACH, CALIFORNIA

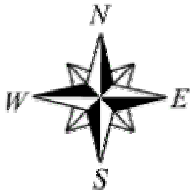
Assumption	Potential Magnitude for Over-Estimation of Risk	Potential Magnitude for Under-Estimation of Risk	Potential Magnitude for Over or Under-Estimation of Risk
IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN			
Number of samples/analyses in 0-5 foot soil zone			Low
Number of samples/analyses in 0-10 foot soil zone			Low
Number of samples/analyses of groundwater data			Low
Use of "comparison" method for evaluation of background data vs. contaminant data	Low		
Use of USEPA ProUCL recommended upper confidence limit (UCL)	Medium		
Use of UCL or maximum detected value	Low		
Use of estimated concentrations in lieu of 1/2 DL for non detect samples with estimated values			Low
QA/QC review			Low
EXPOSURE ASSESSMENT			
Identification of receptors			Low
Completeness determination for exposure pathways			Low
Elimination (dedesignation) of potable groundwater pathways		Low	
Use of Farmers Equation to estimate emission flux from soil vapor	Medium		
Use of Box model for determination of on-site outdoor air concentrations of VOCs	Low		
Use of Screen3 model to estimate dispersion of VOCs to off-site residential receptors	Medium		
Use of PEF calculation to estimate on-site concentrations of non-VOCs for inhalation pathway	Low	Low (construction workers)	
Use of dispersion-adjusted PEF calculation to estimate off-site exposure concentrations of non-VOCs for inhalation pathway	Low		
Use of J&E Model for estimation of indoor air concentrations from groundwater and soil vapor	Medium		
Exposure frequency for hospital patient receptors	High		
Exposure frequency for all other receptors	Low		Low
Exposure duration for hospital patient receptors	High		
Exposure duration for all other receptors	Low		
Soil ingestion rate	Low		
Skin surface area exposed to soil			Low
Soil to skin adherence factor	Low		
Amount of chemical absorbed through skin			Low
Inhalation rate	Low		
Body weight			Low
Averaging time		Low (carcinogenic)	Low (non-carcinogenic)
TOXICITY ASSESSMENT			
Route extrapolation from oral to dermal pathway for non-carcinogens	Low		
Route extrapolation from oral to dermal pathway for carcinogens	Medium		
Reference doses/linear cancer slope factors (CSF) for Group B2/C carcinogens based on animal data			Medium
Synergistic/antagonistic effects not considered			Low
RISK CHARACTERIZATION			
Risk assessment of TPH			Medium

FIGURES



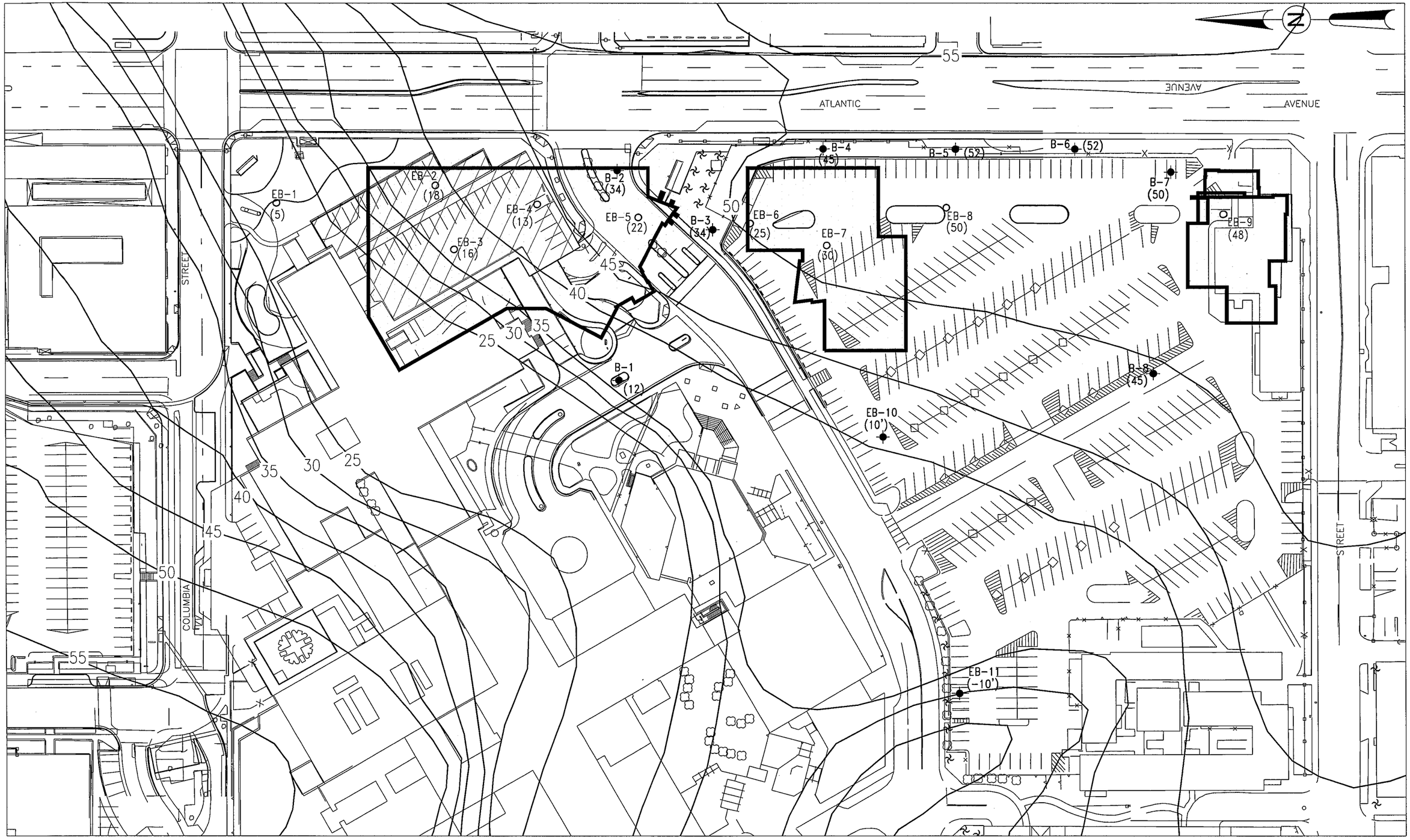
SCS ENGINEERS

Figure 1. Project Site Location, Miller Children's Hospital, Long Beach Memorial Medical Center Long Beach, California



SCS ENGINEERS

Figure 2. Proposed Project Locations, Long Beach Memorial Medical Center, Long Beach, CA



EB-1 (5) — SCS Env. Borings (2004) Elevation of Natural Soil

1951 Contours (Ravine)

B-1 (12) — MacTec Geotechnical Boring (July 2004) – Locations Approximate; Elevation of Natural Soil

Proposed Improvement

Area of Prior Removal

3-2 (15) — Previous Geotechnical Borings; Elevation of Natural Soil

0 80 160
SCALE IN FEET

SCS ENGINEERS
ENVIRONMENTAL CONSULTANTS
3711 LONG BEACH BLVD., 9th FLOOR
LONG BEACH, CA 90807
PH. (562) 426-9544 FAX. (562) 427-0805

Miller's Children's Hospital
Long Beach Memorial Medical Center

DESIGNED
DRAWN
CHECKED
DATE 10/26/2004
REVIEWED
REG. NO.

FIGURE 3

SOIL & GROUND WATER SAMPLING LOCATIONS

SCALE: As Shown
SHEET NO. ---
DWG. NO. FIG. 3

G:\2003\01203219.00 LBMMC\support\TCI 7 MCH Submittals.dwg (MCH - Soil Borings Layout) October 26, 2004 - 2517 MEF

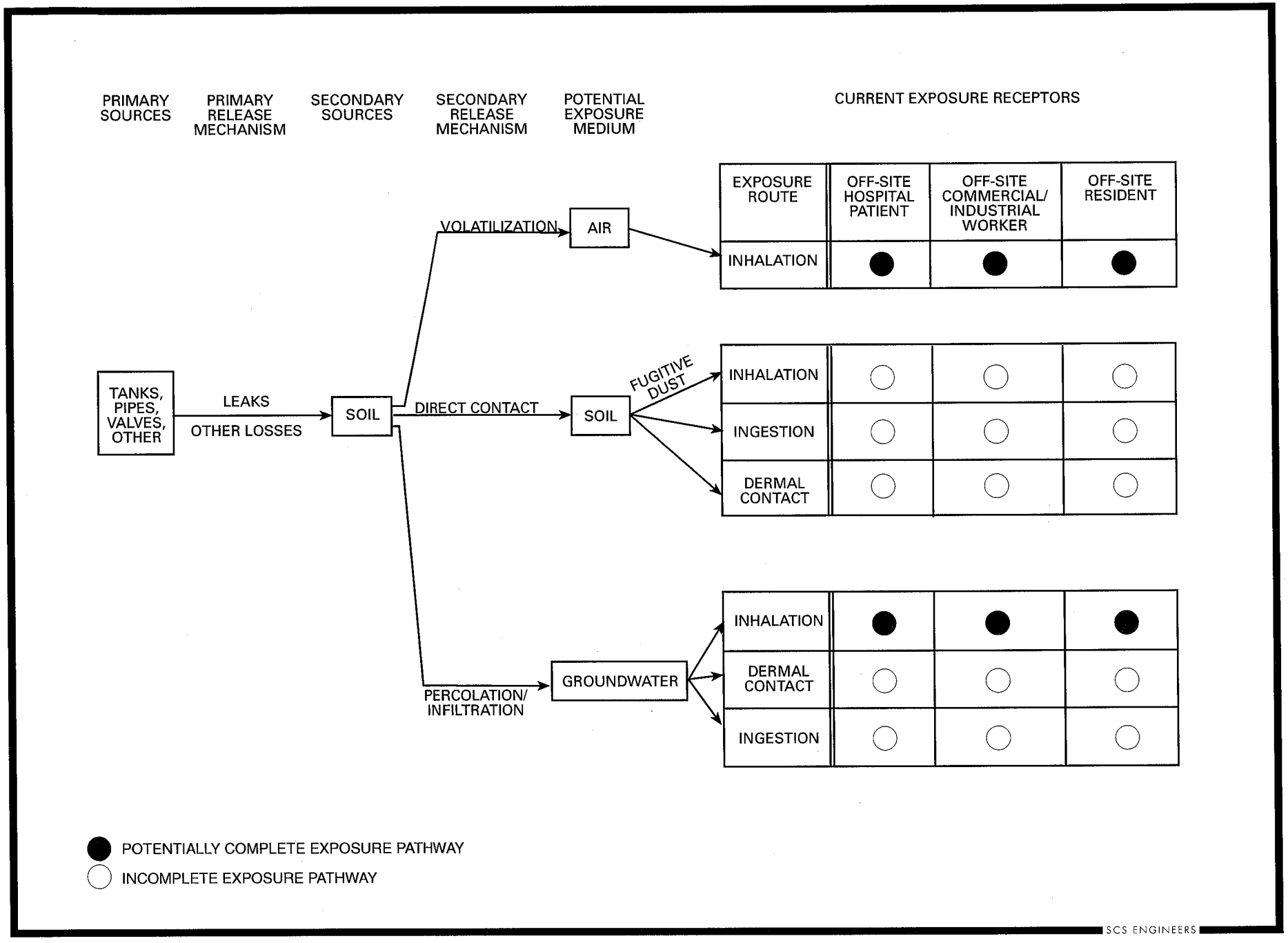


Figure 4a. Conceptual Site Model, Current Scenario, Miller Children's Hospital Expansion, Long Beach Memorial Medical Center, Long Beach, CA

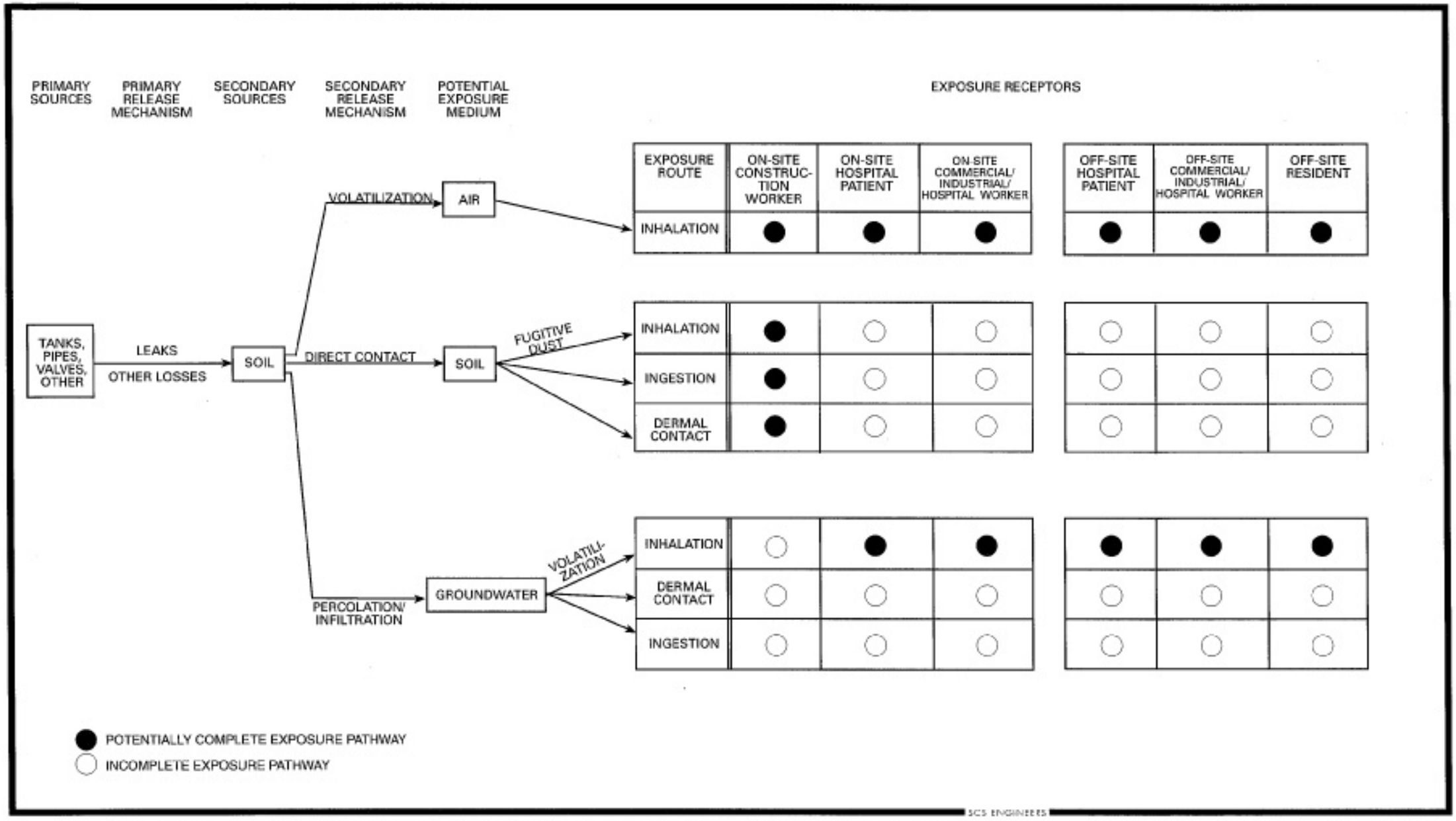


Figure 4b. Conceptual Site Model, Project Scenario, Miller Children's Hospital Expansion, Long Beach Memorial Medical Center, Long Beach, CA

APPENDICES

APPENDIX A

DEFAULT PARAMETERS AND SAMPLE CALCULATIONS FOR AIR PATHWAYS

DEFAULT PARAMETERS AND

SAMPLE CALCULATIONS FOR AIR PATHWAYS

Exposures in air were estimated for pathways, which include volatilization of chemicals from on-site soils into the breathing zone and particles adhered to fugitive dust.

