Screening For Environmental Concerns at Sites with Contaminated Soil and Groundwater

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Table of Contents

EXECUTIVE SUMMARY **ES-1**

1 INTRODUCTION **1-1**

1.1 Tiered Approach to Environmental Risk Assessments 1-1
1.2 Comparison To Existing Screening Levels 1-2
1.2.1 OEHHA CHHSLs 1-3
1.2.2 US EPA Region 9 PRGs 1-5
1.2.3 City of Oakland Screening Levels 1-6
1.2.4 Hazardous Waste Regulations 1-7
1.2.5 OSHA Standards Permissible Exposure Levels 1-8
1.3 Chemicals Not Listed In Lookup Tables 1-10
1.4 Limitations 1-10

2 TIER 1 LOOKUP TABLES **2-1**

2.1 Use of Lookup Tables 2-3
2.2 Evaluation of Petroleum Contamination 2-6
2.3 Groundwater Beneficial Use 2-7
2.4 Shallow Versus Deep Soils 2-9
2.5 Land Use 2-11
2.6 Threat to Surface Water Habitats 2-12
2.7 Screening For Vapor Intrusion Concerns 2-14
2.7.1 Stepwise Approach to Vapor Intrusion Evaluation 2-15
2.7.2 Collection and Evaluation of Groundwater Data 2-17
2.7.3 Collection and Evaluation of Soil Gas Data 2-17
2.7.4 Soil Gas and Low-Permeable Soils 2-19
2.7.5 Collection and Evaluation of Indoor Air Data 2-20
2.8 Substitution of Laboratory Reporting Limits and Ambient Background Concentrations for ESLs 2-22
2.9 Implied Land-Use Restrictions Under Tier 1 2-22
2.10 Cumulative Risks at Sites With Multiple Chemicals of Concern 2-24
2.11 Framework for a Tier 1 Environmental Risk Assessment 2-24

3 TIER 2 AND 3 ENVIRONMENTAL RISK ASSESSMENTS **3-1**

3.1 Tier 2 Environmental Risk Assessments 3-3
3.2 Tier 3 Environmental Risk Assessments 3-7
3.2.1 Laboratory-Based Soil Leaching Tests 3-7

3.2.2 Tier 3 Environmental Risk Assessments for Parklands 3-10
3.2.3 Tier 3 Reference Documents 3-11

4 DEVELOPMENT OF TIER 1 LOOKUP TABLES 4-1

4.1 Example Selection of Tier 1 ESLs for Tetrachloroethene (PCE).....4-2
4.2 Cumulative Risk 4-4

5 GROUNDWATER AND SURFACE WATER SCREENING LEVELS.....5-1

5.1 Screening Levels for Drinking Water 5-2
5.2 Screening Levels for Aquatic Habitat Protection.....5-3
5.3 Groundwater Screening Levels for Aquatic Habitat Impacts.....5-6
5.4 Groundwater Screening Levels for Potential Vapor Intrusion Concerns5-7
5.4.1 Background and Use of US EPA Vapor Intrusion Model 5-10
5.5 Surface Water and Groundwater Ceiling Levels For Gross Contamination Concerns 5-10
5.6 Other Groundwater Screening Levels.....5-12

6 SOIL SCREENING LEVELS.....6-1

6.1 Soil Screening Levels for Direct-Exposure Concerns 6-2
6.1.1 Residential Receptors.....6-2
6.2 Non-residential land uses 6-6
6.2.1 Commercial/Industrial Worker 6-6
6.2.2 Construction Worker 6-8
6.3 Lead.....6-10
6.4 Background Metal Concentrations 6-12
6.5 Soil Screening Levels for Potential Vapor Intrusion Concerns.....6-12
6.6 Soil Screening Levels for Groundwater Protection 6-13
6.7 Soil Screening Levels for Terrestrial Habitats 6-17
6.8 Ceiling Levels for Gross Contamination Concerns 6-18

7 INDOOR AIR AND SOIL GAS SCREENING LEVELS.....7-1

7.1 Indoor Air Screening Levels 7-1
7.2 Soil Gas Screening Levels.....7-2

8 SOIL AND GROUNDWATER SCREENING LEVELS FOR TPH 8-1

8.1 TPH Screening Levels for Groundwater.....8-3
8.2 TPH Screening Levels for Soil 8-4
8.2.1 TPH (gasolines, middle distillates) 8-4
8.2.2 TPH (residual fuels).....8-6

9 OTHER ISSUES.....9-1

9.1 Laboratory Reporting Levels and Background Concentrations.....9-1
9.2 Reporting of Soil Data 9-1

9.3 Degradation to Daughter Products 9-2

10 REFERENCES 10-1

FIGURES

1 Summary of Human Health and Environmental Concerns Considered In Lookup Tables.

2 Summary of Individual Screening Levels Used to Select Final, Tier 1 Soil and Groundwater ESLs for Tetrachloroethene.

3 Selection of Environmental Screening Levels from Tier 1 Lookup Tables

TABLES

A Shallow Soil (<3m bgs), Groundwater is a Current or Potential Source of Drinking Water

B Shallow Soil (<3m bgs), Groundwater is not a Current or Potential Source of Drinking Water

C Deep Soil (>3m bgs), Water is a Current or Potential Source of Drinking Water

D Deep Soil (>3m bgs), Water is not a Current or Potential Source of Drinking Water

E Shallow Soil Gas and Indoor Air

F Surface Water

A-1 Shallow Soil Screening Levels (<3 m bgs) Residential Land Use (Potentially Contaminated Groundwater is a Current or Potential Drinking Water Resource)

A-2 Shallow Soil Screening Levels (<3 m bgs) Commercial / Industrial Land Use (Potentially Contaminated Groundwater is a Current or Potential Drinking Water Resource)

B-1 Shallow Soil Screening Levels (<3 m bgs) Residential Land Use (Potentially Contaminated Groundwater is not a Current or Potential Drinking Water Resource)

B-2 Shallow Soil Screening Levels (<3 m bgs) Commercial / Industrial Land Use (Potentially Contaminated Groundwater is not a Current or Potential Drinking Water Resource)

C-1 Deep Soil Screening Levels (>3 m bgs) Residential Land Use (Potentially Contaminated Groundwater is a Current or Potential Drinking Water Resource)

C-2 Deep Soil Screening Levels (>3 m bgs) Commercial / Industrial Land Use (Potentially Contaminated Groundwater is a Current or Potential Drinking Water Resource)

D-1 Deep Soil Screening Levels (>3 m bgs) Residential Land Use (Potentially Contaminated Groundwater is not a Current or Potential Drinking Water Resource)

D-2 Deep Soil Screening Levels (>3 m bgs) Commercial / Industrial Land Use (Potentially Contaminated Groundwater is not a Current or Potential Drinking Water Resource)

E-1a Groundwater Screening Levels for Evaluation of Potential Indoor-Air Impacts (Volatile Chemicals Only)

E-2 Shallow Soil Gas Screening Levels for Evaluation of Potential Indoor-Air Impacts (Volatile Chemicals Only)

E-3 Indoor Air Screening Levels

F-1a Groundwater Screening Levels (Groundwater is Current or Potential Drinking Water Resource)

F-1b Groundwater Screening Levels (Groundwater is not a Current or Potential Drinking Water Resource)

F-2a Surface Water Screening Levels Fresh Water Habitats

F-2b Surface Water Screening Levels Marine Habitats

F-2c Surface Water Screening Levels Estuary Habitats

F-3 Summary of Drinking Water Screening Levels for Human Toxicity

F-4a Summary of Selected Chronic Aquatic Habitat Goals

F-4b Summary of California Continuous and Maximum Aquatic Habitat Goals

F-4c Summary Of US EPA and Other Published Aquatic Habitat Goals

F-4d Surface Water Quality Standards for Bioaccumulation and Human Consumption of Aquatic Organisms

F-5 Agricultural Water Quality Goals

F-6 US EPA Region 9 Tap Water Goals

G-1 Soil Screening Levels for Leaching Concerns

H-1 Criteria for Assignment of Soil Gross Contamination Ceiling Levels

H-2 Components for Shallow Soil Gross Contamination Ceiling Levels

H-3 Components for Deep Soil Gross Contamination Ceiling Levels

I-1 Groundwater Ceiling Levels (Groundwater is a Current or Potential Source of Drinking Water)

I-2 Groundwater Gross Contamination Ceiling Levels (Groundwater is not a Current or Potential Source of Drinking Water)

I-3 Surface Water Ceiling Levels (Surface Water is a Current or Potential Source of Drinking Water)

I-4 Surface Water Gross Contamination Ceiling Levels (Surface Water is not a Current or Potential Source of Drinking Water)

J Physical-Chemical and Toxicity Constants Used in Models

K-1 Direct-Exposure Screening Levels, Residential Exposure Scenario

K-2 Direct-Exposure Screening Levels, Commercial/Industrial Worker Exposure Scenario

K-3 Direct-Exposure Screening Levels, Construction/Trench Worker Exposure Scenario

L Target Organs and Chronic Health Effects

Executive Summary

This document presents Environmental Screening Levels (ESLs) for chemicals commonly found in soil and groundwater at sites where releases of hazardous chemicals have occurred. The terminology "environmental" screening levels is intended to better convey the broad scope of the document and clarify that some screening levels are not risk-based in a strict definition of this term.

The ESLs are considered to be conservative. Under most circumstances, and within the limitations described, the presence of a chemical in soil, soil gas or groundwater at concentrations below the corresponding ESL can be assumed to not pose a significant, long-term (chronic) threat to human health and the environment. Additional evaluation will generally be necessary at sites where a chemical is present at concentrations above the corresponding ESL. Active remediation may or may not be required depending on site-specific conditions and considerations. This document may especially be beneficial for use at sites with limited impacts, where the preparation of a more formal environmental assessment may not be warranted or feasible due to time and cost constraints.

The ESLs were developed to address environmental protection goals presented in the *Water Quality Control Plan for the San Francisco Bay Basin* (Basin Plan; San Francisco Bay Area Regional Water Quality Control Board; RWQCBSF 2006). These goals include:

Surface Water and Groundwater:

- Protection of drinking water resources;
- Protection of aquatic habitats;
- Protection against vapor intrusion into buildings;
- Protection against adverse nuisance conditions.

Soil:

- Protection of human health (direct-exposure);
- Protection against vapor intrusion into buildings;

- Protection against leaching and subsequent impacts to groundwater;
- Protection of terrestrial biota;
- Protection against adverse nuisance conditions.

The ESLs are presented in a series of lookup tables. Each table reflects a specific combination of soil, groundwater and land-use characteristics that strongly influence the magnitude of environmental concerns at a given site. This allows the user to select ESLs that are most applicable to a given site.

The ESL document presents a tiered approach to environmental risk assessments. Under Tier 1, sample data are directly compared to ESLs selected for the site and decisions are made regarding the need for additional site investigation, remedial action or a more detailed risk assessment. In a Tier 2 risk assessment, a selected component(s) of the Tier 1 ESL is modified with respect to site-specific considerations. An example may be the adjustment of a screening level for direct exposure with respect to an approved, alternative target risk level. Site data are then compared to the revised screening level as well as the remaining, unmodified components of the Tier 1 ESL. This provides an intermediate but still relatively rapid and cost-effective option for preparing more site-specific risk assessments. Risk assessment models and assumptions that depart significantly depart from those used to develop the Tier 1 ESLs are described in a more traditional, Tier 3 risk assessment. The Tier 1 methodology can still provide a common platform to initiate a Tier 3 risk assessment and help ensure that all potentially significant environmental concerns are considered.

The Tier 1 ESLs presented in the lookup tables are NOT regulatory cleanup standards. Use of the ESLs and this document in general is intended to be entirely optional on the part of the regulated facility and subject to the approval of the case manager in the overseeing regulatory agency. The presence of a chemical at concentrations in excess of an ESL does not necessarily indicate that adverse impacts to human health or the environment are occurring; this simply indicates that a potential for adverse risk may exist and that additional evaluation is warranted. Use of

the ESLs as cleanup levels should be evaluated in view of the overall site investigation results and the cost/benefit of performing a more site-specific risk assessment.

Reliance on only the Tier 1 ESLs to identify potential environmental concerns may not be appropriate for some sites. Examples include sites that require a detailed discussion of potential risks to human health, sites where physical conditions substantially differ from those assumed in development of the ESLs (e.g., mine sites, landfills, etc., with high or low pH) and sites where impacts pose heightened threats to sensitive ecological habitats. The latter could include sites that are adjacent to wetlands, streams, rivers, lakes, ponds, marine shorelines, or sites that otherwise contain or border on areas where protected or endangered species may be present. Potential impacts to sediment are also not addressed. (e.g., presence of endangered or protected species). The need for a detailed ecological risk assessment should be evaluated on a site-by-site basis for areas where significant concerns may exist. Notification to the Natural Resource Trustee Agencies (including the state Department of Toxics Substances Control and Department of Fish and Game and the federal Fish and Wildlife Service, Department of the Interior and National Oceanic and Atmospheric Administration) may also be required, particularly if the release of a hazardous substance may impact surface waters.

The ESLs should not be used to determine when impacts at a site should be reported to a regulatory agency. All releases of hazardous substances to the environment should be reported to the appropriate regulatory agency in accordance with governing regulations. The lookup tables will be updated on a regular basis, as needed, in order to reflect changes in the referenced sources as well as lessons gained from site investigations and field observations.

1 Introduction

Preparation of detailed environmental risk assessments for sites contaminated by releases of hazardous chemicals can be a time consuming and costly effort that requires expertise in a multiple of disciplines, including toxicology, geology, ecology, chemistry, physics and engineering, among others. For small-business owners and property owners with limited financial resources, preparation of such risk assessments can be time and cost-prohibitive.

As a means to partially address this problem, this document presents a series of conservative Environmental Screening Levels (ESLs) for soil, groundwater and soil gas that can be directly compared to environmental data collected at a site. Screening levels for surface water are also provided. Screening levels for over 100 commonly detected contaminants are given in a series of lookup tables. The tables are arranged in a format that allows the user to take into account site-specific factors that help define environmental concerns at a given property.

Within noted limits, risks to human health and the environment can be considered to be insignificant at sites where concentrations of chemicals of concern do not exceed the respective ESLs. The presence of chemicals at concentrations above the ESLs does not necessarily indicate that a significant risk exists at the site. It does generally indicate that additional investigation and evaluation of potential environmental concerns is warranted.

1.1 Tiered Approach to Environmental Risk Assessments

This document presents a three-tiered approach to environmental risk assessment. Under Tier 1, sample data are directly compared to ESLs selected for the site and decisions are made regarding the need for additional site investigation, remedial action or a more detailed risk

assessment. A detailed understanding of the derivation of the screening levels is not required for use at this level.

Under Tier 2, selected components of the models used to develop the Tier 1 ESLs are modified with respect to site-specific data or considerations. Examples include adjustment of the assumed depth to contaminated groundwater in the Tier 1 indoor-air impact model. Site data are then compared to the revised screening level as well as the remaining, unmodified components of the Tier 1 ESLs. This provides an intermediate but still relatively rapid and cost-effective option for preparing more site-specific risk assessments.

Under Tier 3, the user employs alternative models and modeling assumptions to develop site-specific screening or final cleanup levels or quantitatively evaluate the actual risk posed to human and/or ecological receptors by the contaminated media. Consideration of the methodologies and potential environmental concerns discussed in this document is still encouraged. This will help increase the comprehensiveness and consistency of Tier 3 risk assessments as well as expedite their preparation and review.

1.2 Comparison To Existing Screening Levels

The CalEPA Office of Environmental Health Hazard Assessment published California Human Health Screening Levels (CHHSLs) for a number of common contaminants in soil and soil gas (CalEPA 2004a). The CHHSLs are similar to Preliminary Remediation Goals (PRGs) developed by Region 9 of the U.S. Environmental Protection Agency and in use since the early 1990s (US EPA 2004). The City of Oakland (Oakland 2000) has also prepared lookup tables of Environmental Screening Levels for soil and water.

The Environmental Screening Levels or ESLs presented in this document represent an expansion of the US EPA PRGs (and by default, the CalEPA CHHSLs) and the City of Oakland screening levels to reflect the broader

scope of environmental concerns put forth in the Basin Plan. Differences and similarities between the ESL document and lookup tables prepared by the other programs are summarized below.

1.2.1 OEHHA CHHSLs

The CalEPA Office of Environmental Health Hazard Assessment (OEHHA) published "California Human Health Screening Levels (CHHSLs)" in a reported entitled *Proposed Methodology for Calculating Advisory Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil* (November 2004, CalEPA 2004a). Preparation of the CHHSLs was required under the California Land Environmental Restoration and Reuse Act (CLRRA 2002). An accompanying guidance document entitled *Use of California Human Health Screening Levels in Evaluation of Contaminated Properties* was also prepared (CalEPA 2005). The documents present human health-based screening levels for more than 50 common contaminants in soil and/or soil gas. The CHHSLs are essentially identical to the corresponding soil and soil gas screening levels incorporated into the ELS lookup tables. CHHSLs were not developed for groundwater or surface water. CHHSLs were not developed for groundwater or surface water. A brief discussion of the CHHSLs is provided below.

Soil CHHSLs for direct-exposure concerns were developed by OEHHA in coordination with the Department of Toxic Substances Control. Screening levels are presented for semi-volatile and nonvolatile chemicals. Models and exposure assumptions used are essentially identical to those used to develop the US EPA Region 9 Preliminary Remediation Goals (see Section 1.3.2) as well as comparable ESLs (see Appendices 1 and 2). CalEPA toxicity factors and skin absorption factors were used in preference over US EPA factors when available. The same factors were incorporated into this edition of the ESLs, with only minor adjustments to affected screening levels. One exception is the use of a more conservative Hazard Quotient of 0.2 to calculate ESLs for noncarcinogens (versus 1.0 in both the CHHSLs and the PRGs). This is done in order to address potential cumulative

health effects at sites with multiple contaminants. Cumulative effects must be evaluated on a site-by-site basis under both the CHHSLs and the US EPA PRGs.

The DTSC and OEHHA opted not to publish direct-exposure CHHSLs for volatile organic chemicals or VOCs. Screening levels for VOCs are included in the ESL document. The ESL screening levels are based on the same model and exposure assumptions used to develop the US EPA Region 9 Preliminary Remediation Goals, with the addition of CalEPA toxicity factors and an adjustment of the target Hazard Quotient for noncarcinogens.

Soil gas screening levels for potential vapor intrusion concerns are presented in the CHHSLs document (VOCs only). Staff with the San Francisco Bay Area Regional Water Quality Control Board as well as DTSC assisted in preparation of these screening levels. The screening levels were also developed using the same US EPA model as used to develop the soil gas screening levels presented in the ESL document and referenced in the recent DTSC vapor intrusion guidance document (CalEPA 2004b). One difference is the use of a higher, assumed indoor-air exchange rate in the ESL model, due to the more moderate climate of the San Francisco Bay Area (1.0 and 2.0 exchanges per hour for residences and commercial/industrial settings, respectively, versus 0.5 and 1.0 exchanges per hour referenced in the CHHSLs document). As a result, soil gas screening levels presented in the CHHSLs document are roughly half of those presented in the ESL document at similar target risk goals for comparative site scenarios (see Appendix 9). For noncarcinogens, soil gas ESLs remain lower than comparable CHHSLs due to the use of a target Hazard Quotient of 0.2.

1.2.1.1 Use of ESLs versus CHHSLs

Soil, soil gas and indoor air screening levels essentially identical to the CHHSLs are already incorporated into the ESL document. While important, the CHHSLs do not address potential groundwater protection

concerns and address only two of five environmental concerns potentially related to contaminated soil (refer also to Section 2.1 and Figure 1):

Environmental Concerns Addressed

	ESLs	CHHSLs
Groundwater Quality		
Drinking Water	Yes	No
Vapor Intrusion to Buildings	Yes	No
[1]Aquatic Receptors	Yes	No
[2]Gross Contamination	Yes	No
Soil Quality		
Direct Exposure	Yes	Yes
Vapor Intrusion to Buildings	No	No
Leaching to Groundwater	Yes	No
Terrestrial Receptors	Yes	No
[2]Gross Contamination	Yes	No
Soil Gas		
Vapor Emission	Yes	Yes

1. Groundwater discharge to surface water.
2. Nuisances (odors, etc.), general resource degradation.

The CHHSLs should be thought of as one component of the ESLs, not as an alternative to the ESLs**.** Because the CHHSLs do not address the full scope of potential environmental concerns, they should not be used as a stand-alone tool to evaluate contaminated sites. It is important to understand that for many chemicals, the need to clean up contaminated soil may be based on environmental concerns other than direct exposure or vapor intrusion.

1.2.2 US EPA Region 9 PRGs

The U.S. Environmental Protection Agency (US EPA) Region 9 Preliminary Remediation Goals or PRGs are intended to address human health concerns regarding direct exposure with contaminated soils (US EPA 2004). The equations used to develop the US EPA PRGs are generally consistent with human health risk assessment guidance prepared by the Department of Toxic Substances Control, including the CalTOX model (CalEPA 1994a) and the documents *Preliminary*

Endangerment Assessment Guidance Manual (CalEPA 1994b) and *Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (CalEPA 1996). As noted in Chapter 3, use of the CalTOX model and other CalEPA guidance documents and models may be necessary where more detailed risk assessments are required.

As discussed in the US EPA Region 9 document, the PRGs are intended to address human direct-exposure with contaminated soil and "...do not consider impact to groundwater or address ecological concerns." (US EPA 2004). Expansion of the US EPA PRGs in the lookup tables presented in this document includes:

- Modification of soil PRGs to reflect CalEPA-specific toxicity factors;
- Adjustment of PRGs for noncarcinogens to reflect a target hazard quotient of 0.2 to address potential cumulative health concerns;
- Addition of direct-exposure screening levels for construction and trench workers' exposure to subsurface soils;
- Addition of soil and groundwater screening levels for indoor-air impact concerns;
- Addition of groundwater screening levels for the protection of aquatic habitats/surface water quality;
- Use of a more rigorous leaching model to develop soil screening levels for protection of groundwater quality;
- Addition of soil screening levels for urban area, ecological concerns;
- Addition of soil and groundwater ceiling levels to address gross contamination and general resource degradation concerns; and
- Addition of soil and groundwater screening levels for Total Petroleum Hydrocarbons (TPH).

A summary of the direct-exposure models is provided in Appendix 2.

1.2.3 City of Oakland Screening Levels

Since 1999, the City of Oakland has presented environmental screening levels for soil and groundwater through its Urban Land Redevelopment (ULR) Program. The ULR Program is a collaborative effort by the City of

Oakland and the principal agencies charged with enforcing environmental regulations in Oakland to facilitate the cleanup and redevelopment of contaminated properties (Oakland 2000). It includes innovative institutional mechanisms for tracking residual contamination and ensuring long-term compliance with risk management plans. The ULR Program is coordinated by the City and is specific to Oakland sites.

The City of Oakland approach is based on the guidelines prescribed in *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM 1995). The Guidance Document, Technical Background Document and other information on the Oakland ULR program is available on the internet at www.oaklandpw.com/ulrprogram. Modifications have been made to better address child exposure and recreational water use scenarios. In addition, many input values reflect Oakland-specific geologic, hydrogeologic and climatic conditions (Oakland Technical Background 2000 and updates). These values may not be appropriate for other areas within the Water Board's jurisdiction.

The Water Board has agreed that the Oakland look-up tables are appropriate for use at Oakland sites under the conditions and limitations discussed in the ULR Program Guidance (memo dated August 3, 2001; RWQCBSF 2001b). In particular, sites where surface or groundwater conditions present ecological, aesthetic, taste or odor concerns may require additional analysis. Active remediation to address these concerns may not be necessary at most sites in Oakland that are not near sensitive water bodies due to its highly-developed, urban setting

1.2.4 Hazardous Waste Regulations

California Total Threshold Limit Concentrations (TTLC) criteria for solids and Soluble Threshold Limit Concentration (STLC) criteria for liquids should not in most cases be used as soil and groundwater screening or cleanup levels. The TTLC and STLC criteria are intended to determine the type of landfill a waste material must be sent to (Title 22, Section 66699 - Persistent and Bioaccumulative Toxic Waste). Where TTLC or STLC

criteria are exceeded, the waste must in general be sent to a Class I, hazardous waste landfill. The criteria, developed in the 1980s, are only loosely based on human health and environmental considerations. STLC values generally reflect drinking water or surface water goals of the time, although some are clearly out-of-date (e.g. trichloroethene STLC value of 204 mg/L). TTLC values were derived by simply multiplying the STLC value by 10 (organic substances) or 100 (metals).

In most cases, TTLC values exceed the most conservative environmental screening levels presented in this document. In the case of endrin and DDT/DDE/DDD, the TTLC is somewhat lower than the screening levels for human health concerns. For example, the TTLC for combined DDT/DDE/DDD is 1.0 mg/kg while the residential, direct-exposure soil screening is 1.7 mg/kg. This presents the enigma that while soil contaminated below 1.7 mg/kg is not considered to pose a significant risk to human health, it could be classified as a hazardous waste if it were excavated and transported offsite for disposal. Again, this is not a difference of opinion about the potential toxic effects of these chemicals, it is merely a reflection of the less rigorous development of the TTLC values.

Unfortunately, it is not anticipated that the TTLC and STLC values will be revised in the near future. To avoid potential future problems with soil disposal and even public perception, it may be prudent to use TTLCs as final cleanup values for sites where the TTLC is less than cleanup values based on actual risk to human health and the environment.

1.2.5 OSHA Standards Permissible Exposure Levels

The National Institute for Occupational Safety and Health (NIOSH) is the Federal agency responsible for conducting research and making recommendations for the prevention of work-related disease and injury, including exposure to hazardous chemicals in air (NIOSH 2003). NIOSH develops and periodically revises Recommended Exposure Limits (RELs) for hazardous substances in the workplace. The RELs are used to

promulgate Permissible Exposure Levels (PELs) under the Occupational Safety and Health Act (OSHA).

OSHA exposure limits are not appropriate for health risk evaluations for commercial settings where the chemical is not currently being used as part of a regulated, industrial process. This includes sites affected by the migration of offsite releases (e.g., via emissions from a moving plume of contaminated groundwater). OSHA limits are derived for an occupational setting, where the chemical in question is used in the industrial process, i.e., workers and others who might be exposed to the chemical have knowledge of the chemical's presence, receive appropriate health and safety training, and may be provided with protective gear to minimize exposures. OSHA limits are derived for adult, healthy workers and are not intended to protect children, pregnant women, the elderly, or people with compromised immune systems.

According to State Water Resources Control Board Resolution No. 92-49, Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304, the Regional Water Boards must set cleanup levels that protect the full range of people who might be exposed to contaminants in soil and groundwater, including sensitive receptors. This goes beyond adult, healthy workers for which OSHA limits are intended. OSHA limits are not intended to evaluate risks posed by involuntary exposures to the general public, where site residents and occupants generally do not expect to be exposed to chemicals from a vapor intrusion pathway, do not receive training on such exposure, and have no protective gear to minimize exposures. For all these reasons, the OSHA limits provide inappropriate indoor air targets for both residential and commercial land use scenarios.

As one example, the current OSHA PEL for tetrachloroethene (PCE) is 678,000 $\mu g/m^3$ (100 ppmv, NIOSH 2003). Comparable risk-based screening levels for commercial/industrial exposure settings included in this document fall between 0.68 $\mu g/m^3$ and 10 $\mu g/m^3$ (carcinogenic effects and noncarcinogenic effects, respectively; Table E-3).

1.3 Chemicals Not Listed In Lookup Tables

The lookup tables list 100-plus chemicals most commonly found at sites with contaminated soil or groundwater. Inclusion of ESLs for additional chemicals is a relatively straightforward process, provided that adequate supporting data are available. To obtain ESLs for chemicals not listed in the lookup tables, the interested party should contact the Water Board staff noted at the beginning of this document. Development of ESLs will be carried out in the same manner as done for the listed chemicals. As an alternative, ESLs may be developed by qualified persons and submitted to the overseeing regulatory agency for review.

1.4 Limitations

The Tier 1 ESLs presented in the lookup tables are not regulatory cleanup standards. Use of the ESLs as actual cleanup levels should be evaluated in view of the overall site investigation results and the cost/benefit of performing a more detailed environmental risk assessment. The ESLs are intended to be conservative for use at the vast majority of contaminated sites in developed areas. As discussed in Chapter 3 use of the Environmental Screening Levels may not be appropriate for final assessment of all sites. Examples include:

- Sites that have a high public profile and warrant a detailed, fully documented environmental risk assessment;

- Sites where the depth to groundwater is less than 3.0 m (10 feet; groundwater screening levels for vapor intrusion concerns may not be adequately conservative);

- Sites with high rainfall and subsequent high surface water infiltration rates [i.e., infiltration >720 mm (28 inches) per year].

- Sites where inorganic chemicals (e.g., metals) are potentially mobile in leachate due to soil or groundwater conditions different from those

assumed in development of the lookup tables (e.g., low pH at mine sites);

- Conservation areas where impacts pose heightened threats to ecological habitats (e.g., presence of endangered or protected species); and

- Sites where more than three known or suspected carcinogens or more than five chemicals with similar noncarcinogenic health effects have been identified.

- Sites affected by tides, rivers, streams, etc. where there is a potential for erosion and concentration of contaminants in aquatic habitats.

Examples of other site characteristics that may warrant a more detailed environmental risk assessment are discussed in Chapter 3. In such cases, the information provided in this document may still be useful for identification of potential environmental concerns and development of strategies for preparation of a more site-specific risk assessment.

ESLs for chemicals that are known to be biodegradable in the environment may be conservative for use as final cleanup levels. For example, final soil ESLs for Total Petroleum Hydrocarbon (TPH) and many noncarcinogenic, petroleum-related compounds (e.g., xylenes) are driven by the protection of groundwater quality. If long-term monitoring demonstrates that actual impacts to groundwater are insignificant then less stringent soil (and groundwater) screening levels may be warranted. Additional guidance regarding the management of contaminated soil and groundwater at petroleum-release sites is provided in the following documents (refer also to overseeing regulatory agency):

- Interim Guidance on Required Cleanup at Low-Risk Fuel Sites (RWQCBSF 1996);

- Guidelines for Investigation and Cleanup of MtBE and Other Ether-Based Oxygenates (SWRCB 2000).

Copies of these documents can be obtained from the Water Board.

Soil ESLs do not consider potential water- or wind-related erosion and deposition of contaminants in a sensitive ecological habitat. They also do not consider issues potentially related to anticipated Total Maximum Daily Load regulations (TMDLs). This may especially be of concern for metals and pesticides that are only moderately toxic to humans but highly toxic to aquatic and terrestrial biota (e.g., copper). The Water Board *Erosion and Sediment Control Field Manual* provides practical information on the mitigation of erosion and runoff concerns.

In certain instances groundwater and soil gas screening levels for the emission of chlorinated, volatile organic compounds to indoor air concerns may not be adequately conservative in some cases. This is most likely to occur at sites where the vapor permeability of vadose-zone soils is high (e.g., highly fractured bedrock, gravels, etc.) and/or where building designs, ventilation systems and local environmental conditions otherwise lead to higher-than-expected vapor flow rates through foundations (e.g., houses with heating systems in basements).

2 Tier 1 Lookup Tables

Environmental risk assessments may be carried out in either a forward mode, where actual risks are quantified based on concentrations of a chemical in contaminated media, or backward mode, where acceptable concentrations of a chemical in a given media are developed based on specified target goals. The Environmental Screening Levels (ESLs) presented in this document represent an example of the latter. Tier 1 ESLs for soil and groundwater are summarized in Tables A through E. Each ESL in the tables collectively addresses environmental concerns stated or inferred in the *Water Quality Control Plan for the San Francisco Bay Basin* (Basin Plan; San Francisco Bay Regional Water Quality Control Board; RWQCBSF 2006). These concerns include:

Groundwater Quality:

- Protection of human health
- Current or potential drinking water resource;
- Emission of subsurface vapors to building interiors;
- Protection of aquatic receptors (discharges to surface water);
- Protection against gross contamination concerns (nuisance, odors, etc.) and general resource degradation.

Soil Quality:

- Protection of human health
- Direct/indirect exposure to contaminated soil (ingestion, dermal absorption, inhalation of vapors and dust in outdoor air);
- Protection of groundwater quality (leaching of chemicals from soil);
- Protection of terrestrial (nonhuman) receptors;
- Protection against gross contamination concerns (nuisance, odors, etc.) and general resource degradation.

Soil Vapor:

- Protection of human health
- Migration of subsurface vapors to building interiors.

For the purpose of this document, soil refers to any unlithified material in the unsaturated zone that is situated above the capillary fringe of the shallowest saturated unit. A summary of environmental concerns considered in the ESLs is depicted schematically in Figure 1. This correlates to a conceptual site model prepared for a detailed environmental risk assessment. The degree to which any given concern will drive environmental risk at a site depends on the actual potential for exposure and the toxicity and mobility of the chemical.

Site characteristics that play an important role in evaluating potential environmental concerns or developing site-specific cleanup levels include:

- Physical location of the contaminated soil (e.g., currently or potentially exposed at the ground surface versus isolated in the subsurface);
- Beneficial use of the groundwater immediately underlying the site or otherwise potentially threatened by the release (e.g., drinking water resource threatened versus no drinking water resource threatened);
- Current and anticipated future use of the site (e.g., residential land use permitted or commercial/industrial land use only).

In order to include consideration of these site characteristics in the ESLs, four different tables were prepared (Tables A through D). Each table reflects varying combinations of site characteristics:

- Table A – Shallow soils, potential drinking water resource threatened;
- Table B – Shallow soils, potential drinking water resource not threatened;
- Table C – Deep soils, potential drinking water resource threatened;

- Table D – Deep soils, potential drinking water resource not threatened;

Each of the tables provides separate soil screening levels for residential (i.e., unrestricted) and commercial/industrial land-use scenarios.

For each chemical listed in the lookup tables, screening levels were selected to address each applicable environmental concern under the specified combination of site characteristics. The lowest of the individual screening levels for each concern was selected for inclusion in the summary ESL tables presented in this document. This ensures that the ESLs presented in these tables are protective of all potential environmental concerns and provides a tool for rapid screening of site data. Where ESLs are exceeded, the detailed tables can be used to identify the specific environmental concerns that may be present at the site.

An example of the selection of summary, Tier 1 ESLs for tetrachloroethene (PCE) is presented in Figure 2 (surface soils, drinking water resource threatened, unrestricted land use desired).

2.1 Use of Lookup Tables

The step-by-step use of the lookup tables is summarized below and discussed in more detail in the following sections. A summary of the process is also provided in Figure 3. An outline and discussion of information that should be included in a Tier 1 environmental risk assessment is provided in Section 2.11.

Step 1 - ESL Updates and Applicability
Check with the overseeing regulatory agency to determine if the ESLs can be applied to the subject site. Ensure that the most up-to-date version of this document is being used (updated every 1-2 years in general).

Step 2: Identify All Chemicals of Potential Concern

An environmental risk assessment must be based on the results of a thorough site investigation. A summary of the site investigation results should be included in the risk assessment in order for it to be reviewed as a stand alone document. A general outline of site investigation information that should be included in a Tier 1 risk assessment is provided in Section 2.11.

Step 3: Select Lookup Table(s)

Determine the designated beneficial use of contaminated or threatened groundwater beneath the site. In general, all groundwater must initially be treated as a current or potential source of drinking water (see Section 2.4). Next, determine the depth below ground surface to the top of contaminated soil (see Section 2.5). This site information is then used to select the most appropriate lookup table (see Figure 3).

Steps 4: Determine Desired Land Use (soil ESLs only)

ESLs for soil are selected based on the present and desired future use of the site. Two options are provided in the lookup tables, Residential Land Use or Commercial/Industrial Land Use Only. Screening levels for residential land used are considered to be adequate for unrestricted use of a property. For evaluation of commercial/industrial properties, it is recommended that site data be compared to ESLs for both unrestricted/residential and commercial/industrial land use. Reference only to ESLs for commercial/industrial land use will in most cases require that a covenant to the deed be prepared that restricts use of the property (see Section 2.10). The costs of cleanup to unrestricted use may be justified when compared to ongoing costs of maintaining administrative remedies such as a deed restriction.

Steps 5 and 6: Select Soil and/or Groundwater ESLs

Based on the desired land use(s), select appropriate soil ESLs. ESLs for groundwater are provided in the adjacent column of each table and are not dependent on land use or depth to contaminated soil. Screening levels for surface water are also provided. Replace ESLs with naturally

occurring, background concentrations of chemicals of concern (e.g., arsenic) if higher (see Section 2.9).

Step 7: Determine Extent of Contaminated Soil and/or Groundwater
Using the selected ESLs, determine the extent of contaminated soil or groundwater and areas of potential environmental concern at the site and offsite, as required. Soil data should be reported on a dry-weight basis. The use of data from filtered groundwater samples is generally acceptable, although this should be confirmed with the overseeing regulatory agency. For sites where sample data are limited, it will be most appropriate to compare the maximum-detected concentrations of chemicals of concern to the ESLs. For Tier 1 assessments, the use of statistical methods to estimate more site-specific exposure point concentrations and evaluate environmental risks is not appropriate. An alternate exposure point concentration, such as the lesser of the maximum-detected concentration and the 95 percent upper confidence interval of the arithmetic mean of sample data *may* be appropriate for more detailed Tier 2 or Tier 3 assessments. Guidance for the estimation of exposure point concentrations, use of non-detect data, and other issues is provided in the documents *Preliminary Endangerment Assessment Guidance Manual* (CalEPA 1994b), *Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (CalEPA 1996) and *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (US EPA 2002b), among other sources. As discussed in these documents, sample data collected outside of contaminated areas should generally not be included in estimation of exposure point concentrations. For commercial/industrial areas, soil data may be averaged within known or anticipated outdoor work areas, if needed. For vapor intrusion concerns, groundwater or soil gas data should not be averaged over an area greater than the floor space area of existing or anticipated buildings.

Steps 8 and 9: Evaluate the Need for Additional Investigation or Corrective Actions; Submit Appropriate Reports

Based on a comparison of available site data to the ESLs, evaluate the need for additional action at the site (e.g. additional site investigation, remedial action, preparation of a more site-specific risk assessment, etc.). This is then summarized in the Tier 1 Environmental Risk Assessment report and workplans for additional corrective actions as needed. Decisions for or against additional actions should always be made in conjunction with guidance from the overseeing regulatory agency.

2.2 Evaluation of Petroleum Contamination

Contamination of soil, water and air with petroleum mixtures is evaluated in terms of both Total Petroleum Hydrocarbon (TPH) and target indicator chemicals for the given petroleum mixture. Indicator chemicals typically recommended for petroleum mixtures include (after CalEPA 1996):

Aromatic compounds (primarily gasolines and middle distillates)

- benzene
- ethylbenzene
- toluene
- xylene

Fuel additives (primarily gasolines)

- MtBE
- other oxygenates as necessary

Polycyclic aromatic compounds (primarily middle distillates and residual fuels)

- acenaphthene
- acenaphthylene
- anthracene
- benzo(a)anthracene
- benzo(b)fluoranthene
- benzo(g,h,i)perylene
- benzo(a)pyrene
- benzo(k)fluoranthene

- chrysene
- dibenz(a,h)anthracene
- fluoranthene
- fluorene
- indeno(1,2,3-c,d)pyrene
- methylnaphthalene (1- and 2-)
- naphthalene
- phenanthrene
- pyrene

The TPH ESLs should be used in conjunction with ESLs for these chemicals. The middle distillates category of TPH includes diesel fuel kerosene, Stoddard Solvent, home heating fuel, jet fuel and similar petroleum mixtures. Residual fuels include heavy petroleum products such as No. 6 fuel oil (Bunker C), lubricating oils, oil and grease, waste oils and asphalts. Soil and groundwater contaminated by releases of waste oil may also require testing for heavy metals and chemicals such as chlorinated solvents and PCBs. Screening levels for these chemicals are included in the lookup tables.

Trimethylbenzenes, butylbenzenes, methylnaphthalenes and a number of other common constituents of petroleum products (especially gasolines) are sometimes reported separately in analyses of contaminated soil and groundwater. In general, these constituents should be collectively evaluated under TPH and do not need to be evaluated separately. A brief summary of common constituents of gasoline is provided in the New England Interstate Water Pollution Control Commission Leaking Underground Storage Tank bulletin No. 44 (NEIWPCC 2003).

2.3 Groundwater Beneficial Use

As stated in the Basin Plan, "Unless otherwise designated by the Regional Board, all groundwaters are considered suitable, or potentially suitable, for municipal or domestic water supply." All groundwater beneath a given site should be initially treated as a potential source of drinking water unless otherwise approved by the Water Board office. For the

purposes of this document, it is also assumed that all shallow groundwater will ultimately discharge to a body of surface water and potentially impact aquatic organisms (see Section 2.7). Soil and groundwater ESLs were therefore developed to be protective of both drinking water resources and aquatic habitats.

The Basin Plan recognizes that site-specific factors may render groundwater unsuitable for potential drinking water purposes. Tables B and D in this document are intended for use at such sites. The ESLs presented in these tables consider the potential discharge of groundwater to surface water but do not consider potential impacts to sources of drinking water. The ESLs also consider gross contamination issues such as the presence of free product and aesthetic or odor problems. Use of these tables for screening level environmental risk assessments must be approved by the Water Board but may not necessarily require regulatory de-designation of groundwater beneficial use.

Hydrogeologic criteria presented in the Basin Plan for potential exclusion of a given occurrence of groundwater from consideration as a potential source of drinking water typically include:

Total dissolved solids in groundwater is greater than or equal to 3,000 mg/L; or

Water bearing unit is not sufficiently permeable to produce an average, sustained yield of 200 gallons of water per day.

Groundwater in coastal areas, geothermal fields, etc., may contain levels of dissolved solids that make the water unsuitable as a potential source of drinking water. In addition, the permeability of soils and sediments that lack a significant amount of coarse-grained material (or fractures, in the case of bedrock) may be too low to allow for an adequate, sustained yield of groundwater. Unconsolidated geologic units that are comprised of less than 20 percent sand-size (or larger) material or more than 30 percent clay-size material are typically not considered to be viable aquifers or potential

sources of useable groundwater (inferred from Fetter 1994). The potential for a given unit of bedrock to serve as a viable source of groundwater similarly depends on the primary and secondary porosity in the rock and the quality of the groundwater. Consideration must also be made for the potential migration of groundwater out of a geologic unit that in itself is insufficiently permeable to be considered to be an aquifer and into a more permeable unit that could serve as a viable source of drinking water.

In general, soil and groundwater screening levels are more stringent for sites that threaten a potential source of drinking water (e.g., compare Tables A and B). This is particularly true for chemicals that are highly mobile in the subsurface and easily leached from contaminated soil. For chemicals that are especially toxic to aquatic life (e.g., several long-chain hydrocarbons, pesticides and heavy metals) screening levels for sites that threaten drinking water resources may be driven by surface water/aquatic habitat protection concerns.

2.4 Shallow Versus Deep Soils

For the purposes of this document, a depth of three meters (approximately 10 feet) was used to delineate between shallow soils, where a potential exists for regular direct exposure of residents and/or office workers, and deep soils where only periodic exposure during construction and utility maintenance work is considered likely. This is consistent with guidance presented in the CalEPA document *Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (CalEPA 1996) and is regarded as the maximum, likely depth that contaminated soil could at some point in the future be excavated and left exposed or intermixed with surface soil during typical redevelopment activities. The potential for deeper soils to be brought to the surface in the future should be evaluated on a site-by-site basis based on planned redevelopment or maintenance activities.

The full suite of environmental concerns noted in Figure 1 was considered in development of ESLs for shallow soils. For deep soils, regular exposure

of residents or commercial/industrial workers and impacts to terrestrial flora and fauna was not considered. As a result, ESLs for relatively non-mobile chemicals are generally less stringent for deep soils than corresponding ESLs for shallow soils (e.g., compare PCB ESLs in Tables A and C). For chemicals that are easily leached from soil or potentially volatized to the air, groundwater and indoor-air protection concerns usually drive selection of the final ESL regardless of the depth of the contaminated soil. This is the case for several of the volatile, chlorinated organic compounds. As a result, the corresponding shallow and deep soil ESLs are identical (e.g., compare trichloroethene ESLs in Tables A and C).

If contamination is found in shallow soil and deep soil, it may be appropriate to use a separate set of screening levels for each zone (e.g., Table A for the shallow soils and Table C for the deep soils). As discussed in Section 2.10, the advantages and disadvantages of remediating deep soils to shallow soil criteria should be evaluated on a site-by-site basis. This may help avoid concerns regarding future disturbance and reuse of deeper soils.

As another alternative, the less stringent ESLs for deep soils could be applied to shallower soils under a Tier 2 or Tier 3 risk assessment, provided that appropriate actions to prevent future exposure and unmanaged reuse are taken. Such controls may include (but not necessarily be limited to):

- placement and maintenance of adequate cap or other risk-management measures to eliminate potential direct exposure;
- modeling and/or direct field measurement to evaluate potential impacts to indoor air due to vapor emissions; and
- preparation of a risk management plan and other appropriate institutional controls (e.g., deed restrictions) in order to prevent unauthorized disturbance of the soil in the future and allow for appropriate management of the soil if it is exposed.

Capping of shallow, contaminated soil and other engineered controls used in place of full cleanup are generally not allowed for properties that are to be used for single-family homes. The need to consider these actions at sites with contaminated soils situated more than three meters below the ground surface should be discussed with the overseeing regulatory agency on a site-by-site basis.

2.5 Land Use

Land uses are categorized based on the assumed length, duration and magnitude of potential human exposure. The category Residential Land Use is intended for use at sites where future land-use restrictions are not desirable or allowed. This includes sites to be used for residences, hospitals, day-care centers and other sensitive purposes (CalEPA 2002). ESLs listed under this category incorporate conservative assumptions regarding long-term, frequent exposure of children and adults to contaminated soils in a residential setting. In contrast, the land-use category Commercial/Industrial Use Only assumes that only working age adults will be present at the site on a regular basis. Direct-exposure assumptions incorporated into the soil ESLs are somewhat less conservative than assumptions used in the residential land-use scenario.

Land use should be selected with respect to the current and foreseeable future use of the site in question. Reference to adopted General Plan zoning maps and local redevelopment plans is an integral part of this process. Use of the lookup tables for sites with other land uses (e.g., agriculture, parkland, etc.) should be discussed with and approved by the overseeing regulatory agency. As the category heading implies, use of the soil ESLs listed under Commercial/Industrial Use Only places implicit land-use restrictions on the affected property. While this may be considered acceptable for properties currently zoned for such purposes, the need for such restrictions in the future should be weighed against the cost-benefit of remediating the property to meet the sometimes more conservative but less restrictive ESLs for unrestricted land use.

Implications for land-use restriction are discussed in more detail in Section 2.10.

A 2003 amendment to the Porter-Cologne Act (Section 13307.1(c)) requires that formal land-use restrictions be placed on sites that are not remediated to an extent that allows unrestricted future use (e.g., residential, day care, etc.). This rule does not currently apply to sites regulated under the state underground storage tank program. It is anticipated that this rule will be especially applied to non petroleum-contaminated sites.

2.6 Threat to Surface Water Habitats

Screening levels for freshwater, marine and estuarine water bodies are presented in Table F. These screening levels consider the same set of environmental concerns as groundwater (excluding potential impacts to indoor air), with the addition of screening levels for the potential bioaccumulation of chemicals in aquatic organisms and subsequent human consumption of these organisms. In the San Francisco Bay Area, the areas north of the Dumbarton Bridge and west of the Richmond-San Rafael Bridge are considered to be marine. Screening levels for estuarine environments are based on the more stringent of screening levels for marine versus freshwater environments. The areas south of the Dumbarton Bridge and east of the Richmond-San Rafael Bridge to the upstream extent of tidal influences are considered to be estuarine. Tidally influenced portions of creeks, rivers and streams flowing into the Bay between these areas should also be considered to be estuarine in screening level assessments. Screening levels for estuarine environments are based on the more stringent of screening levels for marine versus freshwater environments but do not consider drinking water goals.

For the purposes of the Tier 1 lookup tables, it is assumed that contaminated or potentially contaminated groundwater at all sites could at some time migrate offsite and discharge into a body of surface water. This could occur due to the natural, downgradient migration of groundwater or to human activities such as dewatering of construction

sites. For several pesticides and heavy metals, including dieldrin, endrin and endosulfan, aquatic habitat goals are more stringent than drinking water toxicity goals for humans. This is reflected in the final groundwater screening levels.

The groundwater screening levels for potential impacts to aquatic habitats do not consider dilution of groundwater upon discharge to a body of surface water. Benthic flora and fauna communities situated below or at the groundwater/surface water interface are assumed to be exposed to the full concentration of chemicals in contaminated groundwater. Use of a generic dilution factor to adjust the surface water protection screening levels with respect to dilution of groundwater upon discharge to surface water was therefore not considered. Consideration of dilution/attenuation factor and alternative groundwater screening levels for the protection of surface water quality may be appropriate on a site-specific basis.

Consideration of surface water standards for bioaccumulation concerns in groundwater investigations and cleanup actions may be warranted at sites where large plumes of contaminated groundwater threaten to cause long-term impacts to important aquatic habitats. The bioaccumulation standards will generally not need to be considered at sites with small, isolated plumes of contaminated groundwater located some distance from a body of surface water. Although these plumes could conceivably migrate offsite and discharge into a body of surface water in the distant future, impacts are likely to be short-lived and the plumes are likely to become significantly diluted as they mix with surface water. The need for a more detailed study of potential groundwater impacts on surface water with respect to bioaccumulation of chemicals in aquatic organisms should be evaluated on a site-by-site basis. This may include the need for more stringent soil cleanup levels (to prevent additional leaching) and development of a more comprehensive, ecological risk assessment.

The soil and groundwater screening levels presented in the lookup tables do not directly address the protection of sediment quality. Site-specific concerns could include the accumulation and magnification of

concentrations of highly sorptive chemicals in sediment over time due to long-term discharges of contaminated groundwater. This may be especially true for groundwater contaminated with highly sorptive (lipophilic) chemicals, including heavy petroleum products.

Potential erosion and runoff of surface soils from contaminated sites may also need to be considered, particularly at sites contaminated with metals and pesticides that are situated near a sensitive body of surface water. The need for a more detailed, ecological risk assessment of impacts to sediment should be evaluated on a site-by-site basis and discussed with the overseeing regulatory agency.