Emission Flux – VOCs from Soil to Outdoor Air

Volatilization emission rates from soil into outdoor air were calculated using the Farmer Equation, re-evaluated by Shen, as presented in the California Site Mitigation Decision Tree Manual (DHS, 1986) and the Superfund Exposure Assessment Manual (EPA, 1988). The Farmer equation is based on Fick's Law of Diffusion and is used to calculate the diffusion of vapors through soil-gas. Emission rates were approximated using the contaminant flux estimation method, which is presented below:

$$Q = D_i(p_a^{10/3}/p_T^2)(P_iM_iW_i/RT)/L$$

Where:

Q = Volatilization emission flux (g/cm^2-sec).

D_i = Air diffusion coefficient of chemical i (cm^2/sec).

p_a = Air filled porosity (dimensionless).

p_T = Total soil porosity (dimensionless).

P_i = Vapor pressure of i at the temperature T (mmHg).

M_i = Molecular weight of i (g/mole).

W_i = Weight fraction of i in the soil (mg/mg).

R = Universal gas constant.

T = Temperature (K).

L = Average depth of deeper soil strata samples (cm).

Pertinent chemical properties for VOCs of concern, which were used in the Farmer Equation calculations, are presented in Table 4-1. The results of the Farmer Equation calculations (on-site emission fluxes) for VOCs are presented in Table 4-2a and 4-2b. The weight fraction of each chemical in soil was calculated using the 0-25 feet bgs soil data presented in Table 3-10.

The default parameters, which were utilized to calculate volatile emission fluxes for the various contaminants of concern, are listed below:

D_i = Chemical specific (cm^2/sec); from EPA, 1988.

p_a = 0.28 (dimensionless); from EPA, 1998a.

p_T = 0.447 (dimensionless); from LARWQCB, 1996.

P_i = Chemical specific (mmHg); from NIOSH, 1990.

M_i = Chemical specific (g/mole); from DTSC, 1994.

W_i = Chemical specific (mg/mg); from 0-25 foot soil zone data (Table 3-10).

R = 62,361 (mmHg-cm^3/mole-K); standard.

T = 298 (K); standard.

L = 610 (cm); calculated value; it is the mean sample depths for all VOC soil samples.

A sample calculation for **toluene** is shown below:

$$Q_{toluene} = D_i(p_a^{10/3}/p_T^2)(P_iM_iW_i/RT)/L$$

$$Q_{toluene} = 0.087(0.28^{10/3}/0.434^2)(2.1)(92)(1.02E\text{-}07)/(62{,}361)(298)/610 * 10{,}000$$

$$Q_{toluene} = 1.56E\text{-}12\ (g/m^2\text{-sec})$$

On-Site Outdoor Concentration of VOCs

To calculate on-site airborne concentrations of VOCs, a "box" model was utilized as recommended by the California Air Resources Board (CARB, 1992). A box model is a simple mass-balance equation that uses the concept of a theoretically enclosed space (i.e., box) over the impacted area. The model assumes that emissions of contaminants into a box, with their removal based on wind speed. Airborne concentrations within the box can be calculated and used as on-site EPCs for contaminant concentrations via soil-gas and fugitive dust. The EPC within the box is calculated by the following equation:

$$B = QA/(u)(h)(l) \times CF$$

Where:

B = Box concentration, EPC (ug/m^3)

Q = Volatilization emission flux (g/cm^2-sec).

A = Emitting area of site (cm^2)

u = Wind speed (cm/sec)

h = Height of box (cm)

l = Length of box (cm)

CF = Conversion factor, 10^{12} (ug-cm^3/g-m^3)

The results of the Box Model calculations (on-site airborne chemical concentrations) are presented in Table 4-3.

The default parameters, which were utilized to calculate on-site emission concentrations for the various contaminants of concern, are listed below:

Q = Chemical specific (g/cm^2-sec); from soil flux calculations (Table 4-2b).

A = 3.78E+08 (cm^2), site area

u = 277 (cm/sec); average wind speed in the City of Long Beach

h = 150 (cm); average height of receptor's nose and mouth.

l = 24,079 (cm), measured length of site

A sample calculation for **toluene** is shown below:

$$B_{toluene} = QA/(u)(h)(l) \times CF$$

$$B_{toluene} = (1.67E\text{-}10)(3.78E+08)/(277)(150)(24{,}079) \times (1.0E+12)$$

$$B_{toluene} = 6.31E+01 \text{ (ug/m}^3\text{)}$$

On-Site Outdoor Concentration of Non-VOCs (Fugitive Dust)

Fugitive dust emissions by wind erosion were calculated using a Particulate Emission Factor (PEF) method developed by the EPA, and included as part of the Preliminary Remediation Goals (PRG) published by EPA Region 9 (EPA, 2002). The PEF converts the RC in surface soil to an on-site concentration using the following equation:

$$C_{air} = C_{soil}/PEF \times CF$$

Where:

C_{air} = On-site airborne concentration, EPC (µg/m^3)

C_{soil} = EPC in surface soil (mg/kg)

PEF = Particulate emission factor (m^3/kg)

CF = Conversion factor (1000 µg/mg)

A summary of the fugitive dust calculations is presented in Table 4-4. The concentration in soil for each chemical in soil was calculated using EPCs for surface soil presented in Table 3-10.

The default parameters, which were utilized to calculate on-site emission concentrations for the various contaminants of concern, are listed below:

C_{soil} = EPC in surface soil (mg/kg)

PEF = 1.32E+09; USEPA PRG Guidance Manual, 2002

A sample calculation for **zinc** is shown below:

$$C_{air(zinc)} = C_{soil}/PEF \times CF$$

$$C_{air(zinc)} = 2.39E+02/1.32E+09 \times 1000$$

$$C_{air(zinc)} = 1.82E-04\ \mu g/m^3$$

The fugitive dust calculations were used to estimate non-VOC concentrations in outdoor air for the project on-site construction worker.

APPENDIX B

DOCUMENTATION FOR JOHNSON & ETTINGER MODEL RUNS

DOCUMENTATION FOR JOHNSON & ETTINGER MODEL RUNS

To calculate on-site VOC concentrations in indoor air due to volatilization from concentrations of soil and soil vapor, the Johnson and Ettinger Model was used (USEPA 2003). The Johnson and Ettinger (J&E) Model was used in the advanced mode for calculation of both soil and soil vapor chemical concentrations inside of the Miller Children's Hospital Inpatient Tower (Phase I) and the Long Beach Memorial Medical Center Main Building. Silt soils were assumed based on a review of boring logs. All of the model default settings were used with the exception of the following:

- **Building Area for Miller Children's Hospital Inpatient Tower (Phase I) Model Run**

  For the J&E model run, the default building area was changed from the model default of 2000 square feet to 38,000 square feet of the proposed Miller Children's Hospital Inpatient Tower building footprint. The value of 38,000 square feet was estimated from the grading plan provided by Moffat and Nichol and/or dimension estimates provided in the EIR project description.

- **Building Area for Long Beach Memorial Medical Center Main Building**

  For the J&E model run, the default building area was changed from the model default of 2000 square feet to 33,794 square feet for the main building of the Long Beach Memorial Medical Center.

- **Soil Type Used in Model Runs**

  Soil type (Stratum A, B, C SCS soil type) used in model was silt (SI). This is based on boring logs created during the drilling of soil borings created during the drilling of soil borings at the site (SCS, 2004).

- **Ventilation Rate for Model Runs**

  The ventilation rate (i.e. indoor air exchange rate) was changed from the model default value of 0.25/hour to 2/hour. The air exchange rate of 2/hour is based on a personal communication with Marion Vinton, Construction Manager of Long Beach Memorial Medical Center/Miller Children's Hospital, dated January 7, 2005 via facsimile.

J&E SOIL-ADV MODEL WORKSHEETS

Miller Children's Hospital Inpatient Tower

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
71432	1.80E+02	Benzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	5.89E+01	1.79E+03	7.8E-06	0.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.80E+02	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	8,040	3.99E-03	1.67E-01	1.78E-04	8.45E-03	0.00E+00	0.00E+00	8.45E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.18E-01	1.07E+05	0.10	2.30E+01	8.45E-03	2.38E+03	9.29E+04	NA	NA	1.47E+04	3.72E-03	5.48E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.18E-06	NA	3.40E-01	3.40E-01	7.8E-06	NA

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
104518	3.00E+02	n-Butylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.70E-02	8.12E-06	1.31E-02	25	9,290	456.46	660.50	1.11E+03	2.00E+00	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	3.00E+02	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	11,747	8.15E-03	3.41E-01	1.78E-04	5.48E-03	0.00E+00	0.00E+00	5.48E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.22E+00	4.21E+04	0.10	2.30E+01	5.48E-03	2.38E+03	4.68E+07	NA	NA	9.55E+03	5.70E-04	2.37E+10	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	1.34E-01	1.34E-01	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
135988	3.70E+02	sec-Butylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	0.48	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.70E-02	8.12E-06	1.39E-02	25	88,730	446.50	679.00	9.66E+02	3.94E+00	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	3.70E+02	1.72E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	107,259	1.78E-04	7.47E-03	1.78E-04	5.49E-03	0.00E+00	0.00E+00	5.49E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.93E+00	1.34E+03	0.10	2.30E+01	5.49E-03	2.38E+03	4.51E+07	NA	NA	9.57E+03	1.47E-05	9.18E+11	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.33E-05	NA	1.79E-02	1.79E-02	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
98066	3.03E+01	tert-Butylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.65E-02	8.02E-06	1.19E-02	25	8,980	442.10	1220.00	7.71E+02	2.95E+01	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	3.03E+01	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	9,471	8.09E-03	3.38E-01	1.78E-04	5.43E-03	0.00E+00	0.00E+00	5.43E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.54E+00	5.87E+03	0.10	2.30E+01	5.43E-03	2.38E+03	5.47E+07	NA	NA	9.46E+03	7.79E-04	1.72E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	1.87E-02	1.87E-02	NA	1.4E-01

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.65E-02	8.02E-06	1.19E-02	25	8,980	442.10	1220.00	7.71E+02	2.95E+01	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	3.03E+01	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	9,471	8.09E-03	3.38E-01	1.78E-04	5.43E-03	0.00E+00	0.00E+00	5.43E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.54E+00	5.87E+03	0.10	2.30E+01	5.43E-03	2.38E+03	5.47E+07	NA	NA	9.46E+03	7.79E-04	1.72E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	1.87E-02	1.87E-02	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
100414	8.55E+02	Ethylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
7.50E-02	7.80E-06	7.86E-03	25	8,501	409.34	617.20	3.63E+02	1.69E+02	1.1E-06	1.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	8.55E+02	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	10,063	5.22E-03	2.19E-01	1.78E-04	7.20E-03	0.00E+00	0.00E+00	7.20E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
7.26E-01	2.07E+05	0.10	2.30E+01	7.20E-03	2.38E+03	6.75E+05	NA	NA	1.26E+04	1.29E-03	1.35E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	6.61E-01	6.61E-01	1.1E-06	1.0E+00

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
98828	4.48E+02	Cumene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.50E-02	7.10E-06	1.16E+00	25	10,335	425.56	631.10	4.89E+02	6.13E+01	0.0E+00	4.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	4.48E+02	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	12,532	6.96E-01	2.91E+01	1.78E-04	6.24E-03	0.00E+00	0.00E+00	6.24E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
9.77E-01	1.62E+06	0.10	2.30E+01	6.24E-03	2.38E+03	5.33E+06	NA	NA	1.09E+04	1.67E-02	9.14E+08	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.04E-06	NA	4.92E+00	4.92E+00	NA	4.0E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
108883	3.95E+02	Toluene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	4.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	3.95E+02	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	9,067	4.58E-03	1.92E-01	1.78E-04	8.36E-03	0.00E+00	0.00E+00	8.36E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.64E-01	1.42E+05	0.10	2.30E+01	8.36E-03	2.38E+03	1.06E+05	NA	NA	1.46E+04	2.23E-03	9.06E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	4.53E-01	4.53E-01	NA	4.0E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
75092	1.11E+03	Methylene chloride

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.01E-01	1.17E-05	2.18E-03	25	6,706	313.00	510.00	1.17E+01	1.30E+04	4.7E-07	3.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.11E+03	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	6,949	1.65E-03	6.90E-02	1.78E-04	9.70E-03	0.00E+00	0.00E+00	9.70E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.34E-02	4.68E+05	0.10	2.30E+01	9.70E-03	2.38E+03	2.13E+04	NA	NA	1.69E+04	3.03E-03	7.68E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	1.49E+00	1.49E+00	4.7E-07	3.0E+00

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
91203	1.30E+03	Naphthalene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.90E-02	7.50E-06	4.82E-04	25	10,373	491.14	748.40	2.00E+03	3.10E+01	0.0E+00	3.0E-03	S

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.30E+03	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	12,830	2.86E-04	1.20E-02	1.78E-04	5.67E-03	0.00E+00	0.00E+00	5.67E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
4.00E+00	3.78E+03	0.10	2.30E+01	5.67E-03	2.38E+03	2.52E+07	NA	NA	9.89E+03	1.22E-05	1.15E+12	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.20E-06	NA	1.21E-02	1.21E-02	NA	3.0E-03

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
103651	1.03E+03	n-Propylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.01E-02	7.83E-06	1.07E-02	25	9,123	432.20	630.00	5.62E+02	6.00E+01	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.03E+03	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	11,264	6.75E-03	2.82E-01	1.78E-04	5.77E-03	0.00E+00	0.00E+00	5.77E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.12E+00	2.21E+05	0.10	2.30E+01	5.77E-03	2.38E+03	1.88E+07	NA	NA	1.01E+04	9.18E-04	1.55E+10	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	7.06E-01	7.06E-01	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
100425	4.15E+03	Styrene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
7.10E-02	8.00E-06	2.74E-03	25	8,737	418.31	636.00	7.76E+02	3.10E+02	0.0E+00	1.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	4.15E+03	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	10,362	1.80E-03	7.54E-02	1.78E-04	6.82E-03	0.00E+00	0.00E+00	6.82E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.55E+00	1.85E+05	0.10	2.30E+01	6.82E-03	2.38E+03	1.44E+06	NA	NA	1.19E+04	2.25E-04	7.39E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.20E-06	NA	5.91E-01	5.91E-01	NA	1.0E+00

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
108883	1.02E+02	Toluene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	4.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.02E+02	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	9,067	4.58E-03	1.92E-01	1.78E-04	8.36E-03	0.00E+00	0.00E+00	8.36E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.64E-01	3.67E+04	0.10	2.30E+01	8.36E-03	2.38E+03	1.06E+05	NA	NA	1.46E+04	2.23E-03	9.06E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	1.17E-01	1.17E-01	NA	4.0E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
95636	1.18E+03	1,2,4-Trimethylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.06E-02	7.92E-06	6.14E-03	25	9,369	442.30	649.17	1.35E+03	5.70E+01	0.0E+00	6.0E-03	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.18E+03	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	11,592	3.84E-03	1.61E-01	1.78E-04	5.82E-03	0.00E+00	0.00E+00	5.82E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.70E+00	6.59E+04	0.10	2.30E+01	5.82E-03	2.38E+03	1.64E+07	NA	NA	1.02E+04	2.42E-04	5.92E+10	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.20E-06	NA	2.11E-01	2.11E-01	NA	6.0E-03

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
108678	1.12E+03	1,3,5-Trimethylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.02E-02	8.67E-06	5.87E-03	25	9,321	437.89	637.25	1.35E+03	2.00E+00	0.0E+00	6.0E-03	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.12E+03	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	11,574	3.67E-03	1.54E-01	1.78E-04	5.78E-03	0.00E+00	0.00E+00	5.78E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.70E+00	6.00E+04	0.10	2.30E+01	5.78E-03	2.38E+03	1.83E+07	NA	NA	1.01E+04	2.30E-04	6.20E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.20E-06	NA	1.92E-01	1.92E-01	NA	6.0E-03

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
106423	1.84E+03	p-Xylene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
7.69E-02	8.44E-06	7.64E-03	25	8,525	411.52	616.20	3.89E+02	1.85E+02	0.0E+00	7.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	23,776	1.84E+03	7.18E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
4.01E+07	5.93E-05	200	10,155	5.06E-03	2.12E-01	1.78E-04	7.39E-03	0.00E+00	0.00E+00	7.39E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
7.78E-01	4.10E+05	0.10	2.30E+01	7.39E-03	2.38E+03	4.84E+05	NA	NA	1.29E+04	1.22E-03	1.47E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.19E-06	NA	1.31E+00	1.31E+00	NA	7.0E+00

END

Long Beach Memorial Medical Center Main Building

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
71432	1.80E+02	Benzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.80E-02	9.80E-06	5.54E-03	25	7,342	353.24	562.16	5.89E+01	1.79E+03	7.8E-06	0.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.80E+02	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	8,040	3.99E-03	1.67E-01	1.78E-04	8.45E-03	0.00E+00	0.00E+00	8.45E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.18E-01	1.07E+05	0.10	2.17E+01	8.45E-03	2.24E+03	9.29E+04	NA	NA	1.40E+04	3.72E-03	5.21E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.37E-06	NA	3.60E-01	3.60E-01	7.8E-06	NA

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
104518	3.00E+02	n-Butylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.70E-02	8.12E-06	1.31E-02	25	9,290	456.46	660.50	1.11E+03	2.00E+00	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	3.00E+02	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	11,747	8.15E-03	3.41E-01	1.78E-04	5.48E-03	0.00E+00	0.00E+00	5.48E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.22E+00	4.21E+04	0.10	2.17E+01	5.48E-03	2.24E+03	4.68E+07	NA	NA	9.06E+03	5.70E-04	2.26E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.39E-06	NA	1.43E-01	1.43E-01	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
135988	3.70E+02	sec-Butylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.70E-02	8.12E-06	1.39E-02	25	88,730	446.50	679.00	9.66E+02	3.94E+00	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	3.70E+02	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	107,259	1.78E-04	7.47E-03	1.78E-04	5.49E-03	0.00E+00	0.00E+00	5.49E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.93E+00	1.34E+03	0.10	2.17E+01	5.49E-03	2.24E+03	4.51E+07	NA	NA	9.08E+03	1.47E-05	8.75E+11	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.39E-06	NA	4.56E-03	4.56E-03	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
98066	3.03E+01	tert-Butylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.65E-02	8.02E-06	1.19E-02	25	8,980	442.10	1220.00	7.71E+02	2.95E+01	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	3.03E+01	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	9,471	8.09E-03	3.38E-01	1.78E-04	5.43E-03	0.00E+00	0.00E+00	5.43E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.54E+00	5.87E+03	0.10	2.17E+01	5.43E-03	2.24E+03	5.47E+07	NA	NA	8.99E+03	7.79E-04	1.64E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	1.99E-02	1.99E-02	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
100414	8.55E+02	Ethylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
7.50E-02	7.80E-06	7.86E-03	25	8,501	409.34	617.20	3.63E+02	1.69E+02	1.1E-06	1.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	8.55E+02	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	10,063	5.22E-03	2.19E-01	1.78E-04	7.20E-03	0.00E+00	0.00E+00	7.20E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
7.26E-01	2.07E+05	0.10	2.17E+01	7.20E-03	2.24E+03	6.75E+05	NA	NA	1.19E+04	1.29E-03	1.29E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	7.01E-01	7.01E-01	1.1E-06	1.0E+00

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
98828	4.48E+02	Cumene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	0.48	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.50E-02	7.10E-06	1.16E+00	25	10,335	425.56	631.10	4.89E+02	6.13E+01	0.0E+00	4.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	4.48E+02	1.53E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	12,532	6.96E-01	2.91E+01	1.78E-04	6.24E-03	0.00E+00	0.00E+00	6.24E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
9.77E-01	1.62E+06	0.10	2.17E+01	6.24E-03	2.24E+03	5.33E+06	NA	NA	1.03E+04	1.67E-02	8.70E+08	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.34E-05	NA	2.16E+01	2.16E+01	NA	4.0E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
108883	3.95E+02	Toluene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	4.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	3.95E+02	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	9,067	4.58E-03	1.92E-01	1.78E-04	8.36E-03	0.00E+00	0.00E+00	8.36E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.64E-01	1.42E+05	0.10	2.17E+01	8.36E-03	2.24E+03	1.06E+05	NA	NA	1.38E+04	2.23E-03	8.62E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	4.81E-01	4.81E-01	NA	4.0E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
75092	1.11E+03	Methylene chloride

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
1.01E-01	1.17E-05	2.18E-03	25	6,706	313.00	510.00	1.17E+01	1.30E+04	4.7E-07	3.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.11E+03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	6,949	1.65E-03	6.90E-02	1.78E-04	9.70E-03	0.00E+00	0.00E+00	9.70E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.34E-02	4.68E+05	0.10	2.17E+01	9.70E-03	2.24E+03	2.13E+04	NA	NA	1.61E+04	3.03E-03	7.31E+09	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	1.58E+00	1.58E+00	4.7E-07	3.0E+00

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
91203	1.30E+03	Naphthalene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
5.90E-02	7.50E-06	4.82E-04	25	10,373	491.14	748.40	2.00E+03	3.10E+01	0.0E+00	3.0E-03	S

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.30E+03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	12,830	2.86E-04	1.20E-02	1.78E-04	5.67E-03	0.00E+00	0.00E+00	5.67E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
4.00E+00	3.78E+03	0.10	2.17E+01	5.67E-03	2.24E+03	2.52E+07	NA	NA	9.39E+03	1.22E-05	1.09E+12	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.39E-06	NA	1.28E-02	1.28E-02	NA	3.0E-03

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
103651	1.03E+03	n-Propylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.01E-02	7.83E-06	1.07E-02	25	9,123	432.20	630.00	5.62E+02	6.00E+01	0.0E+00	1.4E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.03E+03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	11,264	6.75E-03	2.82E-01	1.78E-04	5.77E-03	0.00E+00	0.00E+00	5.77E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.12E+00	2.21E+05	0.10	2.17E+01	5.77E-03	2.24E+03	1.88E+07	NA	NA	9.56E+03	9.18E-04	1.47E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	7.48E-01	7.48E-01	NA	1.4E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
100425	4.15E+03	Styrene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
7.10E-02	8.00E-06	2.74E-03	25	8,737	418.31	636.00	7.76E+02	3.10E+02	0.0E+00	1.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	4.15E+03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	10,362	1.80E-03	7.54E-02	1.78E-04	6.82E-03	0.00E+00	0.00E+00	6.82E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
1.55E+00	1.85E+05	0.10	2.17E+01	6.82E-03	2.24E+03	1.44E+06	NA	NA	1.13E+04	2.25E-04	7.04E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.39E-06	NA	6.27E-01	6.27E-01	NA	1.0E+00

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
108883	1.02E+02	Toluene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	4.0E-01	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (µg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.02E+02	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	9,067	4.58E-03	1.92E-01	1.78E-04	8.36E-03	0.00E+00	0.00E+00	8.36E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
3.64E-01	3.67E+04	0.10	2.17E+01	8.36E-03	2.24E+03	1.06E+05	NA	NA	1.38E+04	2.23E-03	8.62E+09	NO

Finite source indoor attenuation coefficient, <α> (unitless)	Mass limit bldg. conc., $C_{building}$ (µg/m^3)	Finite source bldg. conc., $C_{building}$ (µg/m^3)	Final finite source bldg. conc., $C_{building}$ (µg/m^3)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	1.24E-01	1.24E-01	NA	4.0E-01

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
95636	1.18E+03	1,2,4-Trimethylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.06E-02	7.92E-06	6.14E-03	25	9,369	442.30	649.17	1.35E+03	5.70E+01	0.0E+00	6.0E-03	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.18E+03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	11,592	3.84E-03	1.61E-01	1.78E-04	5.82E-03	0.00E+00	0.00E+00	5.82E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.70E+00	6.59E+04	0.10	2.17E+01	5.82E-03	2.24E+03	1.64E+07	NA	NA	9.64E+03	2.42E-04	5.64E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.39E-06	NA	2.23E-01	2.23E-01	NA	6.0E-03

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
108678	1.12E+03	1,3,5-Trimethylbenzene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
6.02E-02	8.67E-06	5.87E-03	25	9,321	437.89	637.25	1.35E+03	2.00E+00	0.0E+00	6.0E-03	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.12E+03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	11,574	3.67E-03	1.54E-01	1.78E-04	5.78E-03	0.00E+00	0.00E+00	5.78E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
2.70E+00	6.00E+04	0.10	2.17E+01	5.78E-03	2.24E+03	1.83E+07	NA	NA	9.57E+03	2.30E-04	5.90E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.39E-06	NA	2.04E-01	2.04E-01	NA	6.0E-03

END

SL-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES X

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemica
106423	1.84E+03	p-Xylene

MORE ↓

ENTER Average soil temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Depth below grade to bottom of contamination, (enter value of 0 if value is unknown) L_b (cm)	ENTER Totals must add up to value of L_t (cell G28) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
18	200	200	1524	200	0	0	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum A soil organic carbon fraction, f_{oc}^A (unitless)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum B soil organic carbon fraction, f_{oc}^B (unitless)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)	ENTER Stratum C soil organic carbon fraction, f_{oc}^C (unitless)
SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002	SI	1.35	0.489	0.167	0.002

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1

Used to calculate risk-based soil concentration.