2.7 Screening For Vapor Intrusion Concerns

Detailed discussions of subsurface vapor intrusion into buildings is provided in the US EPA document *User's Guide For Evaluating Subsurface Vapor Intrusion Into Buildings* (US EPA 2003), the OEHHA document *Human Exposure Based Screening Numbers* (CalEPA 2004a) and the DTSC document *Guidance for the Evaluation of the Vapor Intrusion to Indoor Air Pathway* (CalEPA 2004b).

Volatile organic chemicals (VOCs) can volatize from contaminated soil or groundwater and become concentrated in overlying buildings, impacting the quality of indoor air. While actual impacts to indoor air can vary widely from building to building, and even within buildings, it is generally possible to estimate worst case scenarios for use in screening level risk assessments. Soil gas and groundwater screening levels were developed for this purpose and incorporated into the ESLs.

Heating, ventilation and air conditioning (HVAC) systems, basements, strong winds and other factors can exacerbate vapor intrusion problems by reducing internal air pressure and creating a vacuum effect that enhances the advective flow of vapors through building floors (e.g., US EPA 2003, CalEPA 2004b). For buildings with a slab-on-grade design, this can result in the direct flow of subsurface vapors into a building with little

or no dilution beforehand. The vapors become diluted as they mix with fresh air being drawn in through the buildings HVAC system or through open doors and windows (generally by a factor of 500 to 1,000 for residential buildings and higher for commercial/industrial buildings).

For buildings with a crawl space design, subsurface vapors may be diluted as they diffuse into and mix air in the crawl space below the building floor. Additional mixing may or may not occur as the air from the crawl space is pulled into the building. Vapor transport through the building floor could be significantly elevated in comparison to slab-on-grade design buildings due to the operation of HVAC systems in poorly ventilated rooms (e.g., an unvented closet). This issue is still being evaluated. An initial review of published literature and site data suggests that ultimate soil gas-to-indoor air attenuation factors for buildings with crawl spaces can be very similar to slab-on-grade design buildings.

The field of vapor intrusion investigations is still evolving. Approaches to site investigations and evaluation of vapor intrusion concerns presented in guidance documents noted above and discussed below should not be taken as stringent requirements that must be applied at all sites. Appropriate investigation and risk assessment needs should be determined on a site-by-site basis. Ultimate requirements could be less or more stringent than those presented here and other guidance documents.

2.7.1 Stepwise Approach to Vapor Intrusion Evaluation

The direct collection and analysis of indoor air samples may seem to be an easy way to evaluate vapor intrusion concerns. Identification of the source of any VOCs identified is complicated by the presence of the same chemicals in auto emissions and many household goods (aerosol sprays, dry-cleaned clothing, cleaners, etc.), however. For example, ambient levels of benzene in outdoor air in the San Francisco Bay area (related to auto exhaust) typically exceed the indoor air screening level presented in Table E (0.085 $\mu g/m^3$) by an order of magnitude or more (e.g., Air Resources Control Board, CalEPA 2004c). Ambient levels of dry cleaning

solvent (tetrachloroethene) and other chlorinated solvents in indoor air may also exceed the screening levels presented in Table E.

As an alternative, the sequential collection and evaluation of groundwater or soil gas data and, if needed, indoor air data is recommended. These data can then be compared to screening levels for vapor intrusion concerns presented in this document and areas of elevated concern quickly identified. The following approach is recommended (refer also to CalEPA 2004b):

1) Compare groundwater data to appropriate screening levels for vapor intrusion concerns (see Table E-1a); for sites with significant contamination, proceed directly to Step 2;

2) For areas where groundwater screening levels for vapor intrusion concerns are approached or exceeded or sites where significant releases to the vadose-zone have occurred, collect shallow soil gas samples immediately beneath (preferred) or adjacent to buildings and compare results to soil-gas screening levels (Table E or Table E-2).

3) At buildings where soil-gas screening levels for vapor intrusion concerns are approached or exceeded, further evaluate the need to carry out an indoor air study (Section 2.8.3).

A more detailed discussion is provided below and in the DTSC vapor intrusion guidance document. Note that site data should in general not be averaged over an area greater than the existing area of buildings for initial evaluation of vapor intrusion concerns.

The screening levels are based on scientific models for vapor intrusion into buildings as well as a growing body of data from actual field investigations. Methods used to develop the screening levels are similar to those used by OEHHA to develop soil gas screening levels for vapor

intrusion concerns and recommended by DTSC in the guidance documents noted above (CalEPA 2004a, CalEPA 2004b).

2.7.2 Collection and Evaluation of Groundwater Data

Groundwater data should be collected at all sites where significant releases of VOCs may have occurred and compared to screening levels presented in this document (Table E-1, see also Tables F-1a and F-1b). Vapor emission rates are controlled by the concentration of VOCs in the uppermost part of the saturated zone. Sample data from this zone are preferable over data from monitoring wells when available. This is due to potential mixing effects in wells with long screens or with screens that do not placed in the upper portion of the saturated zone.

The groundwater screening levels for vapor intrusion concerns are based on an assumed three-meter depth to groundwater. These screening levels may not be adequately conservative for use at sites characterized by a shallower water table. The need to develop more site-specific screening levels or proceed directly to soil gas sampling should be reviewed with the overseeing regulatory agency. Imported fill material or disturbed native soils should be considered to be highly permeable in site-specific assessments unless measured vapor flow data into existing buildings indicate otherwise. This is incorporated into the updated US EPA spreadsheets by use of a default vapor flow rate into buildings of five liters per minute per 100 m^2 of floor space (Q_{soil}).

2.7.3 Collection and Evaluation of Soil Gas Data

Soil gas samples should be collected at sites where groundwater data suggest potentially significant vapor intrusion concerns. The collection of soil gas data is discussed in the document *Soil Gas Advisory* prepared by DTSC and the Los Angeles Regional Water Quality Control Board (CalEPA 2003). Approaches to soil gas studies are also presented in the above-noted vapor intrusion guidance document prepared by DTSC (CalEPA 2004b).

Initial soil gas samples should be collected over the core of the groundwater plume and in nearby areas of concern (e.g., residential areas, nearby buildings, utility corridors, etc.). Ideally, samples should be collected immediately beneath the foundations of existing buildings (e.g., sub-slab). Samples should be collected from areas immediately adjacent to buildings (preferably paved) if it is impractical to collect sub-slab samples. In areas away from buildings or where buildings are to be constructed in the future, samples should be collected from a depth of 3 m (10 feet) below ground surface. Soil gas samples collected from depths less than 3 m are considered unreliable due to the increased potential to draw in ambient, surface air and may not provide an accurate measure of contaminant mass. If site-specific modeling of vapor flow rates or indoor-air impacts is to be carried out, the collection of additional soil geotechnical data should be considered (soil grain-size analysis, moisture content and fraction organic carbon). The use of lab-based, soil vapor permeability data to override the default vapor flux rate (Q_{soil}) of 5 liters/minute (per 100 m^2 of ground floor area) used in the US EPA and DTSC models is discouraged. These tests often do not adequately take into account enhanced permeability due to soil heterogeneities, soil fractures, relict root structures, shallow fill material, disturbance during redevelopment, and other types of potential secondary permeability. Data collected from soils within 1.5 m of the ground surface and well above the water table are especially pertinent in the models. The collection of deeper soil gas samples and soil-type data may also be useful in evaluating the lateral and vertical extent of VOCs in the subsurface.

Both subslab sample data and shallow soil gas data (i.e., $\leq$1.5 m bgs) should be compared to the soil gas screening levels presented in Table E. Where screening levels are approached or exceeded, the need to carry out an indoor air study should be more closely evaluated. Approaches for determining when an indoor air study should be carried out are still being developed. The DTSC vapor intrusion guidance (CalEPA 2004b) recommends that an indoor air study be carried out if site-specific, soil-gas-to-indoor vapor intrusion models suggest that impacts to indoor air

may exceed a cumulative excess cancer risk of 10^{-6} or a noncancer hazard index >1 (CalEPA 2004b).

While this approach is generally appropriate for sensitive land use scenarios (e.g., residential, day care, etc.), it may be impractical in areas of high ambient outdoor air pollution. For example, the concentration of benzene and other auto exhaust-related contaminants in outdoor air can exceed risk-based screening levels by up to two orders of magnitude. In such cases, impacts to indoor air related to vapor intrusion from subsurface contamination can easily be masked by existing outdoor pollution. Sampling of indoor air would not be useful. Decisions for cleanup of contaminated soil and groundwater for vapor intrusion concerns should instead be based on an evaluation of soil gas data in conjunction with ideal, target indoor air goals (even if these goals cannot be currently met due to other sources of contamination, including vehicle exhaust in ambient air).

2.7.4 Soil Gas and Low-Permeable Soils

At sites where soil gas samples cannot be collected using traditional methods due to tight soil conditions (e.g., wet, clayey soils), other approaches should be attempted. In many cases, simply moving the collection probe over a few feet from the initial location will address the problem. If problems still persist, the installation of temporary soil vapor probes encased in permeable sand packs and capped with a bentonite clay mixture can be considered (CalEPA 2002). The diameter and depth of the vapor probe borehole should be adjusted to allow sufficient pore space for the collection of soil gas samples. Adequate time (generally several weeks) should be allowed for VOCs in the surrounding clays to equilibrate with soil gas in the vapor probe sand pack.

At sites where groundwater is contaminated with VOCs and the collection of soil gas data is not possible, groundwater data should be compared to conservative screening levels and the need to proceed to crawl space and/or indoor air sampling evaluated.

2.7.5 Collection and Evaluation of Indoor Air Data

The collection of indoor data will be necessary to further evaluate vapor intrusion concerns in some cases. The collection of indoor air data in absence of soil gas and, if applicable, crawl space is not recommended. Such data are critical in determining the source of any VOCs identified in indoor air. Guidance on the collection and evaluation of indoor air data is provided in the above-noted DTSC document (CalEPA 2004b) and will not be repeated in detail here. Additional information is available in the Massachusetts Department of Environmental Protection document *Indoor Air Sampling and Evaluation Guide* (MADEP 2002).

The DTSC guidance document provides a table of recommend actions at sites where impacts to indoor air are identified (CalEPA 2004b). A copy is provided below:

Indoor Air Sampling Results (minimum of two indoor air sampling events needed	Response	Activities
Risk: $<10^{-6}$ HI: <1	Minimal	Confirm that vapor intrusion impacts are not likely to increase in the future.
Risk: 10^{-4} to 10^{-6} HI: 1 to 3	Monitoring and/or Mitigation	Collect soil gas, indoor air and/or crawl space samples semi-annually as appropriate. Mitigation may be recommended in some cases to reduce exposure even though health risk goals may not be exceeded.
Risk: $>10^{-4}$ HI: >3	Mitigation Required	Institute engineering controls to mitigate exposure and collect soil gas samples and indoor air samples semiannually to verify mitigation of exposure.

Risk = Cumulative excess cancer risk
HI = Hazard Index – Cumulative risk posed by sum of noncancer hazard quotients.

If buildings or homes in the subject area are underlain by crawl spaces then the concurrent collection air samples from these areas should also be considered. Crawl space data should be compared directly to indoor air data. As discussed above, the dilution of VOCs in crawl spaces as the air is pulled into a building is difficult to predict.

The above are initial recommendations only. Ultimate actions required at a given site should be determined on a case-by-case basis in coordination with the overseeing regulatory agency. As noted in the DTSC guidance document, indoor air data should be used to better ascertain human health concerns when potentially significant impacts are implied by soil gas and other subsurface data. The DTSC document recommends that at least two rounds of indoor data be collected prior to determining appropriate response activities. The scope of specific responses should be determined on a case-by-case basis in coordination with the overseeing regulatory agency. Active mitigation of indoor air impacts may be recommended (or even required) at sites where a need to reduce exposure of individuals is desired even though health risk objectives noted above are not exceeded.

If vapor intrusion concerns are primarily for future buildings, then remediation of VOC impacts prior to construction should be considered. If this is not feasible (e.g., impacts due to continuing offsite source) then engineered controls to mitigate vapor intrusion concerns should be incorporated into future building designs. The scope and oversight of these controls should be determined on a site-specific basis in coordination with the overseeing regulatory agency. Long-term oversight requirements are typically much more stringent for residential properties. In some cases, formal incorporation of engineered controls in building permits (e.g., under CEQA) may be warranted with long-term oversight of the controls being undertaken by the local municipal agency.

2.8 Substitution of Laboratory Reporting Limits and Ambient Background Concentrations for ESLs

In cases where an ESL for a specific chemical is less than the laboratory method reporting limit for that chemical (as agreed upon by the overseeing regulatory agency), it is generally acceptable to consider the method reporting limit in place of the screening level. Examples include the risk-based ESLs for dioxin in soil (0.0000046 mg/kg for residential exposure).

Site-specific or regional-specific background can be substituted for risk-based concentrations at sites where the conceptual model indicates that concentrations are indicative of site-related contamination. The natural background concentration of a chemical in soil or groundwater can vary substantially between and even within sites, and is most appropriately evaluated by the collection of on-site samples or by reference to local data collected from past studies. Guidance for estimating background concentrations of chemicals in soil and groundwater is provided in the CalEPA document *Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (CalEPA 1996).

2.9 Implied Land-Use Restrictions Under Tier 1

Allowing the option to tie screening levels or cleanup levels to site-specific land use and exposure conditions can save considerably in investigation and remediation costs. The use of final cleanup levels less stringent than those appropriate for unrestricted land use will place restrictions on future use of the property. For example, if a site is remediated using ESLs (or alternative criteria) intended for commercial/industrial land use then the site cannot be used for residential purposes in the future without additional evaluation. In most cases, this will require that a formal covenant to the deed be recorded to restrict future use of the property. As stated in recent provisions in the Porter-Cologne Act (Section 13307.1(c)):

> "…if the state board or the regional board finds that the property is not suitable for unrestricted use...then the state board and regional boards may not issue a closure letter, or make a determination that no further action is required...unless a land restriction is recorded…."

The use of ESLs for deep soils at a site similarly assumes that the contaminated soil will remain isolated below the ground surface. For single-family, residential areas, future disturbance of soil situated greater than three meters is generally considered to be unlikely (CalEPA 1996) and use of the ESLs for deep soil below this depth without restrictions may be reasonable (see Section 2.5). During the redevelopment of properties for commercial/industrial or high-density residential use excavation and removal of soils from depths in excess of five or even 10 meters could take place (e.g., for underground parking garages, elevator shafts, utilities, etc.). The need to impose enforceable, institutional controls for proper management of deep, contaminated soils at properties where the ESLs for deep soil (or alternative cleanup levels) are applied should be discussed with the overseeing regulatory agency on a site-by-site basis.

Land-use restrictions inherent in the selection of ESLs from the Tier 1 lookup tables (or assumptions used in site-specific risk assessments) should be kept as minimal as possible. Concentrations of chemicals in contaminated soils left in place at a commercial/industrial site should always be compared to both commercial/industrial and residential ESLs (or alternative criteria for unrestricted land use). If contaminant concentrations are less than ESLs for unrestricted land use after cleanup then this should be clearly stated in the site closure report. Recognizing this point may prove important should the site become desirable for other use in the future (e.g., residential, school day care, health care, etc.). Assumptions that contaminated soil at a property will remain isolated at shallow depths under pavement, buildings or some other type of cover should be avoided. Such assumptions place significant and oftentimes unnecessary restrictions on the future use and redevelopment of a site. If

done, appropriate covenants to the property deed should be prepared and methods to prevent or manage future disturbance of the soil should be clearly described and ensured. A foresighted approach in the use of Tier 1 ESLs or alternative, site-specific cleanup levels will allow more flexibility in future use of a site, help avoid unexpected complications during site redevelopment and minimize the liability of future land owners.

2.10 Cumulative Risks at Sites With Multiple Chemicals of Concern

Risks posed by direct exposure to multiple chemicals with similar health affects are considered to be additive or cumulative. For example, the total risk of cancer posed by the presence of two carcinogenic chemicals in soil is the sum of the risk posed by each individual chemical. The same is true for chemicals that cause noncarcingenic health effects. A summary of example target health effects for the chemicals listed in the lookup tables is provided in Table L.

Use of ESLs for single chemicals is limited to the extent that the screening levels remain protective of human health should other chemicals with similar health effects also be present. Soil ESLs are considered to be adequate for use at sites where no more three carcinogenic chemicals or five chemicals with similar noncarcinogenic health effects are present. This is based on a combination of conservative exposure assumptions and target risk factors in direct-exposure models.

2.11 Framework for a Tier 1 Environmental Risk Assessment

Tier 1 environmental risk assessments should serve as stand alone documents that provide a good summary of environment impacts at a site and assess the threats posed to human health and the environment by these impacts. The risk assessment can be prepared as a component of a site investigation or remedial action report or as a separate document. Information on each of the topics listed below should be addressed in report that presents the risk assessment, however (after MADEP 1995).

Together, this information is intended to provide a basic conceptual model of site conditions. The level of detailed required for each topic will vary depending on site-specific considerations.

1. Summarize Past, Current and Anticipated Future Site Activities and Uses:

- Describe past and current site uses and activities;
- Describe foreseeable future site uses and activities. (Always include a comparison of site data to ESLs for residential/unrestricted land use to evaluate need for formal covenants to the deed; see Section 2.10).

2. Summary of Site Investigation:

- Identify all types of contaminated media;
- Identify all sources of chemical releases;
- Identify all chemicals of concern;
- Identify magnitude and extent of impacts that exceed ESLs to extent feasible and applicable (include maps of site with isoconcentration contours for soil and groundwater);
- Identify nearby groundwater extraction wells, bodies of surface water and other potentially sensitive ecological habitats;
- Ensure data are representative of site conditions.

3. Summarize Appropriateness of Use of Tier 1 Lookup Tables and ESLs (see Section 1.5):

- Do Tier 1 ESLs exist for all chemicals of concern?
- Does the site have a high public profile and warrant a fully documented, detailed environmental risk assessment?
- Do soil and groundwater conditions at the site differ significantly from those assumed in development of the lookup tables (e.g., low pH at mine sites)?
- Do impacts pose a heightened threat to sensitive ecological habitats (e.g., presence of endangered or protected species)?
- Have more than three carcinogens or five chemicals with similar noncarcinogenic health effects been identified (see Section 2.11)?

- Other issues as applicable to the site.

4. Soil and Groundwater Categorization (see Sections 2.4 and 2.5):

- State the regulatory beneficial use of contaminated or potentially contaminated groundwater beneath the site; discuss the actual, likely beneficial use of groundwater based on measured or assumed quality of the groundwater and the hydrogeologic nature of the soil or bedrock containing the groundwater.
- Characterize the soil type(s) and location of contaminated soil as applicable to the lookup tables (e.g., soil stratigraphy, soil texture and permeability, depth to and thickness of contaminated soil, etc.).
- 5. Exposure Point Concentrations (see Section 2.2, Step 7):
- Identify maximum concentrations of chemicals present in contaminated media.
- Describe how alternative exposure point concentrations were determined (e.g., 95 percent UCLs), if proposed, and provide supporting data. For vapor intrusion concerns, groundwater, soil and/or soil gas data should not be averaged over the floor space area of existing or anticipated buildings.
- Discuss the need to evaluate groundwater data with respect to surface water standards for potential bioaccumulation of chemicals in aquatic organisms due to the size of the plume, the proximity of the plume to a body of surface water and the potential for minimal dilution of groundwater upon discharge to surface water (see Section 2.7).
- Discuss how background concentrations of chemicals were determined, if considered for use in the risk assessment (see Section 2.9).

6. Selection of Tier 1 ESLs and Comparison to Site Data (see Section 2.2)

- Summarize how Tier 1 ESLs were selected with respect to the information provided above and additional assumptions as applicable.
- Compare site data to the selected summary Tier 1 ESLs and discuss general results.

- If desired or recommended, compare site data to detailed ESLs for individual environmental concerns and discuss specific, potential environmental concerns present at site.

7. Conclusions (see Section 2.10):

Describe the extent of soil and groundwater impacts above Tier 1 ESLs, using maps and cross sections as necessary.

- Discuss if a condition of potential risk to human health and the environment exists at the site.
- Discuss if a more site-specific risk assessment is warranted at the site.
- Present a summary of recommended future actions proposed to address environmental concerns ay the site.
- Discuss the need to impose land-use restrictions and institutional controls at the site based on the results of the Tier 1 assessment (e.g., requirements for caps, etc.; need for covenant to deed to restrict land use to commercial/industrial purposes only, etc).

The above list is not intended to be exhaustive or representative of an exact outline required for all Tier 1 risk assessments. Requirements for completion of an adequate site investigation and Tier 1 environmental risk assessment should be discussed with the overseeing regulatory agency.

3 Tier 2 and 3 Environmental Risk Assessments

Use of the Tier 1 Environmental Screening Levels is optional and independent environmental risk assessments may be undertaken for any site. In some cases, site conditions may negate the full use of the Tier 1 ESLs and require preparation of a Tier 2 or Tier 3 risk assessment. Examples of site conditions that may warrant a more site-specific or detailed risk assessment include (see also Section 1.5):

- Sites where alternative target risk levels or chemical-specific toxicity factors may be acceptable to the regulatory agency;
- Sites where the thickness of vadose-zone soils contaminated by volatile organic compounds is greater than three meters;
- Sites where screening levels for soil are driven by potential leaching concerns and groundwater data are available for evaluating actual groundwater impacts;
- Sites where inorganic chemicals (e.g., metals) cannot be assumed to be immobile in soil (potential threat to groundwater quality);
- Sites with soils contaminated by pesticides, where final screening levels are driven by leaching concerns and potential impacts to aquatic habitats but the site is not located near a body of surface water (e.g., dieldrin, endrin, endosulfan, etc.);
- Sites where the depth to groundwater is greater than 10 meters below the base of contaminated soil (soil screening levels for leaching concerns may be conservative;
- Sites where protected terrestrial habitats or other ecologically sensitive areas are threatened;
- Sites where engineered controls will be implemented to eliminate or reduce specific exposure pathways;

- Sites where the future erosion of shallow soils could lead to significant transport and concentration of contaminants in sensitive ecological habitats; and
- Sites where field observations or site conditions are not consistent with the assumptions and models used to derive the ESLs.

Reliance on only the Tier 1 ESLs to identify potential environmental concerns may not be appropriate for some sites. Examples include sites that require a detailed discussion of potential risks to human health; sites where physical conditions differ drastically from those assumed in development of the ESLs (e.g., mine sites, landfills, etc., with high or low pH) and sites where impacts pose heightened threats to sensitive ecological habitats. The latter could include sites that are adjacent to wetlands, streams, rivers, lakes, ponds, marine shorelines, or sites that otherwise contain or border on areas where protected or endangered species may be present. Potential impacts to sediment are also not addressed (e.g., presence of endangered or protected species). The need for a detailed ecological risk assessment should be evaluated on a site-by-site basis for areas where these concerns may be present (see Section 3.3.5). Notification to the Natural Resource Trustee Agencies (including the state Department of Toxics Substances Control and Department of Fish and Game and the federal Fish and Wildlife Service, Department of the Interior and National Oceanic and Atmospheric Administration) may also be required, particularly if the release of a hazardous substance may impact surface waters.

Evaluation of landfills and sites contaminated by mine wastes may in particular require the preparation of a detailed, site-specific assessment of groundwater and surface water impact concerns due to the possible increased mobility of metals and other chemicals and potential explosive gases concerns (e.g., methane). Soil leaching models incorporated into the Tier 1 ESLs assume typical, ambient physical-chemical conditions in soil and groundwater (e.g., soil pH 5.0 to 9.0) and the relatively immobility of heavy metals and organic chemicals with very high sorption factors (e.g., PCBs, PAHs). This assumption may not hold true at many landfill and

mine sites, where extreme pH and Eh conditions could lead to substantial mobility of these compounds. In these and other related cases, more rigorous field and laboratory studies may be required to adequately assess risk to human health and the environment.

Final surface water and groundwater screening levels for several pesticides that are highly toxic to aquatic organisms are very stringent (e.g., dieldrin, endrin, endosulfan). Screening levels for leaching concerns are likewise stringent (Tables A-D). The pesticides in question are only moderately mobile in the environment. The final soil and groundwater screening levels are likely to be conservative for sites not located near a body of surface water. The need to apply the screening levels to soil and groundwater data should be evaluated on a site-by-site basis. Less conservative screening levels for evaluation of human-toxicity concerns only may be appropriate at many sites.

Site-specific risk assessments are grouped under the loosely defined terms Tier 2 and Tier 3. The nature of these risk assessments is briefly discussed in the following sections.

3.1 Tier 2 Environmental Risk Assessments

Tier 2 environmental risk assessments are intended to be relatively easy and cost-effective to prepare. Preparation of Tier 2 risk assessments will require a thorough understanding of the Tier 1 ESLs being re-evaluated, however. Under Tier 2, specific Tier 1 screening levels are adjusted or deleted to more closely reflect site conditions or alternative risk assumptions. Replacing only targeted components of the Tier 1 ESLs reduces the need to prepare and justify an independent, detailed risk assessment when Tier 1 ESLs cannot or should not be fully applied. This greatly reduces the time and cost incurred by both the regulated business and the overseeing regulatory agency in finalizing the risk assessment.

For example, the Tier 1 screening level for leaching concerns may not need to be considered at sites where groundwater monitoring data indicate that

leaching impacts from soil to groundwater are minimal or not posing an adverse risk. Modifications to Tier 1 assumptions are described and justified in the text of the report and the revised set of screening levels are presented.

A more detailed list of potential Tier 2 modifications to Tier 1 screening levels is presented below. These examples are not intended to reflect the full range of modifications possible:

Groundwater Screening Levels

Drinking Water:

- Exclusion of drinking water impact concerns based on natural groundwater quality or geologic characteristics of groundwater containing unit (e.g., brackish groundwater in coastal areas);

Vapor Intrusion:

- Use of site-specific data for model input parameters (depth to groundwater, soil properties, building characteristics;
- Use of indoor air data to more directly evaluate potential impacts;

Surface Water Impacts:

- Exclusive use of freshwater or saltwater screening levels;
- Consideration of alternative surface water screening levels;
- Consideration of groundwater monitoring data and observed plume migration over time;
- Consideration of site-specific dilution effects during potential discharge of groundwater to surface water (generally not recommended except in highly developed and disturbed water front properties);

Gross Contamination:

- Use of alternative ceiling levels and/or site-specific observations and considerations regarding gross contamination concerns;

General:

- Consideration of method reporting limits or natural background concentrations of a chemical in place of the risk-based ESL.

Soil Screening Levels

Direct Exposure:

- Use of alternative screening level for lead at sites where backyard gardens or other exposure scenarios considered in ESLs are not anticipated;
- Elimination of direct-exposure concerns through imposition of institutional controls;
- Exclusion of direct-exposure concerns due to depth of contaminated soil below ground surface (e.g., >10 meters bgs).

Vapor Intrusion:

- Use of soil gas or indoor air data to more directly evaluate potential impacts;

Groundwater Protection (leaching effects):

- Consideration of alternative target groundwater levels;
- Use of groundwater monitoring data to evaluate leaching impacts and groundwater quality concerns (most appropriate where main mass of chemical is in contact with groundwater);

- Use of laboratory leaching test to evaluate potential groundwater impacts (see Section 3.3.3).

Ecological Impact Concerns:

- Use of alternative screening levels based on site studies or published data;
- Reconsideration of need to include ecological screening levels in highly developed or industrialized areas.

Gross Contamination:

- Use of alternative ceiling levels and/or site-specific observations and considerations for gross contamination concerns.

Soil Gas Screening Levels

- Use of indoor air data to more directly evaluate potential health risk concerns.

In each of these examples, an alternative screening level is generated for the specified environmental concern and re-compared to site data. The format of the Tier 2 Environmental Risk Assessment Report should be similar to that outlined for Tier 1 reports. Adjustments to Tier 1 screening levels should be clearly described and justified within the report and additional information included as necessary.

It is beyond the scope of this document to provide detailed examples of potential Tier 2 assessments. A discussion of mass-balance issues and soil gas data is presented below given the current emphasis on the vapor intrusion exposure pathway.

3.2 Tier 3 Environmental Risk Assessments

Under Tier 3, alternative models and assumptions are used and fully justified to develop a detailed, comprehensive environmental risk assessment. Portions of the Tier 1 models may still be retained for some components of the risk assessment. A detailed review of the preparation of Tier 3 environmental risk assessments is beyond the scope of this document. A few potentially useful methods and some general cautions are highlighted below. Example references for the preparation of Tier 3 risk assessments are provided at the end of this section.

3.2.1 Laboratory-Based Soil Leaching Tests

Laboratory-based soil leaching tests offer an alternative to the use of conservative, model-derived soil screening levels for groundwater protection concerns. These tests may be especially useful for evaluating soils contaminated by inorganic chemicals (e.g., metals and salts) and relatively mobile and nonvolatile organic chemicals. Screening levels for leaching of metals from soil are specifically excluded from this document. Where releases of metal compounds to soil are identified, groundwater monitoring (if appropriate) and/or laboratory-based leaching tests should be carried out to fully evaluate potential leaching impacts.

The US EPA Synthetic Precipitation Leaching Procedure (SPLP) is one example of laboratory-based soil leaching tests (US EPA 1994). The SPLP test differs from the more commonly referenced Toxicity Characteristic Leaching Procedure (TCLP) for hazardous waste in that it is specifically designed to evaluate the mobility of organic and inorganic compounds in soils. The results of an SPLP test are compared to regulatory levels for disposal of materials in landfills and this is then used to determine the type of landfill most appropriate for disposal of the soil (e.g., lining, leachate collection system requirements, etc.).

The SPLP test was not specifically developed to evaluate leaching of chemicals from soil outside of a controlled, landfill environment but can

be used to do so with some caveats. From a groundwater protection standpoint, one goal is to predict the dissolved-phase concentration of a chemical in the pore space of a saturated soil sample (i.e. the leachate) through either models or laboratory tests. The SPLP test does **not** directly provide this information. Using the SPLP test method, 100 grams of soil are added to two liters of reagent water, the sample is mixed for a specified period of time, and an extract of the regent water is analyzed for targeted chemicals. The volume of reagent water added to the sample significantly exceeds the volume of the sample pore space. This leads to significant dilution of the potential leachate had the volume of added reagent water only been equal to the volume of the sample pore space.

For example, the pore volume of a 100-gram sample of soil with 35 percent effective porosity is approximately 20 cm^3 (assumes bulk density of 1.8, total volume 57 cm^3). Adding two liters, or 2,000 cm^3, of water to the sample therefore introduces a laboratory-based, leachate dilution factor of approximately 100 to the SPLP test results (volume reagent divided by volume sample pore space). Concentrations of chemicals reported under the SPLP test could therefore be up to 100 times less than the dissolved-phase concentration of the chemical in a saturated sample.

The inherent dilution effect of the SPLP test method is only significant for chemicals that are highly mobile and not significantly volatile (or biodegradable). From a fate and transport perspective, the dilution factor inherent in the SPLP test could be considered to reflect the decrease in chemical concentrations due to resorption, volatilization and dilution as the leachate migrates downward and mixes with groundwater. Based on comparisons of soil leaching models that take these fate and transport considerations into account (e.g., SESOIL) and those that don't (e.g., US EPA 1996), the dilution factor inherent in the SPLP test method appears to be adequately conservative for chemicals that are at least moderately sorptive (i.e., sorption coefficient of at least 100 cm^3/g) or highly volatile (i.e., Henry's Constant of at least 0.001 atm-m^3/mole.). For moderately sorptive and/or volatile chemicals, the results of the SPLP test can be

directly compared to target groundwater goals. This includes most of the organic chemicals listed in the ESL lookup tables (Table J).

Chemicals listed in the ESL document that are not adequately sorptive or volatile to justify unmodified use of the SPLP test method include all inorganic compounds (e.g., metals and perchlorate) as well as acetone, 2,4-dinitrophenol, and methyl ethyl ketone (very low sorption coefficients). Other organic chemicals that fail this test but only moderately include bis(2-chloroethyl)ether, bis(2-chloroisopropyl)ether, chloraniline, 1,2-dibromoethane, 2,4-dimethylphenol, 2,4-dinitrotoluene, MtBE, phenol, 1,1,1,2-tetrachloroethane and 1,1,2,2-tetrachloroethane. For these and other relatively nonsorptive and nonvolatile chemicals not listed in the ESL tables, the results of the SPLP test should be multiplied by a factor of 100 (or a sample-specific factor) to negate the method-related dilution effect. The sample results can then be adjusted with respect to chemical-specific and site-specific Dilution/Attenuation Factors (DAFs) that take into account volatilization, resorption, degradation and other factors anticipated to reduce the concentrations of chemicals in leachate as the leachate migrates downward and ultimately mixes with groundwater.

Relatively simple DAFs that only address mixing of leachate with groundwater can be calculated using equations provided in the US EPA *Soil Screening Guidance* (US EPA 1996), among other sources. For the Bay Area, simple leachate/groundwater mixing DAFs for shallow aquifers would typically fall in the range of 5 for silty soils to 20 for sandy soils (e.g., assuming 2 m thick shallow aquifer, 30 percent effective porosity, infiltration rate of 8.0 cm/year (3 inches/year or approximately 15 percent of total, average rainfall), and hydraulic conductivities of 2 m/day and 15 m/day, respectively). DAFs could be much higher for areas with fast moving groundwater and/or little infiltration of precipitation and lower in areas with slow moving groundwater and/or greater infiltration of precipitation. Potentially less conservative DAFs that also address resorption, volatilization and other factors can be calculated using more rigorous models such as SESOIL.

3.2.2 Tier 3 Environmental Risk Assessments for Parklands

For initial cleanup efforts at sites to be used as parks or wildlife refuges, it is recommended that such areas be remediated to meet unrestricted land use (i.e., assumed residential exposure, target excess cancer risk of 1×10^{-6}; target Hazard Index of 1 and address potential ecological concerns). From a risk-based standpoint, a typical recreational-use exposure scenario may suggest that substantially higher concentrations of contaminants could be left in place at the site and not pose a threat to human health. In addition, cleanup levels based on recreational land-use scenarios are oftentimes higher (less stringent) than levels that would be allowed for commercial/industrial properties. This intuitively goes against the concept of developing a park as refuge for humans and wildlife. Public parks are typically frequented by children, young mothers, elderly people and other groups of people with potentially elevated sensitivities to environmental contaminants, however. Assumption of a limited exposure frequency and duration also puts an inherent restriction on the number of days and years that an individual can visit the park without exceeding potential health hazards. Long-term, future uses of such properties are also difficult to predict.

In some cases, remediation of proposed parklands to unrestricted land-use standards may not be technically or economically feasible. This should be evaluated on a site-specific basis and receive approval from the overseeing regulatory agency. In such cases, the appropriateness of allowing unrestricted access to the area should be carefully evaluated. This could include the need to impose access restrictions on the property (i.e., based on the exposure assumptions used in the risk assessment) and/or cap contaminated soils with a minimal amount of clean fill. It may also be prudent to post signs at the property entrance that warn of potential health hazards (see Section 2.10).

3.2.3 Tier 3 Reference Documents

Potentially useful reference documents for preparation of Tier 3 environmental risk assessments include the following:

Human Health Risk Assessment:

- Superfund Exposure Assessment Manual (US EPA 1988)
- Risk Assessment Guidance for Superfund. Volume I, Human Health Evaluation Manual (Part A) (US EPA 1989a);
- Soil Screening Guidance: Technical Background Document (US EPA 1996);
- CalTOX, A Multimedia Total Exposure Model For Hazardous-Waste Sites (CalEPA 1994a);
- Preliminary Endangerment Assessment Guidance Manual (CalEPA 1994b);
- Supplemental Guidance For Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities (CalEPA 1996);
- Exposure Factors Handbook (US EPA 1997);
- Standard Provisional Guide for Risk-Based Corrective Action (ASTM 1995); and
- Assessing the Significance of Subsurface Contaminant Vapor Migration to Enclosed Spaces (Johnson et. al, 1998, Johnson 2002).

Ecological Risk Assessment:

- Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual (US EPA 1989b);

- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (US EPA 1997b)
- Guidance for Ecological Risk Assessments at Hazardous Waste Sites and Permitted Facilities (CalEPA 1996b).

The above list of references is not intended to be comprehensive. Additional risk assessment guidance should be referred to as needed.

4 Development of Tier 1 Lookup Tables

Compilation and presentation of the environmental screening levels (ESLs) presented in this document is modeled after similar documents published by the Ontario Ministry of Environment and Energy (MOEE 1996), the Massachusetts Department of Environmental Protection (MADEP 1994) and the Netherlands (Vetger 1993). Screening levels for the following environmental concerns are presented (refer also to Figure 1):

Groundwater:

- Protection of human health
  - Current or potential drinking water resource;
  - Emission of subsurface vapors to building interiors;
- Protection of aquatic habitats (discharges to surface water);
- Protection against nuisance concerns (odors, etc.) and general resource degradation.

Soil:

- Protection of human health
  - Direct/indirect exposure to contaminated soil (ingestion, dermal absorption, inhalation of vapors and dust in outdoor air);
  - Emission of subsurface vapors to building interiors;
- Protection of groundwater quality (leaching of chemicals from soil);
- Protection of terrestrial (nonhuman) habitats;
- Protection against nuisance concerns (odors, etc.) and general resource degradation.

Shallow Soil Gas:

- Protection of human health
- Emission of subsurface vapors to building interiors.

For use in this document, the term soil refers to any unconsolidated material found in the subsurface, including actual soil, saprolite, sediment, fill material, etc. Screening levels for each concern are organized as follows:

[1]Beneficial Use Of Threatened Groundwater	[2]Location Of Contaminated Soil	
	Shallow Soil (≤ 3m bgs)	[3]Deep Soil (> 3m bgs)
Current or Potential Source of Drinking Water	Soil: Tables A-1, A-2 Soil Gas: Table E-3 Water: Table F-1	Soil: Tables C-1, C-2 Water: Table F-1
NOT a Current or Potential Source of Drinking Water	Soil: Tables B-1, B-2 Soil Gas: Table E-3 Water: Table F-2	Soil: Tables D-1, D-2 Water: Table F-2

bgs: below ground surface
1. Shallow-most saturated zone beneath the subject site and deeper zones as appropriate.
2. Depth to top of contaminated soil from ground surface (3 meters = 10 feet).
3. Application of Deep Soil ESLs to soils <3m deep may require institutional controls (see text).

The A through D series tables summarize individual screening levels complied for soil under unrestricted (A-1, B-1, C-1, D-1) and commercial/industrial (A-2, B-2, C-2, D-2) land use scenarios. The E series tables summarize screening levels complied specifically for indoor-air impact concerns. Screening levels for groundwater and surface water are summarized in the F series tables. Tables G through L provide supporting screening levels and other information for the earlier tables.

A discussion of screening levels compiled for surface water and groundwater is provided in Section5. A detailed discussion of screening levels compiled for soil is provided in Section 6. Section 7 discusses screening levels compiled for indoor air and related screening levels for shallow soil gas. Screening levels developed for Total Petroleum Hydrocarbon (TPH) are discussed in Section 8. Other issues pertinent to the lookup tables are discussed in Section 9.

4.1 Example Selection of Tier 1 ESLs for Tetrachloroethene (PCE)

Figure 2 illustrates the selection of final Tier 1 soil and groundwater ESLs for the chemical tetrachloroethene (PCE). The example assumes impacts

to shallow soils (≤3 meters below ground surface) under an unrestricted (e.g., residential) land-use scenario. Groundwater immediately underlying the site is assumed to be a potential source of drinking water. This scenario places the site under Table A-1 of the Tier 1 lookup tables (Section 1.1).

The Tier 1 ESL for PCE in shallow soil is selected as the lowest of the individual screening levels for Direct Exposure (0.34 mg/kg), Gross Contamination (230 mg/kg), and Groundwater Protection (leaching concerns (0.7 mg/kg)). The final soil ESL for PCE is the lowest of the individual screening levels, or 0.34 mg/kg.

The process for selection of a Tier 1 PCE ESL in groundwater is similar. Individual screening levels for Drinking Water (5.0 μg/L), Indoor Air (120 μg/L), Discharge to Surface Water (120 μg/L) and Gross Contamination (230 μg/L) concerns are compared and the lowest of these is selected for inclusion in the Tier 1 lookup tables. In this example, the groundwater screening level for drinking water concerns drives potential risks and is selected as the Tier 1 ESL (5.0 μg/L).

Selection of ESLs for PCE in deep soils is similar. For deep soils, potential impacts to terrestrial biota are not considered. Screening levels for groundwater protection concerns remain the same.

The process described above was carried out for each of the chemicals included in the Tier 1 lookup tables under each combination of groundwater beneficial use, soil depth and land use. The results are summarized in Tables A through D (soil) and Table F (groundwater). As can be seen from a review of these tables, the selection of final, Tier 1 ESLs is typically driven by groundwater protection or indoor-air impact concerns (e.g., see selection process for benzene or vinyl chloride ESLs in Table A-1). Final ESLs for chemicals that are relatively immobile in soils are typically driven by direct-exposure concerns (e.g., see selection process for PCBs in Table A-1). In contrast, selection of ESLs for heavy metals is typically driven by ecological concerns or ceiling levels for general resource degradation (e.g., see selection process for copper ESL in

Table A-1). For chemicals that have particularly strong odors, selection of ESLs may be driven in part by nuisance concerns or ceiling levels (e.g., see Total Petroleum Hydrocarbons (TPH) in Table B-1). The consideration of ceiling levels becomes especially important in the selection of ESLs for relatively immobile chemicals in deep soils (Table C-1).

4.2 Cumulative Risk

Additive risk due to the potential presence of multiple chemicals with similar target health effects is addressed under Tier 1 through use of conservative target risk and hazard levels. Exposure assumptions used to develop direct-exposure and indoor-air screening levels are primarily based on values presented in US EPA Risk Assessment Guidance for Superfund (US EPA 2004). Alternative exposure assumptions are presented in the *Exposure Factors Handbook* (US EPA 1997), among other examples. For example, recommended inhalation rates for residents are 11.3 m^3/day for women and 15.2 m^3/day for men, compared to the value of 20 m^3/day used to develop the direct-exposure screening levels.

For carcinogens, the human health screening levels presented are based on a target cancer risk of 10^{-6}. This represents the lower end of the acceptable range of 10^{-4} to 10^{-6} recommended by the US EPA (US EPA 1989a,b). As stated in the National Contingency Plan "The 10^{-6} level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure." (US EPA 1994). Remediation is generally not warranted at sites where the estimated cancer risk does not exceed 10^{-6}. Remediation generally warranted at sites where the estimated cancer risk exceeds 10^{-4}. For sites where the estimated risk is between 10^{-4} and 10^{-6}, the need for active remediation is evaluated on a site-specific basis (i.e., risks within this range are potentially acceptable, depending on site-specific considerations).

A cumulative, target Hazard Index of 1 is typically used in human health risk assessments for evaluation of noncarcinogenic hazard. The US EPA

Preliminary Remediation Goals (PRGs) for soil were developed based on a chemical-specific, target Hazard Quotient of 1. To account for potential cumulative effects, the PRGs were adjusted to a target Hazard Quotient of 0.2 for use in the ESL lookup tables (Tables K-1 and K-2). A similar target Hazard Quotient was used by the Massachusetts DEP (MADEP 1994) and Ontario MOEE (MOEE 1996) to develop screening levels for direct-exposure concerns. Additional evaluation may be required for sites where multiple contaminants are present. For reference, a compilation of chronic health effects for the chemicals listed in the ESLs is provided in Table L.

5 Groundwater and Surface Water Screening Levels

Screening levels for groundwater and surface water are summarized in the F series of tables. A discuss of individual concerns considered in the screening levels is provided in this Chapter and summarized below. For the purpose of developing Tier 1 screening levels, it is assumed that all groundwater could at some point in time potentially discharge to a body of surface water. Discharge could occur through natural processes (e.g., natural discharge of groundwater to a stream, river, lake, wetland, bay, etc. via springs) or through human activities (e.g., pumping and discharge of groundwater at remediation or construction dewatering projects).

The final groundwater ESL for sites that threaten drinking water resources reflects the lowest screening level for drinking water toxicity, aquatic habitat protection (discharges to surface water), indoor-air impacts (volatile chemicals only), and a ceiling level for tastes and odors or other nuisance concerns (Table F-1a). The final groundwater ESL for sites where drinking water resources are not a concern(Table F-1b) reflects the lower of screening levels for the same set of environmental concerns, with the exception of the drinking water component and an alternative ceiling level.

Screening levels for surface water were compiled in a similar manner, with the exception that impacts to indoor air were not considered. For freshwater surface water bodies, the final ESL reflects the lower of screening levels for drinking water toxicity, aquatic habitat protection (discharges to surface water) and nuisance concerns (Table F-2a). For marine surface water bodies, the final ESL reflects the lower of screening levels for aquatic habitat protection (discharges to surface water) and nuisance concerns (Table F-2b). For estuarine systems, the lower of the screening levels for freshwater and marine surface water bodies were selected (Table F-2c).

As discussed below, groundwater screening levels for potential discharges to aquatic habitats only consider goals for chronic surface water quality goals. Aquatic habitat goals for surface water consider an additional goal/standard for the potential bioaccumulation of contaminants in aquatic organisms and subsequent consumption of the organisms by humans. Use of the bioaccumulation goals as additional screening levels for groundwater should be evaluated on a site-by-site basis.

5.1 Screening Levels for Drinking Water

A summary of drinking water standards and guidelines used in this document is provided in Table F-3. The Central Valley Water Board *A Compilation of Water Quality Goals* (RWQCBCV 2003 and updates) was used as the primary reference. Screening levels for drinking water intended to address human toxicity were generally selected based on the following order of preference:

- California DHS Primary Maximum Contaminant Level (MCL);
- CalEPA OEHHA Public Health Goal;
- California DHS Action Level based on toxicity;
- Risk-based goal.

(Note that the above order of preference may differ in other regions of California.)

California or US EPA primary MCLs for drinking water are available for many chemicals listed in the lookup tables. Although numerous factors are taken into account in development of primary MCLs (toxicity, detection limits, attainability, etc.), these standards are primarily intended to address toxicity to humans in drinking water supplies and are used for this purpose in this document.

For chemicals where MCLs have not been established, Public Health Goals (PHGs) published by the California Office of Environmental Health Hazard Assessment (OEHHA) were used. If a PHG was not available,

Action Levels, published by the California Department of Health Services (CalDHS), were used. In cases where MCLs, PHGs or Action Levels were not available, separate risk-based goals were calculated using the CalDHS model, as presented in the Central Valley Water Board document referenced above. Drinking water goals intended to address esthetic concerns (taste and odor, e.g., Secondary MCLs) were given precedence over toxicity-based goals if concentrations protective of esthetic concerns were lower risk-based concentrations(discussed under ceiling levels for groundwater, Section 2.5).

For comparison purposes, tapwater Preliminary Remediation Goals prepared by US EPA Region 9 are presented in Table F-6. Goals for carcinogens were adjusted to CalEPA cancer potency factors when available. For volatile chemicals, the tapwater goals take into account uptake via inhalation of vapors during showering and other activities in addition to toxicity via normal ingestion of drinking water. Goals for nonvolatile chemicals are based on ingestion only.

5.2 Screening Levels for Aquatic Habitat Protection

A summary of aquatic habitat goals considered for use in this document is provided in Tables F-4a through F-4d. Separate goals were compiled for freshwater, marine and estuarine habitats. In the San Francisco Bay Area, the areas south of the Dumbarton Bridge and east of the Richmond-San Rafael Bridge to the upstream extent of tidal influences are considered to be estuarine. Tidally influenced portions of creeks, rivers and streams flowing into the Bay between these areas should also be considered to be estuarine in screening level assessments. Final goals were selected based on the following order of preference and availability:

- CTR CCC;
- US EPA CCC;
- Lowest of US EPA Ecotox AWQC and FVC Threshold Value (or Tier II value if no AWQC or FVC) or 50% US EPA Chronic LOEL;

- USDOE Chronic PRG;
- 50% MOEE Chronic AWQC or LOEL;
- 10% CTR CMC
- 10% US EPA CMC (or 10% Acute LOEL if no CMC);
- 10% MOEE Acute AWQC or LOEL;
- Other aquatic water quality criteria (e.g., 5% LC 50);
- Drinking water screening level.

abbreviations:
AWQC: Aquatic Water Quality Criteria
CCC: Criterion for Continuous Concentration
CCM: Criterion for Maximum Concentration
CTR: California Toxics Rule (as presented in RWQCBCV 2003 and US EPA 2000)
EPA: Environmental Protection Agency
FVC: Final Chronic Value
LC50: Lethal Concentration (50th percentile)
MOEE: Ontario Ministry of Environment and Energy
PRG: Preliminary Remediation Goals
US EPA: U.S. Environmental Protection Agency
USDOE: U.S. Department of Energy (chronic values only)

Goals provided in each reference are generally based on dissolved-phase concentrations of the chemicals in water. However, goals for arsenic, selenium and hexavalent chromium are based on total concentrations.

Chronic freshwater goals were used as screening levels for saltwater (marine) if chronic goals for the latter were not available. Conversely, saltwater goals were used as screening levels for freshwater if chronic goals for the latter were not available. Acute goals were substituted in a similar manner. Other exceptions to the prioritization scheme include the use of chemical-specific US DOE PRGs in place of US EPA chronic LOELs when the LOEL was developed for a general group of compounds rather

than a specific chemical (e.g., halomethanes). Surface water goals for selenium are based on the National Toxics Rule (US EPA 1992).

The primary sources of data for chronic and acute surface water criteria specific to California were the Region 2 Basin Plan (RWQCBSF 2006), the California Toxics Rule as promulgated in *40 CFR Part 131: Water Quality Standards, Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California* (US EPA 2000) and *A Compilation of Water Quality Goals* (RWQCBCV 2003). Other sources referenced to include the following: US EPA's *Ecotox Thresholds* (US EPA 1996b), US EPA's *National Recommended Water Quality Criteria* (US EPA 2002a), U.S. Department of Energy's *Preliminary Remediation Goals for Ecological Endpoints* (USDOE 1997), and Ontario MOEE's Rational for The Development and Application of Generic Soil, Groundwater and Sediment Criteria (MOEE 1996). (Note that the US Fish and Wildlife Service issues on opinion that the CTR standards for selenium, mercury, PCP and cadmium may not be protective of some endangered and threatened species (USFWS 2000). Responsible parties for sites where surface water is or could be contaminated by these chemicals should review updated goals for these chemicals as available.)

For chemicals where chronic, No Adverse Effect Level goals or the equivalent were not available, alternative goals were selected and modified as noted (refer also to Table F-4a). Modification factors in general followed recommendations and methods provided in the US EPA Great Lakes water quality initiative guidance (US EPA 1995).