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)	Physical state at soil temperature, (S,L,G)
7.69E-02	8.44E-06	7.64E-03	25	8,525	411.52	616.20	3.89E+02	1.85E+02	0.0E+00	7.0E+00	L

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R ($\mu g/kg$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
7.88E+08	1	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	22,412	1.84E+03	6.38E+06

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)	Convection path length, L_p (cm)
3.59E+07	6.25E-05	200	10,155	5.06E-03	2.12E-01	1.78E-04	7.39E-03	0.00E+00	0.00E+00	7.39E-03	1	200

Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source β term (unitless)	Finite source ψ term $(sec)^{-1}$	Time for source depletion, τ_D (sec)	Exposure duration > time for source depletion (YES/NO)
7.78E-01	4.10E+05	0.10	2.17E+01	7.39E-03	2.24E+03	4.84E+05	NA	NA	1.22E+04	1.22E-03	1.40E+10	NO

Finite source indoor attenuation coefficient, $<\alpha>$ (unitless)	Mass limit bldg. conc., $C_{building}$ ($\mu g/m^3$)	Finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Final finite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
3.38E-06	NA	1.39E+00	1.39E+00	NA	7.0E+00

END

J&E GROUNDWATER-ADV MODEL WORKSHEETS

Miller Children's Hospital Inpatient Tower

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75274	6.80E+00	Bromodichloromethane

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.98E-02	1.06E-05	1.60E-03	25	7,800	363.15	585.85	5.50E+01	6.74E+03	1.8E-05	7.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	23,776

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
7.18E+06	4.01E+07	5.93E-05	200	8,586	1.13E-03	4.71E-02	1.78E-04	2.87E-03	0.00E+00	0.00E+00	1.12E-04	7.10E-04	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	3.21E+02	0.10	2.30E+01	2.87E-03	2.38E+03	4.56E+14	1.55E-06	4.96E-04	1.8E-05	7.0E-02

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75003	4.00E+01	Chloroethane (ethyl chloride)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1525	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
2.71E-01	1.15E-05	8.80E-03	25	5,879	285.30	460.40	4.40E+00	5.68E+03	8.3E-07	1.0E+01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1325	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	23,776

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
7.18E+06	4.01E+07	5.93E-05	200	5,811	6.95E-03	2.91E-01	1.78E-04	2.60E-02	0.00E+00	0.00E+00	6.77E-04	4.64E-03	1325

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.16E+04	0.10	2.30E+01	2.60E-02	2.38E+03	4.10E+01	2.81E-06	3.27E-02	8.3E-07	1.0E+01

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75274	1.70E+00	Bromodichloromethane

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.98E-02	1.06E-05	1.60E-03	25	7,800	363.15	585.85	5.50E+01	6.74E+03	1.8E-05	7.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	23,776

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
7.18E+06	4.01E+07	5.93E-05	200	8,586	1.13E-03	4.71E-02	1.78E-04	2.87E-03	0.00E+00	0.00E+00	1.12E-04	7.10E-04	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	8.02E+01	0.10	2.30E+01	2.87E-03	2.38E+03	4.56E+14	1.55E-06	1.24E-04	1.8E-05	7.0E-02

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883	1.20E+00	Toluene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	4.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	23,776

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
7.18E+06	4.01E+07	5.93E-05	200	9,067	4.58E-03	1.92E-01	1.78E-04	8.36E-03	0.00E+00	0.00E+00	2.23E-04	1.52E-03	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	2.30E+02	0.10	2.30E+01	8.36E-03	2.38E+03	1.06E+05	2.13E-06	4.92E-04	NA	4.0E-01

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
106423	8.10E+00	p-Xylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5944	5944	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.69E-02	8.44E-06	7.64E-03	25	8,525	411.52	616.20	3.89E+02	1.85E+02	0.0E+00	7.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	23,776

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
7.18E+06	4.01E+07	5.93E-05	200	10,155	5.06E-03	2.12E-01	1.78E-04	7.39E-03	0.00E+00	0.00E+00	1.97E-04	1.34E-03	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.72E+03	0.10	2.30E+01	7.39E-03	2.38E+03	4.84E+05	2.05E-06	3.51E-03	NA	7.0E+00

END

Long Beach Memorial Medical Center Main Building

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75274	6.80E+00	Bromodichloromethane

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.98E-02	1.06E-05	1.60E-03	25	7,800	363.15	585.85	5.50E+01	6.74E+03	1.8E-05	7.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	22,412

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.38E+06	3.59E+07	6.25E-05	200	8,586	1.13E-03	4.71E-02	1.78E-04	2.87E-03	0.00E+00	0.00E+00	1.12E-04	7.10E-04	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	3.21E+02	0.10	2.17E+01	2.87E-03	2.24E+03	4.56E+14	1.60E-06	5.12E-04	1.8E-05	7.0E-02

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75003	4.00E+01	Chloroethane (ethyl chloride)

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
2.71E-01	1.15E-05	8.80E-03	25	5,879	285.30	460.40	4.40E+00	5.68E+03	8.3E-07	1.0E+01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	22,412

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.38E+06	3.59E+07	6.25E-05	200	5,811	6.95E-03	2.91E-01	1.78E-04	2.60E-02	0.00E+00	0.00E+00	6.77E-04	4.64E-03	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.16E+04	0.10	2.17E+01	2.60E-02	2.24E+03	4.10E+01	2.96E-06	3.44E-02	8.3E-07	1.0E+01

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
75274	1.70E+00	Bromodichloromethane

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.98E-02	1.06E-05	1.60E-03	25	7,800	363.15	585.85	5.50E+01	6.74E+03	1.8E-05	7.0E-02

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	22,412

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.38E+06	3.59E+07	6.25E-05	200	8,586	1.13E-03	4.71E-02	1.78E-04	2.87E-03	0.00E+00	0.00E+00	1.12E-04	7.10E-04	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	8.02E+01	0.10	2.17E+01	2.87E-03	2.24E+03	4.56E+14	1.60E-06	1.28E-04	1.8E-05	7.0E-02

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883	1.20E+00	Toluene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.70E-02	8.60E-06	6.62E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	4.0E-01

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	22,412

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.38E+06	3.59E+07	6.25E-05	200	9,067	4.58E-03	1.92E-01	1.78E-04	8.36E-03	0.00E+00	0.00E+00	2.23E-04	1.52E-03	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	2.30E+02	0.10	2.17E+01	8.36E-03	2.24E+03	1.06E+05	2.23E-06	5.12E-04	NA	4.0E-01

END

GW-ADV
Version 3.0; 02/03

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
106423	8.10E+00	p-Xylene

MORE ↓

ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum directly above water table, (Enter A, B, or C)	ENTER SCS soil type directly above water table	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of L_{WT} (cell G28)							
18	200	1524	1524	0	0	A	SI	SI		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
SI	1.35	0.489	0.167	SI	1.35	0.489	0.167	SI	1.35	0.489	0.167

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP (g/cm-s^2)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)
10	40	5603	5603	366	0.1	2	

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	25	250	1.0E-06	1
				Used to calculate risk-based groundwater concentration.	

END

CHEMICAL PROPERTIES SHEET

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.69E-02	8.44E-06	7.64E-03	25	8,525	411.52	616.20	3.89E+02	1.85E+02	0.0E+00	7.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Exposure duration, τ (sec)	Source-building separation, L_T (cm)	Stratum A soil air-filled porosity, θ_a^A (cm^3/cm^3)	Stratum B soil air-filled porosity, θ_a^B (cm^3/cm^3)	Stratum C soil air-filled porosity, θ_a^C (cm^3/cm^3)	Stratum A effective total fluid saturation, S_{te} (cm^3/cm^3)	Stratum A soil intrinsic permeability, k_i (cm^2)	Stratum A soil relative air permeability, k_{rg} (cm^2)	Stratum A soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
7.88E+08	1324	0.322	0.322	0.322	0.267	6.84E-09	0.830	5.68E-09	163.04	0.489	0.107	0.382	22,412

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Stratum A effective diffusion coefficient, D^{eff}_A (cm^2/s)	Stratum B effective diffusion coefficient, D^{eff}_B (cm^2/s)	Stratum C effective diffusion coefficient, D^{eff}_C (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)	Diffusion path length, L_d (cm)
6.38E+06	3.59E+07	6.25E-05	200	10,155	5.06E-03	2.12E-01	1.78E-04	7.39E-03	0.00E+00	0.00E+00	1.97E-04	1.34E-03	1324

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
200	1.72E+03	0.10	2.17E+01	7.39E-03	2.24E+03	4.84E+05	2.13E-06	3.65E-03	NA	7.0E+00

END

APPENDIX C

DEFAULT PARAMETERS AND

PROCEDURES FOR AIR DISPERSION MODELING

USING SCREEN3

SUMMARY REPORT

SCREEN3 MODELING

DEFAULT PARAMETERS AND

PROCEDURES FOR AIR DISPERSION MODELING

USING SCREEN3

To calculate off-site atmospheric concentrations of VOCs and inorganic substances in fugitive dust, the EPA-approved SCREEN3 dispersion model was utilized. SCREEN3 was used to calculate EPCs for the chemicals of concern at various distances from the Project Site, representing pertinent off-site populations, including the nearest residential populations under the current and project exposure scenarios.

The use of SCREEN3 is very health conservative since it is a screening model that calculates maximum hourly-average ground level concentrations at a particular distance from a source. SCREEN3 does not take into account wind rose data; therefore, the maximum concentration is typically in the prevailing wind direction(s).

In the current and project scenarios, the nearest residential population is assumed to be located 5,500 feet (1676 meters) from the proposed location of the Miller Children's Hospital expansion.

SCREEN3 was utilized in regulatory default mode for the purposes of this HRA. The urban (U) terrain model was utilized since the Project Site is located in a developed urban area. Receptor terrain was assumed to be at the same elevation as the source area since the terrain is generally flat-lying. Receptors were assumed to have a height of 1.5 meters, the height at which the nose and mouth of the average person are located.

The source was designated as an "area" source in order to represent the Project Site surface. The height of the source was assumed to be zero (i.e., ground surface). The width and the length of the source for were assumed to be were estimated to be 250 feet (ft) (76.2 meters [m]) and 150 ft (45.7m), respectively, the width and length of the site on which the proposed TCI facility is to be located.

Full meteorology was used in the SCREEN3 model in which the model examines a series of wind stability classes and their associated wind speeds to identify the "worst case" meteorological conditions (i.e., the combination of wind speed and stability that results in the maximum ground-level concentrations).

A unit emission rate was used in the model to arrive at unit-specific ground level concentrations. The unit-specific ground level concentrations for each receptor location were multiplied by the emission rates for the each COPC, which were obtained from the Farmer Equation calculations (Table 4-2a and 4-4a). Table 4-10 presents the results of SCREEN3 modeling in tabular form. A summary of SCREEN3 results for each chemical evaluated with the air dispersion model is attached as part of this appendix.

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

Miller Children's Hospital: Off-Site Receptors

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE                =        AREA
   EMISSION RATE (G/(S-M**2))  =      1.00000
   SOURCE HEIGHT (M)          =        .0000
   LENGTH OF LARGER SIDE (M)   =      76.2000
   LENGTH OF SMALLER SIDE (M)  =      45.7200
   RECEPTOR HEIGHT (M)        =       1.5000
   URBAN/RURAL OPTION         =       URBAN
THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

   MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION


BUOY. FLUX =     .000 M**4/S**3;  MOM. FLUX =     .000 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************
*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC            U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
   100.   .8153E+07    6     1.0    1.0 10000.0     .00     20.
   200.   .3163E+07    6     1.0    1.0 10000.0     .00      1.
   300.   .1649E+07    6     1.0    1.0 10000.0     .00      0.
   400.   .1024E+07    6     1.0    1.0 10000.0     .00      0.
   500.   .7077E+06    6     1.0    1.0 10000.0     .00      1.
   600.   .5252E+06    6     1.0    1.0 10000.0     .00      1.
   700.   .4091E+06    6     1.0    1.0 10000.0     .00      3.
   1,162.   .3308E+06    6     1.0    1.0 10000.0     .00      2.
   900.   .2748E+06    6     1.0    1.0 10000.0     .00      4.
  1000.   .2333E+06    6     1.0    1.0 10000.0     .00      4.
  1100.   .2017E+06    6     1.0    1.0 10000.0     .00      4.
  1200.   .1769E+06    6     1.0    1.0 10000.0     .00      2.
  1300.   .1570E+06    6     1.0    1.0 10000.0     .00      2.
```

```
  DIST     CONC            U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
  1400.   .1406E+06    6     1.0    1.0 10000.0     .00      2.
  1500.   .1270E+06    6     1.0    1.0 10000.0     .00      4.
  1600.   .1156E+06    6     1.0    1.0 10000.0     .00      4.
  1700.   .1060E+06    6     1.0    1.0 10000.0     .00      4.
  11,162.   .9764E+05    6     1.0    1.0 10000.0     .00      4.
  1900.   .9045E+05    6     1.0    1.0 10000.0     .00      4.
  2000.   .8416E+05    6     1.0    1.0 10000.0     .00      4.
  2100.   .7863E+05    6     1.0    1.0 10000.0     .00      4.
  2200.   .7373E+05    6     1.0    1.0 10000.0     .00      4.
  2300.   .6936E+05    6     1.0    1.0 10000.0     .00      4.
  2400.   .6545E+05    6     1.0    1.0 10000.0     .00      4.
  2500.   .6193E+05    6     1.0    1.0 10000.0     .00      4.
  2600.   .5874E+05    6     1.0    1.0 10000.0     .00      4.
  2700.   .5585E+05    6     1.0    1.0 10000.0     .00      3.
  21,162.   .5321E+05    6     1.0    1.0 10000.0     .00      3.
  2900.   .5080E+05    6     1.0    1.0 10000.0     .00      2.
  3000.   .4858E+05    6     1.0    1.0 10000.0     .00      2.
  3500.   .3975E+05    6     1.0    1.0 10000.0     .00      2.
  4000.   .3352E+05    6     1.0    1.0 10000.0     .00      4.
  4500.   .2892E+05    6     1.0    1.0 10000.0     .00      4.
  5000.   .2539E+05    6     1.0    1.0 10000.0     .00      4.
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND   100. M:
   100.   .8153E+07    6     1.0    1.0 10000.0     .00     20.
*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC            U10M   USTK  MIX HT   PLUME  MAX DIR
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
-------  ----------  ----  -----  -----  ------  ------  -------
  1676.   .1081E+06    6     1.0    1.0 10000.0     .00      4.
   126.   .6097E+07    6     1.0    1.0 10000.0     .00      4.

    ***************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ***************************************
 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      .8153E+07      100.        0.
****************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
```

Appendix F

Environmental Summary Report
Todd Cancer Institute

ENVIRONMENTAL SUMMARY REPORT
LONG BEACH MEMORIAL
MEDICAL CENTER EXPANSION
TODD CANCER INSTITUTE AREA
LONG BEACH, CALIFORNIA

Prepared for:

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November 2004
File No. 01203219.04 task 1

This Expansion Area Environmental Summary Report for a portion of the Long Beach Memorial Medical Center, 2801 Atlantic Avenue, Long Beach, California, dated November 2004, was prepared and reviewed by the following:

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ENVIRONMENTAL SUMMARY REPORT
LONG BEACH MEMORIAL MEDICAL CENTER EXPANSION
TODD CANCER INSTITUTE AREA
LONG BEACH, CALIFORNIA

INTRODUCTION AND BACKGROUND

General

SCS Engineers was retained by Long Beach Memorial Medical Center (LBMMC) to conduct an environmental review and site investigation of an approximately 7.5 acre portion of the LBMMC property located at the southeast corner of Spring Street and Long Beach Boulevard (Figure 1). Construction of additional facilities for LBMMC has been proposed for this area, including a building for outpatient cancer services. Figure 2 is a map of the study area.

Scope of Work and Objectives

The proposed construction involves the placement of a three story building, to be followed by a two story horizontal building expansion several years later. The construction area is currently used as a surface parking lot, with historical uses including oil production and a gas station. The purpose of the subsurface investigation, and other tasks that were conducted, was to evaluate environmental conditions in the area generally and to determine how these might impact proposed construction. In addition, the study aimed to estimate ranges of additional costs that might be expended in order to address the environmental concerns associated with the proposed construction.

Environmental tasks included the following:

- Data review and compilation of historic information. In addition to reports of previous investigations and oil production facility information, historic topographic maps and aerial photographs were reviewed.

- Geophysical investigation. Geophysical techniques were applied to attempt to locate inactive oil production wells, underground storage tanks, pipelines, and similar subsurface features.

- Subsurface sampling and analysis. Twenty-seven temporary soil vapor probes were installed at a depth of five feet bgs and soil vapor samples were collected. Five soil borings were advanced to total depths ranging from 30 to 55 feet bgs for both geotechnical and environmental purposes, and soil samples were collected. One additional soil boring was sampled at 5 feet and 10 feet bgs. Samples were tested with field instruments and examined physically, and boring logs were prepared. Selected soil samples were transported to a laboratory for chemical analysis.

- Preparation of recommendations for mitigation of the environmental issues.

Results of these activities are described in the following sections of this report.

Geology/Hydrogeology

Geologically, the project area is located in the southwestern portion of the Los Angeles basin. The basin formed when basement (older) rocks were structurally downwarped allowing a sequence of Upper Cretaceous through Recent age sedimentary units to form (estimated fill thickness 12,000 feet). The rocks of the basin are cut by numerous faults, most strike-slip faults of generally northwest-southeast orientation. The closest active fault to the site is the Newport-Inglewood fault zone, known as the Cherry Hill segment, located within approximately 1,000 feet northeast.

Surface elevation in the expansion area is between approximately 45 and 50 feet above mean sea level. The investigation area is located on the western flank of the Signal Hill uplift, approximately 1 mile east of the Los Angeles River and approximately 3 miles north of the Long Beach shoreline. Surficial geologic materials in the area consist of Pleistocene and Recent non-marine and marine units, predominantly sand, silty sand, sandy silt, silt, and clay. In addition, unclassified fill, including gravel, debris, and waste oil field material, was used to bring a former on-site ravine up to grade. Native and fill soils were encountered in borings drilled during the site investigation described in the present report.

The uppermost regional aquifer in this area is anticipated to be the Gage, located at a depth of approximately 200 feet below ground surface (bgs). Uppermost groundwater beneath most of the area occurs at a depth estimated at 50 feet bgs within sands of the Lakewood Formation.

HISTORICAL DATA REVIEW

Portions of the LBMMC were formerly occupied by a gas station, a welding shop, residences, and oil production facilities. At least four oil wells have been identified as being located or formerly located in on the site. Historical topographic and California Division of Oil, Gas, and Geothermal Resources (DOGGR) maps and aerial photography were reviewed in order to determine the locations of the former land uses, including the petroleum production facilities.

Historic Topographic Maps

Maps from 1947, 1951, 1964, 1972, and 1980 (photorevision date) were reviewed. Items of note were:

- 1947 (15-minute series). Somewhat generalized because of scale, but this map shows the location of a roadway through the site. Generalized location of a number of oil wells shown immediately east of the site.

- 1951 (7.5-minute series). Somewhat generalized because of scale, generalized location of several oil wells shown immediately east of the site, up to Atlantic Avenue.

- 1964 (7.5-minute series). Several oil wells are shown immediately east of the site. The oldest portion of the Long Beach Memorial Medical Center is shown to the south of the site.

- 1964, photorevised 1972 (7.5-minute series). Long Beach Memorial Medical Center, including the eastern addition, is shown to the south of the site. Very similar to previous.

- 1964, photorevised 1981 (7.5-minute series). Very similar to previous.

Selected portions of maps reviewed are included in Appendix A.

Aerial Photographs

The following aerial photographs from the Whittier College/Fairchild collection were obtained and reviewed:

- 1928/1929 – Several oil wells are visible in the area immediately east of the site. Oil storage tanks are also visible.

- July 1, 1933 – A building structure appears situated on the corner of Long Beach Boulevard and East Spring Street. Pasadena Avenue (which runs immediately east of the site) appears to be a dirt road. Several oil wells and oil storage tanks are visible immediately east of the site.

- June 17, 1947 – Mobile homes are visible in the western portion of the site. Oil storage tanks and wells are visible immediately east of the site.

- January 1953 – Mobile homes (similar to above) are visible in the eastern portion of the site, while evidence of oil production, including oil wells and oil storage tanks are visible.

- July 14, 1956 – Similar to above.

Selected portions of aerial photographs are reproduced in Appendix B.

Historical Oil Production Facilities

The DOGGR Long Beach oil field map indicates that the following wells were located on the eastern side of the property (Figure 2):

- Conoco, Inc. #1.
- Conoco, Inc. #2.

- Sun Denio #1.
- Sun Denio #2.

DOGGR files were referenced for these wells. The following sections summarize information from these files.

Conoco, Inc. #1

Continental Oil Co. submitted a supplemental proposal to the California State Mining Bureau to drill a well at the site in March 1923. The well was indicated as being located "...200 ft. West (W) and 50 ft. North (N) of the Southwest corner (SW Cor.) of Branden and Linden Avenues." Initial work at the site was performed without notice to the agency and included drilling to a depth of 3891 feet. A Notice of Intention to Abandon Well was filed on August 30, 1927 and approved on September 6, 1927. The well was abandoned by filling with heavy mud (drilling fluid) from bottom to 600 feet below ground surface (bgs), cutting the casing and pulling from 595 feet bgs, setting a concrete plug from 570 to 590 feet bgs, filling with mud to surface and capping the well with three sacks of cement. A letter dated July 27, 1928 noted discrepancies with how the well was abandoned and that inspection had revealed that the casing had been removed to "...as great a depth as could be seen with a flashlight, estimated at approximately 75 feet." The letter further states that "Approval of the manner in which the hole was abandoned is therefore withheld." A note at the bottom of the letter states that since the well is on the edge of the oil field and "...will probably do no damage, it is being marked "Abandoned" on our map and model, and the matter dropped without any further action."

Conoco, Inc. #2

A Notice of Intention to drill was filed for this well on July 3, 1923. The well was listed as being located 113.8 feet south and 74.4 feet west from the intersection of the centerlines of Spring Street and Pasadena Avenue. In 1923, the well was initially drilled to a depth of 3590 feet bgs, and later that year, drilled to 4250 feet bgs. In 1924 water was reported to be entering the well in large quantities, and the depth was further extended to 4727 feet bgs. A Notice of Intention to Abandon the well was filed on August 30, 1927. On September 30, 1927, the well was reportedly abandoned by plugging with cement at intervals between 656 to 678 feet, 3394 to 3415 feet, 3640 to 4727 feet and 4255 to 4270 feet. The hole was filled with heavy mud fluid to 700 feet and the casing was cut and pulled from 680 feet. The same letter from the Conoco, Inc. #1 file, dated July 27, 1928, which noted discrepancies with how the well was abandoned also appeared in the file for this well.

Sun Denio #1

A Notice of Intention to drill was filed for this well on June 25, 1928. The well was listed as being located 65 feet south and 630 feet east from the centerlines of Spring Street and Long Beach Boulevard. The well was drilled to 5374 feet bgs initially and further extended to 6350 feet bgs. The well was abandoned in July 1972 with cement plugs from 5303 to 5069 feet bgs and 60 to 10 feet bgs and a steel plate was welded over the casing at 10 feet bgs. An inspection

note from September 26, 1973 indicates that, "The well site had been graded over & there was no indication of seepage."

Sun Denio #2

A Notice of Intention to drill was filed for this well on February 28, 1929. The well was listed as being located 302.8 feet south and 57 feet west from the centerlines of Spring Street and Pasadena Avenue. The well was drilled to 6083 feet bgs initially and further extended to 7487 feet bgs. The well was abandoned in September 1958 with cement plugs from 7486 to 5767 feet, 4870 to 4821 feet, 4595 to 4517 feet, 2790 to 2762 feet, 677 to 623 feet and 18 to 8 feet bgs and a plate was welded on top of the casing.

Summary of Previous Environmental Studies

The following document provides environmental information on the property:

- Signal Geoscience, *Phase I Environmental Site Assessment Report, 300 E. Spring Street, Long Beach, California.* March 24, 2001.

SITE INVESTIGATION

Nature of Investigation

As indicated above, historical records indicate that this portion of the Signal Hill area, including the LBMMC site, was utilized for oil exploration and extraction. During the soils investigation described below, borings were advanced within the expansion area, principally based on historical information and previous reports indicating where the former gas station, welding shop and oil production facilities may have occured.

Geophysical Survey

Between July 21 and 22, 2004, SCS Engineers performed a geophysical analysis of the site in the areas where historical information indicated UST, wells, and oil production facilities had previously been located. A Cesium-Vapor Magnetometer operated by Spectrum Geophysics was used to identify magnetic anomalies that would indicate underground ferromagnetic material (i.e. iron-containing metallic objects).

The investigation resulted in the apparent confirmation of the locations of abandoned oil wells Denio #1 and Denio #2, in the northeast corner and along the eastern edge of the site, respectively (See Spectrum Geophysics report in Appendix B). No magnetic anomalies were detected in the suspected locations for the two Conoco wells. The reason for the failure to confirm the locations of these wells is likely that no casing remains in the upper portion of each well.

Investigation in the northeastern and central part of the site (i.e. west of the employee access gate to the parking lot), identified several geophysical anomalies. Linear trends indicate that some of the anomalies may be attributable to buried pipes or related objects likely remaining from former oil production facilities, however the exact nature of the sources could not be determined.

Investigation in the northwestern corner of the site was conducted to locate potential UST associated with the former gasoline station and welding shop. Anomalies were identified in the area, however the amplitude of the anomalies was not consistent with UST of the size anticipated. The exact nature of the source of other anomalies could not be determined conclusively.

On October 6, 2004, SCS Engineers performed a second geophysical analysis of the far northwestern portion of the property, outside the fence near the corner of Spring Street and Long Beach Boulevard, in an effort to locate the UST associated with the former gas station. A high-sensitivity metal detector operated by Spectrum Geophysics was used to identify magnetic anomalies that would indicate large metallic objects buried underground (e.g. steel USTs). No anomalies were detected that would indicate the presence of USTs.

Both geophysical reports are reproduced in full in Appendix C.

Soil Sampling Protocols

Subsurface soil sampling was conducted between September 27 and 28, 2004. An SCS staff member was in the field to direct driller operations and to describe and log samples. Field activity oversight and boring clearance activities were conducted by MACTEC as part of a geotechnical investigation. SCS Engineers worked in conjunction with MACTEC to collect samples for environmental investigation purposes.

Cascade Drilling Inc. of Norwalk, California provided Drilling and soil sampling services. A CME-85 rig, using hollow stem auger methods, was used to drill five soil borings (designated B1 through B5) and collect soil samples. Only the samples collected for environmental purposes will be discussed in this report. Soil samples were collected every 5 feet within each boring. Boring depths extended to 35 feet below ground surface (bgs) for borings B1, B3, and B5, and to 60 feet bgs for borings B2 and B4. Soil samples were collected from the prescribed depths using an 18-inch long, 2.5-inch diameter split spoon sampler on the end of a steel rod, which was hammered/driven for approximately 18-inches through the open center of the 6-inch diameter hollow-stem augers. The deepest intact sample sleeve was retained for subsequent laboratory analysis.

Following soil sample collection, both ends of each sample sleeve retained for analysis were covered with Teflon squares, capped with plastic end caps, and sealed with solvent-free polyethylene tape. A solvent-free label noting the date of collection, sample number, and project number was affixed to each sample. Samples were analyzed for Total Petroleum Hydrocarbons by EPA Method 8015B, Title 22 Metals by EPA Method 3050B/6010B and Volatile Organic Compounds (VOCs) by EPA Method 8260B. Samples for the intended analysis of VOCs (EPA

8260B) were collected using EPA Method 5035 preservation requirements. Immediately following labeling, samples were placed in a chilled cooler for later transport to Advanced Technology Laboratories (ATL), in Signal Hill, California for analysis. Samples were tracked from the point of collection through the laboratory using chain-of-custody procedures.

Standard three stage decontamination procedures were used for all sampling equipment, including sample sleeves and samplers, between each sampling depth and each boring. New latex surgical gloves were used and frequently replaced in the handling of all soil samples.