Surface water standards for potential bioaccumulation of chemicals in aquatic organisms and subsequent human consumption of these organisms are presented in Table F-4d. Both California and Federal standards are given.

5.3 Groundwater Screening Levels for Aquatic Habitat Impacts

For the purposes of this document, and based on the natural setting of the San Francisco Bay Area, it is assumed that groundwater could discharge into an estuary environment. As such, goals for aquatic habitat protection are based on the lowest of the goals for marine versus freshwater environments. For settings where discharge to surface water is not occurring, target surface water goals and corresponding groundwater goals can be adjusted on a site-specific basis.

Dilution of groundwater upon discharge to surface water was not considered in the selection of groundwater screening levels for aquatic habitat protection. Benthic organisms are assumed to be exposed to the full concentration of chemicals in contaminated groundwater prior to mixing of the groundwater with surface water. Potential dilution of groundwater upon discharge to surface water or in groundwater mixing zones adjacent to shorelines areas is therefore not appropriate for development of conservative screening levels. Adjustment of the final groundwater screening levels with respect to potential dilution may be appropriate on a site-specific basis (e.g., no significant benthic habitat present).

The US EPA Ecotox goal for barium (3.9 μg/L) was not considered as a screening level for groundwater due to low confidence in the goal and comparison to reported natural background concentrations of this metal in Bay Area groundwater (up to >100 μg/L). Background concentrations of boron, copper, lead, mercury, selenium, thallium and zinc have also been reported in excess of the groundwater screening levels presented in Tables F-1 and F-2. This issue is being further evaluated by the Water Board.

Surface water standards for potential bioaccumulation of chemicals in aquatic organisms and subsequent human consumption of these organisms were not considered in the selection of groundwater screening levels for potential aquatic habitat impacts. Consideration of the

standards may be appropriate for sites where the discharge of large plumes of contaminated groundwater threatens long-term impacts to important aquatic habitats. This should be evaluated on a site-by-site basis.

5.4 Groundwater Screening Levels for Potential Vapor Intrusion Concerns

Groundwater screening levels intended to address the intrusion of vapors into buildings and subsequent impact on indoor-air quality are summarized in Table E-1a and included in Tables F-1 and F-2. Corresponding soil gas screening levels and indoor air screening levels are presented in Tables E-2 and E-3, respectively, and discussed in Section 7.

The screening levels were generated using a computer spreadsheet model published by the U.S Environmental Protection Agency (available online, US EPA 2003). The spreadsheet is based on a model presented in the document *Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors Into Buildings* (Johnson and Ettinger, 1991). The model considers both diffusive and convective flow of subsurface vapors into buildings. Summary text from the guidance document accompanying the spreadsheet is provided in Appendix 3, as is a sensitivity evaluation of the Johnson and Ettinger model. Example printouts of the model as used to calculate screening levels for this document are included in Appendix 4. Input parameter values used in the models are noted in the examples (front pages). Default values presented in the spreadsheet technical document were generally selected for use.

Human exposure assumptions were set equal to assumptions used in the US EPA Region 9 PRGs. Default, US EPA toxicity factors included in the original spreadsheet were replaced with California EPA factors as available (see Appendix 4, last page of first example). Screening levels were calculated using a target risk of 1×10^{-6} for chemicals with carcinogenic health effects and a target hazard quotient of 0.2 for chemicals with noncarcinogenic health effects. For consistency, default

physical-chemical constants included in the spreadsheet were replaced with constants used in the US EPA PRGs models if different.

All groundwater was assumed to potentially flow offsite and pass under residential areas. Therefore, final screening levels are based on a residential land use exposure scenario. Groundwater screening levels for commercial/industrial areas are included in Table E-1a for reference but were not carried on for use in subsequent lookup tables.

Default building characteristics presented in the spreadsheet guidance were used in the models. The thickness of the building floor was assumed to be 15 cm. For both residential land use and commercial/industrial exposure scenarios, the models assume a small (10 m x 10 m), one-story building situated on slab concrete base with separate foundation walls. This may be conservative for commercial/industrial sites with existing, larger buildings but is considered to be protective of future redevelopment of such sites. A default value of 0.1 cm was used for the assumed perimeter crack width. A default ceiling height of 2.44 meters was retained for use in the ESL models.

The model assumes that potential convective flow from the subsurface into buildings (i.e., flow driven by air pressures that are lower inside the building than in the vadose zone) is not short circuited by open crawl spaces or other building designs that negate differences between indoor and subsurface air pressures. Default indoor-air exchange rates of one per hour for residences and two per hour for commercial/industrial buildings are based on a comparison of risk assessment guidance published by the City of Oakland (Oakland 2000) and comments received during a 2003 peer review of the December 2001 edition of the screening levels document (RWQCBSF 2003).

The vapor intrusion model is sensitive to the permeability of vadose-zone soil that soil gas must migrate through before being emitted at the ground surface. Screening levels generated for sites characterized by fine-grained, vadose-zone soils (clays and silts) of low permeability can be several orders of magnitude higher than those calculated for more permeable,

coarse-grained soils. For the purposes of this document, a the high-permeability vadose-zone soil profile is modeled as one meter of coarse-grained, dry, sandy soil (S) overlying two meters of somewhat more moist clayey loam (CL, 1/3 sand, 1/3 silt, 1/3 clay). This is considered to be representative of the majority of sites in the Bay Area. Sand is defined as material that is equal to or greater than 0.075 mm in diameter (i.e., will not pass through a U.S. Standard 200 mesh sieve). Silt and clay are defined as material that is less than 0.075 mm in diameter (i.e., will pass through a U.S. Standard 200 mesh sieve). These definitions are consistent with default parameter values for soil types presented in the US EPA model (US EPA 2003). The depth to from the ground surface to the top of contaminated groundwater in both sets of models was assumed to be 3.0 meters. This is slightly greater than the minimum thickness allowed for modeling of vapor transport through the low/moderate permeability vadose-zone soil profile due to capillary fringe height constraints.

Input soil parameter values for total porosity, water-filled porosity and fraction organic carbon for the upper portion of the soil profiles were set equal to values used by US EPA Region 9 in development of the PRGs (US EPA 2004). Soil moisture was assumed to be somewhat higher for the lower soil units than the upper units, at 0.30 (*vs* 0.15), consistent with the default recommended in the US EPA vapor intrusion guidance document. Default values presented in the spreadsheet were used for remaining soil properties. For site-specific assessments, soil moisture data should be collected within five feet of the groundwater surface and well above the capillary fringe zone.

Default soil vapor permeability values for the selected soil types were used in the models. For site-specific estimation of this parameter, the use of rigorous, in-situ methods intended for the design of soil vapor extraction systems is recommended. Secondary porosity and permeability in fine-grained soils can be significantly enhanced by plant roots, desiccation cracks, disturbance during redevelopment, faulting, etc. Reliance on a small number of borings or laboratory analysis could significantly underestimate the actual vapor permeability of the site and in turn underestimate the risk of potential impacts to indoor air.

Note that when using the spreadsheet to back calculate a groundwater screening level from an input target risk, the values appearing in the spreadsheet for C_{source} (concentration in soil gas) and $C_{building}$ (concentration in indoor air) are based on a theoretical initial soil concentration of 1E-6 g/g or 1,000 micrograms per kilogram and are not directly related to the modeled screening level. The values presented do not represent actual modeled concentrations and should be ignored.

5.4.1 Background and Use of US EPA Vapor Intrusion Model

The US EPA version of the Johnson and Ettinger considers both diffusive and convective flow of soil gas into buildings. Diffusive flow occurs as soil gas migrates from areas of higher concentration to areas of lower concentration. Wind effects and indoor heating can cause a decrease in air pressure inside a building and lead to upward, convective flow of subsurface vapors through cracks and gaps in the building floor. As described in the US EPA guidance document, effective convective flow of subsurface vapors into buildings is expected to be limited to soils within the immediate area of the building.

5.5 Surface Water and Groundwater Ceiling Levels For Gross Contamination Concerns

Ceiling levels based on gross contamination concerns for surface water and groundwater are summarized in the Table I series. Ceiling levels for surface water and groundwater that is considered to be a current or potential source of drinking water are based on the lowest of the chemicals taste and odor threshold (e.g., Secondary MCLs), one-half the solubility and a maximum of 50,000 µg/L for any chemical based on general resource degradation concerns (Tables I-1 and I-3, after MADEP 1994). Taste and odor thresholds for drinking water were selected in the following order of preference and availability:

- California Department of Health Services (DHS) Secondary MCLs;
- US EPA Secondary MCLs;

- California DHS taste and Odor Action Levels;
- Taste and odor levels developed by Amoore and Hautala (as presented in RWQCBCV 2003);
- Odor thresholds presented in Massachusetts DEP (MADEP 1994) and Ontario MOEE (MOEE 1996) guidance documents.

With the exception of the MADEP and MOEE odor thresholds, data for each of the listed sources are summarized in the document *A Compilation of Water Quality Goals* (RWQCBCV 2005).

Ceiling levels for surface water and groundwater that is NOT considered to be a current or potential source of drinking water were selected in a similar manner with the exception that the drinking water taste and odor thresholds were replaced with general nuisance thresholds and gross contamination concerns (Tables I-2 and I-4). Nuisance thresholds are intended to reflect the concentration at which a chemical in water poses unacceptable odor problems. Thresholds presented in the Massachusetts DEP and Ontario MOEE guidance documents were used as the primary sources of data. Taste and odor levels developed by Amoore and Hautala (in RWQCBCV 2000) were referred to for chemicals that lack odor thresholds in the Ontario guidance. It is apparent that similar sources were used to develop both the Ontario MOEE and the Amoore and Hautala databases (compare Tables I-1 and I-2). In keeping with the Ontario and Massachusetts guidance documents, a 10-fold dilution/attenuation of chemical concentrations in groundwater upon discharge to surface water was assumed (non-drinking water resources, nuisance thresholds only). The nuisance threshold for MtBE presented in Table I-2 is based on average, upper range at which most subjects in a US EPA study could smell MtBE in water (180 μg/L), as summarized in the public health goals document for MtBE prepared by Cal EPA (CalEPA 1999a). This was selected as a nuisance screening level for MtBE in surface water. Assuming a dilution factor of 10 yields an odor threshold of 1,800 μg/L for groundwater.

5.6 Other Groundwater Screening Levels

Additional screening levels for groundwater provided in *A Compilation of Water Quality Goals* include US EPA and National Academy of Sciences Suggested No-Adverse-Response (SNARL) goals for toxicity other than cancer risk and Agricultural Water Quality goals developed by the United Nations (RWQCBCV 2003). The SNARL goals largely duplicate risk-based screening levels for drinking water presented in Table F-3. Agricultural Water Quality goals for 12 metals are provided in Table F-5. These goals were not considered in the final lookup tables but may need to be considered on a site-specific basis. The agricultural goals are higher than screening levels for both drinking water and surface water protection for seven of the 12 metals listed. Agricultural goals for copper, cobalt, selenium and zinc are higher than goals for aquatic habitat protection but are lower than goals for drinking water (i.e., drinking water goals may not be adequately protective for irrigation use). The agricultural goal for molybdenum is lower than both the drinking water goal and the surface water goal for this metal. The development of these goals was not reviewed for preparation of the ESL document.

6 Soil Screening Levels

Residents and commercial or industrial workers may regularly be exposed to contaminated, vadose-zone soils or dust derived from these soils (Regular exposure to contaminated soils below the water table is not generally considered except for construction workers.) A depth of three meters (approximately 10 feet) is used to delineate between shallow, surface soils where regular exposure to residents and/or workers is assumed and deeper, subsurface soils where only periodic contact during construction and utility maintenance work is assumed. A depth of three meters is consistent with guidance presented in the CalEPA document *Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities* (CalEPA 1996). This is regarded as the maximum, likely depth that contaminated soil could at some point in the future be excavated and left exposed at the surface. The potential for deeper soils to be brought to the surface during large-scale redevelopment activities should be evaluated on a site-by-site basis.

Environmental concerns specifically considered for shallow versus deep soil ESLs are summarized in Table 3-1. Final ESLs for relatively non-mobile chemicals are generally less stringent for deep soils in comparison to shallow soils (e.g., compare final ESLs for polychlorinated biphenyls in Tables A-1 and C-1). A few exceptions are noted in Section 3.2. For chemicals that are highly mobile in the subsurface and easily leached from soil or emitted as vapors to the ground surface, groundwater protection and indoor-air impact concerns usually drive risk regardless of the depth of the contaminated soil (e.g., chlorinated solvents). Final shallow and deep soil ESLs for these chemicals are therefore identical (e.g., compare benzene and vinyl chloride ESLs in Tables A-1 and C-1).

6.1 Soil Screening Levels for Direct-Exposure Concerns

The following sections present the technical basis and limitations used to calculate ESLs for residential, commercial/industrial, and construction land use scenarios. .

6.1.1 Residential Receptors

A residential receptor is assumed to be a long-term receptor occupying a dwelling within the site boundaries 24 hours per day, and is assumed to live at the site for 30 years (representing the 90th percentile of the length of time someone lives in a single location), for 350 days per year. Exposure to soil is expected to occur during home maintenance activities, yard work and landscaping, and outdoor play activities. Contaminant intake is assumed to occur via three exposure pathways – direct ingestion, dermal absorption, and inhalation of volatiles and fugitive dusts. For the residential scenario, both adult and child receptors were evaluated because children often exhibit behavior (e.g., greater hand-to-mouth contact) that can result in greater exposure to soils than those associated with a typical adult. In addition, children also have a lower overall body weight relative to the predicted intake.

Equations 1 and 2 are used to calculate cumulative ESLs for a residential receptor exposed to non-carcinogenic and carcinogenic contaminants via all three exposure pathways. Default exposure parameters are provided for use when site-specific data are not available.

Equation 1: Combined Exposures to Noncarcinogenic Contaminants in Soil - Residential Scenario

$$C = \frac{THQ \times BW_c \times AT_n}{EF_r \times ED_c \left[\left(\frac{1}{RfD_o} \times \frac{IRS_c}{10^{-6}\ mg/kg} \right) + \left(\frac{1}{RfD_o} + \frac{SA_c \times AF_c \times ABS}{10^{-6}\ mg/kg} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_c}{VF\ or\ PEF} \right) \right]}$$

Parameter	Definition (units)	Value
C	Contaminant concentration (mg/kg)	Chemical-specific
THQ	Target hazard quotient	1
BW_c	Body weight, child (kg)	15
AT_n	Averaging time, noncarcinogens (days)	ED x 365
EF_r	Exposure frequency, resident (day/yr)	350
ED_c	Exposure duration, child (years)	6
IRS_c	Soil ingestion rate, child (mg/day)	200
RfD_o	Oral reference dose (mg/kg-day)	Chemical-specific
SA_c	Dermal surface area, child (cm^2/day)	2,800
AF_c	Soil adherence factor, child (mg/cm^2)	0.2
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_c	Inhalation rate, child (m^3/day)	10
RfD_I	Inhalation reference dose (mg/kg-day)	Chemical-specific
VF	Volatilization factor (m^3/kg)	Chemical-specific
PEF	Particulate emission factor (m^3/kg)	1.3×10^9

Equation 2: Combined Exposures to Carcinogenic Contaminants in Soil - Residential Scenario

$$C = \frac{TR \times AT_c}{EF_r \left[\left(\frac{IFS_{adj} \times CSF_o}{10^6 \text{ mg/kg}} \right) + \left(\frac{SFS_{adj} \times ABS \times CSF_o}{10^6 \text{ mg/kg}} \right) + \left(\frac{InhF_{adj} \times CSF_i}{VF \text{ or } PEF} \right) \right]}$$

Parameter	Definition (units)	Value
C	Contaminant concentration (mg/kg)	Chemical-specific
TR	Target cancer risk	1×10^{-5}
AT_c	Averaging time, carcinogens (days)	25,550
EF_r	Exposure frequency, resident (day/yr)	350
IFS_{adj}	Age-adjusted soil ingestion factor ([mg-yr]/[kg-day])	114
CSF_o	Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
SFS_{adj}	Age-adjusted dermal factor ([mg-yr]/[kg-day])	361
ABS	Skin absorption factor (unitless)	Chemical-specific
$InhF_{adj}$	Age-adjusted inhalation factor ([m^3-yr]/[kg-day])	11
CSF_i	Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
VF	Volatilization factor (m^3/kg)	Chemical-specific
PEF	Particulate emission factor (m^3/kg)	1.3×10^9

Noncarcinogenic contaminants are evaluated based solely on childhood exposures using Equation 1. By combining the higher contaminant intake rates with the lower relative body weight, childhood only exposures lead to a lower, or more conservative, risk-based concentration compared to an adult-only exposure. In addition, this approach is considered conservative because it combines the higher 6-year exposure for children with chronic toxicity criteria.

Unlike non-carcinogens, the duration of exposure to carcinogens is averaged over the lifetime of the receptor because of the assumption that cancer may develop even after actual exposure has ceased. As a result, the total dose received is averaged over a lifetime of 70 years. In addition, to be protective of exposures in a residential setting, the carcinogenic exposure parameter values are age-adjusted to account for exposures incurred in children (1-6 years of age) and adults (7-31 years of age). Carcinogenic exposures are age-adjusted to account for the physiological differences between children and adults as well as behavioral differences that result in markedly different relative rates of exposure. Equations 3, 4, and 5 are used to calculate age-adjusted ingestion, dermal and inhalation factors which account for the differences in soil ingestion rate, skin surface

area, soil adherence factors, inhalation rate, and body weight for children versus adults. The age-adjusted factors calculated using these equations were used in Equation 2 to develop ESLs for carcinogenic effects.

Equation 3: Calculation of Age-Adjusted Ingestion Factor

$$IFS_{adj} = \frac{ED_c \text{ x } IRS_c}{BW_c} + \frac{(ED_r - ED_c) \text{ x } IRS_a}{BW_a}$$

Parameter	Definition (units)	Value
IFS_{adj}	Age-adjusted soil ingestion factor for carcinogens [(mg-yr)/(kg-day)]	114
ED_c	Exposure duration, child (years)	6
IRS_c	Soil ingestion rate, child (mg/day)	200
BW_c	Body weight, child (kg)	15
ED_r	Exposure duration, resident (years)	30
IRS_a	Soil ingestion rate, adult (mg/day)	100
BW_a	Body weight, adult (kg)	70

Equation 4
Calculation of Age-Adjusted Dermal Factor

$$SFS_{adj} = \frac{ED_c \text{ x } AF_c \text{ x } SA_c}{BW_c} + \frac{(ED_r - ED_c) \text{ x } AF_a \text{ x } SA_a}{BW_a}$$

Parameter	Definition (units)	Default
SFS_{adj}	Age-adjusted dermal factor for carcinogens [(mg-yr)/(kg-day)]	361
ED_c	Exposure duration, child (years)	6
AF_c	Soil adherence factor, child (mg/cm^2)	0.2
SA_c	Dermal surface area, child (cm^2/day)	2,800
BW_c	Body weight, child (kg)	15
ED_r	Exposure duration, resident (years)	30
AF_a	Soil adherence factor, adult (mg/cm^2)	0.07
SA_a	Dermal surface area, adult (cm^2/day)	5,700
BW_a	Body weight, adult (kg)	70

Equation 5: Calculation of Age-Adjusted Inhalation Factor

$$InhF_{adj} = \frac{ED_c \times IRA_c}{BW_c} + \frac{(ED_r - ED_c) \times IRA_a}{BW_a}$$

Parameter	Definition (units)	Default
$InhF_{adj}$	Age-adjusted inhalation factor for carcinogens [(mg-yr)/(kg-day)]	11
ED_c	Exposure duration, child (years)	6
IRA_c	Inhalation rate, child (m^3/day)	10
BW_c	Body weight, child (kg)	15
ED_r	Exposure duration, resident (years)	30
IRA_a	Inhalation rate, adult (m^3/day)	20
BW_a	Body weight, adult (kg)	70

6.2 Non-residential land uses

Non-residential land uses encompass all commercial and industrial land uses and focus on two very different receptors – a commercial/industrial worker and a construction worker. Unlike those calculated for residential land-uses, ESLs for non-residential land uses are based solely on exposures to adults. Consequently, exposures to carcinogens are not age-adjusted. Due to the wide range of activities and exposure levels a non-residential receptor may be exposed to during various work-related activities, it is important to ensure that the default exposure parameters are representative of site-specific conditions.

6.2.1 Commercial/Industrial Worker

The commercial/industrial scenario is considered representative of on-site workers who spend all or most of their workday outdoors. A commercial/industrial worker is assumed to be a long-term receptor exposed during the course of a work day as either (1) a full time employee of a company operating on-site who spends most of the work day conducting maintenance or manual labor activities outdoors or (2) a worker who is assumed to regularly perform grounds-keeping activities as part of his/her daily responsibilities. Exposure to surface and shallow subsurface soils (i.e., at depths of zero to two feet below ground surface) is expected to occur during moderate digging associated with routine maintenance and grounds-keeping activities. A commercial/industrial

receptor is expected to be the most highly exposed receptor in the outdoor environment under generic or day-to-day commercial/industrial conditions. Thus, the screening levels for this receptor are expected to be protective of other reasonably anticipated indoor and outdoor workers at a commercial/industrial facility. However, screening levels developed for the commercial/industrial worker may not be protective of a construction worker due to the latter's increased soil contact rate during construction activities. Equations 6 and 7 were used to develop generic SSLs for cumulative exposure to carcinogenic and non-carcinogenic contaminants by all exposure pathways. Default exposure parameters are provided and were used in calculating the ESLs.

Equation 6: Combined Exposures to Carcinogenic Contaminants in Soil - Commercial/Industrial Scenario

$$C = \frac{TR \times BW_a \times AT_c}{EF_{CI} \times ED_{CI}\left[\left(\frac{IRS_{CI} \times CSF_o}{10^6\ mg/kg}\right)\right] + \left(\frac{SA_{CI} \times AF_{CI} \times ABS \times CSF_o}{10^6\ mg/kg}\right) + \left(\frac{IRA_{CI} \times CSF_i}{VF\ or\ PEF}\right)}$$

Parameter	Definition (units)	Value
C	Contaminant concentration (mg/kg)	Chemical-specific
TR	Target Risk	1×10^{-5}
BW_a	Body weight, adult (kg)	70
AT_c	Averaging time, carcinogens (days)	25,550
EF_{CI}	Exposure frequency, commercial/industrial (day/yr)	250
ED_{CI}	Exposure duration, commercial/industrial (years)	25
IRS_{CI}	Soil ingestion rate, commercial/industrial (mg/day)	100
CSF_o	Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
SA_{CI}	Dermal surface area, commercial/industrial (cm^2/day)	3,300
AF_{CI}	Soil adherence factor, commercial/industrial (mg/cm^2)	0.2
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CI}	Inhalation rate, commercial/industrial (m^3/day)	20
CSF_i	Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
VF	Volatilization factor (m^3/kg)	Chemical-specific
PEF	Particulate emission factor (m^3/kg)	1.3×10^9

Equation 7: Combined Exposures to Noncarcinogenic Contaminants in Soil - Commercial/Industrial Scenario

$$C = \frac{THQ \times BW_a \times AT_n}{EF_{CI} \times ED_{CI}\left[\left(\frac{1}{RfD_o} \times \frac{IRS_{CI}}{10^6\ mg/kg}\right)\right] + \left(\frac{1}{RfD_o} \times \frac{SA_{CI} \times AF_{CI} \times ABS}{10^6\ mg/kg}\right) + \left(\frac{1}{RfD_i} \times \frac{IRA_{CI}}{VF\ or\ PEF}\right)}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
THQ	Target hazard quotient	1
BW_a	Body weight, adult (kg)	70
AT_n	Averaging time, noncarcinogens (days)	ED x 365
EF_{CI}	Exposure frequency, commercial/industrial (day/yr)	250
ED_{CI}	Exposure duration, commercial/industrial (years)	25
IRS_{CI}	Soil ingestion rate, commercial/industrial (mg/day)	100
RfD_o	Oral reference dose (mg/kg-day)	Chemical-specific
SA_{CI}	Dermal surface area, commercial/industrial (cm^2/day)	3,300
AF_{CI}	Soil adherence factor, commercial/industrial (mg/cm^2)	0.2
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CI}	Inhalation rate, commercial/industrial (m^3/day)	20
RfD_i	Inhalation reference dose (mg/kg-day)	Chemical-specific
VF	Volatilization factor (m^3/kg)	Chemical-specific
PEF	Particulate emission factor (m^3/kg)	1.3×10^9

6.2.2 Construction Worker

A construction worker is assumed to be a receptor who is exposed to contaminated soil during the work day for the duration of a single on-site construction project. If multiple construction projects are anticipated, it is assumed that different workers will be employed for each project. The activities for this receptor typically involve substantial exposures to surface and subsurface soils (i.e., at depths of zero to 10 feet below ground surface) during excavation, maintenance and building construction projects (intrusive operations). A construction worker is assumed to be exposed to contaminants via the following pathways: incidental soil ingestion, dermal contact with soil, and inhalation of contaminated outdoor air (volatile and particulate emissions). While a construction worker receptor is assumed to have a higher soil ingestion rate than a commercial/industrial worker due to the type of activities performed during construction projects, the exposure frequency and duration are assumed to be significantly shorter due to the short-term nature of

construction projects. However, chronic toxicity information was used when developing screening levels for a construction worker receptor. This approach is significantly more conservative than using sub-chronic toxicity data because it combines the higher soil exposures for construction workers with chronic toxicity criteria. Equations 8 and 9 were used to develop generic SSLs for cumulative exposure to carcinogenic and non-carcinogenic contaminants by all exposure pathways. Default exposure parameters are provided and were used in calculating the ESLs (US EPA 2002c).

Equation 8: Combined Exposures to Carcinogenic Contaminants in Soil - Construction Worker Scenarios

$$C = \frac{TR \times BW_a \times AT_c}{EF_{CW} \times ED_{CW} \left[\left(\frac{IRS_{CW} \times CSF_o}{10^6 \text{ mg/kg}} \right) \right] + \left(\frac{SA_{CW} \times AF_{CW} \times ABS \times CSF_o}{10^6 \text{ mg/kg}} \right) + \left(\frac{IRA_{CW} \times CSF_i}{VF \text{ or } PEF} \right)}$$

Parameter	Definition (units)	Default
C	Contaminant concentration (mg/kg)	Chemical-specific
TR	Target Risk	1×10^{-5}
AT_c	Averaging time, carcinogens (days)	25,550
EF_{CW}	Exposure frequency, construction worker (day/yr)	250
ED_{CW}	Exposure duration, construction worker (years)	1
IRS_{CW}	Soil ingestion rate, construction worker (mg/day)	480
CSF_o	Oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
SA_{CW}	Dermal surface area, construction worker (cm^2/day)	3,300
AF_{CW}	Soil adherence factor, construction worker (mg/cm^2)	0.3
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CW}	Inhalation rate, construction worker (m^3/day)	20
CSF_i	Inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$	Chemical-specific
VF	Volatilization factor (m^3/kg)	Chemical-specific
PEF	Particulate emission factor (m^3/kg)	1.4×10^6

Equation 9: Combined Exposures to Noncarcinogenic Contaminants in Soil Construction Worker Scenario

$$C = \frac{THQ \times BW_a \times AT_n}{EF_{CW} \times ED_{CW} \left[\left(\frac{1}{RfD_o} \times \frac{IRS_{CW}}{10^6 \text{ mg/kg}} \right) \right] + \left(\frac{1}{RfD_o} \times \frac{SA_{CW} \times AF_{CW} \times ABS}{10^6 \text{ mg/kg}} \right) + \left(\frac{1}{RfD_i} \times \frac{IRA_{CW}}{VF \text{ or } PEF} \right)}$$

C	Contaminant concentration (mg/kg)	Chemical-specific
THQ	Target hazard quotient	1
AT_n	Averaging time, noncarcinogens (days)	ED x 365
EF_{CW}	Exposure frequency, commercial/industrial (day/yr)	250
ED_{CW}	Exposure duration, commercial/industrial (years)	1
IRS_{CW}	Soil ingestion rate, commercial/industrial (mg/day)	480
RfD_o	Oral reference dose (mg/kg-day)	Chemical-specific
SA_{CW}	Dermal surface area, commercial/industrial (cm^2/day)	3,300
AF_{CW}	Soil adherence factor, commercial/industrial (mg/cm^2)	0.3
ABS	Skin absorption factor (unitless)	Chemical-specific
IRA_{CW}	Inhalation rate, commercial/industrial (m^3/day)	20
RfD_i	Inhalation reference dose (mg/kg-day)	Chemical-specific
VF	Volatilization factor (m^3/kg)	Chemical-specific
PEF	Particulate emission factor (m^3/kg)	1.4×10^6

Screening levels for human health/direct-exposure concerns for shallow soils are summarized in Tables K-1 (residential land use exposure scenario) and K-2 (commercial/industrial exposure scenario). Direct-exposure screening levels for deep soils are summarized in Table K-3 (construction/utility workers exposure scenario). Only construction workers and utility trench workers are assumed to come into periodic contact with contaminants in deep soils.

6.3 Lead

Direct-exposure screening levels for lead of 150 mg/kg and 750 mg/kg are presented for residential land use (Tables A-1, B-1 and K-1) and commercial/industrial land use (Tables A-2, B-2 and K-2), respectively. The commercial screening level is also presented for deep soils (Tables C-1, C-2, D-1, D-2 and K-3). The residential screening level of 150 mg/kg is published in the Office of Environmental Health Hazard Evaluation document *Human-Health-Based Screening Numbers Developed to*

Aid Estimation of Cleanup Costs for Contaminated Soil (CalEPA 2004b) and was developed through use of the DTSC LeadSpread model. The screening levels are based on a target blood-lead level of 10 μg/dL (99th percentile). The model incorporates concurrent exposure to lead in air at an ambient concentration of 0.0028 $\mu g/m^3$ and in drinking water at a concentration of 15 μg/L (Primary MCL). The screening level also takes into account the potential uptake of lead in home-grown produce. Additional information is provided in the referenced document.

The DTSC schools unit has published a screening level for lead of 255 mg/kg, also based on use of the DTSC LeadSpread model (CalEPA 2001). This screening level is based on an identical residential exposure scenario as noted above with the exception that uptake of lead in homegrown produce is not considered. While this screening level may be appropriate for schools and even high-density housing areas, the more comprehensive OEHHA screening level was selected for use as a screening level. US EPA Region 9 presents a residential screening level for lead of 400 mg/kg (US EPA 2004). This screening level is based on a model similar to LeadSpread, but only considers the uptake of lead via direct exposure to contaminated soil.

The commercial/industrial soil screening level for lead of 750 mg/kg referenced in Tables K-2 and K-3 of this document is based on the US EPA Region 9 Preliminary Remediation Goal for this exposure scenario (US EPA 2004). The OEHHA CHHSLs document presents a lead screening level of 3,500 mg/kg for commercial/industrial exposure, based on the DTSC LeadSpread model. While perhaps technically appropriate, this screening level is considered high for sites adjacent to residential areas that are susceptible to wind-blown dust from commercial/industrial areas. Residential exposure could occur via inhalation of air-born dust as well as ingestion of dust that has entered living spaces. A decision was therefore made to refer to the US EPA screening level.

As also stated in the OEHHA CHHSLs document, the commercial/industrial screening number of 3,500 mg/kg is above the hazardous waste, Total Threshold Limit Concentration for lead of

1,000 mg/kg (Title 22 of the California Code of Regulations). Because of the regulatory implications during remediation of a site, the document recommends that the actual screening level used be below 1,000 mg/kg (footnote to Table 5 in the updated OEHHA CHHSLs document). Use of the US EPA screening level satisfies this recommendation.

6.4 Background Metal Concentrations

Ambient background concentrations of arsenic in Bay Area soils typically exceed risk-based screening levels for direct-exposure concerns. For example, the risk-based screening level for arsenic in residential soils is 0.39 mg/kg (Table K-1), while naturally-occurring concentrations of arsenic in soil typically exceed this concentration throughout the Bay Area. Alternative screening levels based on site-specific or regionally-specific established background levels may represent a more appropriate screening level in such instances. Methods to establish a site-specific background or the use appropriate regional background studies should be discussed with Water Board staff before using non risk-based values at a specific site. Cal EPA does not generally require cleanup of naturally-occurring chemicals to less than background. For sites where metals are known to be present due to site-related activities, cleanup levels may be determined on a site-specific or region-specific determination of appropriate background.

6.5 Soil Screening Levels for Potential Vapor Intrusion Concerns

Soil screening levels for evaluating vapor intrusion concerns are no longer provided. This is due to concerns associated with contaminant loss during sampling, which would lead to an under-prediction of contaminant mass, as well as concerns associated with the ability of the soil version of the EPA Johnson and Ettinger models to accurately predict indoor air concentrations based on soil VOC measurements. DTSC no longer supports use of the finite-source version of the model (which uses bulk soil concentrations as the source term), and has removed it from its web site.

6.6 Soil Screening Levels for Groundwater Protection

Soil screening levels for groundwater protection concerns are summarized in Table G and included in summary lookup tables for both shallow and deep soils (Tables A through D). These screening levels are intended to address potential leaching of chemicals from vadose-zone soils and subsequent impact on groundwater. The soil screening levels are back calculated based on target groundwater screening levels. Target groundwater screening levels are summarized in the Table F series and discussed in Chapter 2.

The majority of the screening levels were calculated based on an empirical equation presented in guidance published by the Massachusetts DEP (MADEP 1994):

$$C_{soil} = DAF \times C_{gw} \times 0.001 \text{ mg/}\mu\text{g}$$

$$DAF = (6207 \times H) + (0.166 \times K_{oc})$$

where:

DAF	=	SESOIL-based dilution/attenuation factor;
H	=	Henry's Law Constant (atm-m^3/mol);
K_{oc}	=	organic carbon partition coefficient (cm^3/g);
C_{soil}	=	leaching based soil concentration (mg/kg);
C_{gw}	=	target groundwater screening level (µg/L).

The algorithm was originally developed by the state of Oregon (Anderson 1992), slightly modified for use by the Massachusetts DEP (MADEP 1994) and then incorporated into the Ontario MOEE lookup table guidance (MOEE 1996). The algorithm is based on a combined use of the computer applications SESOIL and AT123D. These applications model leaching of chemicals from the vadose zone and subsequent migration of the leachate to groundwater, respectively.

SESOIL models the generation and downward migration of leachate in the vadose zone. The AT123D application models the mixing of leachate with groundwater immediately below the contaminated area. A more detailed

discussion of the derivation and application of the SESOIL/AT123D algorithm as modified by the Massachusetts DEP and adopted for use by the Ontario MOEE is provided in Appendix 5. The algorithm is based on a three-meter thick vadose zone characterized by one meter of contaminated soil sandwiched between two one-meter thick layers of clean soil. The lower layer immediately overlies groundwater. All vadose-zone soil is conservatively assumed to be very permeable sand that freely allows the migration of leachate to groundwater. The organic carbon content of the soil is assumed to be 0.1 percent. (Note that this is more conservative than the 0.6 percent organic carbon content assumed in the direct-exposure models.) Mixing with groundwater is modeled over a 10-meter by 10-meter area. Use of a thicker assumed sequence of contaminated soil would not significantly alter the results of the model given the assumed one-meter depth to groundwater.

Annual rainfall is assumed to be 1,100 mm (approximately 43 inches). A total of 720 mm (28 inches) of the total rainfall is assumed to infiltrate the ground surface and reach groundwater (conservative for most portions of the San Francisco Bay Area). Biodegradation during migration of leachate to groundwater is not considered. The model does allow for resorption and re-volatilization of chemicals from the leachate during migration based on the physical-chemical properties of the chemical and the assumed soil properties. Groundwater is assumed to flow at a moderate rate of approximately 73 meters (240 feet) per year. The concentration of a chemical in leachate is assumed to be further reduced upon mixing of the leachate with groundwater (dilution factor approximately 3).

For moderately volatile and sorptive chemicals (e.g., benzene), screening levels developed using the SESOIL-derived algorithm are similar to screening levels generated using the full SESOIL application under a scenario where contaminated soil is within a few meters of groundwater (HIDOH 1995). Comparison to screening levels developed using SESOIL suggests that the simplified algorithm may be conservative in the following cases:

- Leaching of highly volatile chemicals (e.g., vinyl chloride);

- Leaching of highly sorptive chemicals (e.g., polynuclear aromatic hydrocarbons);
- Leaching of highly biodegradable chemicals (e.g., common petroleum compounds);
- Sites where the depth to groundwater is greater than 10 meters below the bottom of the contaminated soil.

As the distance between the base of contaminated soil and groundwater increases, there is additional time and area for chemicals to volatilize out of the leachate, re-sorb to soil particles or degrade by naturally occurring biological processes. Site-specific evaluation of the potential for leaching of chemicals from soil may be warranted in such cases (including more rigorous modeling, laboratory leaching tests, groundwater monitoring, etc.).

SESOIL modeling carried out by the Hawai'i Department of Health (HIDOH 1995) suggests that chemicals with sorption coefficients greater than 30,000 cm^3/g will be immobile in the surface under normal soil conditions and not likely to impact groundwater. The SESOIL models were run conservatively assuming an annual rainfall of 400 cm/year (158 inches/year), an infiltration rate of 144 cm/year (57 inches/year) and permeable soil overlying fractured bedrock.

Based on modeling studies as well as field experience in general, screening levels for chemicals with sorption coefficients greater than 30,000 cm^3/g were set at the theoretical soil saturation level for that chemical if higher than the screening level generated by use of the SESOIL algorithm (Table G). The equation and assumptions used to calculate the saturation levels is presented and discussed in Appendix 2. Exceptions to this approach are pentachlorophenol and bis(2-ethylhexyl)phthalate, both of which have a higher solubility than other the highly sorptive chemicals. Leaching based screening levels for these chemicals were developed using only the SESOIL algorithm described above (see Table G).

The majority of PCBs releases identified in the Bay Area are related to 1242 to 1260 range Aroclors. The default K_{oc} of 33,000 cm^3/g presented in Table J was considered to be adequately conservative for this range and used in the leaching model. For less chlorinated PCB mixtures, a site-specific evaluation of potential leaching concerns and possible vapor emission concerns is required.

Leaching based screening levels were generated only for chemicals considered to be significantly soluble and mobile in groundwater under normal, ambient conditions (e.g., pH 5.0 to 9.0 and normal redox conditions). Leaching based soil screening levels were not developed for metals. Leaching of metals from soil is highly dependent on the species of the metal present and the geochemical nature of the soil. At sites where physical-chemical conditions may promote enhanced leaching of metals and other chemicals from soils or waste piles (e.g., mining related wastes), the use of laboratory-based leaching tests is recommended.

Leaching based soil screening levels were developed for perchlorate (ClO_4^-). Perchlorate is a salt, and is not significantly sorptive, volatile or biodegradable under normal conditions. Use of the SESOIL/AT123D algorithm was therefore not considered appropriate. As an alternative, a simple, chemical partitioning model presented in the US EPA Soil Screening Level Guidance document was referred to (US EPA 1996, 2001):

$$C_{soil} = C_{water} \times \left(\left(K_{oc} \times f_{oc} \right) + \left(\frac{\theta_w + \left(\theta_a \times H' \right)}{\varrho_b} \right) \right) \times DAF$$

where:

C_{soil} = soil screening level for leaching concerns (mg/kg);

C_{water} = target dissolved-phase concentration of chemical (mg/L);

K_{oc} = sorption coefficient;

f_{oc} = fraction organic carbon in soil;

θ_w = water-filled porosity;

θ_a = air-filled porosity;

H' = dimensionless Henry's Law constant;

ρ_b = soil bulk density (g/cm^3);

DAF = Dilution/Attenuation Factor

This model can be used to back-calculate the total soil concentration of a chemical based on a target dissolved-phase concentration of the chemical in the soil (i.e., concentration in leachate). For perchlorate, K_{oc} and H' are presumed to be zero and the equation reduces to:

$$C_{soil} = C_{water} \times \left(\frac{\theta_w}{\rho_b} \right) \times DA$$

The default water-filled porosity in the models is 0.15 and the default soil bulk density is 1.5. Laboratory-based tests are recommended for more site-specific analysis of potential leaching of perchlorate from soil.

6.7 Soil Screening Levels for Terrestrial Habitats

Soil screening levels for the protection of terrestrial flora and fauna are included in summary ESL tables for shallow soils in both the Residential and Commercial/Industrial Only land-use scenarios (Tables A-1, A-2, B-1 and B-2). The screening levels were taken directly from guidance developed by the Ontario Ministry of Environment and Energy (MOEE 1996). Screening levels were available for heavy metals and some high-molecular-weight organic compounds and pesticides.

The MOEE guidance is primarily a compilation of criteria published by environmental agencies in Canada and elsewhere and is an update to previous guidance (e.g., MOEE 1991; CCME 1994). Ecological effects-based soil values developed by the Dutch government (Vegter 1993; van den Berg 1993) were in particular reviewed for inclusion in the MOEE guidance. The Netherlands C values referenced are intended to represent the concentration of a chemical in soil at which the No Observed Effects Concentration for 50 percent of the target ecological species would be exceeded. Earlier versions of the Canadian and Dutch guidance are presented in the U. S. Fish and Wildlife Service document *Evaluation of Soil*

Contamination (USFWS 1990). Pertinent sections from the MOEE guidance are presented in Appendix 6.

Soil screening levels for terrestrial ecological concerns can be highly specific to the species of fauna or flora potentially contaminated as well as the specific form of the metal present and the geochemistry of the soil. The Ontario MOEE intended use of the screening levels over a broad range of land-use scenarios, including residential land use, agricultural and parkland. For the purposes of consideration in the Tier 1 lookup tables the screening levels are considered to be adequate only for general screening purposes in and around developed, urban areas.

The screening levels are not intended for use in areas where a significant risk to endangered or threatened species may exist or where there is a potentially significant threat to terrestrial ecological receptors that extends beyond the general boundary of a subject site. This could include sites that are adjacent to wetlands, streams, rivers, lakes, ponds, marine shorelines, or sites that otherwise contain or border on areas where protected or endangered species may be present. Potential impacts to sediment are also not addressed. The need for a detailed risk assessment should be evaluated on a site-by-site basis for areas where significant ecological concerns may exist. Notification to the Natural Resource Trustee Agencies (including the state Department of Toxics Substances Control and Department of Fish and Game and the federal Fish and Wildlife Service, Department of the Interior and National Oceanic and Atmospheric Administration) may also be required, particularly if the release of a hazardous substance may impact bodies of surface water.

6.8 Ceiling Levels for Gross Contamination Concerns

Ceiling levels for gross contamination concerns are presented in each of the ESL summary tables for soil. These screening levels are intended to be protective against odor and other nuisance and aesthetic concerns, as well as restrict the presence of potentially mobile, free product and limit the overall degradation of soil quality (i.e., gross contamination). The selection of soil ceiling levels was based on methods originally published

by the Massachusetts DEP (MADEP 1994) and also used by the Ontario MOEE (MOEE 1996), as described in the Table H series.

Odor Thresholds presented in the Table H series are intended to represent the concentration of a chemical in air at which 50 percent of the population can detect a chemical odor. An Odor Index for a chemical is calculated by dividing the chemicals vapor pressure (in Torr, at 20-30 degrees Celsius) by its odor threshold (in ppm-volume, see Tables H-2 and H-3). This provides a relative ranking of chemicals for potential nuisance concerns. As summarized in H-2 (shallow soils) and H-3 (deep soils), ceiling levels were then selected based a comparison of a chemicals vapor pressure and odor index to a table of generic screening levels (Tables H-1). For chemicals that are liquids under ambient conditions, the final ceiling level was selected as the lowest of the generic level from Table H-1 and the chemicals theoretical saturation level in soil (see Appendix 2). This was intended to prevent the presence of mobile, free product in the subsurface.

ENVIRONMENTAL CONCERNS CONSIDERED IN SOIL ESLs

Category	Human Health (Direct-Exposure)	Human Health (Indoor-Air)	*Groundwater Protection (Drinking Water Resource Threatened)	*Groundwater Protection (Drinking Water Resource NOT Threatened)	Ecological Concerns (Terrestrial Receptors)	Ceiling Values
Table A						
Residential Land Use	X		X	X	X	X
Commercial/Industrial Land Use Only	X		X	X	X	X
Table B						
Residential Land Use	X			X	X	X
Commercial/Industrial Land Use Only	X			X	X	X
Table C						
Residential Land Use	X		X	X		X
Commercial/Industrial Land Use Only	X		X	X		X
Table D						
Residential Land Use	X			X		X
Commercial/Industrial Land Use Only	X			X		X

*Groundwater protection concerns not related to drinking water include discharge to surface water, indoor-air impacts, and ceiling levels (nuisance concerns, etc.).

Table A - Shallow Soils Overlying Drinking Water Resource

Table B - Shallow Soils NOT Overlying Drinking Water Resource

Table C - Deep Soils Overlying Drinking Water Resource

Table D - Deep Soils NOT Overlying Drinking Water Resource

7 Indoor Air and Soil Gas Screening Levels

The US EPA spreadsheet version of the Johnson & Ettinger model for soil gas intrusion into buildings (US EPA 2003) was used to develop indoor air and soil gas screening levels for volatile chemicals. Example printouts of the model are included in Appendix 4. The model can be condensed into three simple steps: 1) calculation of a target indoor-air goal based on input exposure assumptions and chemical toxicity factors; 2) calculation of soil gas-to-indoor air attenuation factors based on a comparison of vapor flow rates into a building and air flow rates through the building and 3) calculation of a soil gas screening level. A summary of these steps is provided below. A more detailed discussion of the model is provided in Appendix 3.

7.1 Indoor Air Screening Levels

Indoor air screening levels were calculated using the following equation incorporated in the model:

Carcinogens:

$$C_{air} = \left(\frac{TR \text{ x } AT_c \text{ x } 365 \text{ days/yr}}{URF \text{ x } EF \text{ x } ED} \right)$$

Noncarcinogens:

$$C_{air} = \left(\frac{THQ \times AT_{nc} \times 365\ days/yr}{\left(\frac{1}{RfC}\right) \times EF \times ED} \right)$$

where:

C_{air} = Target indoor air concentration;

TR = Target risk (carcinogens);

THQ = Target hazard quotient (noncarcinogens);

AT_c = Averaging time for carcinogens;

AT_{nc} = Averaging time for noncarcinogens;

URF = Unit risk factor for carcinogens (carcinogens);

RfC = Reference concentration (noncarcinogens);

EF = Exposure frequency;

ED = Exposure duration.

A summary of the calculated indoor-air goals is provided in Table E-3. For carcinogenic effects, the target excess cancer risk was set at 10^{-6}. For noncarcinogenic effects, the target Hazard Quotient was set at 0.2 for all chemicals. Input exposure assumptions were identical to those assumed for direct-exposure models (summary in Appendix 2 and DATAENTER worksheets in Appendix 4).

7.2 Soil Gas Screening Levels

The spreadsheet models the intrusion of soil gas situated immediately beneath the slab-on-grade foundation into the overlying building. Input values used in the groundwater model were retained (one story, 100 m^2 foundation area, sampling depth below grade of 15 cm). Soil underlying the building was assumed to be a permeable fill material. Default values for a sand soil type were used in the model.

Based on the input building characteristics and soil type, a vapor flow rate into the buiding of 67 cm^3/sec was calculated (Q_{soil}, equivalent to 4 liters/minute). Indoor-air exchange rates of 1 per hour and 2 per hour were assumed for residences and commercial/industrial buildings, respectively. Given the assumed dimensions of 10 m x 10 m x 2.44 m for the modeled buildings, indoor-air flow rates of approximately 4,000 L/minute for residences and 8,000 L/minute for commercial/industrial buildings were calculated.

Calculation of a soil gas-to-indoor air attenuation factor (AF) is calculated as:

$$AF = \left(\frac{\text{vapor intrusion rate}}{\text{vapor intrusion rate} + \text{indoor air flow rate}} \right).$$

For residences, a soil gas-to-indoor air attenuation factor of approximately 0.001 (1/1000) was calculated. For commercial/industrial buildings, a soil gas-to-indoor air attenuation factor of approximately 0.0005 (1/2000) was calculated. The shallow depth to soil gas and predominance of advective flow over diffusive flow effectively negates small differences in the fate and transport of individual chemicals. This allows the calculated attenuation factors to be used in a generic fashion for all volatile chemicals. Soil-gas screening levels (C_{sg}) are subsequently calculated as:

$$C_{sg} = \left(\frac{\text{Indoor Air Goal}}{AF} \right).$$

A summary of soil-gas screening levels for volatile chemicals is provided in Table E-2

8 Soil and Groundwater Screening Levels for TPH

The selection of Total Petroleum Hydrocarbons (TPH) soil and groundwater screening levels for use in this document is described below. Use of ESLs as final cleanup levels for petroleum-related compounds that are known to be biodegradable is conservative. This is particularly true for leaching based soil screening levels for TPH and petroleum-related compounds. Final cleanup levels should be evaluated on a site-specific basis and in conjunction with guidance from the overseeing regulatory agency.

Petroleum is a complex mixture of hundreds of different compounds composed of hydrogen and carbon (i.e., hydrocarbon compounds). For the purposes of this document, petroleum mixtures are subdivided into gasolines, middles distillates, and residual fuels, following the methodology used by the American Petroleum Institute (API 1994). Gasolines are defined as petroleum mixtures characterized by a predominance of branched alkanes and aromatic hydrocarbons with carbon ranges of C_6 to C_{12} and lesser amounts of straight-chain alkanes, alkenes and cycloalkanes of the same carbon range. Middle distillates (e.g., kerosene, diesel fuel, home heating fuel, jet fuel, etc.) are characterized by a wider variety of straight, branched and cyclic alkanes, polynuclear aromatic hydrocarbons (PAHs, particularly naphthalene and methyl naphthalenes) and heterocyclic compounds with carbon ranges of approximately C_9 to C_{25}. Residual fuels (e.g., fuel oil Nos. 4, 5, and 6, lubricating oils, waste oils, oil and grease, asphalts, etc.) are characterized as complex, polar PAHs, naphthenoaromatics, asphaltenes and other high-molecular-weight, saturated hydrocarbon compounds with carbon ranges that in general fall between C_{24} and C_{40}.

Laboratory analysis for TPH as gasolines and middle distillates is commonly carried out using EPA Method 8015 (or equivalent) modified

for gasoline-range organics (Volatile Fuel Hydrocarbons) and diesel-range organics (Extractable Fuel Hydrocarbons), respectively. Analysis for TPH as residual fuels up to the C_{40} carbon range can generally be carried out by gas chromatograph methods (e.g., Method 8015 modified for motor oil and waste oil range organics) but can also include the use of infrared or gravimetric methods. More detailed information on analytical methods for TPH and other chemicals can be obtained from environmental laboratories or the overseeing regulatory agency.

Laboratory measurement and assessment of each individual compound within a petroleum mixture is technically complex and generally not feasible or appropriate under most circumstances. More importantly, data regarding the physical-chemical and toxicity characteristics of the majority of petroleum compounds are lacking. Impacts to soil and water from petroleum mixtures are instead evaluated in terms of both TPH and well characterized indicator chemicals (e.g., benzene, toluene, ethylbenzene, xylenes and targeted PAHs). Indicator chemicals typically recommended for petroleum mixtures include (after CalEPA 1996):

Monocyclic Aromatic Compounds (primarily gasolines and middle distillates)

- benzene
- ethylbenzene
- toluene
- xylene

Fuel additives (primarily gasolines)

- MtBE
- other oxygenates as necessary

Polycyclic Aromatic Compounds (primarily middle distillates and residual fuels)

- methylnaphthalene (1- and 2-)
- acenaphthene
- acenaphthylene
- anthracene
- benzo(a)anthracene

- benzo(b)fluoranthene
- benzo(g,h,i)perylene
- benzo(a)pyrene
- benzo(k)fluoranthene
- chrysene
- dibenz(a,h)anthracene
- fluoranthene
- fluorene
- indeno(1,2,3-c,d)pyrene
- naphthalene
- phenanthrene
- pyrene

The TPH ESLs should be used in conjunction with ESLs for these chemicals. Note that volatile chemicals such as butylbenzene, isopropyl benzene, isopropyl toluene and trimethylbenzenes are often reported in analyses of gasoline and other light-end petroleum products. These chemicals are collectively addressed under screening levels for TPH and generally do not need to be evaluated separately.

Soil and groundwater contaminated by releases of waste oil may also require testing for heavy metals and chemicals, such as chlorinated solvents and PCBs. Screening levels for these chemicals are included in the lookup tables.

8.1 TPH Screening Levels for Groundwater

Regulatory drinking water standards for TPH and petroleum in general have not been developed. For the purposes of this document, the TPH-diesel taste and odor threshold of 100 µg/L referenced in *A Compilation of Water Quality Goals* (RWQCBCV 2003) was used as the drinking water screening level for all categories of TPH (see Table F-3). Screening levels for benzene and related light-weight hydrocarbon compounds are considered to provide adequate additional protection of drinking water concerns for gasoline-contaminated groundwater when used in conjunction with the TPH screening level of 100 µg/L. For the protection

of aquatic life, a screening level of 500 μg/L was selected for TPH-gasoline in freshwater and 3,700 μg/L in saltwater (see Table F-4b). A single screening level of 640 μg/L was selected for TPH-diesel and TPH-residual fuels in both freshwater and saltwater. The freshwater screening level for TPH-gasoline is based on a summary of available eco-toxicity data compiled for use at the Presidio of San Francisco under Board Order 96-070 (RWQCBSF 1998b, Montgomery Watson 1999). The TPH-gasoline criteria for saltwater and the TPH criteria for diesel and residual fuels in general are based on screening levels developed for use at the San Francisco Airport under Regional Water Board Order No. 99-045 (RWQCBSF 1999a).

The groundwater nuisance and odor concerns screening level of 5,000 μg/L for TPH (all categories) noted in the Table I series for non-drinking water was taken directly from Massachusetts DEP risk assessment guidance (MADEP 1997a,b). This also corresponds with the approximate solubility of diesel fuel and light motor oil in fresh water (ATSDR 2001a) and is intended to address potential nuisance issues (odors, etc.) if discharged to surface water, as required under the Basin Plan (RWQCBSF 1995). The TPH ceiling levels for gross contamination concerns are based on ½ the solubility of the respective TPH categories (Table I series). The solubility of gasoline in freshwater is approximately 150,000 μg/L. The solubility of diesel range and heavier fuels is assumed to be approximately 5,000 μg/L. These screening levels are intended to highlight the potential presence of free product on groundwater.

8.2 TPH Screening Levels for Soil

8.2.1 TPH (gasolines, middle distillates)

Soil screening levels for lighter fractions of petroleum (gasolines, middle distillates) were selected based on a surrogate approach as described in the Massachusetts Department of Environmental Protection (Hutchinson et. al 1996; MADEP 1997a,b). The Massachusetts approach is similar to

guidance developed by the Total Petroleum Hydrocarbon Working Group (TPHCWG 1998).

Massachusetts used six distinct groups of petroleum hydrocarbon compounds with similar carbon makeup, physical-chemical, and toxicity characteristics to collectively describe the spectrum of all possible petroleum product mixtures (referred to as carbon ranges). For example, petroleum-related aromatic compound with five to 22 carbon atoms are grouped in the C_{11}-C_{22} aromatic carbon range. Surrogate toxicity factors and physical-chemical constants were chosen for each carbon range group. These constants were then used to develop environmental soil and groundwater screening levels for each carbon range in the same manner as done for individual chemicals (see Chapters 2 and 3).

Due to the relative mobility of compounds included within the C_{11}-C_{22} aromatics range fraction and the general predominance of these compounds in lighter-weight fuels, Massachusetts elected to use toxicity factors and physical-chemical constants for this carbon range as a surrogate for TPH in general. The same approach was adopted for use in this document. This may not be sufficiently conservative for gasoline-range mixtures with a predominance of more lighter and more mobile compounds. The use of conservative target indicator compounds (e.g., BTEX) in conjunction with the TPH screening level is assumed to adequately address this issue.

Massachusetts selected an oral reference dose (RfD) of 0.03 mg/kg-day and an inhalation reference dose of 0.14 mg/kg-day for the C_{11}-C_{22} aromatics fraction, based in part on comparison to the Massachusetts RfDs for pyrene. An oral RfD of 0.03 mg/kg-day is also used in the US EPA PRGs for pyrene. The TPH Working Group selected a slightly less conservative oral RfD of 0.04 mg/kg-day and inhalation RfD of 0.06 mg/kg-day (based on reference concentration of 0.20 mg/m^3) for the same carbon range group (THPWG 1998). In this document, the reference doses developed by MADEP were ultimately used to generate direct-exposure

soil screening levels for TPH. The screening levels are based on a target hazard quotient of 0.2.

Massachusetts developed generic physical-chemical constants for the C_{11}-C_{22} aromatics carbon range fraction based on a review of compounds included within this fraction. These constants were adopted in this document to develop a soil leaching screening level for TPH as gasolines and middle distillates (see Table G). The TPH soil screening level calculated for protection of drinking water (rounded to 100 mg/kg) is coincidental with screening levels presented in other s prepared by regulatory agencies (RWQCBSF 1990; RWQCBLA 1996). Similarly, the soil screening level calculated for protection of surface water habitats (rounded to 400 mg/kg (gasolines) and 500 mg/kg (middle distillates)) is coincidental with the screening level developed for use in the Board Order for the San Francisco Airport (RWQCB 1999a).

Ceiling levels for nuisance and other gross contamination concerns developed by Massachusetts for TPH as gasoline and diesel (latter included under middle distillates) were modified for use in this document (MADEP 1997a,b). Based on calculated odor indexes, a shallow soil ceiling level of 100 mg/kg was selected for residential land-use and 500 mg/kg was selected for commercial/industrial land-use. For deep soils, a ceiling level of 5,000 mg/kg was retained, primarily intended to prevent the presence of potentially mobile free product in soil.

8.2.2 TPH (residual fuels)

Direct-exposure screening levels developed for TPH as gasoline and as middle distillates were retained for use with TPH as residual fuels (Table K-1). Following Massachusetts DEP guidance (MADEP 1997a,b), ceiling levels for gross contamination concerns of 500 mg/kg and 2,500 mg/kg were selected for residential and commercial/industrial shallow soils, respectively. The Massachusetts DEP ceiling level of 5,000 mg/kg was used for deep soils.

The Massachusetts DEP did not develop specific screening levels for leaching of heavy hydrocarbons from soil (C_{19}-C_{36} carbon range summary in Appendix 7). Residual fuels are by definition characterized by a predominance hydrocarbon compounds with carbon ranges greater than C_{24}. These compounds are considered to be substantially less mobile in the subsurface than hydrocarbon compounds comprising lighter-weight petroleum mixtures. For TPH that is characterized by a predominance of C_{23}-C_{32} carbon range compounds, the Los Angeles Regional Water Board proposed a screening level of 1,000 mg/kg for protection of drinking water resources (RWQCBLA 1996). This screening level was adopted for use in this document (Table G). The target TPH screening level for groundwater was not specifically stated but is presumed to be 100 μg/L or less.

The Los Angeles Regional Water Board did not present a similar screening level for potential leaching of TPH from soil and subsequent discharge of contaminated groundwater to a body of surface water. Although conservative, the Los Angeles TPH soil leaching screening level of 1,000 mg/kg was retained for this purpose (see Table G).

9 Other Issues

9.1 Laboratory Reporting Levels and Background Concentrations

Laboratory method reporting limits and background concentrations of chemicals were not directly considered in development of the lookup tables. As already discussed, reporting limits approved by the overseeing regulatory agency may be used in place of the ESLs presented in this document when the reporting limit is higher. Additionally, arsenic and chromium are often naturally present in Bay Area soils at levels above risk-based screening levels. The ESL may be replaced with the natural background concentration of the chemical if the background value is higher.

9.2 Reporting of Soil Data

Soil data are calculated by dividing the mass of the chemical of concern detected in the soil by the total weight of the soil. The weight of a soil sample can be measured on either a dry-weight basis (i.e., excluding the weight of water in the soil sample) or a wet-weight basis (i.e., including the weight of water in the soil sample). For a typical soil sample, the inclusion of soil moisture in calculation of chemical concentrations can effectively reduce the reported concentrations by 10-20 percent or greater, simply because the measured total weight of the sample is greater.

From a site-investigation and risk assessment-standpoint, a difference in the reported concentration of a chemical of 10-20 percent is not necessarily significant. For consistency and for comparison to soil ESLs presented in this document soil data should be reported on dry-weight basis. This is in part because soil ingestion rates assumed in direct-exposure models are based on dry-weight studies (US EPA 1997). Comparison of wet-weight data to direct-exposure screening level would technically require adjustment of the direct-exposure screening levels to reflect wet weight-

based soil ingestion rates. A site-specific consideration of wet-weight soil data will be dependent on assumptions in the model(s) being used to evaluate risk or generate environmental screening levels. Existing wet-weight soil data may not necessarily need to be adjusted prior to comparison to the ESLs unless the introduced bias is considered to be a potentially significant factor at the site. (Note that sediment data should also be reported on a dry-weight basis.)

9.3 Degradation to Daughter Products

Consideration of the degradation of a chemical to daughter products, such as the breakdown of tetrachloroethene to vinyl chloride, is an important part of site investigations. Tier 1 lookup tables generated by some regulatory agencies incorporate a conservative assumption that the entire mass of a parent chemical will be eventually be transformed to the daughter product at the same initial concentration (e.g., MADEP 1994, MOEE 1996). They in turn reduce the initially derived screening levels for these parent compounds to reflect the screening levels for more toxic daughter products. In the case of tetrachlorethene, for example, degradation to vinyl chloride and further degradation of vinyl chloride to ethene (and ultimately carbon dioxide and water) may be a steady-state process at sites where degradation is occurring, removing a portion of the vinyl chloride as it is generated. The need to consider this assumption should be evaluated on a site-by-site basis. It should be pointed out that at some sites degradation of chlorinated solvents in groundwater is minimal (e.g., PCE) but levels of daughter products in soil gas may be elevated (e.g., vinyl chloride). This emphasizes the need to collect soil gas data at sites where vapor intrusion is of potential concern.

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FIGURES

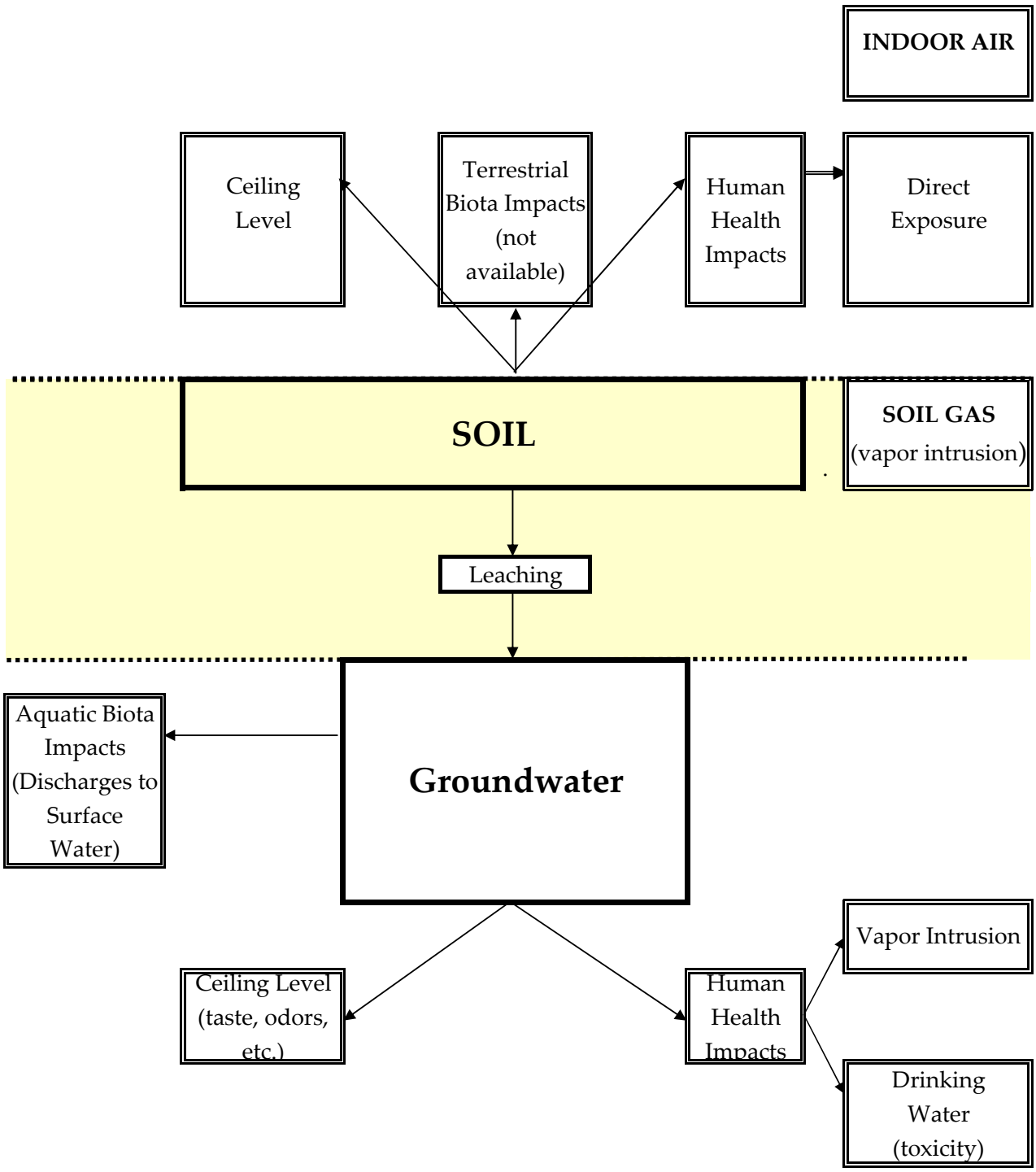

Figure 1. Summary of human health and environmental concerns considered in screening levels. Additional site-specific considerations include groundwater beneficial use, depth to impacted soil, soil type and land use. Evaluation of environmental concerns not shown requires site-specific assessment

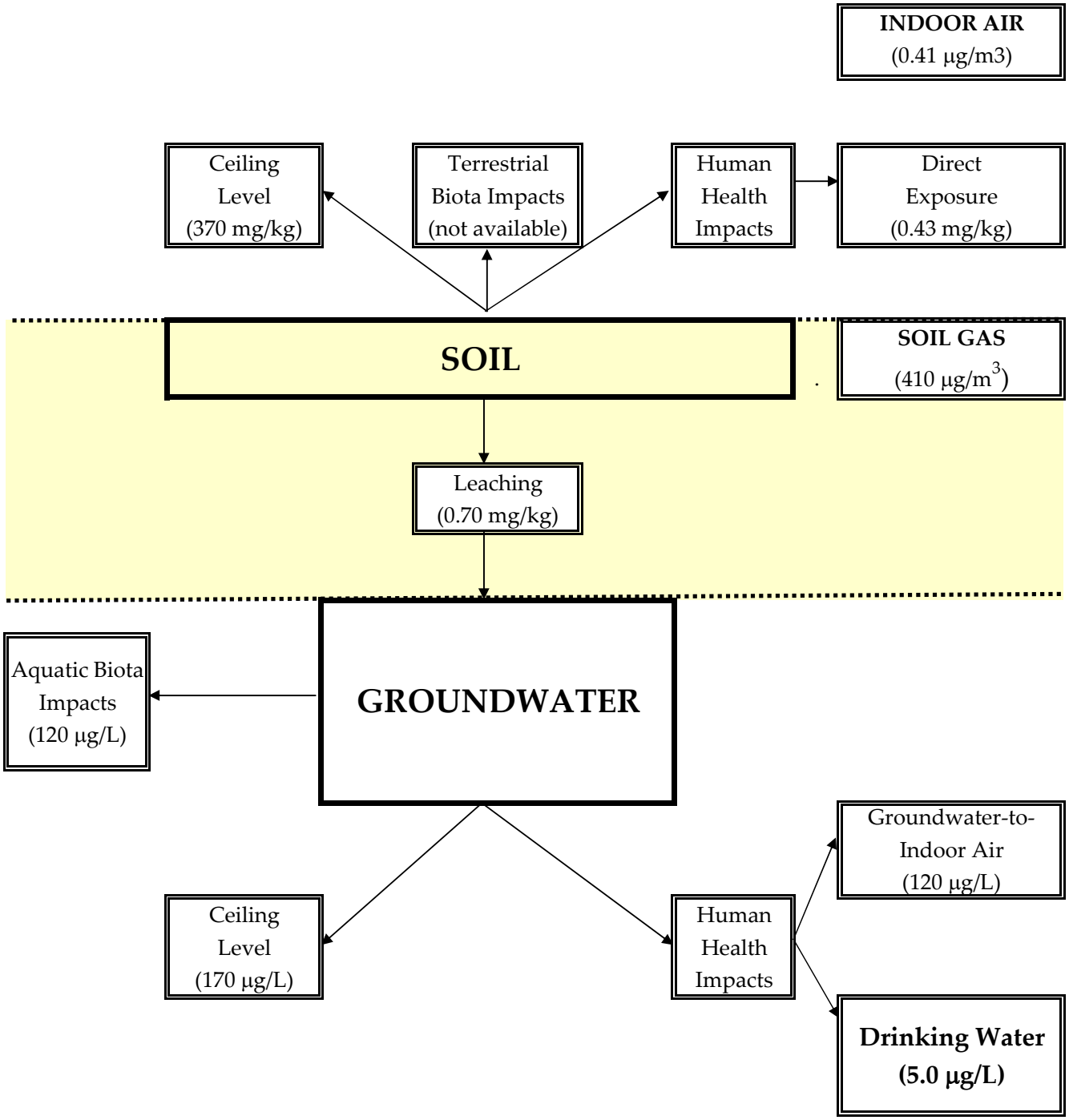

Figure 2. Summary of individual screening levels used to select final, Tier 1 ESLs for tetrachloroethene in soils situated within ten feet of the ground surface and in groundwater that is a current or potential source of drinking water, based on a residential land-use scenario. Final ESLs presented in summary tables are the lowest of the individual screening levels. Direct exposure concerns drive selection of the final soil ESL (0.43 mg/kg). For groundwater, the MCL drives selection of final ESL (5.0 µg/L).

STEP 1: Check with the overseeing regulatory agency to ensure that the version of the lookup tables you have is up-to-date and that the screening levels can be applied to your site.

STEP 2: Select chemicals of potential concern for site based on knowledge of past site use and/or analytical data for soil or groundwater samples collected at the site.

STEP 3: Choose appropriate lookup table based on location of contaminated soil and beneficial use of contaminated or potentially contaminated groundwater at the subject site, as summarized below:

[1]Beneficial Use Of Threatened Groundwater	[2]Location Of Contaminated Soil	
	Shallow Soils (≤ 3m bgs)	**[3]Deep Soils (> 3m bgs)**
Current or Potential Source of Drinking Water	TABLE A	TABLE C
NOT a Current or Potential Source of Drinking Water	TABLE B	TABLE D

bgs: below ground surface

1. Shallow-most saturated zone beneath the subject site and deeper zones as appropriate.
2. Depth to top of contaminated soil from ground surface (3 meters ≈ 10 feet).
3. Application of deep soil ESLs to soils <3 m deep may require institutional controls (see text).

STEP 4: Go to selected lookup table. Determine desired or anticipated future use of property - "Residential Land Use Permitted" (recommended for initial use at all sites to avoid potential deed restrictions) *vs*. "Commercial/Industrial Land Use Only".

STEP 5: Select soil ESLs for chemicals of concern from appropriate land-use column in table and/or select correlative groundwater ESLs.

STEP 6: Determine vertical and lateral extent of soil and/or groundwater contaminated above screening levels to extent required by overseeing agency.

STEP 7: Evaluate additional actions needed at site based on results of Step 7. (e.g., cleanup to Tier 1 or Tier 2 ESLs, track and monitor defined groundwater plume, develop alternative screening levels in a site-specific environmental risk assessment, etc.). Determine specific environmental concerns for site as needed.

Figure 3. Steps to selection and use of Environmental Screening Levels in Tier 1 Lookup Tables.

TABLES

Table A. Environmental Screening Levels (ESLs)
Shallow Soils (≤3m bgs)
Groundwater IS Current or Potential Source of Drinking Water

	[1]Shallow Soil		
Chemical	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	[3]Groundwater (ug/L)
Acenaphthene	1.6E+01	1.6E+01	2.0E+01
Acenaphthylene	8.9E+01	8.9E+01	2.1E+02
Acetone	2.1E+00	2.1E+00	6.3E+03
Aldrin	3.2E-02	1.3E-01	2.0E-03
Anthracene	4.0E+01	4.0E+01	2.2E+01
Antimony	6.1E+00	4.0E+01	6.0E+00
Arsenic	3.8E-01	1.5E+00	5.0E+01
Barium	7.5E+02	1.5E+03	1.0E+03
Benzene	4.4E-02	4.4E-02	1.0E+00
Benzo(a)anthracene	3.8E-01	1.3E+00	2.9E-02
Benzo(b)fluoranthene	3.8E-01	1.3E+00	2.9E-02
Benzo(k)fluoranthene	3.8E-01	1.3E+00	2.9E-02
Benzo(g,h,i)perylene	3.5E+01	3.5E+01	1.3E-01
Benzo(a)pyrene	3.8E-02	1.3E-01	2.0E-01
Beryllium	4.0E+00	8.0E+00	4.0E+00
1,1-Biphenyl	6.5E-01	6.5E-01	5.0E-01
Bis(2-chloroethyl) ether	4.0E-04	4.0E-04	3.2E-02
Bis(2-chloroisopropyl) ether	1.5E-04	1.5E-04	1.4E-02
Bis(2-ethylhexyl) phthalate	3.5E+01	1.2E+02	4.0E+00
Boron	1.6E+00	2.0E+00	1.0E+03
Bromodichloromethane	5.6E-01	1.2E+00	1.0E+02
Bromoform (Tribromomethane)	2.2E+00	2.2E+00	1.0E+02
Bromomethane	3.9E-01	3.9E-01	9.8E+00
Cadmium	1.7E+00	7.4E+00	5.0E+00
Carbon tetrachloride	2.0E-02	4.4E-02	5.0E-01
Chlordane	4.4E-01	1.7E+00	1.0E-01
p-Chloroaniline	3.0E-01	3.0E-01	2.8E+01
Chlorobenzene	3.0E+00	3.0E+00	5.0E+01
Chloroethane	8.5E-01	8.5E-01	1.2E+01
Chloroform	6.7E-01	1.4E+00	7.0E+01
Chloromethane	6.4E+00	6.4E+00	4.1E+01
2-Chlorophenol	1.2E-02	1.2E-02	1.8E-01
Chromium (total)			5.0E+01
Chromium III	7.5E+02	7.5E+02	5.0E+04
Chromium VI	8.0E+00	8.0E+00	2.1E+01
Chrysene	4.0E+01	4.0E+01	8.0E-01
Cobalt	4.0E+01	8.0E+01	1.4E+02
Copper	2.3E+02	2.3E+02	1.0E+03
Cyanide	5.4E-01	5.4E-01	1.5E+02
Dibenz(a,h)anthracene	6.2E-02	2.1E-01	4.8E-03
Dibromochloromethane	5.8E+00	8.3E+00	1.0E+02
1,2-dibromo-3-chloropropane	4.5E-03	4.5E-03	2.0E-01
1,2-Dibromoethane	3.3E-04	3.3E-04	5.0E-02
1,2-Dichlorobenzene	1.1E+00	1.1E+00	1.0E+01

Table A. Environmental Screening Levels (ESLs)
Shallow Soils (≤3m bgs)
Groundwater IS Current or Potential Source of Drinking Water

Chemical	[1]Shallow Soil		[3]Groundwater (ug/L)
	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
1,3-Dichlorobenzene	2.4E+01	2.4E+01	2.1E+02
1,4-Dichlorobenzene	5.9E-01	5.9E-01	5.0E+00
3,3-Dichlorobenzidine	7.7E-03	7.7E-03	2.9E-02
Dichlorodiphenyldichloroethane (DDD)	2.3E+00	9.0E+00	1.5E-01
Dichlorodiphenyldichloroethene (DDE)	1.6E+00	4.0E+00	1.0E-01
Dichlorodiphenyltrichloroethane (DDT)	1.6E+00	4.0E+00	1.0E-01
1,1-Dichloroethane	2.0E-01	2.0E-01	5.0E+00
1,2-Dichloroethane	4.5E-03	4.5E-03	5.0E-01
1,1-Dichloroethene	4.1E-02	8.8E-02	6.0E+00
cis -1,2-Dichloroethene	1.9E-01	1.9E-01	6.0E+00
trans -1,2-Dichloroethene	6.7E-01	6.7E-01	1.0E+01
2,4-Dichlorophenol	3.0E-01	3.0E-01	3.0E-01
1,2-Dichloropropane	1.2E-01	1.2E-01	5.0E+00
1,3-Dichloropropene	5.9E-02	5.9E-02	5.0E-01
Dieldrin	2.7E-03	2.7E-03	2.2E-03
Diethyl phthalate	1.3E+02	1.3E+02	5.6E+03
Dimethyl phthalate	5.0E+02	1.0E+03	5.0E+04
2,4-Dimethylphenol	6.7E-01	6.7E-01	1.0E+02
2,4-Dinitrophenol	4.0E-01	4.0E-01	1.4E+02
2,4-Dinitrotoluene	3.9E-04	3.9E-04	5.1E-02
1,4-Dioxane	1.8E-03	1.8E-03	3.0E+00
Dioxin (2,3,7,8-TCDD)	4.6E-06	1.9E-05	3.0E-05
Endosulfan	2.2E+01	2.2E+01	4.2E+01
Endrin	6.0E-02	6.0E-02	2.0E+00
Ethylbenzene	3.3E+00	3.3E+00	3.0E+01
Fluoranthene	4.0E+01	4.0E+01	1.3E+02
Fluorene	4.1E+02	6.4E+02	2.8E+02
Heptachlor	3.7E-02	3.7E-02	1.0E-02
Heptachlor epoxide	3.8E-02	3.8E-02	1.0E-02
Hexachlorobenzene	3.0E-01	1.1E+00	1.0E+00
Hexachlorobutadiene	2.2E+00	2.2E+00	4.5E-01
γ-Hexachlorocyclohexane (Lindane)	1.2E-01	1.2E-01	2.0E-01
Hexachloroethane	3.0E+00	3.0E+00	9.0E-01
Indeno(1,2,3-c,d)pyrene	6.2E-01	2.1E+00	4.8E-02
Lead	2.0E+02	7.5E+02	1.5E+01
Mercury (elemental)	1.0E+00	1.0E+01	2.0E+00
Methoxychlor	2.6E+02	2.6E+02	2.0E+01
Methylene chloride	7.7E-02	7.7E-02	5.0E+00
Methyl ethyl ketone	3.9E+00	3.9E+00	4.2E+03
Methyl isobutyl ketone	2.8E+00	2.8E+00	1.2E+02
Methyl mercury	1.2E+00	1.2E+01	7.0E-01
2-Methylnaphthalene	1.2E+00	1.2E+00	1.0E+01
tert -Butyl methyl ether	2.3E-02	2.3E-02	5.0E+00
Molybdenum	4.0E+01	4.0E+01	3.5E+01

Table A. Environmental Screening Levels (ESLs)
Shallow Soils (≤3m bgs)
Groundwater IS Current or Potential Source of Drinking Water

Chemical	[1]Shallow Soil: [2]Residential Land Use (mg/kg)	[1]Shallow Soil: Commercial/ Industrial Land Use Only (mg/kg)	[3]Groundwater (ug/L)
Naphthalene	1.3E+00	2.8E+00	1.7E+01
Nickel	1.5E+02	1.5E+02	1.0E+02
Pentachlorophenol	3.0E+00	5.0E+00	1.0E+00
Perchlorate	1.1E+01	1.3E+02	6.0E+00
Phenanthrene	4.0E+01	4.0E+01	2.1E+02
Phenol	7.6E-02	7.6E-02	5.0E+00
Polychlorinated biphenyls (PCBs)	8.9E-02	3.0E-01	5.0E-01
Pyrene	5.0E+02	1.0E+03	6.8E+01
Selenium	1.0E+01	1.0E+01	5.0E+01
Silver	2.0E+01	4.0E+01	3.5E+01
Styrene	1.5E+00	1.5E+00	1.0E+01
tert -Butyl alcohol	1.0E-06		
1,1,1,2-Tetrachloroethane	2.4E-02	2.4E-02	1.3E+00
1,1,2,2-Tetrachloroethane	1.8E-02	1.8E-02	1.0E+00
Tetrachloroethene	3.4E-01	7.0E-01	5.0E+00
Thallium	1.2E+00	1.5E+01	2.0E+00
Toluene	2.9E+00	2.9E+00	4.0E+01
Toxaphene	4.6E-01	1.8E+00	3.0E+00
TPH (gasolines)	8.3E+01	8.3E+01	1.0E+02
TPH (middle distillates)	8.3E+01	8.3E+01	1.0E+02
TPH (residual fuels)	4.1E+02	2.5E+03	1.0E+02
1,2,4-Trichlorobenzene	1.5E+00	1.5E+00	5.0E+00
1,1,1-Trichloroethane	2.5E+01	2.5E+01	2.0E+02
1,1,2-Trichloroethane	7.0E-02	7.0E-02	5.0E+00
Trichloroethene	4.6E-01	4.6E-01	5.0E+00
2,4,5-Trichlorophenol	3.2E+00	3.2E+00	2.0E+02
2,4,6-Trichlorophenol	2.3E-01	2.3E-01	7.0E-01
Vanadium	1.5E+01	1.9E+02	1.5E+01
Vinyl chloride	2.1E-02	4.7E-02	5.0E-01
Xylenes	2.3E+00	2.3E+00	2.0E+01
Zinc	6.0E+02	6.0E+02	5.0E+03

Notes:

1. Shallow soils defined as soils less than or equal to 3 meters (approximately 10 feet) below ground surface.
2. Category "Residential Land Use" generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.)
3. Assumes potential discharge of groundwater into a freshwater, marine or estuary surface water system.

Soil ESLs intended to address direct-exposure, groundwater protection, ecologic (urban areas) and nuisance concerns under noted land-use scenarios. **Soil gas data should be collected for additional evaluation of potential indoor-air impacts at sites with significant areas of VOC-contaminated soil.**

Groundwater ESLs intended to be address drinking water, surface water, indoor-air and nuisance concerns. **Use in conjunction with soil gas screening levels to more closely evaluate potential impacts to indoor-air if groundwater screening levels for this concern approached or exceeded.**

Aquatic habitat goals for bioaccumulation concerns not considered in selection of groundwater goals.

Soil and water ESLs for ethanol based on gross contamination concerns.

TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.).

Table B. Environmental Screening Levels (ESLs)
Shallow Soils (≤3 m bgs)
Groundwater IS NOT a Current or Potential Source of Drinking Water

	[1]Shallow Soil		
Chemical	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	[3]Groundwater (ug/L)
Acenaphthene	1.6E+02	1.6E+02	2.0E+02
Acenaphthylene	3.7E+02	8.3E+02	2.0E+03
Acetone	1.7E+01	1.7E+01	5.0E+04
Aldrin	3.2E-02	1.3E-01	8.5E+00
Anthracene	4.0E+01	4.0E+01	2.2E+01
Antimony	6.1E+00	4.0E+01	5.0E+04
Arsenic	3.8E-01	1.5E+00	5.0E+04
Barium	7.5E+02	1.5E+03	5.0E+04
Benzene	1.2E-01	2.6E-01	5.4E+02
Benzo(a)anthracene	3.8E-01	1.3E+00	5.0E+00
Benzo(b)fluoranthene	3.8E-01	1.3E+00	7.0E+00
Benzo(k)fluoranthene	3.8E-01	1.3E+00	4.0E-01
Benzo(g,h,i)perylene	3.5E+01	3.5E+01	1.3E-01
Benzo(a)pyrene	3.8E-02	1.3E-01	1.9E+00
Beryllium	4.0E+00	8.0E+00	5.0E+04
1,1-Biphenyl	6.5E+00	6.5E+00	5.0E+00
Bis(2-chloroethyl) ether	1.4E-01	3.5E-01	6.5E+01
Bis(2-chloroisopropyl) ether	3.2E-02	7.4E-02	3.2E+03
Bis(2-ethylhexyl) phthalate	3.5E+01	1.2E+02	6.5E+02
Boron	1.6E+00	2.0E+00	5.0E+04
Bromodichloromethane	5.6E-01	1.2E+00	1.7E+02
Bromoform (Tribromomethane)	6.1E+01	1.1E+02	5.1E+03
Bromomethane	6.9E-01	2.3E+00	5.8E+02
Cadmium	1.7E+00	7.4E+00	5.0E+04
Carbon tetrachloride	2.0E-02	4.4E-02	9.3E+00
Chlordane	4.4E-01	1.7E+00	2.5E+01
p-Chloroaniline	4.9E+01	4.9E+02	5.0E+04
Chlorobenzene	3.0E+01	3.0E+01	5.0E+02
Chloroethane	1.0E+01	1.1E+01	1.6E+02
Chloroform	6.7E-01	1.4E+00	3.3E+02
Chloromethane	6.4E+00	6.4E+00	4.1E+01
2-Chlorophenol	1.2E-01	1.2E-01	1.8E+00
Chromium (total)			5.0E+04
Chromium III	7.5E+02	7.5E+02	5.0E+04
Chromium VI	8.0E+00	8.0E+00	5.0E+04
Chrysene	4.0E+01	4.0E+01	8.0E-01
Cobalt	4.0E+01	8.0E+01	5.0E+04
Copper	2.3E+02	2.3E+02	5.0E+04
Cyanide	6.2E+00	6.2E+00	1.7E+03
Dibenz(a,h)anthracene	6.2E-02	2.1E-01	2.5E-01
Dibromochloromethane	5.8E+00	1.4E+01	1.7E+02
1,2-dibromo-3-chloropropane	6.9E-02	2.5E-01	1.0E+02
1,2-Dibromoethane	1.9E-02	4.2E-02	1.5E+02
1,2-Dichlorobenzene	1.1E+01	1.1E+01	1.0E+02

Table B. Environmental Screening Levels (ESLs)
Shallow Soils (≤3 m bgs)
Groundwater IS NOT a Current or Potential Source of Drinking Water

	[1]Shallow Soil		
Chemical	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	[3]Groundwater (ug/L)
1,3-Dichlorobenzene	3.0E+01	3.0E+01	5.0E+04
1,4-Dichlorobenzene	1.2E+00	2.6E+00	1.1E+02
3,3-Dichlorobenzidine	4.0E-01	1.4E+00	1.6E+03
Dichlorodiphenyldichloroethane (DDD)	2.3E+00	9.0E+00	8.0E+01
Dichlorodiphenyldichloroethene (DDE)	1.6E+00	4.0E+00	2.0E+01
Dichlorodiphenyltrichloroethane (DDT)	1.6E+00	4.0E+00	1.5E+00
1,1-Dichloroethane	2.2E+00	4.7E+00	1.0E+03
1,2-Dichloroethane	2.2E-01	4.8E-01	2.0E+02
1,1-Dichloroethene	4.1E-02	8.8E-02	6.3E+03
cis -1,2-Dichloroethene	6.4E+00	2.2E+01	6.2E+03
trans -1,2-Dichloroethene	1.0E+01	3.4E+01	2.6E+03
2,4-Dichlorophenol	3.0E+00	3.0E+00	3.0E+00
1,2-Dichloropropane	4.6E-01	1.0E+00	1.0E+02
1,3-Dichloropropene	1.7E-01	3.6E-01	5.3E+01
Dieldrin	3.4E-02	1.3E-01	9.3E+01
Diethyl phthalate	5.0E+02	1.0E+03	5.0E+04
Dimethyl phthalate	5.0E+02	1.0E+03	5.0E+04
2,4-Dimethylphenol	2.7E+01	2.7E+01	4.0E+03
2,4-Dinitrophenol	1.4E+02	1.4E+02	5.0E+04
2,4-Dinitrotoluene	7.1E-01	2.5E+00	5.0E+04
1,4-Dioxane	1.8E+01	3.0E+01	5.0E+04
Dioxin (2,3,7,8-TCDD)	4.6E-06	1.9E-05	7.0E+03
Endosulfan	4.0E+01	4.0E+01	7.5E+01
Endrin	6.0E-02	6.0E-02	1.3E+02
Ethylbenzene	3.3E+01	3.3E+01	3.0E+02
Fluoranthene	4.0E+01	4.0E+01	1.3E+02
Fluorene	4.1E+02	1.0E+03	9.5E+02
Heptachlor	1.2E-01	4.8E-01	2.8E+01
Heptachlor epoxide	5.3E-02	1.9E-01	1.8E+02
Hexachlorobenzene	3.0E-01	1.1E+00	5.5E+01
Hexachlorobutadiene	2.4E+00	2.2E+01	6.0E+01
γ-Hexachlorocyclohexane (Lindane)	2.0E+00	2.0E+00	3.5E+03
Hexachloroethane	1.2E+01	4.4E+01	1.0E+02
Indeno(1,2,3-c,d)pyrene	6.2E-01	2.1E+00	2.7E-01
Lead	2.0E+02	7.5E+02	5.0E+04
Mercury (elemental)	1.0E+00	1.0E+01	5.0E+04
Methoxychlor	2.6E+02	2.6E+02	2.0E+01
Methylene chloride	6.9E+00	1.6E+01	2.4E+03
Methyl ethyl ketone	4.6E+01	4.6E+01	5.0E+04
Methyl isobutyl ketone	1.0E+01	1.0E+01	1.3E+04
Methyl mercury	1.2E+00	1.2E+01	5.0E+04
2-Methylnaphthalene	1.2E+01	1.2E+01	1.0E+02
tert -Butyl methyl ether	8.4E+00	8.4E+00	1.8E+03
Molybdenum	4.0E+01	4.0E+01	5.0E+04

Table B. Environmental Screening Levels (ESLs)
Shallow Soils (≤3 m bgs)
Groundwater IS NOT a Current or Potential Source of Drinking Water

	[1]Shallow Soil		
Chemical	**[2]Residential Land Use (mg/kg)**	**Commercial/ Industrial Land Use Only (mg/kg)**	**[3]Groundwater (ug/L)**
Naphthalene	1.3E+00	2.8E+00	2.1E+02
Nickel	1.5E+02	1.5E+02	5.0E+04
Pentachlorophenol	3.0E+00	5.0E+00	5.9E+03
Perchlorate	1.1E+01	1.3E+02	5.0E+04
Phenanthrene	4.0E+01	4.0E+01	4.1E+02
Phenol	4.0E+01	4.0E+01	5.0E+04
Polychlorinated biphenyls (PCBs)	8.9E-02	3.0E-01	1.6E+01
Pyrene	5.0E+02	1.0E+03	6.8E+01
Selenium	1.0E+01	1.0E+01	5.0E+04
Silver	2.0E+01	4.0E+01	5.0E+04
Styrene	1.6E+01	1.6E+01	1.1E+02
tert -Butyl alcohol	1.0E+02	3.1E+02	5.0E+04
1,1,1,2-Tetrachloroethane	2.0E+00	4.4E+00	5.0E+04
1,1,2,2-Tetrachloroethane	2.6E-01	5.8E-01	1.9E+02
Tetrachloroethene	3.4E-01	8.5E-01	1.2E+02
Thallium	1.2E+00	1.5E+01	5.0E+04
Toluene	2.9E+01	2.9E+01	4.0E+02
Toxaphene	4.6E-01	1.8E+00	1.4E+02
TPH (gasolines)	1.0E+02	4.5E+02	5.0E+03
TPH (middle distillates)	1.0E+02	1.5E+02	2.5E+03
TPH (residual fuels)	4.1E+02	2.5E+03	2.5E+03
1,2,4-Trichlorobenzene	7.8E+00	2.7E+01	2.5E+03
1,1,1-Trichloroethane	2.7E+02	9.4E+02	5.0E+04
1,1,2-Trichloroethane	4.9E-01	1.1E+00	3.5E+02
Trichloroethene	1.9E+00	4.0E+00	5.3E+02
2,4,5-Trichlorophenol	1.0E+01	1.0E+01	2.0E+03
2,4,6-Trichlorophenol	1.2E+00	1.0E+01	1.0E+03
Vanadium	1.5E+01	1.9E+02	5.0E+04
Vinyl chloride	2.1E-02	4.7E-02	3.8E+00
Xylenes	3.1E+01	1.0E+02	5.3E+03
Zinc	6.0E+02	6.0E+02	5.0E+04

Notes:
1. Shallow soils defined as soils less than or equal to 3 meters (approximately 10 feet) below ground surface.
2. Category "Residential Land Use" generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.)
3. Assumes potential discharge of groundwater into a freshwater, marine or estuary surface water system.

Soil ESLs intended to address direct-exposure, groundwater protection, ecologic (urban areas) and nuisance concerns under noted land-use scenarios. **Soil gas data should be collected for additional evaluation of potential indoor-air impacts at sites with significant areas of VOC-contaminated soil.**

Groundwater ESLs intended to be address drinking water, surface water, indoor-air and nuisance concerns. **Use in conjunction with soil gas screening levels to more closely evaluate potential impacts to indoor-air if groundwater screening levels for this concern approached or exceeded.**

Aquatic habitat goals for bioaccumulation concerns not considered in selection of groundwater goals.

Soil and water ESLs for ethanol based on gross contamination concerns.

TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.).

Table C. Environmental Screening Levels (ESLs)
Deep Soils (>3m bgs)
Groundwater IS a Current or Potential Source of Drinking Water

	[1]Deep Soil		
Chemical	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	[3]Groundwater (ug/L)
Acenaphthene	1.6E+01	1.6E+01	2.0E+01
Acenaphthylene	8.9E+01	8.9E+01	2.1E+02
Acetone	2.1E+00	2.1E+00	6.3E+03
Aldrin	1.5E+00	1.5E+00	2.0E-03
Anthracene	8.5E+01	8.5E+01	2.2E+01
Antimony	2.8E+02	2.8E+02	6.0E+00
Arsenic	1.4E+01	1.4E+01	5.0E+01
Barium	2.5E+03	2.6E+03	1.0E+03
Benzene	4.4E-02	4.4E-02	1.0E+00
Benzo(a)anthracene	1.2E+01	1.2E+01	2.9E-02
Benzo(b)fluoranthene	1.5E+01	1.5E+01	2.9E-02
Benzo(k)fluoranthene	2.7E+00	2.7E+00	2.9E-02
Benzo(g,h,i)perylene	3.5E+01	3.5E+01	1.3E-01
Benzo(a)pyrene	1.5E+00	1.5E+00	2.0E-01
Beryllium	9.8E+01	9.8E+01	4.0E+00
1,1-Biphenyl	6.5E-01	6.5E-01	5.0E-01
Bis(2-chloroethyl) ether	4.0E-04	4.0E-04	3.2E-02
Bis(2-chloroisopropyl) ether	1.5E-04	1.5E-04	1.4E-02
Bis(2-ethylhexyl) phthalate	7.8E+02	7.8E+02	4.0E+00
Boron	4.6E+04	4.6E+04	1.0E+03
Bromodichloromethane	1.9E+00	1.9E+00	1.0E+02
Bromoform (Tribromomethane)	2.2E+00	2.2E+00	1.0E+02
Bromomethane	3.9E-01	3.9E-01	9.8E+00
Cadmium	3.9E+01	3.9E+01	5.0E+00
Carbon tetrachloride	1.1E-01	1.1E-01	5.0E-01
Chlordane	1.5E+01	1.5E+01	1.0E-01
p-Chloroaniline	3.0E-01	3.0E-01	2.8E+01
Chlorobenzene	3.0E+00	3.0E+00	5.0E+01
Chloroethane	8.5E-01	8.5E-01	1.2E+01
Chloroform	2.1E+00	2.1E+00	7.0E+01
Chloromethane	6.4E+00	6.4E+00	4.1E+01
2-Chlorophenol	1.2E-02	1.2E-02	1.8E-01
Chromium (total)	2.5E+03	5.0E+03	5.0E+01
Chromium III	2.5E+03	5.0E+03	5.0E+04
Chromium VI	5.3E-01	5.3E-01	2.1E+01
Chrysene	5.3E+01	5.3E+01	8.0E-01
Cobalt	9.4E+01	9.4E+01	1.4E+02
Copper	2.5E+03	5.0E+03	1.0E+03
Cyanide	5.4E-01	5.4E-01	1.5E+02
Dibenz(a,h)anthracene	2.4E+00	2.4E+00	4.8E-03
Dibromochloromethane	8.3E+00	8.3E+00	1.0E+02
1,2-dibromo-3-chloropropane	4.5E-03	4.5E-03	2.0E-01
1,2-Dibromoethane	3.3E-04	3.3E-04	5.0E-02
1,2-Dichlorobenzene	1.1E+00	1.1E+00	1.0E+01

Table C. Environmental Screening Levels (ESLs)
Deep Soils (>3m bgs)
Groundwater IS a Current or Potential Source of Drinking Water

	[1]Deep Soil		
Chemical	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	[3]Groundwater (ug/L)
1,3-Dichlorobenzene	2.4E+01	2.4E+01	2.1E+02
1,4-Dichlorobenzene	5.9E-01	5.9E-01	5.0E+00
3,3-Dichlorobenzidine	7.7E-03	7.7E-03	2.9E-02
Dichlorodiphenyldichloroethane (DDD)	1.1E+02	1.1E+02	1.5E-01
Dichlorodiphenyldichloroethene (DDE)	7.6E+01	7.6E+01	1.0E-01
Dichlorodiphenyltrichloroethane (DDT)	4.3E+00	4.3E+00	1.0E-01
1,1-Dichloroethane	2.0E-01	2.0E-01	5.0E+00
1,2-Dichloroethane	4.5E-03	4.5E-03	5.0E-01
1,1-Dichloroethene	1.0E+00	1.0E+00	6.0E+00
cis -1,2-Dichloroethene	1.9E-01	1.9E-01	6.0E+00
trans -1,2-Dichloroethene	6.7E-01	6.7E-01	1.0E+01
2,4-Dichlorophenol	3.0E-01	3.0E-01	3.0E-01
1,2-Dichloropropane	1.2E-01	1.2E-01	5.0E+00
1,3-Dichloropropene	5.9E-02	5.9E-02	5.0E-01
Dieldrin	2.7E-03	2.7E-03	2.2E-03
Diethyl phthalate	1.3E+02	1.3E+02	5.6E+03
Dimethyl phthalate	1.0E+03	1.2E+03	5.0E+04
2,4-Dimethylphenol	6.7E-01	6.7E-01	1.0E+02
2,4-Dinitrophenol	4.0E-01	4.0E-01	1.4E+02
2,4-Dinitrotoluene	3.9E-04	3.9E-04	5.1E-02
1,4-Dioxane	1.8E-03	1.8E-03	3.0E+00
Dioxin (2,3,7,8-TCDD)	2.4E-04	2.4E-04	3.0E-05
Endosulfan	2.2E+01	2.2E+01	4.2E+01
Endrin	5.6E-01	5.6E-01	2.0E+00
Ethylbenzene	3.3E+00	3.3E+00	3.0E+01
Fluoranthene	8.4E+02	8.4E+02	1.3E+02
Fluorene	6.4E+02	6.4E+02	2.8E+02
Heptachlor	3.7E-02	3.7E-02	1.0E-02
Heptachlor epoxide	3.8E-02	3.8E-02	1.0E-02
Hexachlorobenzene	1.2E+01	1.2E+01	1.0E+00
Hexachlorobutadiene	2.2E+00	2.2E+00	4.5E-01
γ-Hexachlorocyclohexane (Lindane)	1.2E-01	1.2E-01	2.0E-01
Hexachloroethane	3.0E+00	3.0E+00	9.0E-01
Indeno(1,2,3-c,d)pyrene	1.3E+01	1.3E+01	4.8E-02
Lead	7.5E+02	7.5E+02	1.5E+01
Mercury (elemental)	3.3E+01	3.3E+01	2.0E+00
Methoxychlor	2.6E+02	2.6E+02	2.0E+01
Methylene chloride	7.7E-02	7.7E-02	5.0E+00
Methyl ethyl ketone	3.9E+00	3.9E+00	4.2E+03
Methyl isobutyl ketone	2.8E+00	2.8E+00	1.2E+02
Methyl mercury	4.1E+01	4.1E+01	7.0E-01
2-Methylnaphthalene	1.2E+00	1.2E+00	1.0E+01
tert -Butyl methyl ether	2.3E-02	2.3E-02	5.0E+00
Molybdenum	2.5E+03	3.6E+03	3.5E+01

Table C. Environmental Screening Levels (ESLs)
Deep Soils (>3m bgs)
Groundwater IS a Current or Potential Source of Drinking Water

	[1]Deep Soil		
Chemical	**[2]Residential Land Use (mg/kg)**	**Commercial/ Industrial Land Use Only (mg/kg)**	**[3]Groundwater (ug/L)**
Naphthalene	3.4E+00	3.4E+00	1.7E+01
Nickel	2.6E+02	2.6E+02	1.0E+02
Pentachlorophenol	9.9E+01	9.9E+01	1.0E+00
Perchlorate	5.0E+02	5.0E+02	6.0E+00
Phenanthrene	4.9E+02	4.9E+02	2.1E+02
Phenol	7.6E-02	7.6E-02	5.0E+00
Polychlorinated biphenyls (PCBs)	3.4E+00	3.4E+00	5.0E-01
Pyrene	1.0E+03	1.2E+03	6.8E+01
Selenium	2.5E+03	3.6E+03	5.0E+01
Silver	2.5E+03	3.6E+03	3.5E+01
Styrene	1.5E+00	1.5E+00	1.0E+01
tert -Butyl alcohol			
1,1,1,2-Tetrachloroethane	2.4E-02	2.4E-02	1.3E+00
1,1,2,2-Tetrachloroethane	1.8E-02	1.8E-02	1.0E+00
Tetrachloroethene	7.0E-01	7.0E-01	5.0E+00
Thallium	5.7E+01	5.7E+01	2.0E+00
Toluene	2.9E+00	2.9E+00	4.0E+01
Toxaphene	6.4E+00	6.4E+00	3.0E+00
TPH (gasolines)	8.3E+01	8.3E+01	1.0E+02
TPH (middle distillates)	8.3E+01	8.3E+01	1.0E+02
TPH (residual fuels)	5.0E+03	5.0E+03	1.0E+02
1,2,4-Trichlorobenzene	1.5E+00	1.5E+00	5.0E+00
1,1,1-Trichloroethane	2.5E+01	2.5E+01	2.0E+02
1,1,2-Trichloroethane	7.0E-02	7.0E-02	5.0E+00
Trichloroethene	4.6E-01	4.6E-01	5.0E+00
2,4,5-Trichlorophenol	3.2E+00	3.2E+00	2.0E+02
2,4,6-Trichlorophenol	2.3E-01	2.3E-01	7.0E-01
Vanadium	7.1E+02	7.1E+02	1.5E+01
Vinyl chloride	8.5E-02	8.5E-02	5.0E-01
Xylenes	2.3E+00	2.3E+00	2.0E+01
Zinc	2.5E+03	5.0E+03	5.0E+03

Notes:

1. Deep soils defined as soils greater than 3 meters (approximately 10 feet) below ground surface.
2. Category "Residential Land Use" generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.)
3. Assumes potential discharge of groundwater into a freshwater, marine or estuary surface water system.