Additional soil was collected for visual examination by a SCS geologist. Soil samples used for lithologic descriptions were obtained from sample sleeves immediately adjacent to the samples collected for laboratory analysis and from other key points along the cores. New Nitrile gloves were used and frequently replaced in the handling of all soil samples. Soil boring locations are shown on Figure 2. Boring logs are included in Appendix D.

Vapor Probes Installation and Testing

Spectrum Geophysics of San Fernando, California conducted an additional geophysical survey of the area prior to any subsurface sampling by SCS. On October 5, 2004, Spectrum screened the proposed vapor survey locations using equipment capable of detecting metallic objects, magnetic anomalies, and power cables.

Between October 7 and October 8, 2004, H & P Mobile Geochemistry (H&P) of Solana Beach, California provided a direct push Strataprobe drill rig for vapor and soil sampling services, and an on-site mobile laboratory for the analyses of vapor samples.

During this investigation 27 soil vapor borings (designated SV1 through SV27) were advanced to a maximum depth of 5 feet bgs at various locations across the site. Soil vapor equipment consisted of hollow steel probes that were advanced into subsurface soils using a truck mounted Rotohammer. A soil vapor sample was collected at 5 feet bgs at each location. Once the steel probes were advanced to the desired depth, soil vapor samples were recovered by slightly retracting the probe and exposing sampling ports on the drive point of the steel probe. Vapor samples were extracted with a syringe via tubing attached to the drive tip. Prior to sampling, the tubing was purged of three volumes to remove ambient air from the sampling system and to ensure that the collected soil vapor sample represented conditions in the subsurface. Clean tubing was utilized for each sample. Chain-of-custody documentation was completed in order to accurately track the samples from the point of collection through analysis. Each of the soil vapor samples was analyzed for Volatile Organic Compounds (VOCs) by the on-site laboratory using EPA Method 8260B.

At one of the sample locations (SV21) a soil sample was collected at 5 and 10 feet bgs due to the tentative identification of Total Petroleum Hydrocarbons (TPH) in the soil vapor matrix during the on-site vapor sample analysis. Soil samples were collected using an 18-inch long acetate sleeve within a 2-inch diameter split spoon sampler on the end of a steel rod, which was

hammered/driven for approximately 18-inches during each sampling event. The acetate sleeve containing the soil sample was retained for subsequent laboratory analysis.

Following soil sample collection, both ends of each sample sleeve retained for analysis were covered with Teflon squares, capped with plastic end caps, and sealed with solvent-free polyethylene tape. A solvent-free label noting the date of collection, sample number, and project number was affixed to each sample. Immediately following labeling, samples were placed in a chilled cooler for later transport to Advanced Technology Laboratories (ATL), in Signal Hill, California for analysis. Samples were tracked from the point of collection through the laboratory using chain-of-custody procedures. New latex surgical gloves were used in the handling of all soil samples.

Field Observations

The following field observations are considered particularly relevant to the purpose of the investigation:

- The upper two to three feet bgs is relatively new fill, possibly related to parking lot construction. An additional two to six feet below this may be older fill.
- Between the base of fill and a depth of approximately 20 feet bgs soil consisting predominantly of sandy silt to silty sand was encountered.
- Below this up to approximately 22 to 26 feet bgs a section of sand was encountered.
- Under this, to a depth of 35+ feet, a silty sand with some clay was encountered.
- Between approximately 37 to 60 feet bgs, in the two borings that went to this depth, drilling encountered sandy silt with some clay and a few cleaner sand lenses.

Laboratory Analysis Results

Analytical results from the soil vapor survey are summarized in Table 1. Appendix E contains the full laboratory reports.

Laboratory analyses of the soil vapor samples resulted in one detectable concentration each of Freon113 (4.4 μg/L) and toluene (2.1 μg/L) in sample SV-9, m,p-xylene (2.2 μg/L) in sample SV-16 and benzene (6.8 μg/L) in sample SV-27. No other VOCs were detected in soil vapor samples from the site.

Analytical results from soil samples are summarized in Table 2. Appendix E contains the full laboratory reports and chain-of custody documentation.

Laboratory analyses of the bulk soil samples from borings taken at the site resulted in measurable detections of total petroleum hydrocarbons (TPH) in samples from only one soil boring. The

five and 10 foot bgs samples taken from TSB-21 indicated the presence of hydrocarbons ranging from C10 to greater than C32, relating to diesel or heavier petroleum contamination. The samples from this boring were collected due to visual evidence of contamination during the soil vapor sampling.

The only measurable concentrations of VOCs were bromoform (15 μg/kg) and methylene chloride (25 μg/kg) detected at the 20 foot depth of sample SB-5. Detectable concentrations of arsenic and selenium were greater than would be expected in unimpacted (background) soils. Concentrations of selenium however were less than residential and industrial Preliminary Remediation Goals (PRGs). The maximum concentration of arsenic was 23 mg/kg detected in the 20 foot depth of SB-4 and the maximum concentration of selenium was 4.7 mg/kg in the five foot depth of SB-3.

EFFECT OF ENVIRONMENTAL FINDINGS ON DESIGN AND CONSTRUCTION

Proposed Expansion Area Construction

The proposed expansion area construction has been divided into two phases, as follows:

- Phase 1 will consist of construction of the 3-story Todd Cancer Institute Building.
- Phase 2 will consist the 2-story horizontal expansion of the Todd Cancer Institute Building.

Environmental Conditions in Expansion Area Footprint

The four former oil wells on the site are located greater than approximately 170 feet from the proposed construction. Soil contamination by hydrocarbons was found in two of the samples acquired from one of the six soil borings. Soil gas vapor samples indicated only traces of toluene, xylenes and benzene in three out of 31 samples. The site is located adjacent to an old oil field, and oil production occurred on the eastern portion of the site. In addition, the site is located within less than 1000 feet of an old ravine fill landfill near the Miller Children's Center (MCH) area. Activities in the area could have resulted in localized leaks, spills or dumping of petroleum products.

Site Condition Remedies

Former Oil Wells: The four oil wells, two of which were located by the geophysical surveys, may not require abandonment per current Division of Oil, Gas and Geothermal Resources (DOGGR) requirements, as they are located greater than 10 feet from the proposed buildings, in the parking area. However, this decision lies with DOGGR based upon their review of site maps and the location of the final building footprints.

Soils: The results of the laboratory tests on 18 samples from the six soil borings and 31 samples from 27 soil vapor probes did not indicate the presence of contamination in the subsurface soils,

except one soil sample from boring TSB-1 at 10 feet bgs. The sample is from an area located approximately 175 feet from the Phase I building and approximately 50 feet from the Phase II building. Therefore, removal and treatment of soils for contamination is generally not required. However, it is recommended that the excavations for construction be carefully observed for evidence of petroleum hydrocarbons (staining, oily sheen, hydrocarbon odors) which may occur at random locations. If evidence of petroleum hydrocarbons is encountered, appropriate actions must be taken. This may require a contractor with Hazardous Waste license to excavate and dispose of any impacted soils.

Methane Gas: Since the site is located over an old oil field and within 1000 feet of the old ravine fill landfill at MCH, it is recommended that the buildings have a membrane barrier and passive venting system installed beneath the building slabs.

SUMMARY AND CONCLUSIONS

Historical research was conducted and determined the approximate locations of former oil wells on the site. A subsurface investigation was conducted consisting of (1) a geophysical survey that developed evidence for the location of two oil wells, (2) drilling and sampling that provided visual information on subsurface conditions and samples for laboratory chemical analyses, (3) soil gas probes that provided samples for laboratory chemical analyses, and (4) laboratory analysis of samples that determined the nature and concentration of contaminants in soils encountered during drilling and soil vapors acquired from probes. This information was combined with prior environmental investigations completed within or adjacent to the proposed construction sites.

Based on this information remedies were recommended for each environmental condition. This information forms the basis for cost estimates of the remedial measures for Phase 1 that are presented under separate cover.

RECOMMENDATIONS

Based on the information developed during this site investigation it is recommended that:

- This report be submitted to the Long Beach Health Department and they be asked to review and approve the proposed mitigation.
- A methane mitigation barrier and passive venting system be included in the building design plans.
- A monitor be used during excavation for construction to observe any potential petroleum hydrocarbon in uncovered soils and to take appropriate action as necessary.

Selection of Regulatory Oversight Agency

It is SCS' recommendation that the local certified unified permitting agency (CUPA), the Long Beach Health Department be selected as the lead regulatory oversight agency. Their CUPA status allows them to oversee remedial activities and will also allow for a streamlined permitting and approval process given the fact that they are a local City agency.

Appendix F

Environmental Summary Report
Miller Children's Hospital

ENVIRONMENTAL SUMMARY REPORT
LONG BEACH MEMORIAL
MEDICAL CENTER EXPANSION
MILLER CHILDREN'S HOSPITAL AREA
LONG BEACH, CALIFORNIA

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November 2004
File No. 01203219.03 task 1

This Expansion Area Environmental Summary Report for a portion of the Long Beach Memorial Medical Center, 2801 Atlantic Avenue, Long Beach, California, dated November 2004, was prepared and reviewed by the following:

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ENVIRONMENTAL SUMMARY REPORT
LONG BEACH MEMORIAL MEDICAL CENTER EXPANSION
MILLER CHILDREN'S HOSPITAL AREA
LONG BEACH, CALIFORNIA

INTRODUCTION AND BACKGROUND

General

SCS Engineers was retained by Long Beach Memorial Medical Center (LBMMC) to conduct an environmental review and site investigation of the portion of the LBMMC property immediately west of Atlantic Boulevard between Columbia Avenue and 27th Street (Figure 1). Construction of additional facilities for LBMMC has been proposed for this area, including acute care additions, lobby link building, new pediatric outpatient center, central plant, and entrance and other realigned on-site roads. Figure 2 provides a map showing the location of the study area.

Scope of Work and Objectives

The proposed construction involves the placement of a seven story and a five story building, partially over a former ravine which was historically filled using petroleum impacted soil and debris. The purpose of the subsurface investigation and other tasks that were conducted was to evaluate environmental conditions in the expansion area generally and to determine how these might impact proposed construction.

Environmental tasks conducted included the following:

- Data review and compilation of historic information. In addition to reports of previous investigations and oil production facility information, historic topographic maps and aerial photographs were reviewed.

- Geophysical investigation. Geophysical techniques were applied to attempt to locate inactive oil production and groundwater monitoring wells.

- Subsurface sampling and analysis. Between March 9 and March 11, 2004, nine soil borings were advanced to total depths ranging from 20 to 50 feet bgs and soil samples were collected. On October 7, 2004, two additional soil borings were advanced to total depths of 56 and 61 feet. Samples were tested with field instruments and examined physically and boring logs were prepared. Selected soil samples were transported to a laboratory for chemical analysis. Three of the borings advanced in March 2004 were converted into soil gas probes for later field testing.

- Development of recommendations for methods of mitigation of the adverse environmental conditions including preparation of estimates of the volume of impacted soil that may require removal and off site disposal or treatment within Phase 1 of the expansion (i.e., the new Inpatient Tower, Central Plant, Utility Trench and relocated Entrance road).Historic and subsurface investigative data, as well as foundation information for the proposed development, was assessed in order to estimate these soil removal/replacement volumes.

Results of these activities are described in the following sections of this report.

Geology/Hydrogeology

Surface elevation in the expansion area is between approximately 35 and 50 feet above mean sea level. The investigation area is located on the western flank of the Signal Hill uplift, approximately 1 mile east of the Los Angeles River and approximately 3 miles north of the Long Beach shoreline. Surficial geologic materials in the area consist of Pleistocene and Recent non-marine and marine units, predominantly sand, silty sand, sandy silt, silt, and clay. In addition, unclassified fill, including gravel, debris, and waste oil field material, was used to bring a former on-site ravine up to grade. Native and fill soils were encountered in borings drilled during the site investigation described in the present report.

The uppermost regional aquifer in this area is anticipated to be the Gage, located at a depth of approximately 200 feet below ground surface (bgs). Uppermost groundwater beneath most of the area occurs at a depth estimated at 50 feet bgs within sands of the Lakewood Formation, however a thin perched zone of groundwater was encountered as shallow as 15 feet bgs in the northern portion of the expansion area.

HISTORICAL DATA REVIEW

Portions of the LBMMC were constructed over a former ravine reportedly filled with petroleum containing soil and miscellaneous oil field and other debris. Some unclassified fill was removed prior to previous on-site construction. At least four oil wells have been identified as being located or formerly located in the vicinity of the expansion area. Historical topographic and California Division of Oil, Gas, and Geothermal Resources (DOGGR) maps and aerial photography were reviewed in order to determine the locations of the ravine and petroleum production facilities.

Historic Topographic Maps

Maps from 1947, 1951, 1964, 1972, and 1980 (photorevision date) were reviewed. Items of note were:

- 1947 (15-minute series). Somewhat generalized because of scale, but this map shows the location of a ravine oriented northeast/southwest, located in expansion area. Generalized location of a number of oil wells shown.

- 1951 (7.5-minute series). Provides more detailed topography of the ravine and shows that the ravine was connected to an upstream depression to the east. This map indicates three oil wells in the northern portion of the expansion area.

- 1964 (7.5-minute series). Shows that much of the ravine has been filled, though a depression remained in the northeastern portion of the site. The oldest portion of the hospital building is shown on the map. Oil wells are no longer shown within the expansion area.

- 1964, photorevised 1972 (7.5-minute series). The hospital building, including the eastern addition, is shown in the northeastern portion of the site.

- 1964, photorevised 1981 (7.5-minute series). Very similar to previous.

Selected portions of maps reviewed are included in Appendix A.

Aerial Photographs

The following aerial photographs from the Whittier College/Fairchild collection were obtained and reviewed:

- 1928/1929 – A stream is visible running through the northern portion of the expansion area, southwest from near the intersection of Columbia and Atlantic. The stream runs to a large pond located west of the expansion area but on the LBMMC site. One oil derrick is visible on the site, also near the intersection of Columbia and Atlantic.