Soil ESLs intended to address human health, groundwater protection and nuisance concerns under a construction/trench worker exposure scenario and noted land-use scenarios. **Soil gas data should be collected for additional evaluation of potential indoor-air impacts at sites with significant areas of VOC-contaminated soil.**

Groundwater ESLs intended to be address drinking water, surface water, indoor-air and nuisance concerns. **Use in conjunction with soil gas screening levels to more closely evaluate potential impacts to indoor-air if groundwater screening levels for this concern approached or exceeded.**

Aquatic habitat goals for bioaccumulation concerns not considered in selection of groundwater goals.

Soil and water ESLs for ethanol based on gross contamination concerns (see Appendix 1, Chapter 5 and related tables).

TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.).

Table D. Environmental Screening Levels (ESLs)
Deep Soils (>3m bgs)
Groundwater IS NOT a Current or Potential Source of Drinking Water

Chemical	[1]Deep Soil		[3]Groundwater (µg/L)
	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
Acenaphthene	1.6E+02	1.6E+02	2.0E+02
Acenaphthylene	8.3E+02	8.3E+02	2.0E+03
Acetone	1.7E+01	1.7E+01	5.0E+04
Aldrin	1.5E+00	1.5E+00	8.5E+00
Anthracene	8.5E+01	8.5E+01	2.2E+01
Antimony	2.8E+02	2.8E+02	5.0E+04
Arsenic	1.4E+01	1.4E+01	5.0E+04
Barium	2.5E+03	2.6E+03	5.0E+04
Benzene	1.1E+01	1.1E+01	5.4E+02
Benzo(a)anthracene	1.5E+01	1.5E+01	5.0E+00
Benzo(b)fluoranthene	1.5E+01	1.5E+01	7.0E+00
Benzo(k)fluoranthene	1.5E+01	1.5E+01	4.0E-01
Benzo(g,h,i)perylene	3.5E+01	3.5E+01	1.3E-01
Benzo(a)pyrene	1.5E+00	1.5E+00	1.9E+00
Beryllium	9.8E+01	9.8E+01	5.0E+04
1,1-Biphenyl	6.5E+00	6.5E+00	5.0E+00
Bis(2-chloroethyl) ether	8.2E-01	8.2E-01	6.5E+01
Bis(2-chloroisopropyl) ether	2.5E+00	2.5E+00	3.2E+03
Bis(2-ethylhexyl) phthalate	1.0E+03	1.4E+03	6.5E+02
Boron	4.6E+04	4.6E+04	5.0E+04
Bromodichloromethane	3.2E+00	3.2E+00	1.7E+02
Bromoform (Tribromomethane)	1.1E+02	1.1E+02	5.1E+03
Bromomethane	2.3E+01	2.3E+01	5.8E+02
Cadmium	3.9E+01	3.9E+01	5.0E+04
Carbon tetrachloride	1.9E+00	1.9E+00	9.3E+00
Chlordane	2.1E+01	2.1E+01	2.5E+01
p-Chloroaniline	5.3E+02	5.3E+02	5.0E+04
Chlorobenzene	3.0E+01	3.0E+01	5.0E+02
Chloroethane	1.1E+01	1.1E+01	1.6E+02
Chloroform	9.8E+00	9.8E+00	3.3E+02
Chloromethane	6.4E+00	6.4E+00	4.1E+01
2-Chlorophenol	1.2E-01	1.2E-01	1.8E+00
Chromium (total)	2.5E+03	5.0E+03	5.0E+04
Chromium III	2.5E+03	5.0E+03	5.0E+04
Chromium VI	5.3E-01	5.3E-01	5.0E+04
Chrysene	5.3E+01	5.3E+01	8.0E-01
Cobalt	9.4E+01	9.4E+01	5.0E+04
Copper	2.5E+03	5.0E+03	5.0E+04
Cyanide	6.2E+00	6.2E+00	1.7E+03
Dibenz(a,h)anthracene	2.4E+00	2.4E+00	2.5E-01
Dibromochloromethane	1.4E+01	1.4E+01	1.7E+02
1,2-dibromo-3-chloropropane	2.2E+00	2.2E+00	1.0E+02
1,2-Dibromoethane	1.0E+00	1.0E+00	1.5E+02
1,2-Dichlorobenzene	1.1E+01	1.1E+01	1.0E+02
1,3-Dichlorobenzene	6.0E+02	6.0E+02	5.0E+04
1,4-Dichlorobenzene	1.3E+01	1.3E+01	1.1E+02

Table D. Environmental Screening Levels (ESLs)
Deep Soils (>3m bgs)
Groundwater IS NOT a Current or Potential Source of Drinking Water

Chemical	[1]Deep Soil		[3]Groundwater (µg/L)
	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
3,3-Dichlorobenzidine	1.7E+01	1.7E+01	1.6E+03
Dichlorodiphenyldichloroethane (DDD)	1.1E+02	1.1E+02	8.0E+01
Dichlorodiphenyldichloroethene (DDE)	7.6E+01	7.6E+01	2.0E+01
Dichlorodiphenyltrichloroethane (DDT)	6.0E+01	6.0E+01	1.5E+00
1,1-Dichloroethane	4.1E+01	4.1E+01	1.0E+03
1,2-Dichloroethane	1.8E+00	1.8E+00	2.0E+02
1,1-Dichloroethene	3.6E+00	3.6E+00	6.3E+03
cis -1,2-Dichloroethene	1.9E+02	1.9E+02	6.2E+03
trans -1,2-Dichloroethene	1.7E+02	1.7E+02	2.6E+03
2,4-Dichlorophenol	3.0E+00	3.0E+00	3.0E+00
1,2-Dichloropropane	2.5E+00	2.5E+00	1.0E+02
1,3-Dichloropropene	6.2E+00	6.2E+00	5.3E+01
Dieldrin	1.6E+00	1.6E+00	9.3E+01
Diethyl phthalate	1.0E+03	1.2E+03	5.0E+04
Dimethyl phthalate	1.0E+03	1.2E+03	5.0E+04
2,4-Dimethylphenol	2.7E+01	2.7E+01	4.0E+03
2,4-Dinitrophenol	1.4E+02	1.4E+02	5.0E+04
2,4-Dinitrotoluene	3.0E+01	3.0E+01	5.0E+04
1,4-Dioxane	3.0E+01	3.0E+01	5.0E+04
Dioxin (2,3,7,8-TCDD)	2.4E-04	2.4E-04	7.0E+03
Endosulfan	4.0E+01	4.0E+01	7.5E+01
Endrin	3.7E+01	3.7E+01	1.3E+02
Ethylbenzene	3.3E+01	3.3E+01	3.0E+02
Fluoranthene	8.4E+02	8.4E+02	1.3E+02
Fluorene	1.0E+03	2.2E+03	9.5E+02
Heptachlor	5.8E+00	5.8E+00	2.8E+01
Heptachlor epoxide	2.2E+00	2.2E+00	1.8E+02
Hexachlorobenzene	1.2E+01	1.2E+01	5.5E+01
Hexachlorobutadiene	8.0E+01	8.0E+01	6.0E+01
γ-Hexachlorocyclohexane (Lindane)	1.6E+02	1.6E+02	3.5E+03
Hexachloroethane	3.4E+02	3.4E+02	1.0E+02
Indeno(1,2,3-c,d)pyrene	2.4E+01	2.4E+01	2.7E-01
Lead	7.5E+02	7.5E+02	5.0E+04
Mercury (elemental)	3.3E+01	3.3E+01	5.0E+04
Methoxychlor	2.6E+02	2.6E+02	2.0E+01
Methylene chloride	3.7E+01	3.7E+01	2.4E+03
Methyl ethyl ketone	4.6E+01	4.6E+01	5.0E+04
Methyl isobutyl ketone	3.0E+02	3.0E+02	1.3E+04
Methyl mercury	4.1E+01	4.1E+01	5.0E+04
2-Methylnaphthalene	1.2E+01	1.2E+01	1.0E+02
tert -Butyl methyl ether	8.4E+00	8.4E+00	1.8E+03
Molybdenum	2.5E+03	3.6E+03	5.0E+04

Table D. Environmental Screening Levels (ESLs)
Deep Soils (>3m bgs)
Groundwater IS NOT a Current or Potential Source of Drinking Water

Chemical	[1]Deep Soil		[3]Groundwater (µg/L)
	[2]Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
Naphthalene	4.2E+01	4.2E+01	2.1E+02
Nickel	2.6E+02	2.6E+02	5.0E+04
Pentachlorophenol	9.9E+01	9.9E+01	5.9E+03
Perchlorate	5.0E+02	5.0E+02	5.0E+04
Phenanthrene	9.5E+02	9.5E+02	4.1E+02
Phenol	7.6E+02	7.6E+02	5.0E+04
Polychlorinated biphenyls (PCBs)	3.4E+00	3.4E+00	1.6E+01
Pyrene	1.0E+03	1.2E+03	6.8E+01
Selenium	2.5E+03	3.6E+03	5.0E+04
Silver	2.5E+03	3.6E+03	5.0E+04
Styrene	1.6E+01	1.6E+01	1.1E+02
tert -Butyl alcohol	3.1E+02	3.1E+02	5.0E+04
1,1,1,2-Tetrachloroethane	1.7E+02	1.7E+02	5.0E+04
1,1,2,2-Tetrachloroethane	3.4E+00	3.4E+00	1.9E+02
Tetrachloroethene	1.7E+01	1.7E+01	1.2E+02
Thallium	5.7E+01	5.7E+01	5.0E+04
Toluene	2.9E+01	2.9E+01	4.0E+02
Toxaphene	2.2E+01	2.2E+01	1.4E+02
TPH (gasolines)	4.2E+03	4.2E+03	5.0E+03
TPH (middle distillates)	1.5E+02	1.5E+02	2.5E+03
TPH (residual fuels)	5.0E+03	5.0E+03	2.5E+03
1,2,4-Trichlorobenzene	3.1E+02	3.1E+02	2.5E+03
1,1,1-Trichloroethane	1.0E+03	1.2E+03	5.0E+04
1,1,2-Trichloroethane	4.8E+00	4.8E+00	3.5E+02
Trichloroethene	4.9E+01	4.9E+01	5.3E+02
2,4,5-Trichlorophenol	3.2E+01	3.2E+01	2.0E+03
2,4,6-Trichlorophenol	4.1E+01	4.1E+01	1.0E+03
Vanadium	7.1E+02	7.1E+02	5.0E+04
Vinyl chloride	6.6E-01	6.6E-01	3.8E+00
Xylenes	4.2E+02	4.2E+02	5.3E+03
Zinc	2.5E+03	5.0E+03	5.0E+04

Notes:
1. Deep soils defined as soils greater than 3 meters (approximately 10 feet) below ground surface.
2. Category "Residential Land Use" generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.)
3. Assumes potential discharge of groundwater into marine or estuary surface water system.

Soil ESLs intended to address human health, groundwater protection and nuisance concerns under a construction/trench worker exposure scenario and noted land-use scenarios. **Soil gas data should be collected for additional evaluation of potential indoor-air impacts at sites with significant areas of VOC-contaminated soil.**

Groundwater ESLs intended to address surface water, indoor-air and nuisance concerns. **Use in conjunction with soil gas screening levels to more closely evaluate potential impacts to indoor-air if groundwater screening levels for this concern approached or exceeded.**

Aquatic habitat goals for bioaccumulation concerns not considered in selection of groundwater goals.

Refer to appendices for summary of ESL components.

Soil and water ESLs for ethanol based on gross contamination concerns (see Appendix 1, Chapter 5 and related tables).

TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.).

Table E. Environmental Screening Levels (ESLs)
Indoor Air and Soil Gas
(Vapor Intrusion Concerns)

	Indoor Air Screening Levels		[2]Shallow Soil Gas Screening Levels	
Chemical	[1]Residential Land Use ($\mu g/m^3$)	Commercial/ Industrial Land Use Only ($\mu g/m^3$)	[1]Residential Land Use ($\mu g/m^3$)	Commercial/ Industrial Land Use Only ($\mu g/m^3$)
Acenaphthene	4.4E+01	6.1E+01	4.4E+04	1.2E+05
Acenaphthylene	2.2E+01	3.1E+01	2.2E+04	6.1E+04
Acetone	6.6E+02	9.2E+02	6.6E+05	1.8E+06
Aldrin				
Anthracene	2.2E+02	3.1E+02	2.2E+05	6.1E+05
Antimony				
Arsenic				
Barium				
Benzene	8.4E-02	1.4E-01	8.4E+01	2.8E+02
Benzo(a)anthracene				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				
Benzo(g,h,i)perylene				
Benzo(a)pyrene				
Beryllium				
1,1-Biphenyl				
Bis(2-chloroethyl) ether	7.4E-03	1.2E-02	7.4E+00	2.5E+01
Bis(2-chloroisopropyl) ether	3.4E-03	5.8E-03	3.4E+00	1.2E+01
Bis(2-ethylhexyl) phthalate				
Boron				
Bromodichloromethane	1.4E-01	2.3E-01	1.4E+02	4.6E+02
Bromoform (Tribromomethane)				
Bromomethane	1.0E+00	1.5E+00	1.0E+03	2.9E+03
Cadmium				
Carbon tetrachloride	1.9E-02	3.1E-02	1.9E+01	6.3E+01
Chlordane				
p-Chloroaniline				
Chlorobenzene	2.1E+02	2.9E+02	2.1E+05	5.8E+05
Chloroethane	2.1E+01	2.9E+01	2.1E+04	5.8E+04
Chloroform	4.6E-01	7.7E-01	4.6E+02	1.5E+03
Chloromethane	1.9E+01	2.6E+01	1.9E+04	5.3E+04
2-Chlorophenol	3.7E+00	5.1E+00	3.7E+03	1.0E+04
Chromium (total)				
Chromium III				
Chromium VI				
Chrysene				
Cobalt				
Copper				
Cyanide	1.5E+01	2.0E+01	1.5E+04	4.1E+04
Dibenz(a,h)anthracene				
Dibromochloromethane				
1,2-dibromo-3-chloropropane	1.3E-03	2.2E-03	1.3E+00	4.3E+00
1,2-Dibromoethane	4.1E-03	6.8E-03	4.1E+00	1.4E+01
1,2-Dichlorobenzene	4.2E+01	5.8E+01	4.2E+04	1.2E+05

Table E. Environmental Screening Levels (ESLs)
Indoor Air and Soil Gas
(Vapor Intrusion Concerns)

	Indoor Air Screening Levels		[2]Shallow Soil Gas Screening Levels	
Chemical	[1]Residential Land Use ($\mu g/m^3$)	Commercial/ Industrial Land Use Only ($\mu g/m^3$)	[1]Residential Land Use ($\mu g/m^3$)	Commercial/ Industrial Land Use Only ($\mu g/m^3$)
1,3-Dichlorobenzene	2.2E+01	3.1E+01	2.2E+04	6.1E+04
1,4-Dichlorobenzene	2.2E-01	3.7E-01	2.2E+02	7.4E+02
3,3-Dichlorobenzidine				
Dichlorodiphenyldichloroethane (DDD)				
Dichlorodiphenyldichloroethene (DDE)				
Dichlorodiphenyltrichloroethane (DDT)				
1,1-Dichloroethane	1.5E+00	2.6E+00	1.5E+03	5.1E+03
1,2-Dichloroethane	9.4E-02	1.6E-01	9.4E+01	3.1E+02
1,1-Dichloroethene	4.9E-02	8.2E-02	4.9E+01	1.6E+02
cis -1,2-Dichloroethene	7.3E+00	1.0E+01	7.3E+03	2.0E+04
trans -1,2-Dichloroethene	1.5E+01	2.0E+01	1.5E+04	4.1E+04
2,4-Dichlorophenol				
1,2-Dichloropropane	2.4E-01	4.1E-01	2.4E+02	8.2E+02
1,3-Dichloropropene	1.5E-01	2.6E-01	1.5E+02	5.1E+02
Dieldrin				
Diethyl phthalate				
Dimethyl phthalate				
2,4-Dimethylphenol				
2,4-Dinitrophenol				
2,4-Dinitrotoluene				
1,4-Dioxane				
Dioxin (2,3,7,8-TCDD)				
Endosulfan				
Endrin				
Ethylbenzene	2.1E+02	2.9E+02	2.1E+05	5.8E+05
Fluoranthene				
Fluorene	2.9E+01	4.1E+01	2.9E+04	8.2E+04
Heptachlor				
Heptachlor epoxide				
Hexachlorobenzene				
Hexachlorobutadiene				
γ-Hexachlorocyclohexane (Lindane)				
Hexachloroethane				
Indeno(1,2,3-c,d)pyrene				
Lead				
Mercury (elemental)	1.9E-02	2.6E-02	1.9E+01	5.3E+01
Methoxychlor				
Methylene chloride	5.2E+00	8.7E+00	5.2E+03	1.7E+04
Methyl ethyl ketone	1.0E+03	1.5E+03	1.0E+06	2.9E+06
Methyl isobutyl ketone	6.3E+02	8.8E+02	6.3E+05	1.8E+06
Methyl mercury				
2-Methylnaphthalene				
tert -Butyl methyl ether	9.4E+00	1.6E+01	9.4E+03	3.1E+04
Molybdenum				

Table E. Environmental Screening Levels (ESLs)
Indoor Air and Soil Gas
(Vapor Intrusion Concerns)

	Indoor Air Screening Levels		[2]Shallow Soil Gas Screening Levels	
Chemical	**[1]Residential Land Use ($\mu g/m^3$)**	**Commercial/ Industrial Land Use Only ($\mu g/m^3$)**	**[1]Residential Land Use ($\mu g/m^3$)**	**Commercial/ Industrial Land Use Only ($\mu g/m^3$)**
Naphthalene	7.2E-02	1.2E-01	7.2E+01	2.4E+02
Nickel				
Pentachlorophenol				
Perchlorate				
Phenanthrene	2.2E+01	3.1E+01	2.2E+04	6.1E+04
Phenol				
Polychlorinated biphenyls (PCBs)				
Pyrene	2.2E+01	3.1E+01	2.2E+04	6.1E+04
Selenium				
Silver				
Styrene	1.9E+02	2.6E+02	1.9E+05	5.3E+05
tert -Butyl alcohol				
1,1,1,2-Tetrachloroethane	3.2E-01	5.4E-01	3.2E+02	1.1E+03
1,1,2,2-Tetrachloroethane	4.2E-02	7.0E-02	4.2E+01	1.4E+02
Tetrachloroethene	4.1E-01	6.9E-01	4.1E+02	1.4E+03
Thallium				
Toluene	6.3E+01	8.8E+01	6.3E+04	1.8E+05
Toxaphene				
TPH (gasolines)	1.0E+01	1.4E+01	1.0E+04	2.9E+04
TPH (middle distillates)	1.0E+01	1.4E+01	1.0E+04	2.9E+04
TPH (residual fuels)				
1,2,4-Trichlorobenzene	8.3E-01	1.2E+00	8.3E+02	2.3E+03
1,1,1-Trichloroethane	4.6E+02	6.4E+02	4.6E+05	1.3E+06
1,1,2-Trichloroethane	1.5E-01	2.6E-01	1.5E+02	5.1E+02
Trichloroethene	1.2E+00	2.0E+00	1.2E+03	4.1E+03
2,4,5-Trichlorophenol	7.3E+01	1.0E+02	7.3E+04	2.0E+05
2,4,6-Trichlorophenol				
Vanadium				
Vinyl chloride	3.1E-02	5.2E-02	3.1E+01	1.0E+02
Xylenes	2.1E+01	2.9E+01	2.1E+04	5.8E+04
Zinc				

Notes:

1. Category "Residential Land Use" generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.)
2. Soil Gas: Screening levels based on soil gas data collected less than 1.5 meters (five feet) below a building foundation or the ground surface. Intended for evaluation of potential indoor-air impacts.

Soil gas data should be collected and evaluated at all sites with significant areas of VOC-impacted soil. Screening levels also apply to areas over of impacted groundwater.

TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.).

Table F. Environmental Screening Levels (ESLs)
Surface Water Bodies

Chemical	Surface Water Screening Levels		
	[1]Freshwater (µg/L)	[2]Marine (µg/L)	[3]Estuarine (µg/L)
Acenaphthene	2.0E+01	2.0E+01	2.0E+01
Acenaphthylene	2.1E+02	2.0E+03	2.0E+03
Acetone	6.3E+03	2.0E+04	2.0E+04
Aldrin	1.4E-04	1.4E-04	1.4E-04
Anthracene	2.2E+01	2.2E+01	2.2E+01
Antimony	6.0E+00	4.3E+03	4.3E+03
Arsenic	1.4E-01	1.4E-01	1.4E-01
Barium	1.0E+03	5.0E+04	5.0E+04
Benzene	1.0E+00	7.1E+01	7.1E+01
Benzo(a)anthracene	2.9E-02	4.9E-02	4.9E-02
Benzo(b)fluoranthene	2.9E-02	4.9E-02	4.9E-02
Benzo(k)fluoranthene	2.9E-02	4.9E-02	4.9E-02
Benzo(g,h,i)perylene	1.3E-01	1.3E-01	1.3E-01
Benzo(a)pyrene	4.9E-02	4.9E-02	4.9E-02
Beryllium	4.0E+00	5.0E+04	5.0E+04
1,1-Biphenyl	5.0E-01	5.0E-01	5.0E-01
Bis(2-chloroethyl) ether	3.2E-02	1.4E+00	1.4E+00
Bis(2-chloroisopropyl) ether	1.4E-02	3.2E+02	3.2E+02
Bis(2-ethylhexyl) phthalate	4.0E+00	5.9E+00	5.9E+00
Boron	1.0E+03	5.0E+04	5.0E+04
Bromodichloromethane	1.0E+02	5.0E+04	5.0E+04
Bromoform (Tribromomethane)	1.0E+02	3.6E+02	3.6E+02
Bromomethane	9.8E+00	4.0E+03	4.0E+03
Cadmium	5.0E+00	5.0E+04	5.0E+04
Carbon tetrachloride	5.0E-01	4.4E+00	4.4E+00
Chlordane	5.9E-04	5.9E-04	5.9E-04
p -Chloroaniline	2.8E+01	5.0E+04	5.0E+04
Chlorobenzene	5.0E+01	5.0E+01	5.0E+01
Chloroethane	1.2E+01	1.6E+01	1.6E+01
Chloroform	7.0E+01	4.7E+02	4.7E+02
Chloromethane	1.8E+02	5.0E+04	5.0E+04
2-Chlorophenol	1.8E-01	1.8E-01	1.8E-01
Chromium (total)	5.0E+01	5.0E+04	5.0E+04
Chromium III	5.0E+04	5.0E+04	5.0E+04
Chromium VI	2.1E+01	5.0E+04	5.0E+04
Chrysene	4.9E-02	4.9E-02	4.9E-02
Cobalt	1.4E+02	5.0E+04	5.0E+04
Copper	1.0E+03	5.0E+04	5.0E+04
Cyanide	1.5E+02	1.7E+02	1.7E+02
Dibenz(a,h)anthracene	4.8E-03	4.9E-02	4.9E-02
Dibromochloromethane	4.6E+01	4.6E+01	4.6E+01
1,2-dibromo-3-chloropropane	2.0E-01	1.0E+01	1.0E+01
1,2-Dibromoethane	5.0E-02	5.0E+04	5.0E+04
1,2-Dichlorobenzene	1.0E+01	1.0E+01	1.0E+01
1,3-Dichlorobenzene	2.1E+02	2.6E+03	2.6E+03
1,4-Dichlorobenzene	5.0E+00	1.1E+01	1.1E+01
3,3-Dichlorobenzidine	2.9E-02	7.7E-02	7.7E-02

Table F. Environmental Screening Levels (ESLs)
Surface Water Bodies

Chemical	Surface Water Screening Levels		
	[1]Freshwater (µg/L)	[2]Marine (µg/L)	[3]Estuarine (µg/L)
Dichlorodiphenyldichloroethane (DDD)	8.4E-04	8.4E-04	8.4E-04
Dichlorodiphenyldichloroethene (DDE)	5.9E-04	5.9E-04	5.9E-04
Dichlorodiphenyltrichloroethane (DDT)	5.9E-04	5.9E-04	5.9E-04
1,1-Dichloroethane	5.0E+00	5.0E+04	5.0E+04
1,2-Dichloroethane	5.0E-01	9.9E+01	9.9E+01
1,1-Dichloroethene	3.2E+00	3.2E+00	3.2E+00
cis -1,2-Dichloroethene	6.0E+00	5.0E+04	5.0E+04
trans -1,2-Dichloroethene	1.0E+01	2.6E+02	2.6E+02
2,4-Dichlorophenol	3.0E-01	3.0E-01	3.0E-01
1,2-Dichloropropane	5.0E+00	1.0E+01	1.0E+01
1,3-Dichloropropene	5.0E-01	1.7E+03	1.7E+03
Dieldrin	1.4E-04	1.4E-04	1.4E-04
Diethyl phthalate	5.6E+03	5.0E+04	5.0E+04
Dimethyl phthalate	5.0E+04	5.0E+04	5.0E+04
2,4-Dimethylphenol	1.0E+02	4.0E+02	4.0E+02
2,4-Dinitrophenol	1.4E+02	1.4E+04	1.4E+04
2,4-Dinitrotoluene	5.1E-02	9.1E+00	9.1E+00
1,4-Dioxane	3.0E+00	5.0E+04	5.0E+04
Dioxin (2,3,7,8-TCDD)	1.4E-08	1.4E-08	1.4E-08
Endosulfan	4.2E+01	7.5E+01	7.5E+01
Endrin	8.1E-01	8.1E-01	8.1E-01
Ethylbenzene	3.0E+01	3.0E+01	3.0E+01
Fluoranthene	1.3E+02	1.3E+02	1.3E+02
Fluorene	2.8E+02	9.5E+02	9.5E+02
Heptachlor	2.1E-04	2.1E-04	2.1E-04
Heptachlor epoxide	1.1E-04	1.1E-04	1.1E-04
Hexachlorobenzene	7.7E-04	7.7E-04	7.7E-04
Hexachlorobutadiene	4.5E-01	6.0E+00	6.0E+00
γ-Hexachlorocyclohexane (Lindane)	6.3E-02	6.3E-02	6.3E-02
Hexachloroethane	9.0E-01	8.9E+00	8.9E+00
Indeno(1,2,3-c,d)pyrene	4.8E-02	4.9E-02	4.9E-02
Lead	1.5E+01	5.0E+04	5.0E+04
Mercury (elemental)	5.1E-02	5.1E-02	5.1E-02
Methoxychlor	2.0E+01	2.0E+01	2.0E+01
Methylene chloride	5.0E+00	1.6E+03	1.6E+03
Methyl ethyl ketone	4.2E+03	8.4E+03	8.4E+03
Methyl isobutyl ketone	1.2E+02	1.3E+03	1.3E+03
Methyl mercury	7.0E-01	5.0E+04	5.0E+04
2-Methylnaphthalene	1.0E+01	1.0E+01	1.0E+01
tert -Butyl methyl ether	5.0E+00	1.8E+02	1.8E+02
Molybdenum	3.5E+01	5.0E+04	5.0E+04
Naphthalene	1.7E+01	2.1E+01	2.1E+01
Nickel	1.0E+02	4.6E+03	4.6E+03
Pentachlorophenol	1.0E+00	8.2E+00	8.2E+00
Perchlorate	6.0E+00	5.0E+04	5.0E+04
Phenanthrene	2.1E+02	4.1E+02	4.1E+02
Phenol	5.0E+00	7.9E+03	7.9E+03

Table F. Environmental Screening Levels (ESLs)
Surface Water Bodies

Chemical	Surface Water Screening Levels		
	[1]Freshwater (µg/L)	[2]Marine (µg/L)	[3]Estuarine (µg/L)
Polychlorinated biphenyls (PCBs)	1.7E-04	1.7E-04	1.7E-04
Pyrene	6.8E+01	6.8E+01	6.8E+01
Selenium	5.0E+01	5.0E+04	5.0E+04
Silver	3.5E+01	5.0E+04	5.0E+04
Styrene	1.0E+01	1.1E+01	1.1E+01
tert -Butyl alcohol		5.0E+04	5.0E+04
1,1,1,2-Tetrachloroethane	1.3E+00	5.0E+04	5.0E+04
1,1,2,2-Tetrachloroethane	1.0E+00	1.1E+01	1.1E+01
Tetrachloroethene	5.0E+00	8.9E+00	8.9E+00
Thallium	2.0E+00	6.3E+00	6.3E+00
Toluene	4.0E+01	4.0E+01	4.0E+01
Toxaphene	7.5E-04	7.5E-04	7.5E-04
TPH (gasolines)	1.0E+02	5.0E+03	5.0E+03
TPH (middle distillates)	1.0E+02	2.5E+03	2.5E+03
TPH (residual fuels)	1.0E+02	2.5E+03	2.5E+03
1,2,4-Trichlorobenzene	5.0E+00	3.0E+03	3.0E+03
1,1,1-Trichloroethane	2.0E+02	5.0E+04	5.0E+04
1,1,2-Trichloroethane	5.0E+00	4.2E+01	4.2E+01
Trichloroethene	5.0E+00	8.1E+01	8.1E+01
2,4,5-Trichlorophenol	2.0E+02	2.0E+02	2.0E+02
2,4,6-Trichlorophenol	7.0E-01	6.5E+00	6.5E+00
Vanadium	1.5E+01	5.0E+04	5.0E+04
Vinyl chloride	5.0E-01	5.3E+02	5.3E+02
Xylenes	2.0E+01	5.3E+02	5.3E+02
Zinc	5.0E+03	5.0E+04	5.0E+04

Notes:

Surface water screening levels lowest of drinking water goal (freshwater only), chronic aquatic habitat goal, goal to address bioaccumulation in aquatic organisms and subsequent consumption by humans, and general nuisance goal (odors, etc.).

Estuarine screening levels lowest of freshwater and marine screening levels.

Water ESLs for ethanol based on gross contamination concerns

TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.).

Table A-1. [1]Shallow Soil Screening Levels (≤3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	Drinking Water Resource Table G
Acenaphthene	1.6E+01	1.0E+03	-	5.2E+02	(Use soil gas)	1.6E+01
Acenaphthylene	8.9E+01	5.0E+02	-	3.7E+02	(Use soil gas)	8.9E+01
Acetone	2.1E+00	5.0E+02	-	2.6E+03	(Use soil gas)	2.1E+00
Aldrin	3.2E-02	1.0E+03	3.5E-01	3.2E-02		5.0E+00
Anthracene	4.0E+01	5.0E+02	4.0E+01	3.3E+03	(Use soil gas)	8.5E+01
Antimony	6.1E+00	1.0E+03	2.0E+01	6.1E+00		
Arsenic	3.8E-01	1.0E+03	2.0E+01	3.8E-01		
Barium	7.5E+02	1.0E+03	7.5E+02	2.9E+03		
Benzene	4.4E-02	5.0E+02	2.5E+01	1.2E-01	(Use soil gas)	4.4E-02
Benzo(a)anthracene	3.8E-01	5.0E+02	4.0E+01	3.8E-01		1.2E+01
Benzo(b)fluoranthene	3.8E-01	5.0E+02	4.0E+01	3.8E-01		4.6E+01
Benzo(k)fluoranthene	3.8E-01	5.0E+02	-	3.8E-01		2.7E+00
Benzo(g,h,i)perylene	3.5E+01	5.0E+02	4.0E+01	3.4E+02		3.5E+01
Benzo(a)pyrene	3.8E-02	5.0E+02	4.0E+01	3.8E-02		1.8E+02
Beryllium	4.0E+00	1.0E+03	4.0E+00	3.0E+01		
1,1-Biphenyl	6.5E-01	5.0E+02	-	6.1E+02	(Use soil gas)	6.5E-01
Bis(2-chloroethyl) ether	4.0E-04	5.0E+02	-	1.4E-01	(Use soil gas)	4.0E-04
Bis(2-chloroisopropyl) ether	1.5E-04	5.0E+02	-	3.2E-02	(Use soil gas)	1.5E-04
Bis(2-ethylhexyl) phthalate	3.5E+01	5.0E+02	-	3.5E+01		7.8E+02
Boron	1.6E+00	no criteria	1.6E+00	2.4E+03		
Bromodichloromethane	5.6E-01	1.0E+03	-	5.6E-01	(Use soil gas)	1.9E+00
Bromoform (Tribromomethane)	2.2E+00	5.0E+02	-	6.1E+01		2.2E+00
Bromomethane	3.9E-01	5.0E+02	-	6.9E-01	(Use soil gas)	3.9E-01
Cadmium	1.7E+00	1.0E+03	1.2E+01	1.7E+00		
Carbon tetrachloride	2.0E-02	5.0E+02	-	2.0E-02	(Use soil gas)	1.1E-01
Chlordane	4.4E-01	1.0E+03	-	4.4E-01		1.5E+01
p-Chloroaniline	3.0E-01	1.0E+03	-	4.9E+01		3.0E-01
Chlorobenzene	3.0E+00	5.0E+02	3.0E+01	1.4E+02	(Use soil gas)	3.0E+00
Chloroethane	8.5E-01	5.0E+02	-	1.0E+01	(Use soil gas)	8.5E-01
Chloroform	6.7E-01	5.0E+02	-	6.7E-01	(Use soil gas)	2.1E+00
Chloromethane	6.4E+00	1.0E+02	-	7.6E+00	(Use soil gas)	6.4E+00

Table A-1. [1]Shallow Soil Screening Levels (≤3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	Drinking Water Resource Table G
2-Chlorophenol	1.2E-02	1.0E+02	1.0E+01	7.4E+00	(Use soil gas)	1.2E-02
Chromium (total)	1.0E-06	1.0E+03		-		
Chromium III	7.5E+02	1.0E+03	7.5E+02	2.3E+04		
Chromium VI	8.0E+00	1.0E+03	8.0E+00	9.4E+00		
Chrysene	4.0E+01	1.0E+03	4.0E+01	6.2E+01		5.3E+01
Cobalt	4.0E+01	1.0E+03	4.0E+01	2.7E+02		
Copper	2.3E+02	1.0E+03	2.3E+02	6.1E+03		
Cyanide	5.4E-01	1.0E+02	-	3.4E+01		5.4E-01
Dibenz(a,h)anthracene	6.2E-02	5.0E+02	-	6.2E-02		9.9E+00
Dibromochloromethane	5.8E+00	1.0E+02	-	5.8E+00	(Use soil gas)	8.3E+00
1,2-dibromo-3-chloropropane	4.5E-03	5.0E+02	-	6.9E-02	(Use soil gas)	4.5E-03
1,2-Dibromoethane	3.3E-04	5.0E+02	-	1.9E-02	(Use soil gas)	3.3E-04
1,2-Dichlorobenzene	1.1E+00	6.0E+02	3.0E+01	1.3E+02	(Use soil gas)	1.1E+00
1,3-Dichlorobenzene	2.4E+01	1.0E+02	3.0E+01	6.3E+01	(Use soil gas)	2.4E+01
1,4-Dichlorobenzene	5.9E-01	5.0E+02	3.0E+01	1.2E+00	(Use soil gas)	5.9E-01
3,3-Dichlorobenzidine	7.7E-03	5.0E+02	-	4.0E-01		7.7E-03
Dichlorodiphenyldichloroethane (DDD)	2.3E+00	5.0E+02	-	2.3E+00		7.5E+02
Dichlorodiphenyldichloroethene (DDE)	1.6E+00	5.0E+02	4.0E+00	1.6E+00		1.1E+03
Dichlorodiphenyltrichloroethane (DDT)	1.6E+00	1.0E+03	4.0E+00	1.6E+00		4.3E+00
1,1-Dichloroethane	2.0E-01	5.0E+02	-	2.2E+00	(Use soil gas)	2.0E-01
1,2-Dichloroethane	4.5E-03	5.0E+02	6.0E+01	2.2E-01	(Use soil gas)	4.5E-03
1,1-Dichloroethene	4.1E-02	5.0E+02	-	4.1E-02	(Use soil gas)	1.0E+00
cis -1,2-Dichloroethene	1.9E-01	1.0E+02	-	6.4E+00	(Use soil gas)	1.9E-01
trans -1,2-Dichloroethene	6.7E-01	5.0E+02	-	1.0E+01	(Use soil gas)	6.7E-01
2,4-Dichlorophenol	3.0E-01	5.0E+02	1.0E+01	3.7E+01		3.0E-01
1,2-Dichloropropane	1.2E-01	1.0E+02	-	4.6E-01	(Use soil gas)	1.2E-01
1,3-Dichloropropene	5.9E-02	5.0E+02	-	1.7E-01	(Use soil gas)	5.9E-02
Dieldrin	2.7E-03	1.0E+03	4.0E+00	3.4E-02		2.7E-03
Diethyl phthalate	1.3E+02	5.0E+02	-	9.8E+03		1.3E+02
Dimethyl phthalate	5.0E+02	5.0E+02	-	1.2E+05		1.2E+03
2,4-Dimethylphenol	6.7E-01	1.0E+02	-	2.4E+02	(Use soil gas)	6.7E-01

Table A-1. [1]Shallow Soil Screening Levels (≤3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	Drinking Water Resource Table G
2,4-Dinitrophenol	4.0E-01	5.0E+02	-	2.4E+02		4.0E-01
2,4-Dinitrotoluene	3.9E-04	5.0E+02	-	7.1E-01		3.9E-04
1,4-Dioxane	1.8E-03	5.0E+02	-	1.8E+01		1.8E-03
Dioxin (2,3,7,8-TCDD)	4.6E-06	no criteria	-	4.6E-06		
Endosulfan	2.2E+01	5.0E+02	-	7.3E+01		2.2E+01
Endrin	6.0E-02	5.0E+02	6.0E-02	4.1E+00		5.6E-01
Ethylbenzene	3.3E+00	4.0E+02	-	2.3E+02	(Use soil gas)	3.3E+00
Fluoranthene	4.0E+01	5.0E+02	4.0E+01	4.6E+02		8.4E+02
Fluorene	4.1E+02	5.0E+02	-	4.1E+02	(Use soil gas)	6.4E+02
Heptachlor	3.7E-02	1.0E+03	-	1.2E-01		3.7E-02
Heptachlor epoxide	3.8E-02	1.0E+03	-	5.3E-02		3.8E-02
Hexachlorobenzene	3.0E-01	5.0E+02	3.0E+01	3.0E-01		7.9E+02
Hexachlorobutadiene	2.2E+00	5.0E+02	-	2.4E+00		2.2E+00
γ-Hexachlorocyclohexane (Lindane)	1.2E-01	5.0E+02	2.0E+00	4.1E+00		1.2E-01
Hexachloroethane	3.0E+00	5.0E+02	-	1.2E+01		3.0E+00
Indeno(1,2,3-c,d)pyrene	6.2E-01	5.0E+02	4.0E+01	6.2E-01		1.3E+01
Lead	2.0E+02	1.0E+03	2.0E+02	2.6E+02		
Mercury (elemental)	1.0E+00	5.0E+02	1.0E+01	1.0E+00	(Use soil gas)	
Methoxychlor	2.6E+02	5.0E+02	-	-		2.6E+02
Methylene chloride	7.7E-02	5.0E+02	-	6.9E+00	(Use soil gas)	7.7E-02
Methyl ethyl ketone	3.9E+00	5.0E+02	-	3.8E+03	(Use soil gas)	3.9E+00
Methyl isobutyl ketone	2.8E+00	1.0E+02	1.0E+01	2.9E+03	(Use soil gas)	2.8E+00
Methyl mercury	1.2E+00	1.0E+02	-	1.2E+00		
2-Methylnaphthalene	1.2E+00	5.0E+02	-	4.9E+01	(Use soil gas)	1.2E+00
tert-Butyl methyl ether	2.3E-02	1.0E+02	-	2.9E+01	(Use soil gas)	2.3E-02
Molybdenum	4.0E+01	1.0E+03	4.0E+01	7.6E+01		
Naphthalene	1.3E+00	5.0E+02	4.0E+01	1.3E+00	(Use soil gas)	3.4E+00
Nickel	1.5E+02	1.0E+03	1.5E+02	3.0E+02		
Pentachlorophenol	3.0E+00	5.0E+02	5.0E+00	3.0E+00		2.7E+06
Perchlorate	1.1E+01	1.0E+03	-	1.1E+01		
Phenanthrene	4.0E+01	5.0E+02	4.0E+01	3.7E+02	(Use soil gas)	4.9E+02

Table A-1. [1]Shallow Soil Screening Levels (≤3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	Drinking Water Resource Table G
Phenol	7.6E-02	5.0E+02	4.0E+01	3.7E+03		7.6E-02
Polychlorinated biphenyls (PCBs)	8.9E-02	5.0E+02	-	8.9E-02		6.3E+00
Pyrene	5.0E+02	5.0E+02	-	7.3E+02	(Use soil gas)	1.2E+03
Selenium	1.0E+01	1.0E+03	1.0E+01	7.6E+01		
Silver	2.0E+01	1.0E+03	2.0E+01	7.6E+01		
Styrene	1.5E+00	5.0E+02	-	4.8E+02	(Use soil gas)	1.5E+00
tert-Butyl alcohol	1.0E-06	1.0E+02	-	3.2E+05	(Use soil gas)	
1,1,1,2-Tetrachloroethane	2.4E-02	1.0E+02	-	2.0E+00	(Use soil gas)	2.4E-02
1,1,2,2-Tetrachloroethane	1.8E-02	5.0E+02	-	2.6E-01	(Use soil gas)	1.8E-02
Tetrachloroethene	3.4E-01	2.3E+02	-	3.4E-01	(Use soil gas)	7.0E-01
Thallium	1.2E+00	1.0E+03	-	1.2E+00		
Toluene	2.9E+00	5.0E+02	-	6.3E+01	(Use soil gas)	2.9E+00
Toxaphene	4.6E-01	5.0E+02	-	4.6E-01		6.4E+00
TPH (gasolines)	8.3E+01	1.0E+02	-	1.1E+02	(Use soil gas)	8.3E+01
TPH (middle distillates)	8.3E+01	1.0E+02	-	1.1E+02	(Use soil gas)	8.3E+01
TPH (residual fuels)	4.1E+02	5.0E+02	-	4.1E+02		
1,2,4-Trichlorobenzene	1.5E+00	5.0E+02	3.0E+01	7.8E+00	(Use soil gas)	1.5E+00
1,1,1-Trichloroethane	2.5E+01	5.0E+02	-	2.7E+02	(Use soil gas)	2.5E+01
1,1,2-Trichloroethane	7.0E-02	1.0E+02	-	4.9E-01	(Use soil gas)	7.0E-02
Trichloroethene	4.6E-01	5.0E+02	6.0E+01	1.9E+00	(Use soil gas)	4.6E-01
2,4,5-Trichlorophenol	3.2E+00	1.0E+02	1.0E+01	3.7E+02	(Use soil gas)	3.2E+00
2,4,6-Trichlorophenol	2.3E-01	5.0E+02	1.0E+01	1.2E+00		2.3E-01
Vanadium	1.5E+01	1.0E+03	2.0E+02	1.5E+01		
Vinyl chloride	2.1E-02	5.0E+02	6.0E+01	2.1E-02	(Use soil gas)	8.5E-02
Xylenes	2.3E+00	4.2E+02	-	3.1E+01	(Use soil gas)	2.3E+00
Zinc	6.0E+02	1.0E+03	6.0E+02	4.6E+03		

Table A-1. [1]Shallow Soil Screening Levels (≤3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
		Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-2**		**Table K-1**		**Table G**

Notes:
1. Shallow soils defined as soils situated <3 meters below ground surface.
2. "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

Final Environmental Screening Level is lowest of ceiling value (nuisance concerns etc.), ecotoxicity, direct-exposure, indoor-air impact, and leaching screening levels.
Soil data should be reported on dry-weight basis (see Section 6.2).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table A-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
		Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**		**Table K-2**		**Table G**
Acenaphthene	1.6E+01	2.5E+03	-	3.3E+03	(Use soil gas)	1.6E+01
Acenaphthylene	8.9E+01	1.0E+03	-	3.7E+03	(Use soil gas)	8.9E+01
Acetone	2.1E+00	1.0E+03	-	1.0E+04	(Use soil gas)	2.1E+00
Aldrin	1.3E-01	2.5E+03	3.5E-01	1.3E-01		5.0E+00
Anthracene	4.0E+01	1.0E+03	4.0E+01	2.8E+04	(Use soil gas)	8.5E+01
Antimony	4.0E+01	2.5E+03	4.0E+01	7.7E+01		
Arsenic	1.5E+00	2.5E+03	4.0E+01	1.5E+00		
Barium	1.5E+03	2.5E+03	1.5E+03	3.2E+04		
Benzene	4.4E-02	8.7E+02	2.5E+01	2.6E-01	(Use soil gas)	4.4E-02
Benzo(a)anthracene	1.3E+00	1.0E+03	4.0E+01	1.3E+00		1.2E+01
Benzo(b)fluoranthene	1.3E+00	1.0E+03	4.0E+01	1.3E+00		4.6E+01
Benzo(k)fluoranthene	1.3E+00	1.0E+03	-	1.3E+00		2.7E+00
Benzo(g,h,i)perylene	3.5E+01	1.0E+03	4.0E+01	3.3E+03		3.5E+01
Benzo(a)pyrene	1.3E-01	1.0E+03	4.0E+01	1.3E-01		1.8E+02
Beryllium	8.0E+00	2.5E+03	8.0E+00	3.7E+02		
1,1-Biphenyl	6.5E-01	1.0E+03	-	6.2E+03	(Use soil gas)	6.5E-01
Bis(2-chloroethyl) ether	4.0E-04	1.0E+03	-	3.5E-01	(Use soil gas)	4.0E-04
Bis(2-chloroisopropyl) ether	1.5E-04	7.9E+02	-	7.4E-02	(Use soil gas)	1.5E-04
Bis(2-ethylhexyl) phthalate	1.2E+02	1.0E+03	-	1.2E+02		7.8E+02
Boron	2.0E+00	no critiera	2.0E+00	2.5E+04		
Bromodichloromethane	1.2E+00	2.5E+03	-	1.2E+00	(Use soil gas)	1.9E+00
Bromoform (Tribromomethane)	2.2E+00	1.0E+03	-	2.2E+02		2.2E+00
Bromomethane	3.9E-01	1.0E+03	-	2.3E+00	(Use soil gas)	3.9E-01
Cadmium	7.4E+00	2.5E+03	1.2E+01	7.4E+00		
Carbon tetrachloride	4.4E-02	1.0E+03	-	4.4E-02	(Use soil gas)	1.1E-01
Chlordane	1.7E+00	2.5E+03	-	1.7E+00		1.5E+01
p-Chloroaniline	3.0E-01	2.5E+03	-	4.9E+02		3.0E-01
Chlorobenzene	3.0E+00	6.8E+02	3.0E+01	6.8E+02	(Use soil gas)	3.0E+00
Chloroethane	8.5E-01	1.0E+03	-	3.4E+01	(Use soil gas)	8.5E-01
Chloroform	1.4E+00	1.0E+03	-	1.4E+00	(Use soil gas)	2.1E+00
Chloromethane	6.4E+00	5.0E+02	-	2.5E+01	(Use soil gas)	6.4E+00

Table A-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-3	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-2	Vapor Intrusion Into Buildings	Drinking Water Resource Table G
2-Chlorophenol	1.2E-02	5.0E+02	1.0E+01	2.6E+01	(Use soil gas)	1.2E-02
Chromium (total)		2.5E+03		-		
Chromium III	7.5E+02	2.5E+03	7.5E+02	2.9E+05		
Chromium VI	8.0E+00	2.5E+03	8.0E+00	3.6E+01		
Chrysene	4.0E+01	2.5E+03	4.0E+01	2.1E+02		5.3E+01
Cobalt	8.0E+01	2.5E+03	8.0E+01	1.9E+03		
Copper	2.3E+02	2.5E+03	2.3E+02	7.7E+04		
Cyanide	5.4E-01	5.0E+02	-	1.2E+02		5.4E-01
Dibenz(a,h)anthracene	2.1E-01	1.0E+03	-	2.1E-01		9.9E+00
Dibromochloromethane	8.3E+00	5.0E+02	-	2.1E+01	(Use soil gas)	8.3E+00
1,2-dibromo-3-chloropropane	4.5E-03	1.0E+03	-	2.5E-01	(Use soil gas)	4.5E-03
1,2-Dibromoethane	3.3E-04	1.0E+03	-	4.2E-02	(Use soil gas)	3.3E-04
1,2-Dichlorobenzene	1.1E+00	6.0E+02	3.0E+01	4.5E+02	(Use soil gas)	1.1E+00
1,3-Dichlorobenzene	2.4E+01	6.0E+02	3.0E+01	2.3E+02	(Use soil gas)	2.4E+01
1,4-Dichlorobenzene	5.9E-01	1.0E+03	3.0E+01	2.6E+00	(Use soil gas)	5.9E-01
3,3-Dichlorobenzidine	7.7E-03	1.0E+03	-	1.4E+00		7.7E-03
Dichlorodiphenyldichloroethane (DDD)	9.0E+00	1.0E+03	-	9.0E+00		7.5E+02
Dichlorodiphenyldichloroethene (DDE)	4.0E+00	1.0E+03	4.0E+00	6.3E+00		1.1E+03
Dichlorodiphenyltrichloroethane (DDT)	4.0E+00	2.5E+03	4.0E+00	6.3E+00		4.3E+00
1,1-Dichloroethane	2.0E-01	1.0E+03	-	4.7E+00	(Use soil gas)	2.0E-01
1,2-Dichloroethane	4.5E-03	1.0E+03	6.0E+01	4.8E-01	(Use soil gas)	4.5E-03
1,1-Dichloroethene	8.8E-02	1.0E+03	-	8.8E-02	(Use soil gas)	1.0E+00
cis -1,2-Dichloroethene	1.9E-01	5.0E+02	-	2.2E+01	(Use soil gas)	1.9E-01
trans -1,2-Dichloroethene	6.7E-01	1.0E+03	-	3.4E+01	(Use soil gas)	6.7E-01
2,4-Dichlorophenol	3.0E-01	1.0E+03	1.0E+01	3.7E+02		3.0E-01
1,2-Dichloropropane	1.2E-01	5.0E+02	-	1.0E+00	(Use soil gas)	1.2E-01
1,3-Dichloropropene	5.9E-02	1.0E+03	-	3.6E-01	(Use soil gas)	5.9E-02
Dieldrin	2.7E-03	2.5E+03	4.0E+00	1.3E-01		2.7E-03
Diethyl phthalate	1.3E+02	1.0E+03	-	9.8E+04		1.3E+02
Dimethyl phthalate	1.0E+03	1.0E+03	-	1.2E+06		1.2E+03
2,4-Dimethylphenol	6.7E-01	5.0E+02	-	2.5E+03	(Use soil gas)	6.7E-01

Table A-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-3	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-2	Vapor Intrusion Into Buildings	Drinking Water Resource Table G
2,4-Dinitrophenol	4.0E-01	1.0E+03	-	2.5E+03		4.0E-01
2,4-Dinitrotoluene	3.9E-04	1.0E+03	-	2.5E+00		3.9E-04
1,4-Dioxane	1.8E-03	1.0E+03	-	6.4E+01		1.8E-03
Dioxin (2,3,7,8-TCDD)	1.9E-05	no criteria	-	1.9E-05		
Endosulfan	2.2E+01	1.0E+03	-	7.4E+02		2.2E+01
Endrin	6.0E-02	1.0E+03	6.0E-02	4.6E+01		5.6E-01
Ethylbenzene	3.3E+00	4.0E+02	-	4.0E+02	(Use soil gas)	3.3E+00
Fluoranthene	4.0E+01	1.0E+03	4.0E+01	4.4E+03		8.4E+02
Fluorene	6.4E+02	1.0E+03	-	3.0E+03	(Use soil gas)	6.4E+02
Heptachlor	3.7E-02	2.5E+03	-	4.8E-01		3.7E-02
Heptachlor epoxide	3.8E-02	2.5E+03	-	1.9E-01		3.8E-02
Hexachlorobenzene	1.1E+00	1.0E+03	3.0E+01	1.1E+00		7.9E+02
Hexachlorobutadiene	2.2E+00	1.0E+03	-	2.2E+01		2.2E+00
γ-Hexachlorocyclohexane (Lindane)	1.2E-01	1.0E+03	2.0E+00	4.6E+01		1.2E-01
Hexachloroethane	3.0E+00	1.0E+03	-	4.4E+01		3.0E+00
Indeno(1,2,3-c,d)pyrene	2.1E+00	1.0E+03	4.0E+01	2.1E+00		1.3E+01
Lead	7.5E+02	2.5E+03	-	7.5E+02		
Mercury (elemental)	1.0E+01	1.0E+03	1.0E+01	1.1E+01	(Use soil gas)	
Methoxychlor	2.6E+02	1.0E+03	-	-		2.6E+02
Methylene chloride	7.7E-02	1.0E+03	-	1.6E+01	(Use soil gas)	7.7E-02
Methyl ethyl ketone	3.9E+00	1.0E+03	-	1.9E+04	(Use soil gas)	3.9E+00
Methyl isobutyl ketone	2.8E+00	5.0E+02	1.0E+01	1.2E+04	(Use soil gas)	2.8E+00
Methyl mercury	1.2E+01	5.0E+02	-	1.2E+01		
2-Methylnaphthalene	1.2E+00	1.0E+03	-	4.9E+02	(Use soil gas)	1.2E+00
tert-Butyl methyl ether	2.3E-02	5.0E+02	-	6.4E+01	(Use soil gas)	2.3E-02
Molybdenum	4.0E+01	2.5E+03	4.0E+01	9.6E+02		
Naphthalene	2.8E+00	1.0E+03	4.0E+01	2.8E+00	(Use soil gas)	3.4E+00
Nickel	1.5E+02	2.5E+03	1.5E+02	3.4E+03		
Pentachlorophenol	5.0E+00	1.0E+03	5.0E+00	9.0E+00		2.7E+06
Perchlorate	1.3E+02	2.5E+03	-	1.3E+02		
Phenanthrene	4.0E+01	1.0E+03	4.0E+01	3.7E+03	(Use soil gas)	4.9E+02

Table A-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-3	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-2	Vapor Intrusion Into Buildings	Drinking Water Resource Table G
Phenol	7.6E-02	1.0E+03	4.0E+01	3.7E+04		7.6E-02
Polychlorinated biphenyls (PCBs)	3.0E-01	1.0E+03	-	3.0E-01		6.3E+00
Pyrene	1.0E+03	1.0E+03	-	7.4E+03	(Use soil gas)	1.2E+03
Selenium	1.0E+01	2.5E+03	1.0E+01	9.6E+02		
Silver	4.0E+01	2.5E+03	4.0E+01	9.6E+02		
Styrene	1.5E+00	1.0E+03	-	1.5E+03	(Use soil gas)	1.5E+00
tert-Butyl alcohol		5.0E+02	-	3.2E+05	(Use soil gas)	
1,1,1,2-Tetrachloroethane	2.4E-02	5.0E+02	-	4.4E+00	(Use soil gas)	2.4E-02
1,1,2,2-Tetrachloroethane	1.8E-02	1.0E+03	-	5.8E-01	(Use soil gas)	1.8E-02
Tetrachloroethene	7.0E-01	2.3E+02	-	8.5E-01	(Use soil gas)	7.0E-01
Thallium	1.5E+01	2.5E+03	-	1.5E+01		
Toluene	2.9E+00	6.5E+02	-	2.1E+02	(Use soil gas)	2.9E+00
Toxaphene	1.8E+00	1.0E+03	-	1.8E+00		6.4E+00
TPH (gasolines)	8.3E+01	5.0E+02	-	4.5E+02	(Use soil gas)	8.3E+01
TPH (middle distillates)	8.3E+01	5.0E+02	-	1.5E+02	(Use soil gas)	8.3E+01
TPH (residual fuels)	2.5E+03	2.5E+03	-	4.6E+03		
1,2,4-Trichlorobenzene	1.5E+00	1.0E+03	3.0E+01	2.7E+01	(Use soil gas)	1.5E+00
1,1,1-Trichloroethane	2.5E+01	1.0E+03	-	9.4E+02	(Use soil gas)	2.5E+01
1,1,2-Trichloroethane	7.0E-02	5.0E+02	-	1.1E+00	(Use soil gas)	7.0E-02
Trichloroethene	4.6E-01	8.2E+02	6.0E+01	4.0E+00	(Use soil gas)	4.6E-01
2,4,5-Trichlorophenol	3.2E+00	5.0E+02	1.0E+01	1.5E+03	(Use soil gas)	3.2E+00
2,4,6-Trichlorophenol	2.3E-01	1.0E+03	1.0E+01	1.2E+01		2.3E-01
Vanadium	1.9E+02	2.5E+03	2.0E+02	1.9E+02		
Vinyl chloride	4.7E-02	1.0E+03	6.0E+01	4.7E-02	(Use soil gas)	8.5E-02
Xylenes	2.3E+00	4.2E+02	-	1.0E+02	(Use soil gas)	2.3E+00
Zinc	6.0E+02	2.5E+03	6.0E+02	5.8E+04		

Table A-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
		Table H-3		Table K-2		Table G

Notes:

1. Shallow soils defined as soils situated <3 meters below ground surface.

Final Environmental Screening Level is lowest of ceiling value (nuisance concerns etc.), ecotoxicity, direct-exposure, indoor-air impact, and leaching screening levels.

Soil data should be reported on dry-weight basis (see Section 6.2).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table B-1. [1]Shallow Soil Screening Levels(<3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	NON-Drinking Water Resource Table G
Acenaphthene	1.6E+02	1.0E+03	-	5.2E+02	(Use soil gas)	1.6E+02
Acenaphthylene	3.7E+02	5.0E+02	-	3.7E+02	(Use soil gas)	8.3E+02
Acetone	1.7E+01	5.0E+02	-	2.6E+03	(Use soil gas)	1.7E+01
Aldrin	3.2E-02	1.0E+03	3.5E-01	3.2E-02		6.9E+01
Anthracene	4.0E+01	5.0E+02	4.0E+01	3.3E+03	(Use soil gas)	8.5E+01
Antimony	6.1E+00	1.0E+03	2.0E+01	6.1E+00		
Arsenic	3.8E-01	1.0E+03	2.0E+01	3.8E-01		
Barium	7.5E+02	1.0E+03	7.5E+02	2.9E+03		
Benzene	1.2E-01	5.0E+02	2.5E+01	1.2E-01	(Use soil gas)	2.4E+01
Benzo(a)anthracene	3.8E-01	5.0E+02	4.0E+01	3.8E-01		1.7E+02
Benzo(b)fluoranthene	3.8E-01	5.0E+02	4.0E+01	3.8E-01		6.4E+02
Benzo(k)fluoranthene	3.8E-01	5.0E+02	-	3.8E-01		3.7E+01
Benzo(g,h,i)perylene	3.5E+01	5.0E+02	4.0E+01	3.4E+02		3.5E+01
Benzo(a)pyrene	3.8E-02	5.0E+02	4.0E+01	3.8E-02		1.7E+03
Beryllium	4.0E+00	1.0E+03	4.0E+00	3.0E+01		
1,1-Biphenyl	6.5E+00	5.0E+02	-	6.1E+02	(Use soil gas)	6.5E+00
Bis(2-chloroethyl) ether	1.4E-01	5.0E+02	-	1.4E-01	(Use soil gas)	8.2E-01
Bis(2-chloroisopropyl) ether	3.2E-02	5.0E+02	-	3.2E-02	(Use soil gas)	3.5E+01
Bis(2-ethylhexyl) phthalate	3.5E+01	5.0E+02	-	3.5E+01		1.1E+04
Boron	1.6E+00	no criteria	1.6E+00	2.4E+03		
Bromodichloromethane	5.6E-01	1.0E+03	-	5.6E-01	(Use soil gas)	3.2E+00
Bromoform (Tribromomethane)	6.1E+01	5.0E+02	-	6.1E+01		1.1E+02
Bromomethane	6.9E-01	5.0E+02	-	6.9E-01	(Use soil gas)	2.3E+01
Cadmium	1.7E+00	1.0E+03	1.2E+01	1.7E+00		
Carbon tetrachloride	2.0E-02	5.0E+02	-	2.0E-02	(Use soil gas)	2.0E+00
Chlordane	4.4E-01	1.0E+03	-	4.4E-01		1.8E+02
p-Chloroaniline	4.9E+01	1.0E+03	-	4.9E+01		5.3E+02
Chlorobenzene	3.0E+01	5.0E+02	3.0E+01	1.4E+02	(Use soil gas)	3.0E+01
Chloroethane	1.0E+01	5.0E+02	-	1.0E+01	(Use soil gas)	1.1E+01
Chloroform	6.7E-01	5.0E+02	-	6.7E-01	(Use soil gas)	9.8E+00
Chloromethane	6.4E+00	1.0E+02	-	7.6E+00	(Use soil gas)	6.4E+00

Table B-1. [1]Shallow Soil Screening Levels(<3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	NON-Drinking Water Resource Table G
2-Chlorophenol	1.2E-01	1.0E+02	1.0E+01	7.4E+00	(Use soil gas)	1.2E-01
Chromium (total)		1.0E+03		-		
Chromium III	7.5E+02	1.0E+03	7.5E+02	2.3E+04		
Chromium VI	8.0E+00	1.0E+03	8.0E+00	9.4E+00		
Chrysene	4.0E+01	1.0E+03	4.0E+01	6.2E+01		5.3E+01
Cobalt	4.0E+01	1.0E+03	4.0E+01	2.7E+02		
Copper	2.3E+02	1.0E+03	2.3E+02	6.1E+03		
Cyanide	6.2E+00	1.0E+02	-	3.4E+01		6.2E+00
Dibenz(a,h)anthracene	6.2E-02	5.0E+02	-	6.2E-02		1.4E+02
Dibromochloromethane	5.8E+00	1.0E+02	-	5.8E+00	(Use soil gas)	1.4E+01
1,2-dibromo-3-chloropropane	6.9E-02	5.0E+02	-	6.9E-02	(Use soil gas)	2.2E+00
1,2-Dibromoethane	1.9E-02	5.0E+02	-	1.9E-02	(Use soil gas)	1.0E+00
1,2-Dichlorobenzene	1.1E+01	6.0E+02	3.0E+01	1.3E+02	(Use soil gas)	1.1E+01
1,3-Dichlorobenzene	3.0E+01	1.0E+02	3.0E+01	6.3E+01	(Use soil gas)	5.7E+03
1,4-Dichlorobenzene	1.2E+00	5.0E+02	3.0E+01	1.2E+00	(Use soil gas)	1.3E+01
3,3-Dichlorobenzidine	4.0E-01	5.0E+02	-	4.0E-01		4.1E+02
Dichlorodiphenyldichloroethane (DDD)	2.3E+00	5.0E+02	-	2.3E+00		1.0E+04
Dichlorodiphenyldichloroethene (DDE)	1.6E+00	5.0E+02	4.0E+00	1.6E+00		1.5E+04
Dichlorodiphenyltrichloroethane (DDT)	1.6E+00	1.0E+03	4.0E+00	1.6E+00		6.0E+01
1,1-Dichloroethane	2.2E+00	5.0E+02	-	2.2E+00	(Use soil gas)	4.1E+01
1,2-Dichloroethane	2.2E-01	5.0E+02	6.0E+01	2.2E-01	(Use soil gas)	1.8E+00
1,1-Dichloroethene	4.1E-02	5.0E+02	-	4.1E-02	(Use soil gas)	1.1E+03
cis -1,2-Dichloroethene	6.4E+00	1.0E+02	-	6.4E+00	(Use soil gas)	1.9E+02
trans -1,2-Dichloroethene	1.0E+01	5.0E+02	-	1.0E+01	(Use soil gas)	1.7E+02
2,4-Dichlorophenol	3.0E+00	5.0E+02	1.0E+01	3.7E+01		3.0E+00
1,2-Dichloropropane	4.6E-01	1.0E+02	-	4.6E-01	(Use soil gas)	2.5E+00
1,3-Dichloropropene	1.7E-01	5.0E+02	-	1.7E-01	(Use soil gas)	6.2E+00
Dieldrin	3.4E-02	1.0E+03	4.0E+00	3.4E-02		1.1E+02
Diethyl phthalate	5.0E+02	5.0E+02	-	9.8E+03		1.2E+03
Dimethyl phthalate	5.0E+02	5.0E+02	-	1.2E+05		1.2E+03
2,4-Dimethylphenol	2.7E+01	1.0E+02	-	2.4E+02	(Use soil gas)	2.7E+01

Table B-1. [1]Shallow Soil Screening Levels(<3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	NON-Drinking Water Resource Table G
2,4-Dinitrophenol	1.4E+02	5.0E+02	-	2.4E+02		1.4E+02
2,4-Dinitrotoluene	7.1E-01	5.0E+02	-	7.1E-01		3.7E+02
1,4-Dioxane	1.8E+01	5.0E+02	-	1.8E+01		3.0E+01
Dioxin (2,3,7,8-TCDD)	4.6E-06	no criteria	-	4.6E-06		
Endosulfan	4.0E+01	5.0E+02	-	7.3E+01		4.0E+01
Endrin	6.0E-02	5.0E+02	6.0E-02	4.1E+00		3.7E+01
Ethylbenzene	3.3E+01	4.0E+02	-	2.3E+02	(Use soil gas)	3.3E+01
Fluoranthene	4.0E+01	5.0E+02	4.0E+01	4.6E+02		8.4E+02
Fluorene	4.1E+02	5.0E+02	-	4.1E+02	(Use soil gas)	2.2E+03
Heptachlor	1.2E-01	1.0E+03	-	1.2E-01		1.0E+02
Heptachlor epoxide	5.3E-02	1.0E+03	-	5.3E-02		6.7E+02
Hexachlorobenzene	3.0E-01	5.0E+02	3.0E+01	3.0E-01		1.1E+04
Hexachlorobutadiene	2.4E+00	5.0E+02	-	2.4E+00		3.0E+02
γ-Hexachlorocyclohexane (Lindane)	2.0E+00	5.0E+02	2.0E+00	4.1E+00		2.1E+03
Hexachloroethane	1.2E+01	5.0E+02	-	1.2E+01		3.4E+02
Indeno(1,2,3-c,d)pyrene	6.2E-01	5.0E+02	4.0E+01	6.2E-01		7.0E+01
Lead	2.0E+02	1.0E+03	2.0E+02	2.6E+02		
Mercury (elemental)	1.0E+00	5.0E+02	1.0E+01	1.0E+00	(Use soil gas)	
Methoxychlor	2.6E+02	5.0E+02	-	-		2.6E+02
Methylene chloride	6.9E+00	5.0E+02	-	6.9E+00	(Use soil gas)	3.7E+01
Methyl ethyl ketone	4.6E+01	5.0E+02	-	3.8E+03	(Use soil gas)	4.6E+01
Methyl isobutyl ketone	1.0E+01	1.0E+02	1.0E+01	2.9E+03	(Use soil gas)	3.0E+02
Methyl mercury	1.2E+00	1.0E+02	-	1.2E+00		
2-Methylnaphthalene	1.2E+01	5.0E+02	-	4.9E+01	(Use soil gas)	1.2E+01
tert -Butyl methyl ether	8.4E+00	1.0E+02	-	2.9E+01	(Use soil gas)	8.4E+00
Molybdenum	4.0E+01	1.0E+03	4.0E+01	7.6E+01		
Naphthalene	1.3E+00	5.0E+02	4.0E+01	1.3E+00	(Use soil gas)	4.2E+01
Nickel	1.5E+02	1.0E+03	1.5E+02	3.0E+02		
Pentachlorophenol	3.0E+00	5.0E+02	5.0E+00	3.0E+00		2.7E+06
Perchlorate	1.1E+01	1.0E+03	-	1.1E+01		
Phenanthrene	4.0E+01	5.0E+02	4.0E+01	3.7E+02	(Use soil gas)	9.5E+02

Table B-1. [1]Shallow Soil Screening Levels(<3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.) Table H-2	Urban Area Ecotoxicity Criteria	Direct Exposure Table K-1	Vapor Intrusion Into Buildings	NON-Drinking Water Resource Table G
Phenol	4.0E+01	5.0E+02	4.0E+01	3.7E+03		7.6E+02
Polychlorinated biphenyls (PCBs)	8.9E-02	5.0E+02	-	8.9E-02		8.8E+01
Pyrene	5.0E+02	5.0E+02	-	7.3E+02	(Use soil gas)	1.2E+03
Selenium	1.0E+01	1.0E+03	1.0E+01	7.6E+01		
Silver	2.0E+01	1.0E+03	2.0E+01	7.6E+01		
Styrene	1.6E+01	5.0E+02	-	4.8E+02	(Use soil gas)	1.6E+01
tert-Butyl alcohol	1.0E+02	1.0E+02	-	3.2E+05	(Use soil gas)	3.1E+02
1,1,1,2-Tetrachloroethane	2.0E+00	1.0E+02	-	2.0E+00	(Use soil gas)	8.8E+02
1,1,2,2-Tetrachloroethane	2.6E-01	5.0E+02	-	2.6E-01	(Use soil gas)	3.4E+00
Tetrachloroethene	3.4E-01	2.3E+02	-	3.4E-01	(Use soil gas)	1.7E+01
Thallium	1.2E+00	1.0E+03	-	1.2E+00		
Toluene	2.9E+01	5.0E+02	-	6.3E+01	(Use soil gas)	2.9E+01
Toxaphene	4.6E-01	5.0E+02	-	4.6E-01		3.0E+02
TPH (gasolines)	1.0E+02	1.0E+02	-	1.1E+02	(Use soil gas)	4.2E+03
TPH (middle distillates)	1.0E+02	1.0E+02	-	1.1E+02	(Use soil gas)	2.1E+03
TPH (residual fuels)	4.1E+02	5.0E+02	-	4.1E+02		
1,2,4-Trichlorobenzene	7.8E+00	5.0E+02	3.0E+01	7.8E+00	(Use soil gas)	7.7E+02
1,1,1-Trichloroethane	2.7E+02	5.0E+02	-	2.7E+02	(Use soil gas)	6.3E+03
1,1,2-Trichloroethane	4.9E-01	1.0E+02	-	4.9E-01	(Use soil gas)	4.8E+00
Trichloroethene	1.9E+00	5.0E+02	6.0E+01	1.9E+00	(Use soil gas)	4.9E+01
2,4,5-Trichlorophenol	1.0E+01	1.0E+02	1.0E+01	3.7E+02	(Use soil gas)	3.2E+01
2,4,6-Trichlorophenol	1.2E+00	5.0E+02	1.0E+01	1.2E+00		3.3E+02
Vanadium	1.5E+01	1.0E+03	2.0E+02	1.5E+01		
Vinyl chloride	2.1E-02	5.0E+02	6.0E+01	2.1E-02	(Use soil gas)	6.6E-01
Xylenes	3.1E+01	4.2E+02	-	3.1E+01	(Use soil gas)	6.0E+02
Zinc	6.0E+02	1.0E+03	6.0E+02	4.6E+03		

Table B-1. [1]Shallow Soil Screening Levels(<3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
Chemical	Final ESL	Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
		Table H-2		Table K-1		Table G

Notes:
1. Shallow soils defined as soils situated <3 meters below ground surface.
2. Sensitive land use based on residential land-use and exposure scenarios (see Chapter 1).

Final Environmental Screening Level is lowest of ceiling value (nuisance concerns etc.), ecotoxicity, direct-exposure, indoor-air impact, and leaching screening levels.

Soil data should be reported on dry-weight basis (see Section 6.2).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table B-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
		Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-2**		**Table K-2**		**Table G**
Acenaphthene	1.6E+02	2.5E+03	-	3.3E+03	(Use soil gas)	1.6E+02
Acenaphthylene	8.3E+02	1.0E+03	-	3.7E+03	(Use soil gas)	8.3E+02
Acetone	1.7E+01	1.0E+03	-	1.0E+04	(Use soil gas)	1.7E+01
Aldrin	1.3E-01	2.5E+03	3.5E-01	1.3E-01		6.9E+01
Anthracene	4.0E+01	1.0E+03	4.0E+01	2.8E+04	(Use soil gas)	8.5E+01
Antimony	4.0E+01	2.5E+03	4.0E+01	7.7E+01		
Arsenic	1.5E+00	2.5E+03	4.0E+01	1.5E+00		
Barium	1.5E+03	2.5E+03	1.5E+03	3.2E+04		
Benzene	2.6E-01	8.7E+02	2.5E+01	2.6E-01	(Use soil gas)	2.4E+01
Benzo(a)anthracene	1.3E+00	1.0E+03	4.0E+01	1.3E+00		1.7E+02
Benzo(b)fluoranthene	1.3E+00	1.0E+03	4.0E+01	1.3E+00		6.4E+02
Benzo(k)fluoranthene	1.3E+00	1.0E+03	-	1.3E+00		3.7E+01
Benzo(g,h,i)perylene	3.5E+01	1.0E+03	4.0E+01	3.3E+03		3.5E+01
Benzo(a)pyrene	1.3E-01	1.0E+03	4.0E+01	1.3E-01		1.7E+03
Beryllium	8.0E+00	2.5E+03	8.0E+00	3.7E+02		
1,1-Biphenyl	6.5E+00	1.0E+03	-	6.2E+03	(Use soil gas)	6.5E+00
Bis(2-chloroethyl) ether	3.5E-01	1.0E+03	-	3.5E-01	(Use soil gas)	8.2E-01
Bis(2-chloroisopropyl) ether	7.4E-02	7.9E+02	-	7.4E-02	(Use soil gas)	3.5E+01
Bis(2-ethylhexyl) phthalate	1.2E+02	1.0E+03	-	1.2E+02		1.1E+04
Boron	2.0E+00	no critiera	2.0E+00	2.5E+04		
Bromodichloromethane	1.2E+00	2.5E+03	-	1.2E+00	(Use soil gas)	3.2E+00
Bromoform (Tribromomethane)	1.1E+02	1.0E+03	-	2.2E+02		1.1E+02
Bromomethane	2.3E+00	1.0E+03	-	2.3E+00	(Use soil gas)	2.3E+01
Cadmium	7.4E+00	2.5E+03	1.2E+01	7.4E+00		
Carbon tetrachloride	4.4E-02	1.0E+03	-	4.4E-02	(Use soil gas)	2.0E+00
Chlordane	1.7E+00	2.5E+03	-	1.7E+00		1.8E+02
p -Chloroaniline	4.9E+02	2.5E+03	-	4.9E+02		5.3E+02
Chlorobenzene	3.0E+01	6.8E+02	3.0E+01	6.8E+02	(Use soil gas)	3.0E+01
Chloroethane	1.1E+01	1.0E+03	-	3.4E+01	(Use soil gas)	1.1E+01
Chloroform	1.4E+00	1.0E+03	-	1.4E+00	(Use soil gas)	9.8E+00
Chloromethane	6.4E+00	5.0E+02	-	2.5E+01	(Use soil gas)	6.4E+00

Table B-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
		Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-2**		**Table K-2**		**Table G**
2-Chlorophenol	1.2E-01	5.0E+02	1.0E+01	2.6E+01	(Use soil gas)	1.2E-01
Chromium (total)	0.0E+00	2.5E+03	0.0E+00	-		
Chromium III	7.5E+02	2.5E+03	7.5E+02	2.9E+05		
Chromium VI	8.0E+00	2.5E+03	8.0E+00	3.6E+01		
Chrysene	4.0E+01	2.5E+03	4.0E+01	2.1E+02		5.3E+01
Cobalt	8.0E+01	2.5E+03	8.0E+01	1.9E+03		
Copper	2.3E+02	2.5E+03	2.3E+02	7.7E+04		
Cyanide	6.2E+00	5.0E+02	-	1.2E+02		6.2E+00
Dibenz(a,h)anthracene	2.1E-01	1.0E+03	-	2.1E-01		1.4E+02
Dibromochloromethane	1.4E+01	5.0E+02	-	2.1E+01	(Use soil gas)	1.4E+01
1,2-dibromo-3-chloropropane	2.5E-01	1.0E+03	-	2.5E-01	(Use soil gas)	2.2E+00
1,2-Dibromoethane	4.2E-02	1.0E+03	-	4.2E-02	(Use soil gas)	1.0E+00
1,2-Dichlorobenzene	1.1E+01	6.0E+02	3.0E+01	4.5E+02	(Use soil gas)	1.1E+01
1,3-Dichlorobenzene	3.0E+01	6.0E+02	3.0E+01	2.3E+02	(Use soil gas)	5.7E+03
1,4-Dichlorobenzene	2.6E+00	1.0E+03	3.0E+01	2.6E+00	(Use soil gas)	1.3E+01
3,3-Dichlorobenzidine	1.4E+00	1.0E+03	-	1.4E+00		4.1E+02
Dichlorodiphenyldichloroethane (DDD)	9.0E+00	1.0E+03	-	9.0E+00		1.0E+04
Dichlorodiphenyldichloroethene (DDE)	4.0E+00	1.0E+03	4.0E+00	6.3E+00		1.5E+04
Dichlorodiphenyltrichloroethane (DDT)	4.0E+00	2.5E+03	4.0E+00	6.3E+00		6.0E+01
1,1-Dichloroethane	4.7E+00	1.0E+03	-	4.7E+00	(Use soil gas)	4.1E+01
1,2-Dichloroethane	4.8E-01	1.0E+03	6.0E+01	4.8E-01	(Use soil gas)	1.8E+00
1,1-Dichloroethene	8.8E-02	1.0E+03	-	8.8E-02	(Use soil gas)	1.1E+03
cis -1,2-Dichloroethene	2.2E+01	5.0E+02	-	2.2E+01	(Use soil gas)	1.9E+02
trans -1,2-Dichloroethene	3.4E+01	1.0E+03	-	3.4E+01	(Use soil gas)	1.7E+02
2,4-Dichlorophenol	3.0E+00	1.0E+03	1.0E+01	3.7E+02		3.0E+00
1,2-Dichloropropane	1.0E+00	5.0E+02	-	1.0E+00	(Use soil gas)	2.5E+00
1,3-Dichloropropene	3.6E-01	1.0E+03	-	3.6E-01	(Use soil gas)	6.2E+00
Dieldrin	1.3E-01	2.5E+03	4.0E+00	1.3E-01		1.1E+02
Diethyl phthalate	1.0E+03	1.0E+03	-	9.8E+04		1.2E+03
Dimethyl phthalate	1.0E+03	1.0E+03	-	1.2E+06		1.2E+03
2,4-Dimethylphenol	2.7E+01	5.0E+02	-	2.5E+03	(Use soil gas)	2.7E+01

Table B-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
		Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Human Health		Groundwater Protection (Soil Leaching)
				Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-2**		**Table K-2**		**Table G**
2,4-Dinitrophenol	1.4E+02	1.0E+03	-	2.5E+03		1.4E+02
2,4-Dinitrotoluene	2.5E+00	1.0E+03	-	2.5E+00		3.7E+02
1,4-Dioxane	3.0E+01	1.0E+03	-	6.4E+01		3.0E+01
Dioxin (2,3,7,8-TCDD)	1.9E-05	no criteria	-	1.9E-05		
Endosulfan	4.0E+01	1.0E+03	-	7.4E+02		4.0E+01
Endrin	6.0E-02	1.0E+03	6.0E-02	4.6E+01		3.7E+01
Ethylbenzene	3.3E+01	4.0E+02	-	4.0E+02	(Use soil gas)	3.3E+01
Fluoranthene	4.0E+01	1.0E+03	4.0E+01	4.4E+03		8.4E+02
Fluorene	1.0E+03	1.0E+03	-	3.0E+03	(Use soil gas)	2.2E+03
Heptachlor	4.8E-01	2.5E+03	-	4.8E-01		1.0E+02
Heptachlor epoxide	1.9E-01	2.5E+03	-	1.9E-01		6.7E+02
Hexachlorobenzene	1.1E+00	1.0E+03	3.0E+01	1.1E+00		1.1E+04
Hexachlorobutadiene	2.2E+01	1.0E+03	-	2.2E+01		3.0E+02
γ-Hexachlorocyclohexane (Lindane)	2.0E+00	1.0E+03	2.0E+00	4.6E+01		2.1E+03
Hexachloroethane	4.4E+01	1.0E+03	-	4.4E+01		3.4E+02
Indeno(1,2,3-c,d)pyrene	2.1E+00	1.0E+03	4.0E+01	2.1E+00		7.0E+01
Lead	7.5E+02	2.5E+03	-	7.5E+02		
Mercury (elemental)	1.0E+01	1.0E+03	1.0E+01	1.1E+01	(Use soil gas)	
Methoxychlor	2.6E+02	1.0E+03	-	-		2.6E+02
Methylene chloride	1.6E+01	1.0E+03	-	1.6E+01	(Use soil gas)	3.7E+01
Methyl ethyl ketone	4.6E+01	1.0E+03	-	1.9E+04	(Use soil gas)	4.6E+01
Methyl isobutyl ketone	1.0E+01	5.0E+02	1.0E+01	1.2E+04	(Use soil gas)	3.0E+02
Methyl mercury	1.2E+01	5.0E+02	-	1.2E+01		
2-Methylnaphthalene	1.2E+01	1.0E+03	-	4.9E+02	(Use soil gas)	1.2E+01
tert-Butyl methyl ether	8.4E+00	5.0E+02	-	6.4E+01	(Use soil gas)	8.4E+00
Molybdenum	4.0E+01	2.5E+03	4.0E+01	9.6E+02		
Naphthalene	2.8E+00	1.0E+03	4.0E+01	2.8E+00	(Use soil gas)	4.2E+01
Nickel	1.5E+02	2.5E+03	1.5E+02	3.4E+03		
Pentachlorophenol	5.0E+00	1.0E+03	5.0E+00	9.0E+00		2.7E+06
Perchlorate	1.3E+02	2.5E+03	-	1.3E+02		
Phenanthrene	4.0E+01	1.0E+03	4.0E+01	3.7E+03	(Use soil gas)	9.5E+02

Table B-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
		Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Human Health		Groundwater Protection (Soil Leaching)
				Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-2**		**Table K-2**		**Table G**
Phenol	4.0E+01	1.0E+03	4.0E+01	3.7E+04		7.6E+02
Polychlorinated biphenyls (PCBs)	3.0E-01	1.0E+03	-	3.0E-01		8.8E+01
Pyrene	1.0E+03	1.0E+03	-	7.4E+03	(Use soil gas)	1.2E+03
Selenium	1.0E+01	2.5E+03	1.0E+01	9.6E+02		
Silver	4.0E+01	2.5E+03	4.0E+01	9.6E+02		
Styrene	1.6E+01	1.0E+03	-	1.5E+03	(Use soil gas)	1.6E+01
tert -Butyl alcohol	3.1E+02	5.0E+02	-	3.2E+05	(Use soil gas)	3.1E+02
1,1,1,2-Tetrachloroethane	4.4E+00	5.0E+02	-	4.4E+00	(Use soil gas)	8.8E+02
1,1,2,2-Tetrachloroethane	5.8E-01	1.0E+03	-	5.8E-01	(Use soil gas)	3.4E+00
Tetrachloroethene	8.5E-01	2.3E+02	-	8.5E-01	(Use soil gas)	1.7E+01
Thallium	1.5E+01	2.5E+03	-	1.5E+01		
Toluene	2.9E+01	6.5E+02	-	2.1E+02	(Use soil gas)	2.9E+01
Toxaphene	1.8E+00	1.0E+03	-	1.8E+00		3.0E+02
TPH (gasolines)	4.5E+02	5.0E+02	-	4.5E+02	(Use soil gas)	4.2E+03
TPH (middle distillates)	1.5E+02	5.0E+02	-	1.5E+02	(Use soil gas)	2.1E+03
TPH (residual fuels)	2.5E+03	2.5E+03	-	4.6E+03		
1,2,4-Trichlorobenzene	2.7E+01	1.0E+03	3.0E+01	2.7E+01	(Use soil gas)	7.7E+02
1,1,1-Trichloroethane	9.4E+02	1.0E+03	-	9.4E+02	(Use soil gas)	6.3E+03
1,1,2-Trichloroethane	1.1E+00	5.0E+02	-	1.1E+00	(Use soil gas)	4.8E+00
Trichloroethene	4.0E+00	8.2E+02	6.0E+01	4.0E+00	(Use soil gas)	4.9E+01
2,4,5-Trichlorophenol	1.0E+01	5.0E+02	1.0E+01	1.5E+03	(Use soil gas)	3.2E+01
2,4,6-Trichlorophenol	1.0E+01	1.0E+03	1.0E+01	1.2E+01		3.3E+02
Vanadium	1.9E+02	2.5E+03	2.0E+02	1.9E+02		
Vinyl chloride	4.7E-02	1.0E+03	6.0E+01	4.7E-02	(Use soil gas)	6.6E-01
Xylenes	1.0E+02	4.2E+02	-	1.0E+02	(Use soil gas)	6.0E+02
Zinc	6.0E+02	2.5E+03	6.0E+02	5.8E+04		

Table B-2. [1]Shallow Soil Screening Levels (<3m bgs)
Commercial/industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)					
				Human Health		Groundwater Protection (Soil Leaching)
		Gross Contamination Ceiling Value (Odors, etc.)	Urban Area Ecotoxicity Criteria	Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-2**		**Table K-2**		**Table G**

Notes:
1. Shallow soils defined as soils situated <3 meters below ground surface.

Final Environmental Screening Level is lowest of ceiling value (nuisance concerns etc.), ecotoxicity, direct-exposure, indoor-air impact, and leaching screening levels.

Soil data should be reported on dry-weight basis (see Section 6.2).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table C-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Acenaphthene	1.6E+01	2.5E+03	1.8E+04	(Use soil gas)	1.6E+01
Acenaphthylene	8.9E+01	1.0E+03	1.2E+04	(Use soil gas)	8.9E+01
Acetone	2.1E+00	1.0E+03	1.0E+05	(Use soil gas)	2.1E+00
Aldrin	1.5E+00	2.5E+03	1.5E+00		5.0E+00
Anthracene	8.5E+01	1.0E+03	1.1E+05	(Use soil gas)	8.5E+01
Antimony	2.8E+02	2.5E+03	2.8E+02		
Arsenic	1.4E+01	2.5E+03	1.4E+01		
Barium	2.5E+03	2.5E+03	2.6E+03		
Benzene	4.4E-02	8.7E+02	1.1E+01	(Use soil gas)	4.4E-02
Benzo(a)anthracene	1.2E+01	1.0E+03	1.5E+01		1.2E+01
Benzo(b)fluoranthene	1.5E+01	1.0E+03	1.5E+01		4.6E+01
Benzo(k)fluoranthene	2.7E+00	1.0E+03	1.5E+01		2.7E+00
Benzo(g,h,i)perylene	3.5E+01	1.0E+03	1.1E+04		3.5E+01
Benzo(a)pyrene	1.5E+00	1.0E+03	1.5E+00		1.8E+02
Beryllium	9.8E+01	2.5E+03	9.8E+01		
1,1-Biphenyl	6.5E-01	1.0E+03	2.0E+04	(Use soil gas)	6.5E-01
Bis(2-chloroethyl) ether	4.0E-04	1.0E+03	9.6E+00	(Use soil gas)	4.0E-04
Bis(2-chloroisopropyl) ether	1.5E-04	7.9E+02	2.5E+00	(Use soil gas)	1.5E-04
Bis(2-ethylhexyl) phthalate	7.8E+02	1.0E+03	1.4E+03		7.8E+02
Boron	4.6E+04	no criteria	4.6E+04		
Bromodichloromethane	1.9E+00	2.5E+03	4.9E+01	(Use soil gas)	1.9E+00
Bromoform (Tribromomethane)	2.2E+00	1.0E+03	2.6E+03		2.2E+00
Bromomethane	3.9E-01	1.0E+03	2.8E+01	(Use soil gas)	3.9E-01
Cadmium	3.9E+01	2.5E+03	3.9E+01		
Carbon tetrachloride	1.1E-01	1.0E+03	1.9E+00	(Use soil gas)	1.1E-01
Chlordane	1.5E+01	2.5E+03	2.1E+01		1.5E+01
p-Chloroaniline	3.0E-01	2.5E+03	1.6E+03		3.0E-01
Chlorobenzene	3.0E+00	6.8E+02	6.8E+02	(Use soil gas)	3.0E+00
Chloroethane	8.5E-01	1.0E+03	4.2E+02	(Use soil gas)	8.5E-01
Chloroform	2.1E+00	1.0E+03	6.0E+01	(Use soil gas)	2.1E+00
Chloromethane	6.4E+00	5.0E+02	3.1E+02	(Use soil gas)	6.4E+00
2-Chlorophenol	1.2E-02	5.0E+02	2.9E+02	(Use soil gas)	1.2E-02
Chromium (total)	2.5E+03	2.5E+03	-		
Chromium III	2.5E+03	2.5E+03	1.1E+06		
Chromium VI	5.3E-01	2.5E+03	5.3E-01		
Chrysene	5.3E+01	2.5E+03	2.4E+03		5.3E+01
Cobalt	9.4E+01	2.5E+03	9.4E+01		
Copper	2.5E+03	2.5E+03	2.8E+05		
Cyanide	5.4E-01	5.0E+02	1.3E+03		5.4E-01
Dibenz(a,h)anthracene	2.4E+00	1.0E+03	2.4E+00		9.9E+00
Dibromochloromethane	8.3E+00	5.0E+02	2.4E+02	(Use soil gas)	8.3E+00
1,2-dibromo-3-chloropropane	4.5E-03	1.0E+03	2.9E+00	(Use soil gas)	4.5E-03
1,2-Dibromoethane	3.3E-04	1.0E+03	1.5E+00	(Use soil gas)	3.3E-04
1,2-Dichlorobenzene	1.1E+00	6.0E+02	6.0E+02	(Use soil gas)	1.1E+00
1,3-Dichlorobenzene	2.4E+01	6.0E+02	6.0E+02	(Use soil gas)	2.4E+01
1,4-Dichlorobenzene	5.9E-01	1.0E+03	1.0E+02	(Use soil gas)	5.9E-01

Table C-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
3,3-Dichlorobenzidine	7.7E-03	1.0E+03	1.7E+01		7.7E-03
Dichlorodiphenyldichloroethane (DDD)	1.1E+02	1.0E+03	1.1E+02		7.5E+02
Dichlorodiphenyldichloroethene (DDE)	7.6E+01	1.0E+03	7.6E+01		1.1E+03
Dichlorodiphenyltrichloroethane (DDT)	4.3E+00	2.5E+03	7.6E+01		4.3E+00
1,1-Dichloroethane	2.0E-01	1.0E+03	2.0E+02	(Use soil gas)	2.0E-01
1,2-Dichloroethane	4.5E-03	1.0E+03	2.0E+01	(Use soil gas)	4.5E-03
1,1-Dichloroethene	1.0E+00	1.0E+03	3.6E+00	(Use soil gas)	1.0E+00
cis -1,2-Dichloroethene	1.9E-01	5.0E+02	2.6E+02	(Use soil gas)	1.9E-01
trans -1,2-Dichloroethene	6.7E-01	1.0E+03	4.1E+02	(Use soil gas)	6.7E-01
2,4-Dichlorophenol	3.0E-01	1.0E+03	1.2E+03		3.0E-01
1,2-Dichloropropane	1.2E-01	5.0E+02	3.7E+01	(Use soil gas)	1.2E-01
1,3-Dichloropropene	5.9E-02	1.0E+03	1.5E+01	(Use soil gas)	5.9E-02
Dieldrin	2.7E-03	2.5E+03	1.6E+00		2.7E-03
Diethyl phthalate	1.3E+02	1.0E+03	3.2E+05		1.3E+02
Dimethyl phthalate	1.0E+03	1.0E+03	4.0E+06		1.2E+03
2,4-Dimethylphenol	6.7E-01	5.0E+02	8.2E+03	(Use soil gas)	6.7E-01
2,4-Dinitrophenol	4.0E-01	1.0E+03	6.7E+03		4.0E-01
2,4-Dinitrotoluene	3.9E-04	1.0E+03	3.0E+01		3.9E-04
1,4-Dioxane	1.8E-03	1.0E+03	7.4E+02		1.8E-03
Dioxin (2,3,7,8-TCDD)	2.4E-04	no criteria	2.4E-04		
Endosulfan	2.2E+01	1.0E+03	2.4E+03		2.2E+01
Endrin	5.6E-01	1.0E+03	1.6E+02		5.6E-01
Ethylbenzene	3.3E+00	4.0E+02	4.0E+02	(Use soil gas)	3.3E+00
Fluoranthene	8.4E+02	1.0E+03	1.4E+04		8.4E+02
Fluorene	6.4E+02	1.0E+03	1.4E+04	(Use soil gas)	6.4E+02
Heptachlor	3.7E-02	2.5E+03	5.8E+00		3.7E-02
Heptachlor epoxide	3.8E-02	2.5E+03	2.2E+00		3.8E-02
Hexachlorobenzene	1.2E+01	1.0E+03	1.2E+01		7.9E+02
Hexachlorobutadiene	2.2E+00	1.0E+03	8.0E+01		2.2E+00
γ-Hexachlorocyclohexane (Lindane)	1.2E-01	1.0E+03	1.6E+02		1.2E-01
Hexachloroethane	3.0E+00	1.0E+03	4.0E+02		3.0E+00
Indeno(1,2,3-c,d)pyrene	1.3E+01	1.0E+03	2.4E+01		1.3E+01
Lead	7.5E+02	2.5E+03	7.5E+02		
Mercury (elemental)	3.3E+01	1.0E+03	3.3E+01	(Use soil gas)	
Methoxychlor	2.6E+02	1.0E+03	-		2.6E+02
Methylene chloride	7.7E-02	1.0E+03	5.2E+02	(Use soil gas)	7.7E-02
Methyl ethyl ketone	3.9E+00	1.0E+03	3.4E+04	(Use soil gas)	3.9E+00
Methyl isobutyl ketone	2.8E+00	5.0E+02	1.7E+04	(Use soil gas)	2.8E+00
Methyl mercury	4.1E+01	5.0E+02	4.1E+01		
2-Methylnaphthalene	1.2E+00	1.0E+03	1.6E+03	(Use soil gas)	1.2E+00
tert -Butyl methyl ether	2.3E-02	5.0E+02	2.6E+03	(Use soil gas)	2.3E-02
Molybdenum	2.5E+03	2.5E+03	3.6E+03		
Naphthalene	3.4E+00	1.0E+03	1.3E+02	(Use soil gas)	3.4E+00
Nickel	2.6E+02	2.5E+03	2.6E+02		
Pentachlorophenol	9.9E+01	1.0E+03	9.9E+01		2.7E+06
Perchlorate	5.0E+02	2.5E+03	5.0E+02		

Table C-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Phenanthrene	4.9E+02	1.0E+03	1.2E+04	(Use soil gas)	4.9E+02
Phenol	7.6E-02	1.0E+03	1.2E+05		7.6E-02
Polychlorinated biphenyls (PCBs)	3.4E+00	1.0E+03	3.4E+00		6.3E+00
Pyrene	1.0E+03	1.0E+03	2.3E+04	(Use soil gas)	1.2E+03
Selenium	2.5E+03	2.5E+03	3.6E+03		
Silver	2.5E+03	2.5E+03	3.6E+03		
Styrene	1.5E+00	1.0E+03	1.5E+03	(Use soil gas)	1.5E+00
tert-Butyl alcohol		5.0E+02	3.2E+05	(Use soil gas)	
1,1,1,2-Tetrachloroethane	2.4E-02	5.0E+02	1.7E+02	(Use soil gas)	2.4E-02
1,1,2,2-Tetrachloroethane	1.8E-02	1.0E+03	2.2E+01	(Use soil gas)	1.8E-02
Tetrachloroethene	7.0E-01	2.3E+02	2.2E+01	(Use soil gas)	7.0E-01
Thallium	5.7E+01	2.5E+03	5.7E+01		
Toluene	2.9E+00	6.5E+02	6.5E+02	(Use soil gas)	2.9E+00
Toxaphene	6.4E+00	1.0E+03	2.2E+01		6.4E+00
TPH (gasolines)	8.3E+01	5.0E+03	4.2E+03	(Use soil gas)	8.3E+01
TPH (middle distillates)	8.3E+01	5.0E+03	1.5E+02	(Use soil gas)	8.3E+01
TPH (residual fuels)	5.0E+03	5.0E+03	1.5E+04		
1,2,4-Trichlorobenzene	1.5E+00	1.0E+03	3.1E+02	(Use soil gas)	1.5E+00
1,1,1-Trichloroethane	2.5E+01	1.0E+03	1.2E+03	(Use soil gas)	2.5E+01
1,1,2-Trichloroethane	7.0E-02	5.0E+02	4.3E+01	(Use soil gas)	7.0E-02
Trichloroethene	4.6E-01	1.0E+03	1.2E+02	(Use soil gas)	4.6E-01
2,4,5-Trichlorophenol	3.2E+00	5.0E+02	1.4E+04	(Use soil gas)	3.2E+00
2,4,6-Trichlorophenol	2.3E-01	1.0E+03	4.1E+01		2.3E-01
Vanadium	7.1E+02	2.5E+03	7.1E+02		
Vinyl chloride	8.5E-02	1.0E+03	1.9E+00	(Use soil gas)	8.5E-02
Xylenes	2.3E+00	4.2E+02	4.2E+02	(Use soil gas)	2.3E+00
Zinc	2.5E+03	2.5E+03	2.1E+05		

Notes:

1. Deep soils defined as soils situated >3 meters below ground surface (or shallower with institutional controls).

2. "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

Final Environmental Screening Level is lowest of ceiling values (nuisance concerns etc.), direct-exposure, indoor-air impact, and leaching screening levels.

Soil data should be reported on dry-weight basis (see Section 6.2).