- July 1, 1933 – Stream and pond configuration is similar to that described above. At least three oil derricks are visible on the western portion of the site.

- June 17, 1947 – Stream course and pond area visible, but pond area (located inside the bend of the stream) has shrunk.

- January 1953 – Stream course similar to above but pond is dry. There are at least three oil derricks located in the northern portion of the expansion area.

- July 14, 1956 – Steam course similar to above (not part of a stereo pair).

Aerial photographs obtained from the Rupp collection were also reviewed:

- November 19, 1953 – This image is similar to the one dated 1953, described above (not part of a stereo pair).

- January 17, 1958 – The ravine appears to have been at least partially filled (image viewed only, not purchased).

- October 30, 1972 – No stream or ravine is visible on site. The hospital appears to be in approximately its present configuration (not part of a stereo pair).

- 1985, 1997 – similar to above (image viewed only, not purchased).

Historical aerial photographs provide additional resources defining the location of the stream/ravine in the northern portion of the expansion area. Selected portions of aerial photographs are reproduced in Appendix B.

Historical Oil Production Facilities

The DOGGR Long Beach oil field map indicates that the following wells were located in the proposed footprint of the LBMMC expansion area (Figure 2):

- Woolner Oil, Young #10.
- Woolner Oil, Young #11.
- Hub Oil, Young #1.
- Alfred D. Mitchell #4.
- 29-7650 (Roggie Johnson Drilling)

DOGGR files were referenced for these wells. The following sections summarize information from these files.

Woolner Oil Corporation, Ltd, Young #10

Well originally designated as "Young" No. 1 drilled by Continental Oil Company. The well was quitclaimed to the landowner Petroleum Securities Company on March 31, 1929. Re-drilling was started April 14, 1929 by Petroleum Securities. Well completed November 6, 1929 to a depth of 7,303 feet and plugged back to 6,478 feet (perforations from 6,492 to 7,303). Petroleum Securities Company sold the well to J.E. O'Donnel on September 22, 1938. J.E. O'Donnell sold the wells to the Finley Company of Gerlach, Nevada on March 14, 1939. The well was renamed on April 26, 1943 at the request of the Woolner Oil Corporation when the "Young" lease was purchased from M.H. Finley of the Finley Company. Located T4S, R12W, Section 19, 94 feet south and 81.5 feet west from intersection centerlines of Atlantic and Columbia (Lots 1-15, Atlantic Lvd Tract No. 2). The well last produced in July 1953 and was abandoned November 10, 1953.

Woolner Oil Corporation, Ltd, Young #11

Well originally designated as "Young" No. 2 with drilling implemented by the landowner Petroleum Securities Company on August 25, 1929 to a depth of 6,811 feet. The well was

cleaned out and extended to 7,200 feet June 15, 1935 with perforations from 7,200 to 7,180 and 7,125 to 6,825 feet. Well began pumping on August 20, 1935. Petroleum Securities Company sold the well to J.E. O'Donnel on September 22, 1938. J.E. O'Donnell sold the wells to the Finley Company of Gerlach, Nevada on March 14, 1939. The well was renamed on April 26, 1943 at the request of the Woolner Oil Corporation when the "Young" lease was purchased from M.H. Finley of the Finley Company. Located T4S, R12W, Section 19, 51.02 feet north and 53.45 feet west from southeast corner of Young Lease (southeast corner is 300 feet south of southwest corner of Columbia and Atlantic;Lots 1-15, Atlantic Lvd Tract No. 2). The well last produced in July 1953 and was abandoned November 5, 1953.

Hub Oil, Young #1

Drilling was completed on this well on April 24, 1923 at a depth of 4,280 feet. This well apparently never produced more than a small amount of oil and was abandoned in 1926. The well was reportedly located 90 feet north and 30 feet west of the southeast corner of Lot 6, Atlantic Blvd. Tract 2.

Alfred D. Mitchell #4

Well was spudded on June 13, 1929 and completed in October of that year by the W.F. Meyer Company. Total depth was 7,170 feet with perforations from 6,160 to 7,170 feet. Located T4S, R12W, Section 19, 18 feet south and 28 feet west of the northeast corner of Lot 2. The well apparently produced mostly water and was abandoned in 1933.

 # 29-7650 (Roggie Johnson Drilling)

DOGGR staff were unable to locate their file for this well.

Summary of Previous Environmental Studies

A number of investigations have been completed on the Property. The following documents summarize the most significant previous studies dealing with the LBMMC that contain environmental information:

- Law/Crandall, Inc., *Report of Foundation Investigation, Proposed Children's Medical Office Building, Atlantic Avenue and 28th Street, Long Beach, California for the Long Beach Memorial Medical Center*, October 8, 1991.

- Law/Crandall, *Soil Vapor Study, Proposed Parking Structure and Medical Office Building Between Long Beach Boulevard and Atlantic Avenue and 27th and 28th Streets, Long Beach, California.* October 17, 1991.

- Law/Crandall, Inc., *Report of Phase I and Limited Phase II Site Assessment, Proposed Children's Medical Office Building, Long Beach, California.* October 23, 1991.

- Kleinfelder, *Limited Soil Gas Assessment Report, Proposed Addition to the Miller*

Children's Hospital, Long Beach Medical Center, 2801 Atlantic Avenue, Long Beach, California. December 22, 2003.

- Signal Geoscience, *Environmental Update, Proposed Medical Buildings Along Atlantic Avenue.* February 7, 2004.

In addition, a number of purely geotechnical reports reviewed contain boring logs and sometimes other information on soil conditions.

SITE INVESTIGATION

Nature of Investigation

As indicated above, historical records indicate that this portion of the Signal Hill area, including the LBMMC site, was utilized for oil exploration and extraction. A ravine that formerly ran through the expansion area was apparently used for the disposal of waste materials associated with oil exploration in the area. The ravine was brought up to grade in connection with construction of the current hospital. During the soils investigation described below, borings were advanced within expansion area, principally based on historical information and previous geotechnical reports indicating where the ravine fill might occur.

Geophysical Survey

A geophysical survey was conducted prior to subsurface sampling in order to clear boring locations of underground utilities as well as attempt to locate abandoned oil and groundwater monitoring wells. Spectrum Geophysics (Spectrum) of Burbank, conducted the survey March 8, 2004, with the oversight of SCS, using magnetic and electrical induction equipment capable of detecting metallic objects, magnetic anomalies, and electric power cables, and also using ground penetrating radar (GPR) capable of identifying subsurface soil characteristics indicative of an abandoned oil wells or areas of previous excavation.

Spectrum divided the survey in four specific areas, as described below. The full geophysical report is reproduced in Appendix C.

Area 1

Within this area, of approximate dimensions 120 feet north-south by 70 feet east-west, a significant magnetic anomaly with characteristics typical of a well was detected approximately 28 feet due south of where Roggie Johnson, 29-7650 No. 1 appeared on the MACTEC map (Figure 3). Borings EB6, EB7, EB8, and EB9 in this area were cleared of subsurface obstructions.

Area 2

Within this area, of approximate dimensions 40 feet north-south by 50 feet east-west, a significant magnetic anomaly with characteristics typical of a well was detected approximately 5 feet southeast of where Alfred D. Mitchell No. 4 appeared on the MACTEC map. Boring EB5 in this area was cleared of subsurface obstructions.

Area 3

Within this area, of approximate dimensions 120 feet northwest-southeast by 30 feet northeast-southwest, a magnetometer survey could only be conducted and only in the area that was not covered by reinforced concrete. No well-like anomalies were identified in the area of magnetic survey, however the gradiometer identified two significant anomalies at distances of 6 and 10 feet respectively from the suspected location of Woolner, Young No. 11 in the parking structure.

Area 4

Within this area, of approximate dimensions 80 feet north-south by 50 feet east-west, no well-like anomalies were identified. The DOGGR field well location map had indicated that the Woolner, Young No. 10 was located in this area.

<u>Soil Sampling Protocols</u>

March 2004 Investigation

Subsurface soil sampling was conducted between March 9 and 11, 2004. An SCS staff member was in the field to direct driller operations and to describe and log samples. Due to site constraints, three types of drill rigs were utilized in the collection of soil samples, as follows:

- A track mounted hollow stem-auger rig was used for borings EB1 and EB2. This equipment was operated by BC^2 of Fontana. Borings were continuously cored using a series of 12- to 18-inch split spoon drive samplers.

- A hydraulic direct push rig was used for borings EB3 and EB4. This rig was operated by Layne Drilling of Fontana. Samples were obtained with a hydraulically driven 2-foot long, 2-inch diameter split-spoon sampler. These samples were recovered in acetate sleeves.

- A CME 75 hollow stem auger drill rig, also operated by Layne was used at borings EB5, EB6, EB7, EB8, and EB9. Borings were continuously cored using 5-foot long split-spoon samplers that were advanced while drilling.

Immediately following soil sample collection using either the hollow stem or direct push rigs, samples for laboratory analysis were collected by sub-sampling the core into a sealable container or by cutting a section of core within its sample sleeve. The appropriate cap was fitted onto the container or both ends of the sleeve were covered with Teflon squares, capped with plastic end

caps, and sealed with non-VOC tape. Samples were labeled noting the date and time of collection, sample depth, and sample number affixed to each sample.

Immediately following labeling, samples were placed in a chilled cooler for later transport to the laboratory for analysis. Selected samples were analyzed for total petroleum hydrocarbons with carbon chain breakdown (TPH-cc) by EPA Method 8015M, volatile organic compounds (VOCs) by EPA Method 8260B, trace metals by EPA Methods including 6010B and 7000, polychlorinated biphenyls (PCBs) by EPA Method 8082, and chlorinated pesticides by EPA Method 8081A. Soil samples were tracked from point of collection through the laboratory using standard chain-of-custody protocol. The remainder of the core was archived in cardboard core boxes.

Additional soil was collected for visual examination by a SCS geologist. Soil samples used for lithologic descriptions were obtained from sample sleeves immediately adjacent to the samples collected for laboratory analysis and from other key points along the cores. New Nitrile gloves were used and frequently replaced in the handling of all soil samples. Soil boring locations are shown on Figure 2. Boring logs are included in Appendix D.

October 2004 Investigation

Additional subsurface soil sampling was conducted on October 7, 2004. An SCS staff member was in the field to direct driller operations and to describe and log samples. Spectrum Geophysics of San Fernando, California conducted a geophysical survey of the area prior to any subsurface sampling by SCS. On October 5, 2004, Spectrum screened the proposed drilling locations using equipment capable of detecting metallic objects, magnetic anomalies, and power cables.

Drilling and soil sampling services were provided by Layne Christensen of Fontana, California, with field oversight and sample preparation by SCS. A CME-95 rig, using hollow stem auger methods, was used to drill two soil borings (designated EB-10 and EB-11) and collect soil samples. Soil samples were collected at five-foot intervals between 5 and 60 feet bgs at EB-10 and between 5 and 55 feet bgs at EB-11. Soil samples were collected from the prescribed depths using an 18-inch long, 2.5-inch diameter split spoon sampler on the end of a steel rod, which was hammered/driven for approximately 18-inches through the open center of the 6-inch diameter hollow-stem augers. The deepest intact sample sleeve was retained for subsequent laboratory analysis.

Following soil sample collection, both ends of each sample sleeve retained for analysis were covered with Teflon squares, capped with plastic end caps, and sealed with solvent-free polyethylene tape. A solvent-free label noting the date of collection, sample number, and project number was affixed to each sample. Selected samples were analyzed for Volatile Organic Compounds (VOCs) by EPA Method 8260B, TPH-carbon chain identification by EPA Method 8015M, and Title 22 Metals. Samples for the intended analysis of Volatile Organic Compounds (EPA 8260B) were collected using EPA Method 5035 preservation requirements. Immediately following labeling, samples were placed in a chilled cooler for later transport to American Environmental Testing Laboratory (AETL), in Burbank, California for analysis. Samples were

tracked from the point of collection through the laboratory using chain-of-custody procedures.

Standard three stage decontamination procedures were used for all sampling equipment, including sample sleeves and samplers, between each sampling depth and each boring. New latex surgical gloves were used and frequently replaced in the handling of all soil samples.

Additional soil was collected for visual examination by a SCS geologist. Soil samples used for lithologic descriptions were obtained from sample sleeves immediately adjacent to the samples collected for laboratory analysis and from other key points along the cores. New Nitrile gloves were used and frequently replaced in the handling of all soil samples. Soil boring locations are shown on Figure 2. Boring logs are included in Appendix D.

Vapor Probes Installation and Testing

Vapor monitoring probes were placed within borings EB1, EB2, and EB6 to depths of 15, 10, and 20 feet bgs respectively. The probes are constructed of 3/4-inch Schedule 40 PVC with the lower 10 feet perforated. The annular space around the perforated section of each probe was filled with gravel to allow entry of gas into the probe. A 4 to 9 foot layer of hydrated bentonite was placed near the surface. The tops of the probes were fitted with petcocks to allow collection of samples. The wells are protected by traffic-rated well boxes.

On April 16, 2004, the probes were sampled and analyzed in the field using a Landec GEM 500 Gas Analyzer. The results, as summarized in Table 1, indicate that only the probe placed in boring EB6 contained detectable concentrations of methane, and this at the relatively low concentration of 0.6 percent by volume. The source of the methane is unknown.

Field Observations

The following field observations are considered particularly relevant to the purpose of the investigation:

- Fill in boring EB1 extended to a depth of at least 30 feet bgs, and the upper approximately 27 feet or so included concrete, wood, glass, metal, and other debris. This boring exhibited the most obvious soil staining and hydrocarbon odors. Hydrocarbon odors, staining, and other evidence residue were noticeable beginning at approximately 12 feet bgs and continuing throughout the remainder of the boring. Soils consisted of predominantly of sands and silts with some sandy clays. at approximately 18 and 25 feet bgs. A thin wet zone was encountered at approximately 15 feet bgs and saturated soil below approximately 43 feet bgs.

- Fill in boring EB2 extends to approximately 10 feet bgs. Soil in this boring consisted of sandy silt and silty sand. No odors were identified.

- Fill in boring EB3 extends to about 13 feet bgs. The upper portion of the fill is dark and has a “swampy” odor and the uppermost portion contains debris.

- Fill in boring EB4 extends to approximately 15 feet bgs and consists predominantly of fine sand and silt with gravel. Debris consisting of brick gravel and wood were encountered within the uppermost 3 to 4 feet of each boring. A slight hydrocarbon odor was noted in drill cuttings from approximately 1 foot bgs.

- Fill in boring EB5 extends to approximately 18 feet bgs. Portions of this fill are dark and have a hydrocarbon odor.

- In boring EB6, fill extends to a depth of about 17 feet bgs, the upper 6 feet of which is looser and contains concrete and other debris. Soils are predominantly sandy with silt.