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table C-2. [1]Deep Soil Screening Levels (>3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Acenaphthene	1.6E+01	5.0E+03	1.8E+04	(Use soil gas)	1.6E+01
Acenaphthylene	8.9E+01	2.5E+03	1.2E+04	(Use soil gas)	8.9E+01
Acetone	2.1E+00	2.5E+03	1.0E+05	(Use soil gas)	2.1E+00
Aldrin	1.5E+00	5.0E+03	1.5E+00		5.0E+00
Anthracene	8.5E+01	2.5E+03	1.1E+05	(Use soil gas)	8.5E+01
Antimony	2.8E+02	5.0E+03	2.8E+02		
Arsenic	1.4E+01	5.0E+03	1.4E+01		
Barium	2.6E+03	5.0E+03	2.6E+03		
Benzene	4.4E-02	8.7E+02	1.1E+01	(Use soil gas)	4.4E-02
Benzo(a)anthracene	1.2E+01	2.5E+03	1.5E+01		1.2E+01
Benzo(b)fluoranthene	1.5E+01	2.5E+03	1.5E+01		4.6E+01
Benzo(k)fluoranthene	2.7E+00	2.5E+03	1.5E+01		2.7E+00
Benzo(g,h,i)perylene	3.5E+01	2.5E+03	1.1E+04		3.5E+01
Benzo(a)pyrene	1.5E+00	2.5E+03	1.5E+00		1.8E+02
Beryllium	9.8E+01	5.0E+03	9.8E+01		
1,1-Biphenyl	6.5E-01	2.5E+03	2.0E+04	(Use soil gas)	6.5E-01
Bis(2-chloroethyl) ether	4.0E-04	2.5E+03	9.6E+00	(Use soil gas)	4.0E-04
Bis(2-chloroisopropyl) ether	1.5E-04	7.9E+02	2.5E+00	(Use soil gas)	1.5E-04
Bis(2-ethylhexyl) phthalate	7.8E+02	2.5E+03	1.4E+03		7.8E+02
Boron	4.6E+04	no criteria	4.6E+04		
Bromodichloromethane	1.9E+00	4.8E+03	4.9E+01	(Use soil gas)	1.9E+00
Bromoform (Tribromomethane)	2.2E+00	2.5E+03	2.6E+03		2.2E+00
Bromomethane	3.9E-01	2.5E+03	2.8E+01	(Use soil gas)	3.9E-01
Cadmium	3.9E+01	5.0E+03	3.9E+01		
Carbon tetrachloride	1.1E-01	1.1E+03	1.9E+00	(Use soil gas)	1.1E-01
Chlordane	1.5E+01	5.0E+03	2.1E+01		1.5E+01
p-Chloroaniline	3.0E-01	5.0E+03	1.6E+03		3.0E-01
Chlorobenzene	3.0E+00	6.8E+02	6.8E+02	(Use soil gas)	3.0E+00
Chloroethane	8.5E-01	1.6E+03	4.2E+02	(Use soil gas)	8.5E-01
Chloroform	2.1E+00	2.5E+03	6.0E+01	(Use soil gas)	2.1E+00
Chloromethane	6.4E+00	1.0E+03	3.1E+02	(Use soil gas)	6.4E+00
2-Chlorophenol	1.2E-02	1.0E+03	2.9E+02	(Use soil gas)	1.2E-02
Chromium (total)	5.0E+03	5.0E+03	-		
Chromium III	5.0E+03	5.0E+03	1.1E+06		
Chromium VI	5.3E-01	5.0E+03	5.3E-01		
Chrysene	5.3E+01	5.0E+03	2.4E+03		5.3E+01
Cobalt	9.4E+01	5.0E+03	9.4E+01		
Copper	5.0E+03	5.0E+03	2.8E+05		
Cyanide	5.4E-01	1.0E+03	1.3E+03		5.4E-01
Dibenz(a,h)anthracene	2.4E+00	2.5E+03	2.4E+00		9.9E+00
Dibromochloromethane	8.3E+00	1.0E+03	2.4E+02	(Use soil gas)	8.3E+00
1,2-dibromo-3-chloropropane	4.5E-03	1.1E+03	2.9E+00	(Use soil gas)	4.5E-03
1,2-Dibromoethane	3.3E-04	2.5E+03	1.5E+00	(Use soil gas)	3.3E-04
1,2-Dichlorobenzene	1.1E+00	6.0E+02	6.0E+02	(Use soil gas)	1.1E+00
1,3-Dichlorobenzene	2.4E+01	6.0E+02	6.0E+02	(Use soil gas)	2.4E+01
1,4-Dichlorobenzene	5.9E-01	2.5E+03	1.0E+02	(Use soil gas)	5.9E-01

Table C-2. [1]Deep Soil Screening Levels (>3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
3,3-Dichlorobenzidine	7.7E-03	2.5E+03	1.7E+01		7.7E-03
Dichlorodiphenyldichloroethane (DDD)	1.1E+02	2.5E+03	1.1E+02		7.5E+02
Dichlorodiphenyldichloroethene (DDE)	7.6E+01	2.5E+03	7.6E+01		1.1E+03
Dichlorodiphenyltrichloroethane (DDT)	4.3E+00	5.0E+03	7.6E+01		4.3E+00
1,1-Dichloroethane	2.0E-01	1.7E+03	2.0E+02	(Use soil gas)	2.0E-01
1,2-Dichloroethane	4.5E-03	1.8E+03	2.0E+01	(Use soil gas)	4.5E-03
1,1-Dichloroethene	1.0E+00	1.5E+03	3.6E+00	(Use soil gas)	1.0E+00
cis -1,2-Dichloroethene	1.9E-01	1.0E+03	2.6E+02	(Use soil gas)	1.9E-01
trans -1,2-Dichloroethene	6.7E-01	2.5E+03	4.1E+02	(Use soil gas)	6.7E-01
2,4-Dichlorophenol	3.0E-01	2.5E+03	1.2E+03		3.0E-01
1,2-Dichloropropane	1.2E-01	1.0E+03	3.7E+01	(Use soil gas)	1.2E-01
1,3-Dichloropropene	5.9E-02	1.4E+03	1.5E+01	(Use soil gas)	5.9E-02
Dieldrin	2.7E-03	5.0E+03	1.6E+00		2.7E-03
Diethyl phthalate	1.3E+02	2.5E+03	3.2E+05		1.3E+02
Dimethyl phthalate	1.2E+03	2.5E+03	4.0E+06		1.2E+03
2,4-Dimethylphenol	6.7E-01	1.0E+03	8.2E+03	(Use soil gas)	6.7E-01
2,4-Dinitrophenol	4.0E-01	2.5E+03	6.7E+03		4.0E-01
2,4-Dinitrotoluene	3.9E-04	2.5E+03	3.0E+01		3.9E-04
1,4-Dioxane	1.8E-03	2.5E+03	7.4E+02		1.8E-03
Dioxin (2,3,7,8-TCDD)	2.4E-04	no criteria	2.4E-04		
Endosulfan	2.2E+01	2.5E+03	2.4E+03		2.2E+01
Endrin	5.6E-01	2.5E+03	1.6E+02		5.6E-01
Ethylbenzene	3.3E+00	4.0E+02	4.0E+02	(Use soil gas)	3.3E+00
Fluoranthene	8.4E+02	2.5E+03	1.4E+04		8.4E+02
Fluorene	6.4E+02	2.5E+03	1.4E+04	(Use soil gas)	6.4E+02
Heptachlor	3.7E-02	5.0E+03	5.8E+00		3.7E-02
Heptachlor epoxide	3.8E-02	5.0E+03	2.2E+00		3.8E-02
Hexachlorobenzene	1.2E+01	2.5E+03	1.2E+01		7.9E+02
Hexachlorobutadiene	2.2E+00	2.5E+03	8.0E+01		2.2E+00
γ-Hexachlorocyclohexane (Lindane)	1.2E-01	2.5E+03	1.6E+02		1.2E-01
Hexachloroethane	3.0E+00	2.5E+03	4.0E+02		3.0E+00
Indeno(1,2,3-c,d)pyrene	1.3E+01	2.5E+03	2.4E+01		1.3E+01
Lead	7.5E+02	5.0E+03	7.5E+02		
Mercury (elemental)	3.3E+01	2.5E+03	3.3E+01	(Use soil gas)	
Methoxychlor	2.6E+02	2.5E+03	-		2.6E+02
Methylene chloride	7.7E-02	2.4E+03	5.2E+02	(Use soil gas)	7.7E-02
Methyl ethyl ketone	3.9E+00	2.5E+03	3.4E+04	(Use soil gas)	3.9E+00
Methyl isobutyl ketone	2.8E+00	1.0E+03	1.7E+04	(Use soil gas)	2.8E+00
Methyl mercury	4.1E+01	1.0E+03	4.1E+01		
2-Methylnaphthalene	1.2E+00	2.5E+03	1.6E+03	(Use soil gas)	1.2E+00
tert -Butyl methyl ether	2.3E-02	1.0E+03	2.6E+03	(Use soil gas)	2.3E-02
Molybdenum	3.6E+03	5.0E+03	3.6E+03		
Naphthalene	3.4E+00	2.5E+03	1.3E+02	(Use soil gas)	3.4E+00
Nickel	2.6E+02	5.0E+03	2.6E+02		
Pentachlorophenol	9.9E+01	2.5E+03	9.9E+01		2.7E+06
Perchlorate	5.0E+02	5.0E+03	5.0E+02		

Table C-2. [1]Deep Soil Screening Levels (>3m bgs)
Commercial/Industrial Land Use
(potentially contaminated groundwater IS a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Phenanthrene	4.9E+02	2.5E+03	1.2E+04	(Use soil gas)	4.9E+02
Phenol	7.6E-02	2.5E+03	1.2E+05		7.6E-02
Polychlorinated biphenyls (PCBs)	3.4E+00	2.5E+03	3.4E+00		6.3E+00
Pyrene	1.2E+03	2.5E+03	2.3E+04	(Use soil gas)	1.2E+03
Selenium	3.6E+03	5.0E+03	3.6E+03		
Silver	3.6E+03	5.0E+03	3.6E+03		
Styrene	1.5E+00	1.5E+03	1.5E+03	(Use soil gas)	1.5E+00
tert -Butyl alcohol		1.0E+03	3.2E+05	(Use soil gas)	
1,1,1,2-Tetrachloroethane	2.4E-02	1.0E+03	1.7E+02	(Use soil gas)	2.4E-02
1,1,2,2-Tetrachloroethane	1.8E-02	1.7E+03	2.2E+01	(Use soil gas)	1.8E-02
Tetrachloroethene	7.0E-01	2.3E+02	2.2E+01	(Use soil gas)	7.0E-01
Thallium	5.7E+01	5.0E+03	5.7E+01		
Toluene	2.9E+00	6.5E+02	6.5E+02	(Use soil gas)	2.9E+00
Toxaphene	6.4E+00	2.5E+03	2.2E+01		6.4E+00
TPH (gasolines)	8.3E+01	5.0E+03	4.2E+03	(Use soil gas)	8.3E+01
TPH (middle distillates)	8.3E+01	5.0E+03	1.5E+02	(Use soil gas)	8.3E+01
TPH (residual fuels)	5.0E+03	5.0E+03	1.5E+04		
1,2,4-Trichlorobenzene	1.5E+00	2.5E+03	3.1E+02	(Use soil gas)	1.5E+00
1,1,1-Trichloroethane	2.5E+01	1.2E+03	1.2E+03	(Use soil gas)	2.5E+01
1,1,2-Trichloroethane	7.0E-02	1.0E+03	4.3E+01	(Use soil gas)	7.0E-02
Trichloroethene	4.6E-01	1.3E+03	1.2E+02	(Use soil gas)	4.6E-01
2,4,5-Trichlorophenol	3.2E+00	1.0E+03	1.4E+04	(Use soil gas)	3.2E+00
2,4,6-Trichlorophenol	2.3E-01	2.5E+03	4.1E+01		2.3E-01
Vanadium	7.1E+02	5.0E+03	7.1E+02		
Vinyl chloride	8.5E-02	2.5E+03	1.9E+00	(Use soil gas)	8.5E-02
Xylenes	2.3E+00	4.2E+02	4.2E+02	(Use soil gas)	2.3E+00
Zinc	5.0E+03	5.0E+03	2.1E+05		

Notes:

1. Deep soils defined as soils situated >3 meters below ground surface (or shallower with institutional controls).

Final Environmental Screening Level is lowest of ceiling values (nuisance concerns etc.), direct-exposure, indoor-air impact, and leaching screening levels.

Soil data should be reported on dry-weight basis.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table D-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Acenaphthene	1.6E+02	2.5E+03	1.8E+04	(Use soil gas)	1.6E+02
Acenaphthylene	8.3E+02	1.0E+03	1.2E+04	(Use soil gas)	8.3E+02
Acetone	1.7E+01	1.0E+03	1.0E+05	(Use soil gas)	1.7E+01
Aldrin	1.5E+00	2.5E+03	1.5E+00		6.9E+01
Anthracene	8.5E+01	1.0E+03	1.1E+05	(Use soil gas)	8.5E+01
Antimony	2.8E+02	2.5E+03	2.8E+02		
Arsenic	1.4E+01	2.5E+03	1.4E+01		
Barium	2.5E+03	2.5E+03	2.6E+03		
Benzene	1.1E+01	8.7E+02	1.1E+01	(Use soil gas)	2.4E+01
Benzo(a)anthracene	1.5E+01	1.0E+03	1.5E+01		1.7E+02
Benzo(b)fluoranthene	1.5E+01	1.0E+03	1.5E+01		6.4E+02
Benzo(k)fluoranthene	1.5E+01	1.0E+03	1.5E+01		3.7E+01
Benzo(g,h,i)perylene	3.5E+01	1.0E+03	1.1E+04		3.5E+01
Benzo(a)pyrene	1.5E+00	1.0E+03	1.5E+00		1.7E+03
Beryllium	9.8E+01	2.5E+03	9.8E+01		
1,1-Biphenyl	6.5E+00	1.0E+03	2.0E+04	(Use soil gas)	6.5E+00
Bis(2-chloroethyl) ether	8.2E-01	1.0E+03	9.6E+00	(Use soil gas)	8.2E-01
Bis(2-chloroisopropyl) ether	2.5E+00	7.9E+02	2.5E+00	(Use soil gas)	3.5E+01
Bis(2-ethylhexyl) phthalate	1.0E+03	1.0E+03	1.4E+03		1.1E+04
Boron	4.6E+04	no criteria	4.6E+04		
Bromodichloromethane	3.2E+00	2.5E+03	4.9E+01	(Use soil gas)	3.2E+00
Bromoform (Tribromomethane)	1.1E+02	1.0E+03	2.6E+03		1.1E+02
Bromomethane	2.3E+01	1.0E+03	2.8E+01	(Use soil gas)	2.3E+01
Cadmium	3.9E+01	2.5E+03	3.9E+01		
Carbon tetrachloride	1.9E+00	1.0E+03	1.9E+00	(Use soil gas)	2.0E+00
Chlordane	2.1E+01	2.5E+03	2.1E+01		1.8E+02
p-Chloroaniline	5.3E+02	2.5E+03	1.6E+03		5.3E+02
Chlorobenzene	3.0E+01	6.8E+02	6.8E+02	(Use soil gas)	3.0E+01
Chloroethane	1.1E+01	1.0E+03	4.2E+02	(Use soil gas)	1.1E+01

Table D-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Chloroform	9.8E+00	1.0E+03	6.0E+01	(Use soil gas)	9.8E+00
Chloromethane	6.4E+00	5.0E+02	3.1E+02	(Use soil gas)	6.4E+00
2-Chlorophenol	1.2E-01	5.0E+02	2.9E+02	(Use soil gas)	1.2E-01
Chromium (total)	2.5E+03	2.5E+03	-		
Chromium III	2.5E+03	2.5E+03	1.1E+06		
Chromium VI	5.3E-01	2.5E+03	5.3E-01		
Chrysene	5.3E+01	2.5E+03	2.4E+03		5.3E+01
Cobalt	9.4E+01	2.5E+03	9.4E+01		
Copper	2.5E+03	2.5E+03	2.8E+05		
Cyanide	6.2E+00	5.0E+02	1.3E+03		6.2E+00
Dibenz(a,h)anthracene	2.4E+00	1.0E+03	2.4E+00		1.4E+02
Dibromochloromethane	1.4E+01	5.0E+02	2.4E+02	(Use soil gas)	1.4E+01
1,2-dibromo-3-chloropropane	2.2E+00	1.0E+03	2.9E+00	(Use soil gas)	2.2E+00
1,2-Dibromoethane	1.0E+00	1.0E+03	1.5E+00	(Use soil gas)	1.0E+00
1,2-Dichlorobenzene	1.1E+01	6.0E+02	6.0E+02	(Use soil gas)	1.1E+01
1,3-Dichlorobenzene	6.0E+02	6.0E+02	6.0E+02	(Use soil gas)	5.7E+03
1,4-Dichlorobenzene	1.3E+01	1.0E+03	1.0E+02	(Use soil gas)	1.3E+01
3,3-Dichlorobenzidine	1.7E+01	1.0E+03	1.7E+01		4.1E+02
Dichlorodiphenyldichloroethane (DDD)	1.1E+02	1.0E+03	1.1E+02		1.0E+04
Dichlorodiphenyldichloroethene (DDE)	7.6E+01	1.0E+03	7.6E+01		1.5E+04
Dichlorodiphenyltrichloroethane (DDT)	6.0E+01	2.5E+03	7.6E+01		6.0E+01
1,1-Dichloroethane	4.1E+01	1.0E+03	2.0E+02	(Use soil gas)	4.1E+01
1,2-Dichloroethane	1.8E+00	1.0E+03	2.0E+01	(Use soil gas)	1.8E+00
1,1-Dichloroethene	3.6E+00	1.0E+03	3.6E+00	(Use soil gas)	1.1E+03
cis -1,2-Dichloroethene	1.9E+02	5.0E+02	2.6E+02	(Use soil gas)	1.9E+02
trans -1,2-Dichloroethene	1.7E+02	1.0E+03	4.1E+02	(Use soil gas)	1.7E+02
2,4-Dichlorophenol	3.0E+00	1.0E+03	1.2E+03		3.0E+00
1,2-Dichloropropane	2.5E+00	5.0E+02	3.7E+01	(Use soil gas)	2.5E+00
1,3-Dichloropropene	6.2E+00	1.0E+03	1.5E+01	(Use soil gas)	6.2E+00

Table D-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Dieldrin	1.6E+00	2.5E+03	1.6E+00		1.1E+02
Diethyl phthalate	1.0E+03	1.0E+03	3.2E+05		1.2E+03
Dimethyl phthalate	1.0E+03	1.0E+03	4.0E+06		1.2E+03
2,4-Dimethylphenol	2.7E+01	5.0E+02	8.2E+03	(Use soil gas)	2.7E+01
2,4-Dinitrophenol	1.4E+02	1.0E+03	6.7E+03		1.4E+02
2,4-Dinitrotoluene	3.0E+01	1.0E+03	3.0E+01		3.7E+02
1,4-Dioxane	3.0E+01	1.0E+03	7.4E+02		3.0E+01
Dioxin (2,3,7,8-TCDD)	2.4E-04	no criteria	2.4E-04		
Endosulfan	4.0E+01	1.0E+03	2.4E+03		4.0E+01
Endrin	3.7E+01	1.0E+03	1.6E+02		3.7E+01
Ethylbenzene	3.3E+01	4.0E+02	4.0E+02	(Use soil gas)	3.3E+01
Fluoranthene	8.4E+02	1.0E+03	1.4E+04		8.4E+02
Fluorene	1.0E+03	1.0E+03	1.4E+04	(Use soil gas)	2.2E+03
Heptachlor	5.8E+00	2.5E+03	5.8E+00		1.0E+02
Heptachlor epoxide	2.2E+00	2.5E+03	2.2E+00		6.7E+02
Hexachlorobenzene	1.2E+01	1.0E+03	1.2E+01		1.1E+04
Hexachlorobutadiene	8.0E+01	1.0E+03	8.0E+01		3.0E+02
γ-Hexachlorocyclohexane (Lindane)	1.6E+02	1.0E+03	1.6E+02		2.1E+03
Hexachloroethane	3.4E+02	1.0E+03	4.0E+02		3.4E+02
Indeno(1,2,3-c,d)pyrene	2.4E+01	1.0E+03	2.4E+01		7.0E+01
Lead	7.5E+02	2.5E+03	7.5E+02		
Mercury (elemental)	3.3E+01	1.0E+03	3.3E+01	(Use soil gas)	
Methoxychlor	2.6E+02	1.0E+03	-		2.6E+02
Methylene chloride	3.7E+01	1.0E+03	5.2E+02	(Use soil gas)	3.7E+01
Methyl ethyl ketone	4.6E+01	1.0E+03	3.4E+04	(Use soil gas)	4.6E+01
Methyl isobutyl ketone	3.0E+02	5.0E+02	1.7E+04	(Use soil gas)	3.0E+02
Methyl mercury	4.1E+01	5.0E+02	4.1E+01		
2-Methylnaphthalene	1.2E+01	1.0E+03	1.6E+03	(Use soil gas)	1.2E+01
tert -Butyl methyl ether	8.4E+00	5.0E+02	2.6E+03	(Use soil gas)	8.4E+00

Table D-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Molybdenum	2.5E+03	2.5E+03	3.6E+03		
Naphthalene	4.2E+01	1.0E+03	1.3E+02	(Use soil gas)	4.2E+01
Nickel	2.6E+02	2.5E+03	2.6E+02		
Pentachlorophenol	9.9E+01	1.0E+03	9.9E+01		2.7E+06
Perchlorate	5.0E+02	2.5E+03	5.0E+02		
Phenanthrene	9.5E+02	1.0E+03	1.2E+04	(Use soil gas)	9.5E+02
Phenol	7.6E+02	1.0E+03	1.2E+05		7.6E+02
Polychlorinated biphenyls (PCBs)	3.4E+00	1.0E+03	3.4E+00		8.8E+01
Pyrene	1.0E+03	1.0E+03	2.3E+04	(Use soil gas)	1.2E+03
Selenium	2.5E+03	2.5E+03	3.6E+03		
Silver	2.5E+03	2.5E+03	3.6E+03		
Styrene	1.6E+01	1.0E+03	1.5E+03	(Use soil gas)	1.6E+01
tert -Butyl alcohol	3.1E+02	5.0E+02	3.2E+05	(Use soil gas)	3.1E+02
1,1,1,2-Tetrachloroethane	1.7E+02	5.0E+02	1.7E+02	(Use soil gas)	8.8E+02
1,1,2,2-Tetrachloroethane	3.4E+00	1.0E+03	2.2E+01	(Use soil gas)	3.4E+00
Tetrachloroethene	1.7E+01	2.3E+02	2.2E+01	(Use soil gas)	1.7E+01
Thallium	5.7E+01	2.5E+03	5.7E+01		
Toluene	2.9E+01	6.5E+02	6.5E+02	(Use soil gas)	2.9E+01
Toxaphene	2.2E+01	1.0E+03	2.2E+01		3.0E+02
TPH (gasolines)	4.2E+03	5.0E+03	4.2E+03	(Use soil gas)	4.2E+03
TPH (middle distillates)	1.5E+02	5.0E+03	1.5E+02	(Use soil gas)	2.1E+03
TPH (residual fuels)	5.0E+03	5.0E+03	1.5E+04		
1,2,4-Trichlorobenzene	3.1E+02	1.0E+03	3.1E+02	(Use soil gas)	7.7E+02
1,1,1-Trichloroethane	1.0E+03	1.0E+03	1.2E+03	(Use soil gas)	6.3E+03
1,1,2-Trichloroethane	4.8E+00	5.0E+02	4.3E+01	(Use soil gas)	4.8E+00
Trichloroethene	4.9E+01	1.0E+03	1.2E+02	(Use soil gas)	4.9E+01
2,4,5-Trichlorophenol	3.2E+01	5.0E+02	1.4E+04	(Use soil gas)	3.2E+01
2,4,6-Trichlorophenol	4.1E+01	1.0E+03	4.1E+01		3.3E+02
Vanadium	7.1E+02	2.5E+03	7.1E+02		

Table D-1. [1]Deep Soil Screening Levels (>3m bgs)
[2]Residential Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	[2]Residential Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Vinyl chloride	6.6E-01	1.0E+03	1.9E+00	(Use soil gas)	6.6E-01
Xylenes	4.2E+02	4.2E+02	4.2E+02	(Use soil gas)	6.0E+02
Zinc	2.5E+03	2.5E+03	2.1E+05		

Notes:
1. Deep soils defined as soils situated >3 meters below ground surface (or shallower with institutional controls).
2. "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

Final Environmental Screening Level is lowest of ceiling values (nuisance concerns etc.), direct-exposure, indoor-air impact, and leaching screening levels.

Soil data should be reported on dry-weight basis (see Section 6.2).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table D-2. [1]Deep Soil Screening Levels (>3m bgs)
Commerical/Industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
			Human Health		Groundwater Protection (Soil Leaching)
		Gross Contamination Ceiling Value (Odors, etc.)	Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Acenaphthene	1.6E+02	5.0E+03	1.8E+04	(Use soil gas)	1.6E+02
Acenaphthylene	8.3E+02	2.5E+03	1.2E+04	(Use soil gas)	8.3E+02
Acetone	1.7E+01	2.5E+03	1.0E+05	(Use soil gas)	1.7E+01
Aldrin	1.5E+00	5.0E+03	1.5E+00		6.9E+01
Anthracene	8.5E+01	2.5E+03	1.1E+05	(Use soil gas)	8.5E+01
Antimony	2.8E+02	5.0E+03	2.8E+02		
Arsenic	1.4E+01	5.0E+03	1.4E+01		
Barium	2.6E+03	5.0E+03	2.6E+03		
Benzene	1.1E+01	8.7E+02	1.1E+01	(Use soil gas)	2.4E+01
Benzo(a)anthracene	1.5E+01	2.5E+03	1.5E+01		1.7E+02
Benzo(b)fluoranthene	1.5E+01	2.5E+03	1.5E+01		6.4E+02
Benzo(k)fluoranthene	1.5E+01	2.5E+03	1.5E+01		3.7E+01
Benzo(g,h,i)perylene	3.5E+01	2.5E+03	1.1E+04		3.5E+01
Benzo(a)pyrene	1.5E+00	2.5E+03	1.5E+00		1.7E+03
Beryllium	9.8E+01	5.0E+03	9.8E+01		
1,1-Biphenyl	6.5E+00	2.5E+03	2.0E+04	(Use soil gas)	6.5E+00
Bis(2-chloroethyl) ether	8.2E-01	2.5E+03	9.6E+00	(Use soil gas)	8.2E-01
Bis(2-chloroisopropyl) ether	2.5E+00	7.9E+02	2.5E+00	(Use soil gas)	3.5E+01
Bis(2-ethylhexyl) phthalate	1.4E+03	2.5E+03	1.4E+03		1.1E+04
Boron	4.6E+04	no criteria	4.6E+04		
Bromodichloromethane	3.2E+00	4.8E+03	4.9E+01	(Use soil gas)	3.2E+00
Bromoform (Tribromomethane)	1.1E+02	2.5E+03	2.6E+03		1.1E+02
Bromomethane	2.3E+01	2.5E+03	2.8E+01	(Use soil gas)	2.3E+01
Cadmium	3.9E+01	5.0E+03	3.9E+01		
Carbon tetrachloride	1.9E+00	1.1E+03	1.9E+00	(Use soil gas)	2.0E+00
Chlordane	2.1E+01	5.0E+03	2.1E+01		1.8E+02
p-Chloroaniline	5.3E+02	5.0E+03	1.6E+03		5.3E+02
Chlorobenzene	3.0E+01	6.8E+02	6.8E+02	(Use soil gas)	3.0E+01
Chloroethane	1.1E+01	1.6E+03	4.2E+02	(Use soil gas)	1.1E+01
Chloroform	9.8E+00	2.5E+03	6.0E+01	(Use soil gas)	9.8E+00

Table D-2. [1]Deep Soil Screening Levels (>3m bgs)
Commerical/Industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Chloromethane	6.4E+00	1.0E+03	3.1E+02	(Use soil gas)	6.4E+00
2-Chlorophenol	1.2E-01	1.0E+03	2.9E+02	(Use soil gas)	1.2E-01
Chromium (total)	5.0E+03	5.0E+03	-		
Chromium III	5.0E+03	5.0E+03	1.1E+06		
Chromium VI	5.3E-01	5.0E+03	5.3E-01		
Chrysene	5.3E+01	5.0E+03	2.4E+03		5.3E+01
Cobalt	9.4E+01	5.0E+03	9.4E+01		
Copper	5.0E+03	5.0E+03	2.8E+05		
Cyanide	6.2E+00	1.0E+03	1.3E+03		6.2E+00
Dibenz(a,h)anthracene	2.4E+00	2.5E+03	2.4E+00		1.4E+02
Dibromochloromethane	1.4E+01	1.0E+03	2.4E+02	(Use soil gas)	1.4E+01
1,2-dibromo-3-chloropropane	2.2E+00	1.1E+03	2.9E+00	(Use soil gas)	2.2E+00
1,2-Dibromoethane	1.0E+00	2.5E+03	1.5E+00	(Use soil gas)	1.0E+00
1,2-Dichlorobenzene	1.1E+01	6.0E+02	6.0E+02	(Use soil gas)	1.1E+01
1,3-Dichlorobenzene	6.0E+02	6.0E+02	6.0E+02	(Use soil gas)	5.7E+03
1,4-Dichlorobenzene	1.3E+01	2.5E+03	1.0E+02	(Use soil gas)	1.3E+01
3,3-Dichlorobenzidine	1.7E+01	2.5E+03	1.7E+01		4.1E+02
Dichlorodiphenyldichloroethane (DDD)	1.1E+02	2.5E+03	1.1E+02		1.0E+04
Dichlorodiphenyldichloroethene (DDE)	7.6E+01	2.5E+03	7.6E+01		1.5E+04
Dichlorodiphenyltrichloroethane (DDT)	6.0E+01	5.0E+03	7.6E+01		6.0E+01
1,1-Dichloroethane	4.1E+01	1.7E+03	2.0E+02	(Use soil gas)	4.1E+01
1,2-Dichloroethane	1.8E+00	1.8E+03	2.0E+01	(Use soil gas)	1.8E+00
1,1-Dichloroethene	3.6E+00	1.5E+03	3.6E+00	(Use soil gas)	1.1E+03
cis -1,2-Dichloroethene	1.9E+02	1.0E+03	2.6E+02	(Use soil gas)	1.9E+02
trans -1,2-Dichloroethene	1.7E+02	2.5E+03	4.1E+02	(Use soil gas)	1.7E+02
2,4-Dichlorophenol	3.0E+00	2.5E+03	1.2E+03		3.0E+00
1,2-Dichloropropane	2.5E+00	1.0E+03	3.7E+01	(Use soil gas)	2.5E+00
1,3-Dichloropropene	6.2E+00	1.4E+03	1.5E+01	(Use soil gas)	6.2E+00
Dieldrin	1.6E+00	5.0E+03	1.6E+00		1.1E+02
Diethyl phthalate	1.2E+03	2.5E+03	3.2E+05		1.2E+03

Table D-2. [1]Deep Soil Screening Levels (>3m bgs)
Commerical/Industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Dimethyl phthalate	1.2E+03	2.5E+03	4.0E+06		1.2E+03
2,4-Dimethylphenol	2.7E+01	1.0E+03	8.2E+03	(Use soil gas)	2.7E+01
2,4-Dinitrophenol	1.4E+02	2.5E+03	6.7E+03		1.4E+02
2,4-Dinitrotoluene	3.0E+01	2.5E+03	3.0E+01		3.7E+02
1,4-Dioxane	3.0E+01	2.5E+03	7.4E+02		3.0E+01
Dioxin (2,3,7,8-TCDD)	2.4E-04	no criteria	2.4E-04		
Endosulfan	4.0E+01	2.5E+03	2.4E+03		4.0E+01
Endrin	3.7E+01	2.5E+03	1.6E+02		3.7E+01
Ethylbenzene	3.3E+01	4.0E+02	4.0E+02	(Use soil gas)	3.3E+01
Fluoranthene	8.4E+02	2.5E+03	1.4E+04		8.4E+02
Fluorene	2.2E+03	2.5E+03	1.4E+04	(Use soil gas)	2.2E+03
Heptachlor	5.8E+00	5.0E+03	5.8E+00		1.0E+02
Heptachlor epoxide	2.2E+00	5.0E+03	2.2E+00		6.7E+02
Hexachlorobenzene	1.2E+01	2.5E+03	1.2E+01		1.1E+04
Hexachlorobutadiene	8.0E+01	2.5E+03	8.0E+01		3.0E+02
γ-Hexachlorocyclohexane (Lindane)	1.6E+02	2.5E+03	1.6E+02		2.1E+03
Hexachloroethane	3.4E+02	2.5E+03	4.0E+02		3.4E+02
Indeno(1,2,3-c,d)pyrene	2.4E+01	2.5E+03	2.4E+01		7.0E+01
Lead	7.5E+02	5.0E+03	7.5E+02		
Mercury (elemental)	3.3E+01	2.5E+03	3.3E+01	(Use soil gas)	
Methoxychlor	2.6E+02	2.5E+03	-		2.6E+02
Methylene chloride	3.7E+01	2.4E+03	5.2E+02	(Use soil gas)	3.7E+01
Methyl ethyl ketone	4.6E+01	2.5E+03	3.4E+04	(Use soil gas)	4.6E+01
Methyl isobutyl ketone	3.0E+02	1.0E+03	1.7E+04	(Use soil gas)	3.0E+02
Methyl mercury	4.1E+01	1.0E+03	4.1E+01		
2-Methylnaphthalene	1.2E+01	2.5E+03	1.6E+03	(Use soil gas)	1.2E+01
tert-Butyl methyl ether	8.4E+00	1.0E+03	2.6E+03	(Use soil gas)	8.4E+00
Molybdenum	3.6E+03	5.0E+03	3.6E+03		
Naphthalene	4.2E+01	2.5E+03	1.3E+02	(Use soil gas)	4.2E+01
Nickel	2.6E+02	5.0E+03	2.6E+02		

Table D-2. [1]Deep Soil Screening Levels (>3m bgs)
Commerical/Industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**
Pentachlorophenol	9.9E+01	2.5E+03	9.9E+01		2.7E+06
Perchlorate	5.0E+02	5.0E+03	5.0E+02		
Phenanthrene	9.5E+02	2.5E+03	1.2E+04	(Use soil gas)	9.5E+02
Phenol	7.6E+02	2.5E+03	1.2E+05		7.6E+02
Polychlorinated biphenyls (PCBs)	3.4E+00	2.5E+03	3.4E+00		8.8E+01
Pyrene	1.2E+03	2.5E+03	2.3E+04	(Use soil gas)	1.2E+03
Selenium	3.6E+03	5.0E+03	3.6E+03		
Silver	3.6E+03	5.0E+03	3.6E+03		
Styrene	1.6E+01	1.5E+03	1.5E+03	(Use soil gas)	1.6E+01
tert -Butyl alcohol	3.1E+02	1.0E+03	3.2E+05	(Use soil gas)	3.1E+02
1,1,1,2-Tetrachloroethane	1.7E+02	1.0E+03	1.7E+02	(Use soil gas)	8.8E+02
1,1,2,2-Tetrachloroethane	3.4E+00	1.7E+03	2.2E+01	(Use soil gas)	3.4E+00
Tetrachloroethene	1.7E+01	2.3E+02	2.2E+01	(Use soil gas)	1.7E+01
Thallium	5.7E+01	5.0E+03	5.7E+01		
Toluene	2.9E+01	6.5E+02	6.5E+02	(Use soil gas)	2.9E+01
Toxaphene	2.2E+01	2.5E+03	2.2E+01		3.0E+02
TPH (gasolines)	4.2E+03	5.0E+03	4.2E+03	(Use soil gas)	4.2E+03
TPH (middle distillates)	1.5E+02	5.0E+03	1.5E+02	(Use soil gas)	2.1E+03
TPH (residual fuels)	5.0E+03	5.0E+03	1.5E+04		
1,2,4-Trichlorobenzene	3.1E+02	2.5E+03	3.1E+02	(Use soil gas)	7.7E+02
1,1,1-Trichloroethane	1.2E+03	1.2E+03	1.2E+03	(Use soil gas)	6.3E+03
1,1,2-Trichloroethane	4.8E+00	1.0E+03	4.3E+01	(Use soil gas)	4.8E+00
Trichloroethene	4.9E+01	1.3E+03	1.2E+02	(Use soil gas)	4.9E+01
2,4,5-Trichlorophenol	3.2E+01	1.0E+03	1.4E+04	(Use soil gas)	3.2E+01
2,4,6-Trichlorophenol	4.1E+01	2.5E+03	4.1E+01		3.3E+02
Vanadium	7.1E+02	5.0E+03	7.1E+02		
Vinyl chloride	6.6E-01	2.5E+03	1.9E+00	(Use soil gas)	6.6E-01
Xylenes	4.2E+02	4.2E+02	4.2E+02	(Use soil gas)	6.0E+02
Zinc	5.0E+03	5.0E+03	2.1E+05		

Table D-2. [1]Deep Soil Screening Levels (>3m bgs)
Commerical/Industrial Land Use
(potentially contaminated groundwater IS NOT a current or potential drinking water resource)

	Commercial/Industrial Land Use (mg/kg)				
		Gross Contamination Ceiling Value (Odors, etc.)	Human Health		Groundwater Protection (Soil Leaching)
			Direct Exposure	Vapor Intrusion Into Buildings	NON-Drinking Water Resource
Chemical	**Final ESL**	**Table H-3**	**Table K-3**		**Table G**

Notes:
1. Deep soils defined as soils situated >3 meters below ground surface (or shallower with institutional controls).

Final Environmental Screening Level is lowest of ceiling values (nuisance concerns etc.), direct-exposure, indoor-air impact, and leaching screening levels.

Soil data should be reported on dry-weight basis (see Section 6.2).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table E-1. Groundwater Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemical	Physical State		Residential Land Use (µg/L)	Commercial/Industrial Land Use (µg/L)
Acenaphthene	V	S	4.2E+03	4.2E+03
Acenaphthylene	V	S	(Use soil gas)	(Use soil gas)
Acetone	V	L	5.3E+07	1.5E+08
Aldrin	NV	S		
Anthracene	V	S	4.3E+01	4.3E+01
Antimony	NV	S		
Arsenic	NV	S		
Barium	NV	S		
Benzene	V	L	5.4E+02	1.8E+03
Benzo(a)anthracene	NV	S		
Benzo(b)fluoranthene	NV	S		
Benzo(k)fluoranthene	NV	S		
Benzo(g,h,i)perylene	NV	S		
Benzo(a)pyrene	NV	S		
Beryllium	NV	S		
1,1-Biphenyl	V	S	(Use soil gas)	(Use soil gas)
Bis(2-chloroethyl) ether	V	L	6.5E+01	2.2E+02
Bis(2-chloroisopropyl) ether	V	L	(Use soil gas)	(Use soil gas)
Bis(2-ethylhexyl) phthalate	NV	S		
Boron	NV	S		
Bromodichloromethane	V	L	1.7E+02	5.6E+02
Bromoform (Tribromomethane)	NV	S		
Bromomethane	V	G	5.8E+02	1.6E+03
Cadmium	NV	S		
Carbon tetrachloride	V	L	9.3E+00	3.1E+01
Chlordane	NV	S		
p-Chloroaniline	NV	S		
Chlorobenzene	V	L	1.3E+04	3.7E+04
Chloroethane	V	G	8.2E+02	2.7E+03
Chloroform	V	L	3.3E+02	1.1E+03
Chloromethane	V	G	4.1E+01	1.4E+02
2-Chlorophenol	V	L	5.3E+03	1.5E+04
Chromium (total)	NV	S		
Chromium III	NV	S		
Chromium VI	NV	S		
Chrysene	NV	S	(Use soil gas)	(Use soil gas)
Cobalt	NV	S		
Copper	NV	S		
Cyanide	NV	S	(Use soil gas)	(Use soil gas)
Dibenz(a,h)anthracene	NV	S		
Dibromochloromethane	V	S	1.7E+02	5.7E+02
1,2-dibromo-3-chloropropane	V	L	(Use soil gas)	(Use soil gas)
1,2-Dibromoethane	V	S	1.5E+02	5.1E+02
1,2-Dichlorobenzene	V	L	7.7E+04	1.6E+05
1,3-Dichlorobenzene	V	L	(Use soil gas)	(Use soil gas)
1,4-Dichlorobenzene	V	S	3.4E+02	1.1E+03
3,3-Dichlorobenzidine	NV	S		
Dichlorodiphenyldichloroethane (DDD)	NV	S		
Dichlorodiphenyldichloroethene (DDE)	NV	S		
Dichlorodiphenyltrichloroethane (DDT)	NV	S		
1,1-Dichloroethane	V	L	1.0E+03	3.4E+03
1,2-Dichloroethane	V	L	2.0E+02	6.9E+02

Table E-1. Groundwater Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemical	Physical State		Residential Land Use (µg/L)	Commercial/Industrial Land Use (µg/L)
1,1-Dichloroethene	V	L	6.3E+03	1.8E+04
cis -1,2-Dichloroethene	V	L	6.2E+03	1.7E+04
trans -1,2-Dichloroethene	V	L	6.7E+03	1.9E+04
2,4-Dichlorophenol	NV	S		
1,2-Dichloropropane	V	L	2.8E+02	9.3E+02
1,3-Dichloropropene	V	L	5.3E+01	1.8E+02
Dieldrin	NV	S		
Diethyl phthalate	NV	S		
Dimethyl phthalate	NV	S		
2,4-Dimethylphenol	V	S	2.5E+06	7.1E+06
2,4-Dinitrophenol	NV	S		
2,4-Dinitrotoluene	NV	S		
1,4-Dioxane	NV	L		
Dioxin (2,3,7,8-TCDD)	NV	S		
Endosulfan	NV	S		
Endrin	NV	S		
Ethylbenzene	V	L	1.7E+05	1.7E+05
Fluoranthene	NV	S		
Fluorene	V	S	1.9E+03	1.9E+03
Heptachlor	NV	S		
Heptachlor epoxide	NV	S		
Hexachlorobenzene	NV	S		
Hexachlorobutadiene	NV	S		
γ-Hexachlorocyclohexane (Lindane)	NV	S		
Hexachloroethane	NV	S		
Indeno(1,2,3-c,d)pyrene	NV	S		
Lead	NV	S		
Mercury (elemental)	V	S	(Use soil gas)	(Use soil gas)
Methoxychlor	NV	S		
Methylene chloride	V	L	2.4E+03	8.1E+03
Methyl ethyl ketone	V	L	2.4E+07	6.8E+07
Methyl isobutyl ketone	V	L	3.0E+06	8.4E+06
Methyl mercury	NV	S		
2-Methylnaphthalene	V	S	2.6E+04	2.6E+04
tert -Butyl methyl ether	V	L	2.4E+04	8.0E+04
Molybdenum	NV	S		
Naphthalene	V	S	3.2E+03	1.1E+04
Nickel	NV	S		
Pentachlorophenol	NV	S		
Perchlorate	NV	S		
Phenanthrene	V	S	(Use soil gas)	(Use soil gas)
Phenol	NV	S		
Polychlorinated biphenyls (PCBs)	NV	S		
Pyrene	V	S	1.4E+02	1.4E+02
Selenium	NV	S		
Silver	NV	S		
Styrene	V	L	3.1E+05	3.1E+05
tert -Butyl alcohol			(Use soil gas)	(Use soil gas)
1,1,1,2-Tetrachloroethane	V	L	(Use soil gas)	(Use soil gas)
1,1,2,2-Tetrachloroethane	V	L	1.9E+02	6.4E+02
Tetrachloroethene	V	L	1.2E+02	4.2E+02
Thallium	NV	S		

Table E-1. Groundwater Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemical	Physical State		Residential Land Use (µg/L)	Commercial/Industrial Land Use (µg/L)
Toluene	V	L	3.8E+05	5.3E+05
Toxaphene	NV	S		
TPH (gasolines)	V	L	(Use soil gas)	(Use soil gas)
TPH (middle distillates)	V	L	(Use soil gas)	(Use soil gas)
TPH (residual fuels)	NV	L/S		
1,2,4-Trichlorobenzene	V	L	2.5E+03	7.1E+03
1,1,1-Trichloroethane	V	L	1.3E+05	3.6E+05
1,1,2-Trichloroethane	V	L	3.5E+02	1.2E+03
Trichloroethene	V	L	5.3E+02	1.8E+03
2,4,5-Trichlorophenol	V	S	8.3E+05	1.2E+06
2,4,6-Trichlorophenol	NV	S		
Vanadium	NV	S		
Vinyl chloride	V	G	3.8E+00	1.3E+01
Xylenes	V	L	1.6E+05	1.6E+05
Zinc	NV	S		

Notes:

1. "Residential" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

2. High permeability soil model: One meter dry sandy soil (92% sand, 5% silt, 3% clay) over one meter moist clayey loam (33% sand, 34% silt, 33% clay).

Screening levels calculated using spreadhseet provided with *User's Guide for the Johnson and Ettinger Indoor Air model (1991) for Subsurface Vapor*

Intrusion Into Buildings (USEPA 2003). Assumed vadose-zone thickness/depth to groundwater three meters. See Appendix 1 text for model details.

Physical state of chemical at ambient conditions (V - volatile, NV - nonvolatile, S -id, L - liquid, G - gas).

Chemical considered to be "volatile" if Henry's Law constant (atm m3/mole) >0.00001 and molecular weight <200.

Dibromochloromethane, dibromochloropropane and pyrene considered volatile for purposes of modeling (USEPA 2004).
Target cancer risk = 1E-06, Target Hazard Quotient = 0.2

Table E-2. [1]Shallow Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemcial	Physical State		[2]Residential Exposure Lowest Residential (µg/m^3)	Carcinogenic Effects (µg/m^3)	Noncarcinogenic Effects (µg/m^3)	Commercial/Industrial Land Use Lowest C/I (µg/m^3)	Carcinogenic Effects (µg/m^3)	Noncarcinogenic Effects (µg/m^3)
Acenaphthene	V	S	4.4E+04		4.4E+04	1.2E+05		1.2E+05
Acenaphthylene	V	S	2.2E+04		2.2E+04	6.1E+04		6.1E+04
Acetone	V	L	6.6E+05		6.6E+05	1.8E+06		1.8E+06
Aldrin	NV	S						
Anthracene	V	S	2.2E+05		2.2E+05	6.1E+05		6.1E+05
Antimony	NV	S						
Arsenic	NV	S						
Barium	NV	S						
Benzene	V	L	8.4E+01	8.4E+01	6.3E+03	2.8E+02	2.8E+02	1.8E+04
Benzo(a)anthracene	NV	S						
Benzo(b)fluoranthene	NV	S						
Benzo(k)fluoranthene	NV	S						
Benzo(g,h,i)perylene	NV	S						
Benzo(a)pyrene	NV	S						
Beryllium	NV	S						
1,1-Biphenyl	V	S						
Bis(2-chloroethyl) ether	V	L	7.4E+00	7.4E+00		2.5E+01	2.5E+01	
Bis(2-chloroisopropyl) ether	V	L	3.4E+00	3.4E+00	2.9E+04	1.2E+01	1.2E+01	8.2E+04
Bis(2-ethylhexyl) phthalate	NV	S						
Boron	NV	S						
Bromodichloromethane	V	L	1.4E+02	1.4E+02	1.5E+04	4.6E+02	4.6E+02	4.1E+04
Bromoform (Tribromomethane)	NV	S						
Bromomethane	V	G	1.0E+03		1.0E+03	2.9E+03		2.9E+03
Cadmium	NV	S						
Carbon tetrachloride	V	L	1.9E+01	1.9E+01	8.3E+03	6.3E+01	6.3E+01	2.3E+04
Chlordane	NV	S						
p-Chloroaniline	NV	S						
Chlorobenzene	V	L	2.1E+05		2.1E+05	5.8E+05		5.8E+05
Chloroethane	V	G	2.1E+04		2.1E+04	5.8E+04		5.8E+04
Chloroform	V	L	4.6E+02	4.6E+02	6.3E+04	1.5E+03	1.5E+03	1.8E+05
Chloromethane	V	G	1.9E+04		1.9E+04	5.3E+04		5.3E+04
2-Chlorophenol	V	L	3.7E+03		3.7E+03	1.0E+04		1.0E+04
Chromium (total)	NV	S						
Chromium III	NV	S						
Chromium VI	NV	S						

Table E-2. [1]Shallow Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemcial	Physical State		[2]Residential Exposure			Commercial/Industrial Land Use		
			Lowest Residential	Carcinogenic Effects	Noncarcinogenic Effects	Lowest C/I	Carcinogenic Effects	Noncarcinogenic Effects
			(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)	(µg/m^3)
Chrysene	NV	S						
Cobalt	NV	S						
Copper	NV	S						
Cyanide	NV	S	1.5E+04		1.5E+04	4.1E+04		4.1E+04
Dibenz(a,h)anthracene	NV	S						
Dibromochloromethane	V	S						
1,2-dibromo-3-chloropropane	V	L	1.3E+00	1.3E+00	4.2E+01	4.3E+00	4.3E+00	1.2E+02
1,2-Dibromoethane	V	S	4.1E+00	4.1E+00	1.9E+03	1.4E+01	1.4E+01	5.3E+03
1,2-Dichlorobenzene	V	L	4.2E+04		4.2E+04	1.2E+05		1.2E+05
1,3-Dichlorobenzene	V	L	2.2E+04		2.2E+04	6.1E+04		6.1E+04
1,4-Dichlorobenzene	V	S	2.2E+02	2.2E+02	1.7E+05	7.4E+02	7.4E+02	4.7E+05
3,3-Dichlorobenzidine	NV	S						
Dichlorodiphenyldichloroethane (DDD)	NV	S						
Dichlorodiphenyldichloroethene (DDE)	NV	S						
Dichlorodiphenyltrichloroethane (DDT)	NV	S						
1,1-Dichloroethane	V	L	1.5E+03	1.5E+03	1.0E+05	5.1E+03	5.1E+03	2.9E+05
1,2-Dichloroethane	V	L	9.4E+01	9.4E+01	1.0E+03	3.1E+02	3.1E+02	2.9E+03
1,1-Dichloroethene	V	L	4.9E+01	4.9E+01	4.2E+04	1.6E+02	1.6E+02	1.2E+05
cis -1,2-Dichloroethene	V	L	7.3E+03		7.3E+03	2.0E+04		2.0E+04
trans -1,2-Dichloroethene	V	L	1.5E+04		1.5E+04	4.1E+04		4.1E+04
2,4-Dichlorophenol	NV	S						
1,2-Dichloropropane	V	L	2.4E+02	2.4E+02	8.3E+02	8.2E+02	8.2E+02	2.3E+03
1,3-Dichloropropene	V	L	1.5E+02	1.5E+02	4.2E+03	5.1E+02	5.1E+02	1.2E+04
Dieldrin	NV	S						
Diethyl phthalate	NV	S						
Dimethyl phthalate	NV	S						
2,4-Dimethylphenol	V	S						
2,4-Dinitrophenol	NV	S						
2,4-Dinitrotoluene	NV	S						
1,4-Dioxane	NV	L						
Dioxin (2,3,7,8-TCDD)	NV	S						
Endosulfan	NV	S						
Endrin	NV	S						
Ethylbenzene	V	L	2.1E+05		2.1E+05	5.8E+05		5.8E+05
Fluoranthene	NV	S						

Table E-2. [1]Shallow Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemcial	Physical State		[2]Residential Exposure			Commercial/Industrial Land Use		
			Lowest Residential ($\mu g/m^3$)	Carcinogenic Effects ($\mu g/m^3$)	Noncarcinogenic Effects ($\mu g/m^3$)	Lowest C/I ($\mu g/m^3$)	Carcinogenic Effects ($\mu g/m^3$)	Noncarcinogenic Effects ($\mu g/m^3$)
Fluorene	V	S	2.9E+04		2.9E+04	8.2E+04		8.2E+04
Heptachlor	NV	S						
Heptachlor epoxide	NV	S						
Hexachlorobenzene	NV	S						
Hexachlorobutadiene	NV	S						
γ-Hexachlorocyclohexane (Lindane)	NV	S						
Hexachloroethane	NV	S						
Indeno(1,2,3-c,d)pyrene	NV	S						
Lead	NV	S						
Mercury (elemental)	V	S	1.9E+01		1.9E+01	5.3E+01		5.3E+01
Methoxychlor	NV	S						
Methylene chloride	V	L	5.2E+03	5.2E+03	8.3E+04	1.7E+04	1.7E+04	2.3E+05
Methyl ethyl ketone	V	L	1.0E+06		1.0E+06	2.9E+06		2.9E+06
Methyl isobutyl ketone	V	L	6.3E+05		6.3E+05	1.8E+06		1.8E+06
Methyl mercury	NV	S						
2-Methylnaphthalene	V	S						
tert-Butyl methyl ether	V	L	9.4E+03	9.4E+03	6.3E+05	3.1E+04	3.1E+04	1.8E+06
Molybdenum	NV	S						
Naphthalene	V	S	7.2E+01	7.2E+01	6.3E+02	2.4E+02	2.4E+02	1.8E+03
Nickel	NV	S						
Pentachlorophenol	NV	S						
Perchlorate	NV	S						
Phenanthrene	V	S	2.2E+04		2.2E+04	6.1E+04		6.1E+04
Phenol	NV	S						
Polychlorinated biphenyls (PCBs)	NV	S						
Pyrene	V	S	2.2E+04		2.2E+04	6.1E+04		6.1E+04
Selenium	NV	S						
Silver	NV	S						
Styrene	V	L	1.9E+05		1.9E+05	5.3E+05		5.3E+05
tert-Butyl alcohol	V	L						
1,1,1,2-Tetrachloroethane	V	L	3.2E+02	3.2E+02		1.1E+03	1.1E+03	
1,1,2,2-Tetrachloroethane	V	L	4.2E+01	4.2E+01	4.4E+04	1.4E+02	1.4E+02	1.2E+05
Tetrachloroethene	V	L	4.1E+02	4.1E+02	8.3E+04	1.4E+03	1.4E+03	2.3E+05
Thallium	NV	S						
Toluene	V	L	6.3E+04		6.3E+04	1.8E+05		1.8E+05

Table E-2. [1]Shallow Soil Gas Screening Levels for Evaluation of Potential Vapor Intrusion Concerns (volatile chemicals only)

Chemcial	Physical State		[2]Residential Exposure			Commercial/Industrial Land Use		
			Lowest Residential ($\mu g/m^3$)	Carcinogenic Effects ($\mu g/m^3$)	Noncarcinogenic Effects ($\mu g/m^3$)	Lowest C/I ($\mu g/m^3$)	Carcinogenic Effects ($\mu g/m^3$)	Noncarcinogenic Effects ($\mu g/m^3$)
Toxaphene	NV	S						
TPH (gasolines)	V	L	1.0E+04		1.0E+04	2.9E+04		2.9E+04
TPH (middle distillates)	V	L	1.0E+04		1.0E+04	2.9E+04		2.9E+04
TPH (residual fuels)	NV	L/S						
1,2,4-Trichlorobenzene	V	L	8.3E+02		8.3E+02	2.3E+03		2.3E+03
1,1,1-Trichloroethane	V	L	4.6E+05		4.6E+05	1.3E+06		1.3E+06
1,1,2-Trichloroethane	V	L	1.5E+02	1.5E+02	2.9E+03	5.1E+02	5.1E+02	8.2E+03
Trichloroethene	V	L	1.2E+03	1.2E+03	1.3E+05	4.1E+03	4.1E+03	3.5E+05
2,4,5-Trichlorophenol	V	S	7.3E+04		7.3E+04	2.0E+05		2.0E+05
2,4,6-Trichlorophenol	NV	S						
Vanadium	NV	S						
Vinyl chloride	V	G	3.1E+01	3.1E+01	2.1E+04	1.0E+02	1.0E+02	5.8E+04
Xylenes	V	L	2.1E+04		2.1E+04	5.8E+04		5.8E+04
Zinc	NV	S						

Notes:

1. Shallow soil gas defined as soil gas sample data collected within 1.5 meters (five feet) from a building foundation or the ground surface. Assumes very permeable (e.g., sandy) fill material is present below building foundation or could be present below future buildings following redevelopment. Evaluation of deeper soil gas data (e.g., >1.5m bgs) should be carried out on a site-specific basis.
2. "Residential" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

Soil gas screening levels intended to be protective of indoor air quality, calculated for volatile chemicals only.
Physical state of chemical at ambient conditions (V - volatile, NV - nonvolatile, S - solid, L - liquid, G - gas).
Chemical considered to be "volatile" if Henry's Law constant (atm m^3/mole) >0.00001 and molecular weight <200 (see Table E-1).
Dibromochloromethane, dibromochloropropane and pyrene considered volatile for purposes of modeling (USEPA 2004).
Target cancer risk = 1E-06, Target Hazard Quotient = 0.2 for all chemicals.
Residential soil gas:indoor air attenuation factor = 0.001 (1/1000). Commercial/industrial soil gas:indoor air attenuation factor = 0.0005 (1/2000).
Soil gas screening level for ethanol based on potential indoor air nuisance concerns (refer to Section 5.3.3 and Table H series).
soils or limited soil impacts and no groundwater source of VOCs.