- In boring EB7, the upper approximately 5 feet is relatively loose, debris laden fill, the next 4 to 5 feet is well-graded reddish fill, and the fill section extends to about 15 feet bgs. Soil in this area is predominantly sandy silt.

- Fill in boring EB8 consists of approximately 1 foot of loose material, underlain by approximately 8 feet of well-graded reddish fill soil. Soil below this consists of sand and sandy silt in this location.

- Fill in boring EB9 consists of approximately 1 foot of loose material with debris, underlain by approximately 8 feet of well graded reddish fill soil. Soil in this boring is primarily silty sand.

- Fill in boring EB10 extends to approximately 32.5 feet bgs or elevation approximately 8 feet msl with some oily material at further depths, possibly because this was part of the pond, as seen in the 1928/1929 aerial photograph.

- Fill in boring EB11 extends to approximately 30 feet (no sample at this depth) or elevation approximately 8 feet msl. Some oily odor below this depth.

Cross sections, illustrating the subsurface information summarized above, was constructed based on the results of this and previous soil sampling (Figures 4 and 5). The cross section shows the approximate location of impacted and relatively clean fill soils. Also, contours of the elevation (above mean sea level) of artificial fill/contaminated soil were interpreted from the data as shown on Figure 3.

Laboratory Analysis Results

Analytical results are summarized in Tables 2 through 6. Appendix E contains the full laboratory reports and chain-of custody documentation.

Laboratory analyses detected petroleum hydrocarbons in various concentrations in fill soils encountered in boring EB1. The maximum concentration of TPH was in the 20-foot depth of this sample. This sample also contained benzene and other petroleum related VOCs. The 15-foot depth sample from EB1 contained petroleum hydrocarbons and concentrations of lead, arsenic, and mercury greater than would be expected in unimpacted (background) soils. The concentration of arsenic was 26 mg/kg.

Petroleum hydrocarbons were detected in various concentrations in EB-10 and EB-11 up to 40 foot and 20 foot depths respectively. EB-10 also contained the maximum concentrations of benzene and other petroleum related VOCs.

Petroleum hydrocarbons were also detected in the 5-foot depth samples from EB-3, EB-4, and EB-5, and the 10-foot depth samples from EB-3 and EB-5, but generally at lower concentrations than in samples from boring EB1. Arsenic was detected at a concentration of 26.8 mg/kg in the 15-foot depth sample from EB4. All of the soil samples analyzed were non-detect for PCBs.

EFFECT OF ENVIRONMENTAL FINDINGS ON DESIGN AND CONSTRUCTION

Proposed Expansion Area Construction

The proposed Phase 1 expansion area construction includes:

- realigning 820 linear feet of the entry drive (Patterson Street) and installation of a 1,000 foot underground utility trench to provide services to the Pediatric Inpatient Tower from the Central Plant;

- demolition of the existing parking structure located immediately southeast of the hospital east wing and construction of the first 4-stories of the Pediatric Inpatient Tower in the area of the former parking structure;

- demolition of the “ranch house” currently housing the WIC Medical Center on the southeastern portion of the LBMMC site, construction of a new Central Plant at the former location of the ranch house.

Environmental Conditions in Expansion Area Footprint

Old Oil Wells: Four old oil wells are located within or very near the area of proposed construction and records do not support proper abandonment of these wells per current DOGR requirements. Two of the wells are located within the footprint of the proposed Acute Care building.

Ravine Fill or Landfill Materials: Based on historical soil exploration, the deepest portion of the ravine that formerly existed on the LBMMC site extended south-southwest from Columbia Street in the northeastern portion of the site (centered approximately 50 feet east of Atlantic Boulevard). Maps, soil borings and other records indicate that the ravine was filled over many years with waste, debris (wood, concrete and asphalt chunks) “oily soils” and other oil field

waste. Based on information in the summary report prepared by Mactec (March 2004), much of the ravine fill underlying the existing parking structure to be demolished had previously (circa 1970) been removed and replaced by engineered fill. However, some of the excavated soil was replaced in the excavation and leaching from surrounding soil containing oil field waste may have occurred. Also, the ravine fill area is listed as an inactive landfill site on the state Integrated Waste Management Board's Solid Waste Information System (SWIS).

The ravine fill, particularly in the northeastern portion of the LBMMC site, consists of oily soil, debris, and possibly material from oil drilling or production sumps. Remaining fill is, in some areas, dark, soft, very moist to wet, and oily. SCS combined it's 11 recent soil borings and Mactec's recent geotechnical borings with the prior borings to develop cross sections and contours of the ravine fill materials (Figures 3 and 4). Also, cross sections were prepared within the proposed Pediatric Inpatient Tower at a larger scale (Figure 5) and incorporating the SCS borings and total petroleum hydrocarbons (TPH) indicated in laboratory tests on each sample. Laboratory tests on multiple soil samples from the borings did not indicate RCRA hazardous waste, rather some of the samples contained heavy petroleum hydrocarbons and low concentrations of volatile organic compounds associated with fuels and oil field materials.

The contours shown on Figure 3 represent the approximate bottom elevation of unsuitable soils. Also, there is the potential for surficial soils within the Central Plant and Entrance Road and onsite roads and general grading areas to contain localized contamination with oil field materials (e.g., EB-10 and EB-11 encountered "oily soils" near the surface). If left in place within the area of construction, the ravine fill materials and "oily soils" would impact the proposed construction by not providing adequate support to building foundations, floor slabs, etc. and potential exposure of construction workers. Also, they could provide a source of methane that could migrate into building sub-surface floors or other enclosed spaces and present a risk of explosion or asphyxiation.

Methane Gas: Soil gas probes completed by Kleinfelder within the area of the proposed Acute Care building indicated some low levels of methane and the existing MCH building has a methane mitigation system in place.

Ground water: Ground water was encountered at a depth of about 50 feet except for a small perched zone at 15 foot depth in boring EB-1. Ground water depths have been reported to fluctuate considerably in past hospital construction projects. During a Phase I Site Assessment completed at the site by Law/Crandall (Law/Crandall 1991) three ground water monitoring wells well installed and sampled. The test results indicated the presence of petroleum hydrocarbons (up to 120 mg/L in MW-2) in ground water but levels of benzene, ethylbenzene, toluene and total xylenes were below California State Action Levels.

The next section presents a discussion of potential remedies to the adverse site conditions.

Site Condition Remedies

The remedies to the environmental conditions within the proposed construction area recommended should consist of four elements: (1) proper re-abandonment (i.e., abandonment in accordance with current DOGGR requirements) of four old abandoned oil wells located within the work limits, (2) removal of "oily" and otherwise unsuitable soil and replacement with clean compacted fill, (3) installation of methane barrier and passive venting systems beneath the proposed buildings, and (4) construction of a foundation dewatering system at the new Inpatient Pediatric building site. The proposed building and pavement construction will provide an impermeable barrier for groundwater percolating through the affected soil and potentially leaking into the ground water.

A number of alternatives are possible to remediate unclassified fill under the proposed building foundations. The only practical option appears to be complete excavation of unsuitable fill under foundations and encountered in the utility trench excavation and grading for the entrance and onsite roads. Once this material has been excavated it could be treated on site and possibly reused as a component of engineered fill. For practical purposes, significantly contaminated fill could not be reused on site because of the time consuming and relatively costly permitting and treatment that would be necessary. Therefore, it is recommended that plans be developed for excavation, visual sorting (i.e., oily soil and debris from soil that appears free of these materials) followed by confirmation testing by a mobile laboratory (or samples sent to a laboratory for 24-hour turnaround testing) and the results used to determine soil for offsite disposal and that which can be re-used as backfill on site.

To facilitate removal of the impacted soil, shoring would be installed prior to demolition of the existing parking structure and the existing reinforced concrete piles would be cutoff at the elevation of the new pile cap bottom and disposed offsite.

Volume estimates for the soil to be excavated and portions estimated for disposal were made for the two building areas as shown in Table 9. The volume estimates were based on removal of the "oily" or unsuitable soil to the depth of the bottom of the pile caps for the Inpatient Pediatric Tower building and to the depth of two feet at the Central Plant. The elevation of removal shown in the Table was approximated from the contours shown on Figure 3 and the cross sections on Figure 5. An additional 2 feet was added to the thicknesses derived from the figures to allow for over-excavation and re-compaction at the bottom of the excavation to provide a firm foundation for the subsequent construction activities. The average thickness of soil removal within each area was then multiplied by the area of construction to determine the excavation volume. It was assumed that the removals would extend only to 5 feet beyond the proposed new building footprints to allow for shoring and working space for the new construction and that excavation beyond these limits to further remove contaminated soils would not be required.

At the Pediatric Inpatient Tower it was assumed that 100% of the removed soil would require offsite disposal except where the building overlaps the existing area of previously re-compacted fill beneath the existing parking structure where it was assumed that up to 50% of the soil would be disposed offsite. This latter assumption was made because of the potential for leaching of oily materials into the engineered fill and the impracticalities of excavation around and adjacent

to this area (e.g., shoring would likely be required around the limits of the engineered fill to allow removal of adjacent soft and oily soil and placement of this shoring inside the overall excavation footprint would be very difficult with the existing pile foundations).

At the proposed Central Plant location it was assumed that up to 50 % of the soil excavated in the upper two feet of depth would require offsite disposal. This assumption was made, although soil borings in the area did not indicate "oily soil", because of the general experience in the old oil field patch of finding random locations of where soils have been impacted by leaks or spills.

Grading quantities were not yet available from the project civil engineer for the entrance road and onsite roads and general site grading. Therefore, it was assumed that an average of 2 feet of soil would be excavated for this grading work and that up to 25% would require offsite disposal. The latter assumption was made due to the general experience in old oil patches of random occurrences of leaks and spills and the "oily soils" found in the upper portions of borings EB-10 and EB-11.

The utility trench was assumed to be 4 feet wide and 6 feet deep and that up to 50% of the excavated soil would require offsite disposal. The 50% assumption again was based on the general oil patch experience of random leaks and spills.

A swell factor of 20% was applied to each of the excavated volumes to determine the quantities for hauling offsite for disposal or treatment.

It should be planned to have the excavated soils stored on site very near the Acute Care building excavation. Table 9 also includes estimates of the volume of soil in the onsite stockpile (based on 50% in the stockpile at any given time) for purposes of air emissions analyses performed for the EIR. Estimates of the volume of soil needed to backfill the excavation at the Pediatric Inpatient Tower to the approximate elevation of the new pile caps, to the original grade at the Central Plant building and utility trench, and to replace the average 2 feet of removal assumed for the entrance road and other on site grading are also provided. Finally, estimates of the volumes of import soil needed for the backfilling were made based on the assumed % of soil that could be re-used onsite after the sorting and a 15% shrinkage of the soil when compacted.

The information provided in Table 9 was then used to generate remediation cost estimates that are presented under separate cover.

SUMMARY AND CONCLUSIONS

Historical research was conducted and determined the approximate locations of former oil wells and a now-filled ravine located in the LBMMC expansion area. A subsurface investigation was conducted consisting of (1) a geophysical survey that developed evidence for the location of several oil wells, (2) drilling and sampling that identified fill and native soils and that provided indications of locations of oily and debris laden fill, (3) soil gas measurements in probes installed in the proposed Acute Care building area, and (4) laboratory analysis of samples that determined the nature and concentration of contaminants in soils encountered during drilling. This information was combined with prior environmental and geotechnical investigations completed

within or adjacent to the proposed construction sites.

Based on this information remedies were recommended for each environmental condition and cross sections and contours were developed and volumes of fill to be removed were estimated for Phase 1 of the expansion. This information forms the basis for cost estimates of the remedial measures for Phase 1 that are presented under separate cover.

RECOMMENDATIONS

Based on the information developed during the investigation activities, it is recommended that:

- Permits should be acquired and plans prepared for proper abandonment of the oil wells located within and near the proposed construction.

- Demolition plans be prepared that address removal of the existing concrete piles in the parking structure now located at the new Pediatric Inpatient Tower site. The concrete should be examined for evidence of "oily" material and cleaned prior to disposal if necessary.

- A Soil Excavation and Handling Plan be prepared to address removal of the soft and oily soils within the limits of proposed building foundations (plus 5 feet horizontally beyond the limits)) and the upper two feet in the areas of entrance roads and onsite roadways to be constructed.

- A Landfill Closure Plan be prepared and submitted to the regulatory agencies to document the remediation efforts.

- Buildings to be demolished should have asbestos/lead based paint surveys to clear them for the demolition permits.

- Volume of fill removal estimates should be updated and revised once the foundation plans have been developed by the structural engineer and the grading plans have been finalized by the project civil engineer.

Selection of Regulatory Oversight Agency

Due to the nature of the contamination encountered beneath the proposed expansion area, there are several possibilities for the selection of a lead regulatory oversight agency. It is SCS' recommendation that the local certified unified permitting agency (CUPA), the Long Beach Health Department be selected as the lead regulatory oversight agency. Their CUPA status allows them to oversee remedial activities and will also allow for a streamlined permitting and approval process given the fact that they are a City agency.

However, in the event that the Long Beach Health department declines to take a lead oversight role on the project, the solid waste lead enforcement agency (LEA) and or the Regional Water Quality Control Board (RWQCB) are also viable oversight agencies. Also, a landfill closure

plan should be prepared and submitted to these agencies.