Table E-3. Ambient and Indoor Air Screening Levels
(volatile chemicals only)

Chemical	Physical State		Unit Risk URF $(ug/m^3)^{-1}$	Reference RfC $(\mu g/m^3)$	[1]Residential Exposure Lowest Residential $(\mu g/m^3)$	Carcinogens $(\mu g/m^3)$	Noncarcinogens $(\mu g/m^3)$	Commercial/Industrial Exposure C/I $(\mu g/m^3)$	Carcinogens) $(\mu g/m^3)$	Noncarcinogens) $(\mu g/m^3)$	50% Odor Recognition Threshold (Table H-2) $(\mu g/m^3)$
Acenaphthene	V	S		2.1E+02	4.4E+01		4.4E+01	6.1E+01		6.1E+01	5.13E+02
Acenaphthylene	V	S		1.1E+02	2.2E+01		2.2E+01	3.1E+01		3.1E+01	-
Acetone	V	L		3.2E+03	6.6E+02		6.6E+02	9.2E+02		9.2E+02	3.1E+04
Aldrin	NV	S									2.6E+02
Anthracene	V	S		1.1E+03	2.2E+02		2.2E+02	3.1E+02		3.1E+02	-
Antimony	NV	S									-
Arsenic	NV	S									-
Barium	NV	S									-
Benzene	V	L	2.9E-05	3.0E+01	8.4E-02	8.4E-02	6.3E+00	1.4E-01	1.4E-01	8.8E+00	4.9E+03
Benzo(a)anthracene	NV	S									-
Benzo(b)fluoranthene	NV	S									-
Benzo(k)fluoranthene	NV	S									-
Benzo(g,h,i)perylene	NV	S									-
Benzo(a)pyrene	NV	S									-
Beryllium	NV	S									-
1,1-Biphenyl	V	S									6.0E+01
Bis(2-chloroethyl) ether	V	L	3.3E-04		7.4E-03	7.4E-03		1.2E-02	1.2E-02		2.9E+02
Bis(2-chloroisopropyl) ether	V	L	7.1E-04	1.4E+02	3.4E-03	3.4E-03	2.9E+01	5.8E-03	5.8E-03	4.1E+01	2.2E+03
Bis(2-ethylhexyl) phthalate	NV	S									-
Boron	NV	S									-
Bromodichloromethane	V	L	1.8E-05	7.0E+01	1.4E-01	1.4E-01	1.5E+01	2.3E-01	2.3E-01	2.0E+01	1.1E+07
Bromoform (Tribromomethane)	NV	S									1.3E+04
Bromomethane	V	G		5.0E+00	1.0E+00		1.0E+00	1.5E+00		1.5E+00	8.0E+04
Cadmium	NV	S									-
Carbon tetrachloride	V	L	1.3E-04	4.0E+01	1.9E-02	1.9E-02	8.3E+00	3.1E-02	3.1E-02	1.2E+01	6.3E+04
Chlordane	NV	S									8.4E+00
p-Chloroaniline	NV	S									-
Chlorobenzene	V	L		1.0E+03	2.1E+02		2.1E+02	2.9E+02		2.9E+02	1.0E+03
Chloroethane	V	G		1.0E+02	2.1E+01		2.1E+01	2.9E+01		2.9E+01	3.8E+05
Chloroform	V	L	5.3E-06	3.0E+02	4.6E-01	4.6E-01	6.3E+01	7.7E-01	7.7E-01	8.8E+01	4.2E+05
Chloromethane	V	G		9.0E+01	1.9E+01		1.9E+01	2.6E+01		2.6E+01	-
2-Chlorophenol	V	L		1.8E+01	3.7E+00		3.7E+00	5.1E+00		5.1E+00	1.9E+01
Chromium (total)	NV	S									-
Chromium III	NV	S									-
Chromium VI	NV	S									-
Chrysene	NV	S									-
Cobalt	NV	S									-
Copper	NV	S									-
Cyanide	NV	S		7.0E+01	1.5E+01		1.5E+01	2.0E+01		2.0E+01	6.5E+02
Dibenz(a,h)anthracene	NV	S									-
Dibromochloromethane	V	S									-
1,2-dibromo-3-chloropropane	V	L	1.9E-03	2.0E-01	1.3E-03	1.3E-03	4.2E-02	2.2E-03	2.2E-03	5.8E-02	-
1,2-Dibromoethane	V	S	6.0E-04	9.0E+00	4.1E-03	4.1E-03	1.9E+00	6.8E-03	6.8E-03	2.6E+00	2.0E+05
1,2-Dichlorobenzene	V	L		2.0E+02	4.2E+01		4.2E+01	5.8E+01		5.8E+01	3.1E+05

Table E-3. Ambient and Indoor Air Screening Levels
(volatile chemicals only)

Chemical	Physical State		Unit Risk URF $(ug/m^3)^{-1}$	Reference RfC $(\mu g/m^3)$	[1]Residential Exposure Lowest Residential $(\mu g/m^3)$	Carcinogens $(\mu g/m^3)$	Noncarcinogens $(\mu g/m^3)$	Commercial/Industrial Exposure C/I $(\mu g/m^3)$	Carcinogens) $(\mu g/m^3)$	Noncarcinogens) $(\mu g/m^3)$	50% Odor Recognition Threshold (Table H-2) $(\mu g/m^3)$
1,3-Dichlorobenzene	V	L		1.1E+02	2.2E+01		2.2E+01	3.1E+01		3.1E+01	-
1,4-Dichlorobenzene	V	S	1.1E-05	8.0E+02	2.2E-01	2.2E-01	1.7E+02	3.7E-01	3.7E-01	2.3E+02	1.1E+03
3,3-Dichlorobenzidine	NV	S									-
Dichlorodiphenyldichloroethane (DDD)	NV	S									-
Dichlorodiphenyldichloroethene (DDE)	NV	S									-
Dichlorodiphenyltrichloroethane (DDT)	NV	S									-
1,1-Dichloroethane	V	L	1.6E-06	5.0E+02	1.5E+00	1.5E+00	1.0E+02	2.6E+00	2.6E+00	1.5E+02	1.3E+05
1,2-Dichloroethane	V	L	2.6E-05	4.9E+00	9.4E-02	9.4E-02	1.0E+00	1.6E-01	1.6E-01	1.4E+00	2.4E+03
1,1-Dichloroethene	V	L	5.0E-05	2.0E+02	4.9E-02	4.9E-02	4.2E+01	8.2E-02	8.2E-02	5.8E+01	2.0E+06
cis -1,2-Dichloroethene	V	L		3.5E+01	7.3E+00		7.3E+00	1.0E+01		1.0E+01	-
trans -1,2-Dichloroethene	V	L		7.0E+01	1.5E+01		1.5E+01	2.0E+01		2.0E+01	6.7E+04
2,4-Dichlorophenol	NV	S									1.4E+03
1,2-Dichloropropane	V	L	1.0E-05	4.0E+00	2.4E-01	2.4E-01	8.3E-01	4.1E-01	4.1E-01	1.2E+00	1.2E+03
1,3-Dichloropropene	V	L	1.6E-05	2.0E+01	1.5E-01	1.5E-01	4.2E+00	2.6E-01	2.6E-01	5.8E+00	4.2E+03
Dieldrin	NV	S									-
Diethyl phthalate	NV	S									-
Dimethyl phthalate	NV	S									-
2,4-Dimethylphenol	V	S									1.0E+00
2,4-Dinitrophenol	NV	S									-
2,4-Dinitrotoluene	NV	S									-
1,4-Dioxane	NV	L									6.1E+05
Dioxin (2,3,7,8-TCDD)	NV	S									-
Endosulfan	NV	S									-
Endrin	NV	S									-
Ethylbenzene	V	L		1.0E+03	2.1E+02		2.1E+02	2.9E+02		2.9E+02	2.0E+03
Fluoranthene	NV	S									-
Fluorene	V	S		1.4E+02	2.9E+01		2.9E+01	4.1E+01		4.1E+01	-
Heptachlor	NV	S									3.0E+02
Heptachlor epoxide	NV	S									3.0E+02
Hexachlorobenzene	NV	S									-
Hexachlorobutadiene	NV	S									1.2E+04
γ-Hexachlorocyclohexane (Lindane)	NV	S									-
Hexachloroethane	NV	S									-
Indeno(1,2,3-c,d)pyrene	NV	S									-
Lead	NV	S									-
Mercury (elemental)	V	S		9.0E-02	1.9E-02		1.9E-02	2.6E-02		2.6E-02	-
Methoxychlor	NV	S									-
Methylene chloride	V	L	4.7E-07	4.0E+02	5.2E+00	5.2E+00	8.3E+01	8.7E+00	8.7E+00	1.2E+02	5.6E+05
Methyl ethyl ketone	V	L		5.0E+03	1.0E+03		1.0E+03	1.5E+03		1.5E+03	3.2E+04
Methyl isobutyl ketone	V	L		3.0E+03	6.3E+02		6.3E+02	8.8E+02		8.8E+02	4.2E+02
Methyl mercury	NV	S									-
2-Methylnaphthalene	V	S									6.8E+01
tert -Butyl methyl ether	V	L	2.6E-07	3.0E+03	9.4E+00	9.4E+00	6.3E+02	1.6E+01	1.6E+01	8.8E+02	5.3E+02
Molybdenum	NV	S									-

Table E-3. Ambient and Indoor Air Screening Levels
(volatile chemicals only)

Chemical	Physical State		Unit Risk URF $(ug/m^3)^{-1}$	Reference RfC $(\mu g/m^3)$	[1]Residential Exposure Lowest Residential $(\mu g/m^3)$	Carcinogens $(\mu g/m^3)$	Noncarcinogens $(\mu g/m^3)$	Commercial/Industrial Exposure C/I $(\mu g/m^3)$	Carcinogens) $(\mu g/m^3)$	Noncarcinogens) $(\mu g/m^3)$	50% Odor Recognition Threshold (Table H-2) $(\mu g/m^3)$
Naphthalene	V	S	3.4E-05	3.0E+00	7.2E-02	7.2E-02	6.3E-01	1.2E-01	1.2E-01	8.8E-01	4.4E+02
Nickel	NV	S									-
Pentachlorophenol	NV	S									-
Perchlorate	NV	S									-
Phenanthrene	V	S		1.1E+02	2.2E+01		2.2E+01	3.1E+01		3.1E+01	5.5E+01
Phenol	NV	S									1.6E+02
Polychlorinated biphenyls (PCBs)	NV	S									-
Pyrene	V	S		1.1E+02	2.2E+01		2.2E+01	3.1E+01		3.1E+01	-
Selenium	NV	S									-
Silver	NV	S									-
Styrene	V	L		9.0E+02	1.9E+02		1.9E+02	2.6E+02		2.6E+02	1.4E+03
tert -Butyl alcohol	V	L									-
1,1,1,2-Tetrachloroethane	V	L	7.6E-06		3.2E-01	3.2E-01		5.4E-01	5.4E-01		-
1,1,2,2-Tetrachloroethane	V	L	5.8E-05	2.1E+02	4.2E-02	4.2E-02	4.4E+01	7.0E-02	7.0E-02	6.1E+01	1.0E+04
Tetrachloroethene	V	L	5.9E-06	4.0E+02	4.1E-01	4.1E-01	8.3E+01	6.9E-01	6.9E-01	1.2E+02	3.2E+04
Thallium	NV	S									-
Toluene	V	L		3.0E+02	6.3E+01		6.3E+01	8.8E+01		8.8E+01	3.0E+04
Toxaphene	NV	S									-
TPH (gasolines)	V	L		4.9E+01	1.0E+01		1.0E+01	1.4E+01		1.4E+01	1.0E+02
TPH (middle distillates)	V	L		4.9E+01	1.0E+01		1.0E+01	1.4E+01		1.4E+01	1.0E+03
TPH (residual fuels)	NV	L/S									-
1,2,4-Trichlorobenzene	V	L		4.0E+00	8.3E-01		8.3E-01	1.2E+00		1.2E+00	2.2E+04
1,1,1-Trichloroethane	V	L		2.2E+03	4.6E+02		4.6E+02	6.4E+02		6.4E+02	6.5E+04
1,1,2-Trichloroethane	V	L	1.6E-05	1.4E+01	1.5E-01	1.5E-01	2.9E+00	2.6E-01	2.6E-01	4.1E+00	-
Trichloroethene	V	L	2.0E-06	6.0E+02	1.2E+00	1.2E+00	1.3E+02	2.0E+00	2.0E+00	1.8E+02	1.4E+06
2,4,5-Trichlorophenol	V	S		3.5E+02	7.3E+01		7.3E+01	1.0E+02		1.0E+02	-
2,4,6-Trichlorophenol	NV	S									3.0E-01
Vanadium	NV	S									-

Table E-3. Ambient and Indoor Air Screening Levels
(volatile chemicals only)

Chemical	Physical State		Unit Risk URF $(ug/m^3)^{-1}$	Reference RfC $(\mu g/m^3)$	[1]Residential Exposure Lowest Residential $(\mu g/m^3)$	Carcinogens $(\mu g/m^3)$	Noncarcinogens $(\mu g/m^3)$	Commercial/Industrial Exposure C/I $(\mu g/m^3)$	Carcinogens) $(\mu g/m^3)$	Noncarcinogens) $(\mu g/m^3)$	50% Odor Recognition Threshold (Table H-2) $(\mu g/m^3)$
Vinyl chloride	V	G	7.8E-05	1.0E+02	3.1E-02	3.1E-02	2.1E+01	5.2E-02	5.2E-02	2.9E+01	7.7E+05
Xylenes	V	L		1.0E+02	2.1E+01		2.1E+01	2.9E+01		2.9E+01	4.4E+02
Zinc	NV	S									-

Notes:

1. "Residential" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

Target cancer risk = 1E-06, Target Hazard Quotient = 0.2 for all chemicals.
Physical state of chemical at ambient conditions (V - volatile, NV - nonvolatile, S - solid, L - liquid, G - gas).
Chemical considered to be "volatile" if Henry's Law constant (atm m^3/mole) >0.00001 and molecular weight <200 (see Table E-1).
Dibromochloromethane, dibromochloropropane and pyrene considered volatile for purposes of modeling (USEPA 2004).
Calculated based on spreadhseet provided with *User's Guide for the Johnson and Ettinger Indoor Air model (1991) for Subsurface Vapor Intrusion Into Buildings (* USEPA 2003) using default input parameter values noted in Appendix 4 (see text for equations).
Indoor air screening levels listed only for volatile chemicals included in database of referenced model spreadsheet (plus MTBE).
URFs from Cal EPA DHS (Cal EPA 2001) where available (marked by "*") or otherwise as presented in referenced spreadhseet (USEPA 2000). RfCs presented in spreadsheet or added as indicated in Appendix 4 (refer to footnotes to VLOOKUP worksheet).
URF for TBA based on conversion of CSF presented in Table J.
Indoor air screening level for ethanol based on potential odor concerns (refer to Section 5.3.3 and Table H series).
50% Odor Recognition Thresholds from Massachusetts Department of Environmental Protection (MADEP, 1994) and ATSDR; included for reference (potential nuisance concerns, see Table H series).

Table F-1a. Groundwater Screening Levels
(groundwater IS a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
Acenaphthene	2.0E+01	Ceiling Value	2.0E+01	4.2E+02	4.2E+03	-
Acenaphthylene	2.1E+02	Drinking Water Toxicity	2.0E+03	2.1E+02	(Use soil gas)	-
Acetone	6.3E+03	Drinking Water Toxicity	2.0E+04	6.3E+03	5.3E+07	-
Aldrin	2.0E-03	Drinking Water Toxicity	8.5E+00	2.0E-03		-
Anthracene	2.2E+01	Ceiling Value	2.2E+01	2.1E+03	4.3E+01	-
Antimony	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00		-
Arsenic	5.0E+01	Drinking Water Toxicity	5.0E+04	5.0E+01		-
Barium	1.0E+03	Drinking Water Toxicity	5.0E+04	1.0E+03		-
Benzene	1.0E+00	Drinking Water Toxicity	1.7E+02	1.0E+00	5.4E+02	-
Benzo(a)anthracene	2.9E-02	Drinking Water Toxicity	5.0E+00	2.9E-02		-
Benzo(b)fluoranthene	2.9E-02	Drinking Water Toxicity	7.0E+00	2.9E-02		-
Benzo(k)fluoranthene	2.9E-02	Drinking Water Toxicity	4.0E-01	2.9E-02		-
Benzo(g,h,i)perylene	1.3E-01	Ceiling Value	1.3E-01	2.1E+02		-
Benzo(a)pyrene	2.0E-01	Drinking Water Toxicity	1.9E+00	2.0E-01		-
Beryllium	4.0E+00	Drinking Water Toxicity	5.0E+04	4.0E+00		-
1,1-Biphenyl	5.0E-01	Ceiling Value	5.0E-01	3.5E+02	(Use soil gas)	-
Bis(2-chloroethyl) ether	3.2E-02	Drinking Water Toxicity	3.6E+02	3.2E-02	6.5E+01	-
Bis(2-chloroisopropyl) ether	1.4E-02	Drinking Water Toxicity	3.2E+02	1.4E-02	(Use soil gas)	-
Bis(2-ethylhexyl) phthalate	4.0E+00	Drinking Water Toxicity	6.5E+02	4.0E+00		-
Boron	1.0E+03	Drinking Water Toxicity	5.0E+04	1.0E+03		-
Bromodichloromethane	1.0E+02	Drinking Water Toxicity	5.0E+04	1.0E+02	1.7E+02	-
Bromoform (Tribromomethane)	1.0E+02	Drinking Water Toxicity	5.1E+02	1.0E+02		-
Bromomethane	9.8E+00	Drinking Water Toxicity	5.0E+04	9.8E+00	5.8E+02	-
Cadmium	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00		-
Carbon tetrachloride	5.0E-01	Drinking Water Toxicity	5.2E+02	5.0E-01	9.3E+00	-
Chlordane	1.0E-01	Drinking Water Toxicity	2.5E+00	1.0E-01		-
p-Chloroaniline	2.8E+01	Drinking Water Toxicity	5.0E+04	2.8E+01		-
Chlorobenzene	5.0E+01	Ceiling Value	5.0E+01	7.0E+01	1.3E+04	-
Chloroethane	1.2E+01	Drinking Water Toxicity	1.6E+01	1.2E+01	8.2E+02	-
Chloroform	7.0E+01	Drinking Water Toxicity	2.4E+03	7.0E+01	3.3E+02	-
Chloromethane	4.1E+01	Indoor Air Impacts	5.0E+04	1.8E+02	4.1E+01	-
2-Chlorophenol	1.8E-01	Ceiling Value	1.8E-01	3.5E+01	5.3E+03	-
Chromium (total)	5.0E+01	Drinking Water Toxicity	5.0E+04	5.0E+01		-
Chromium III	5.0E+04	Ceiling Value	5.0E+04	2.0E+05		-
Chromium VI	2.1E+01	Drinking Water Toxicity	5.0E+04	2.1E+01		-
Chrysene	8.0E-01	Ceiling Value	8.0E-01	4.8E+00	(Use soil gas)	-

Table F-1a. Groundwater Screening Levels
(groundwater IS a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
Cobalt	1.4E+02	Drinking Water Toxicity	5.0E+04	1.4E+02		-
Copper	1.0E+03	Ceiling Value	1.0E+03	1.3E+03		-
Cyanide	1.5E+02	Drinking Water Toxicity	1.7E+02	1.5E+02	(Use soil gas)	-
Dibenz(a,h)anthracene	4.8E-03	Drinking Water Toxicity	2.5E-01	4.8E-03		-
Dibromochloromethane	1.0E+02	Drinking Water Toxicity	5.0E+04	1.0E+02	1.7E+02	-
1,2-dibromo-3-chloropropane	2.0E-01	Drinking Water Toxicity	1.0E+01	2.0E-01	(Use soil gas)	-
1,2-Dibromoethane	5.0E-02	Drinking Water Toxicity	5.0E+04	5.0E-02	1.5E+02	-
1,2-Dichlorobenzene	1.0E+01	Ceiling Value	1.0E+01	6.0E+02	7.7E+04	-
1,3-Dichlorobenzene	2.1E+02	Drinking Water Toxicity	5.0E+04	2.1E+02	(Use soil gas)	-
1,4-Dichlorobenzene	5.0E+00	Ceiling Value	5.0E+00	5.0E+00	3.4E+02	-
3,3-Dichlorobenzidine	2.9E-02	Drinking Water Toxicity	1.6E+03	2.9E-02		-
Dichlorodiphenyldichloroethane (DDD)	1.5E-01	Drinking Water Toxicity	8.0E+01	1.5E-01		-
Dichlorodiphenyldichloroethene (DDE)	1.0E-01	Drinking Water Toxicity	2.0E+01	1.0E-01		-
Dichlorodiphenyltrichloroethane (DDT)	1.0E-01	Drinking Water Toxicity	1.5E+00	1.0E-01		-
1,1-Dichloroethane	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00	1.0E+03	-
1,2-Dichloroethane	5.0E-01	Drinking Water Toxicity	7.0E+03	5.0E-01	2.0E+02	-
1,1-Dichloroethene	6.0E+00	Drinking Water Toxicity	1.5E+03	6.0E+00	6.3E+03	-
cis -1,2-Dichloroethene	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00	6.2E+03	-
trans -1,2-Dichloroethene	1.0E+01	Drinking Water Toxicity	2.6E+02	1.0E+01	6.7E+03	-
2,4-Dichlorophenol	3.0E-01	Ceiling Value	3.0E-01	2.1E+01		-
1,2-Dichloropropane	5.0E+00	Drinking Water Toxicity	1.0E+01	5.0E+00	2.8E+02	-
1,3-Dichloropropene	5.0E-01	Drinking Water Toxicity	5.0E+04	5.0E-01	5.3E+01	-
Dieldrin	2.2E-03	Drinking Water Toxicity	4.1E+01	2.2E-03		-
Diethyl phthalate	5.6E+03	Drinking Water Toxicity	5.0E+04	5.6E+03		-
Dimethyl phthalate	5.0E+04	Ceiling Value	5.0E+04	7.0E+04		-
2,4-Dimethylphenol	1.0E+02	Drinking Water Toxicity	4.0E+02	1.0E+02	2.5E+06	-
2,4-Dinitrophenol	1.4E+02	Drinking Water Toxicity	5.0E+04	1.4E+02		-
2,4-Dinitrotoluene	5.1E-02	Drinking Water Toxicity	5.0E+04	5.1E-02		-
1,4-Dioxane	3.0E+00	Drinking Water Toxicity	5.0E+04	3.0E+00		-
Dioxin (2,3,7,8-TCDD)	3.0E-05	Drinking Water Toxicity	7.0E+03	3.0E-05		-
Endosulfan	4.2E+01	Drinking Water Toxicity	7.5E+01	4.2E+01		-
Endrin	2.0E+00	Drinking Water Toxicity	4.1E+01	2.0E+00		-
Ethylbenzene	3.0E+01	Ceiling Value	3.0E+01	3.0E+02	1.7E+05	-
Fluoranthene	1.3E+02	Ceiling Value	1.3E+02	2.8E+02		-
Fluorene	2.8E+02	Drinking Water Toxicity	9.5E+02	2.8E+02	1.9E+03	-
Heptachlor	1.0E-02	Drinking Water Toxicity	2.0E+01	1.0E-02		-

Table F-1a. Groundwater Screening Levels
(groundwater IS a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
Heptachlor epoxide	1.0E-02	Drinking Water Toxicity	1.8E+02	1.0E-02		-
Hexachlorobenzene	1.0E+00	Drinking Water Toxicity	5.5E+01	1.0E+00		-
Hexachlorobutadiene	4.5E-01	Drinking Water Toxicity	6.0E+00	4.5E-01		-
γ-Hexachlorocyclohexane (Lindane)	2.0E-01	Drinking Water Toxicity	3.5E+03	2.0E-01		-
Hexachloroethane	9.0E-01	Drinking Water Toxicity	1.0E+01	9.0E-01		-
Indeno(1,2,3-c,d)pyrene	4.8E-02	Drinking Water Toxicity	2.7E-01	4.8E-02		-
Lead	1.5E+01	Drinking Water Toxicity	5.0E+04	1.5E+01		-
Mercury (elemental)	2.0E+00	Drinking Water Toxicity	5.0E+04	2.0E+00	(Use soil gas)	-
Methoxychlor	2.0E+01	Ceiling Value	2.0E+01	4.0E+01		-
Methylene chloride	5.0E+00	Drinking Water Toxicity	9.1E+03	5.0E+00	2.4E+03	-
Methyl ethyl ketone	4.2E+03	Drinking Water Toxicity	8.4E+03	4.2E+03	2.4E+07	-
Methyl isobutyl ketone	1.2E+02	Drinking Water Toxicity	1.3E+03	1.2E+02	3.0E+06	-
Methyl mercury	7.0E-01	Drinking Water Toxicity	5.0E+04	7.0E-01		-
2-Methylnaphthalene	1.0E+01	Ceiling Value	1.0E+01	2.8E+01	2.6E+04	-
tert-Butyl methyl ether	5.0E+00	Ceiling Value	5.0E+00	1.3E+01	2.4E+04	-
Molybdenum	3.5E+01	Drinking Water Toxicity	5.0E+04	3.5E+01		-
Naphthalene	1.7E+01	Drinking Water Toxicity	2.1E+01	1.7E+01	3.2E+03	-
Nickel	1.0E+02	Drinking Water Toxicity	5.0E+04	1.0E+02		-
Pentachlorophenol	1.0E+00	Drinking Water Toxicity	3.0E+01	1.0E+00		-
Perchlorate	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00		-
Phenanthrene	2.1E+02	Drinking Water Toxicity	4.1E+02	2.1E+02	(Use soil gas)	-
Phenol	5.0E+00	Ceiling Value	5.0E+00	4.2E+03		-
Polychlorinated biphenyls (PCBs)	5.0E-01	Drinking Water Toxicity	1.6E+01	5.0E-01		-
Pyrene	6.8E+01	Ceiling Value	6.8E+01	4.2E+02	1.4E+02	-
Selenium	5.0E+01	Drinking Water Toxicity	5.0E+04	5.0E+01		-
Silver	3.5E+01	Drinking Water Toxicity	1.0E+02	3.5E+01		-
Styrene	1.0E+01	Ceiling Value	1.0E+01	1.0E+02	3.1E+05	-
tert-Butyl alcohol		Drinking Water Toxicity	5.0E+04		(Use soil gas)	-
1,1,1,2-Tetrachloroethane	1.3E+00	Drinking Water Toxicity	5.0E+04	1.3E+00	(Use soil gas)	-
1,1,2,2-Tetrachloroethane	1.0E+00	Drinking Water Toxicity	5.0E+02	1.0E+00	1.9E+02	-
Tetrachloroethene	5.0E+00	Drinking Water Toxicity	1.7E+02	5.0E+00	1.2E+02	-
Thallium	2.0E+00	Drinking Water Toxicity	5.0E+04	2.0E+00		-
Toluene	4.0E+01	Ceiling Value	4.0E+01	1.5E+02	3.8E+05	-
Toxaphene	3.0E+00	Drinking Water Toxicity	1.4E+02	3.0E+00		-
TPH (gasolines)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02	(Use soil gas)	-
TPH (middle distillates)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02	(Use soil gas)	-

Table F-1a. Groundwater Screening Levels
(groundwater IS a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-1	Drinking Water (Toxicity) Table F-3	Vapor Intrusion Into Buildings Table E-1a	Aquatic Habitat Goal (Chronic) Table F-4a
TPH (residual fuels)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02		-
1,2,4-Trichlorobenzene	5.0E+00	Drinking Water Toxicity	3.0E+03	5.0E+00	2.5E+03	-
1,1,1-Trichloroethane	2.0E+02	Drinking Water Toxicity	9.7E+02	2.0E+02	1.3E+05	-
1,1,2-Trichloroethane	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00	3.5E+02	-
Trichloroethene	5.0E+00	Drinking Water Toxicity	3.1E+02	5.0E+00	5.3E+02	-
2,4,5-Trichlorophenol	2.0E+02	Ceiling Value	2.0E+02	7.0E+02	8.3E+05	-
2,4,6-Trichlorophenol	7.0E-01	Drinking Water Toxicity	1.0E+02	7.0E-01		-
Vanadium	1.5E+01	Drinking Water Toxicity	5.0E+04	1.5E+01		-
Vinyl chloride	5.0E-01	Drinking Water Toxicity	3.4E+03	5.0E-01	3.8E+00	-
Xylenes	2.0E+01	Ceiling Value	2.0E+01	1.8E+03	1.6E+05	-
Zinc	5.0E+03	Ceiling Value	5.0E+03	5.0E+03		-

Notes:

1. Lowest of Ceiling Value, Drinking Water (toxicity) goal, Indoor-Air Impact goal and Aquatic Habitat Goal>Used to develop soil leaching levels for protection of groundwater quality.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

sol - solubility threshold

Ceiling Level: Odor threshold, 1/2 solubility or 50000 ug/L maximum, whichever is lower. Intended to limit general groundwater resource degradation.

Odor-thresholds assume no dilution.

Human Toxicity: Based on primary maximum concentration levels (MCLs), or equivalent. Considered protective of human health.

Indoor Air Impact: Addresses potential emission of volatile chemicals from groundwater and subsequent impact on indoor air. Value for very permeable (e.g., sandy vadose-zone soils).

Aquatic Habitat Goal: Addresses potential discharge of groundwater to surface waterbody and subsequent impact on aquatic life; Potential dilution upon discharge to surface water not considered.

Review of aquatic ecotoxicty data for ethanol underway. Based on preliminary review of available data, chronic toxicity screening levels likely to be significantly greater than ceiling level of 50,000 ug/L (refer to USEPA 2003b, ECOTOX database).

Method detection limits and background concentrations replace final screening level as appropriate.

Table F-1b. Groundwater Screening Levels
(groundwater IS NOT a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.) Table I-2	Vapor Intrusion Into Buildings Table E-1a	Estuary Aquatic Habitat Goal (Chronic) Table F-4a
Acenaphthene	2.0E+02	Ceiling Value	2.0E+02	4.2E+03	-
Acenaphthylene	2.0E+03	Ceiling Value	2.0E+03	(Use soil gas)	-
Acetone	5.0E+04	Ceiling Value	5.0E+04	5.3E+07	-
Aldrin	8.5E+00	Ceiling Value	8.5E+00		-
Anthracene	2.2E+01	Ceiling Value	2.2E+01	4.3E+01	-
Antimony	5.0E+04	Ceiling Value	5.0E+04		-
Arsenic	5.0E+04	Ceiling Value	5.0E+04		-
Barium	5.0E+04	Ceiling Value	5.0E+04		-
Benzene	5.4E+02	Indoor Air Impacts	2.0E+04	5.4E+02	-
Benzo(a)anthracene	5.0E+00	Ceiling Value	5.0E+00		-
Benzo(b)fluoranthene	7.0E+00	Ceiling Value	7.0E+00		-
Benzo(k)fluoranthene	4.0E-01	Ceiling Value	4.0E-01		-
Benzo(g,h,i)perylene	1.3E-01	Ceiling Value	1.3E-01		-
Benzo(a)pyrene	1.9E+00	Ceiling Value	1.9E+00		-
Beryllium	5.0E+04	Ceiling Value	5.0E+04		-
1,1-Biphenyl	5.0E+00	Ceiling Value	5.0E+00	(Use soil gas)	-
Bis(2-chloroethyl) ether	6.5E+01	Indoor Air Impacts	3.6E+03	6.5E+01	-
Bis(2-chloroisopropyl) ether	3.2E+03	Ceiling Value	3.2E+03	(Use soil gas)	-
Bis(2-ethylhexyl) phthalate	6.5E+02	Ceiling Value	6.5E+02		-
Boron	5.0E+04	Ceiling Value	5.0E+04		-
Bromodichloromethane	1.7E+02	Indoor Air Impacts	5.0E+04	1.7E+02	-
Bromoform (Tribromomethane)	5.1E+03	Ceiling Value	5.1E+03		-
Bromomethane	5.8E+02	Indoor Air Impacts	5.0E+04	5.8E+02	-
Cadmium	5.0E+04	Ceiling Value	5.0E+04		-
Carbon tetrachloride	9.3E+00	Indoor Air Impacts	5.2E+03	9.3E+00	-
Chlordane	2.5E+01	Ceiling Value	2.5E+01		-
p-Chloroaniline	5.0E+04	Ceiling Value	5.0E+04		-
Chlorobenzene	5.0E+02	Ceiling Value	5.0E+02	1.3E+04	-
Chloroethane	1.6E+02	Ceiling Value	1.6E+02	8.2E+02	-
Chloroform	3.3E+02	Indoor Air Impacts	2.4E+04	3.3E+02	-
Chloromethane	4.1E+01	Indoor Air Impacts	5.0E+04	4.1E+01	-
2-Chlorophenol	1.8E+00	Ceiling Value	1.8E+00	5.3E+03	-
Chromium (total)	5.0E+04	Ceiling Value	5.0E+04		-
Chromium III	5.0E+04	Ceiling Value	5.0E+04		-
Chromium VI	5.0E+04	Ceiling Value	5.0E+04		-
Chrysene	8.0E-01	Ceiling Value	8.0E-01	(Use soil gas)	-
Cobalt	5.0E+04	Ceiling Value	5.0E+04		-
Copper	5.0E+04	Ceiling Value	5.0E+04		-

Table F-1b. Groundwater Screening Levels
(groundwater IS NOT a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.) Table I-2	Vapor Intrusion Into Buildings Table E-1a	Estuary Aquatic Habitat Goal (Chronic) Table F-4a
Cyanide	1.7E+03	Ceiling Value	1.7E+03	(Use soil gas)	-
Dibenz(a,h)anthracene	2.5E-01	Ceiling Value	2.5E-01		-
Dibromochloromethane	1.7E+02	Indoor Air Impacts	5.0E+04	1.7E+02	-
1,2-dibromo-3-chloropropane	1.0E+02	Ceiling Value	1.0E+02	(Use soil gas)	-
1,2-Dibromoethane	1.5E+02	Indoor Air Impacts	5.0E+04	1.5E+02	-
1,2-Dichlorobenzene	1.0E+02	Ceiling Value	1.0E+02	7.7E+04	-
1,3-Dichlorobenzene	5.0E+04	Ceiling Value	5.0E+04	(Use soil gas)	-
1,4-Dichlorobenzene	1.1E+02	Ceiling Value	1.1E+02	3.4E+02	-
3,3-Dichlorobenzidine	1.6E+03	Ceiling Value	1.6E+03		-
Dichlorodiphenyldichloroethane (DDD)	8.0E+01	Ceiling Value	8.0E+01		-
Dichlorodiphenyldichloroethene (DDE)	2.0E+01	Ceiling Value	2.0E+01		-
Dichlorodiphenyltrichloroethane (DDT)	1.5E+00	Ceiling Value	1.5E+00		-
1,1-Dichloroethane	1.0E+03	Indoor Air Impacts	5.0E+04	1.0E+03	-
1,2-Dichloroethane	2.0E+02	Indoor Air Impacts	5.0E+04	2.0E+02	-
1,1-Dichloroethene	6.3E+03	Indoor Air Impacts	1.5E+04	6.3E+03	-
cis -1,2-Dichloroethene	6.2E+03	Indoor Air Impacts	5.0E+04	6.2E+03	-
trans -1,2-Dichloroethene	2.6E+03	Ceiling Value	2.6E+03	6.7E+03	-
2,4-Dichlorophenol	3.0E+00	Ceiling Value	3.0E+00		-
1,2-Dichloropropane	1.0E+02	Ceiling Value	1.0E+02	2.8E+02	-
1,3-Dichloropropene	5.3E+01	Indoor Air Impacts	5.0E+04	5.3E+01	-
Dieldrin	9.3E+01	Ceiling Value	9.3E+01		-
Diethyl phthalate	5.0E+04	Ceiling Value	5.0E+04		-
Dimethyl phthalate	5.0E+04	Ceiling Value	5.0E+04		-
2,4-Dimethylphenol	4.0E+03	Ceiling Value	4.0E+03	2.5E+06	-
2,4-Dinitrophenol	5.0E+04	Ceiling Value	5.0E+04		-
2,4-Dinitrotoluene	5.0E+04	Ceiling Value	5.0E+04		-
1,4-Dioxane	5.0E+04	Ceiling Value	5.0E+04		-
Dioxin (2,3,7,8-TCDD)	7.0E+03	Ceiling Value	7.0E+03		-
Endosulfan	7.5E+01	Ceiling Value	7.5E+01		-
Endrin	1.3E+02	Ceiling Value	1.3E+02		-
Ethylbenzene	3.0E+02	Ceiling Value	3.0E+02	1.7E+05	-
Fluoranthene	1.3E+02	Ceiling Value	1.3E+02		-
Fluorene	9.5E+02	Ceiling Value	9.5E+02	1.9E+03	-
Heptachlor	2.8E+01	Ceiling Value	2.8E+01		-
Heptachlor epoxide	1.8E+02	Ceiling Value	1.8E+02		-
Hexachlorobenzene	5.5E+01	Ceiling Value	5.5E+01		-
Hexachlorobutadiene	6.0E+01	Ceiling Value	6.0E+01		-

Table F-1b. Groundwater Screening Levels
(groundwater IS NOT a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.) Table I-2	Vapor Intrusion Into Buildings Table E-1a	Estuary Aquatic Habitat Goal (Chronic) Table F-4a
γ-Hexachlorocyclohexane (Lindane)	3.5E+03	Ceiling Value	3.5E+03		-
Hexachloroethane	1.0E+02	Ceiling Value	1.0E+02		-
Indeno(1,2,3-c,d)pyrene	2.7E-01	Ceiling Value	2.7E-01		-
Lead	5.0E+04	Ceiling Value	5.0E+04		-
Mercury (elemental)	5.0E+04	Ceiling Value	5.0E+04	(Use soil gas)	-
Methoxychlor	2.0E+01	Ceiling Value	2.0E+01		-
Methylene chloride	2.4E+03	Indoor Air Impacts	5.0E+04	2.4E+03	-
Methyl ethyl ketone	5.0E+04	Ceiling Value	5.0E+04	2.4E+07	-
Methyl isobutyl ketone	1.3E+04	Ceiling Value	1.3E+04	3.0E+06	-
Methyl mercury	5.0E+04	Ceiling Value	5.0E+04		-
2-Methylnaphthalene	1.0E+02	Ceiling Value	1.0E+02	2.6E+04	-
tert-Butyl methyl ether	1.8E+03	Ceiling Value	1.8E+03	2.4E+04	-
Molybdenum	5.0E+04	Ceiling Value	5.0E+04		-
Naphthalene	2.1E+02	Ceiling Value	2.1E+02	3.2E+03	-
Nickel	5.0E+04	Ceiling Value	5.0E+04		-
Pentachlorophenol	5.9E+03	Ceiling Value	5.9E+03		-
Perchlorate	5.0E+04	Ceiling Value	5.0E+04		-
Phenanthrene	4.1E+02	Ceiling Value	4.1E+02	(Use soil gas)	-
Phenol	5.0E+04	Ceiling Value	5.0E+04		-
Polychlorinated biphenyls (PCBs)	1.6E+01	Ceiling Value	1.6E+01		-
Pyrene	6.8E+01	Ceiling Value	6.8E+01	1.4E+02	-
Selenium	5.0E+04	Ceiling Value	5.0E+04		-
Silver	5.0E+04	Ceiling Value	5.0E+04		-
Styrene	1.1E+02	Ceiling Value	1.1E+02	3.1E+05	-
tert-Butyl alcohol	5.0E+04	Ceiling Value	5.0E+04	(Use soil gas)	-
1,1,1,2-Tetrachloroethane	5.0E+04	Ceiling Value	5.0E+04	(Use soil gas)	-
1,1,2,2-Tetrachloroethane	1.9E+02	Indoor Air Impacts	5.0E+03	1.9E+02	-

Table F-1b. Groundwater Screening Levels
(groundwater IS NOT a current or potential drinking water resource)
(µg/L)

Chemical	[1]Final Groundwater Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.) Table I-2	Vapor Intrusion Into Buildings Table E-1a	Estuary Aquatic Habitat Goal (Chronic) Table F-4a
Tetrachloroethene	1.2E+02	Indoor Air Impacts	3.0E+03	1.2E+02	-
Thallium	5.0E+04	Ceiling Value	5.0E+04		-
Toluene	4.0E+02	Ceiling Value	4.0E+02	3.8E+05	-
Toxaphene	1.4E+02	Ceiling Value	1.4E+02		-
TPH (gasolines)	5.0E+03	Ceiling Value	5.0E+03	(Use soil gas)	-
TPH (middle distillates)	2.5E+03	Ceiling Value	2.5E+03	(Use soil gas)	-
TPH (residual fuels)	2.5E+03	Ceiling Value	2.5E+03		-
1,2,4-Trichlorobenzene	2.5E+03	Indoor Air Impacts	3.0E+04	2.5E+03	-
1,1,1-Trichloroethane	5.0E+04	Ceiling Value	5.0E+04	1.3E+05	-
1,1,2-Trichloroethane	3.5E+02	Indoor Air Impacts	5.0E+04	3.5E+02	-
Trichloroethene	5.3E+02	Indoor Air Impacts	5.0E+04	5.3E+02	-
2,4,5-Trichlorophenol	2.0E+03	Ceiling Value	2.0E+03	8.3E+05	-
2,4,6-Trichlorophenol	1.0E+03	Ceiling Value	1.0E+03		-
Vanadium	5.0E+04	Ceiling Value	5.0E+04		-
Vinyl chloride	3.8E+00	Indoor Air Impacts	3.4E+04	3.8E+00	-
Xylenes	5.3E+03	Ceiling Value	5.3E+03	1.6E+05	-
Zinc	5.0E+04	Ceiling Value	5.0E+04		-

Notes:

1. Lowest of groundwater Ceiling Value, Indoor-Air Impact goal and Aquatic Habitat Goal. Used to develop soil leaching levels for protection of groundwater quality.

NV: No Value. Use of soil gas screening levels recommended for chemicals with inadequate physio-chemical constant data for groundwater models.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

sol - solubility threshold

Category includes groundwater that does not meet drinking water quality requirements under natural conditions (e.g., excessive total dissolved solids) AND/OR situated in strata that lack adequate aquifer characteristics AND is not likely to otherwise directly impact a source of drinking water.

Ceiling Level: Odor threshold, 1/2 solubility or 50000 ug/L maximum, whichever is lower. Intended to limit general groundwater resource degradation.

Odor-thresholds assume ten-fold dilution of groundwater upon mixing with surface water.

Indoor Air Impact: Addresses potential emission of volatile chemicals from groundwater and subsequent impact on indoor air.

Value for very permeable (e.g., coarse-grained soils).

Aquatic Life Protection: Addresses potential discharge of groundwater to surface waterbody and subsequent impact on aquatic life; screening levels assume no dilution upon discharge to surface water unless otherwise noted.

Review of aquatic ecotoxicty data for ethanol underway. Based on preliminary review of available data, chronic toxicity screening levels likely to be significantly greater than ceiling level of 50,000 ug/L (refer to USEPA 2003b, ECOTOX database).

Table F-2a. Surface Water Screening Levels
Fresh Water Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-3	Drinking Water (Toxicity) Table F-3	Fresh Water Aquatic Habitat Goal (Chronic Toxicity) Table F-4a	Bioaccumulation and Human Consumption Table F-4d
Acenaphthene	2.0E+01	Ceiling Value	2.0E+01	4.2E+02	-	2.7E+03
Acenaphthylene	2.1E+02	Drinking Water Toxicity	2.0E+03	2.1E+02	-	
Acetone	6.3E+03	Drinking Water Toxicity	2.0E+04	6.3E+03	-	
Aldrin	1.4E-04	Bioaccumulation/Human Consumption	8.5E+00	2.0E-03	-	1.4E-04
Anthracene	2.2E+01	Ceiling Value	2.2E+01	2.1E+03	-	1.1E+05
Antimony	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00	-	4.3E+03
Arsenic	1.4E-01	Bioaccumulation/Human Consumption	5.0E+04	5.0E+01	-	1.4E-01
Barium	1.0E+03	Drinking Water Toxicity	5.0E+04	1.0E+03	-	
Benzene	1.0E+00	Drinking Water Toxicity	1.7E+02	1.0E+00	-	7.1E+01
Benzo(a)anthracene	2.9E-02	Drinking Water Toxicity	5.0E+00	2.9E-02	-	4.9E-02
Benzo(b)fluoranthene	2.9E-02	Drinking Water Toxicity	7.0E+00	2.9E-02	-	4.9E-02
Benzo(k)fluoranthene	2.9E-02	Drinking Water Toxicity	4.0E-01	2.9E-02	-	4.9E-02
Benzo(g,h,i)perylene	1.3E-01	Ceiling Value	1.3E-01	2.1E+02	-	
Benzo(a)pyrene	4.9E-02	Bioaccumulation/Human Consumption	1.9E+00	2.0E-01	-	4.9E-02
Beryllium	4.0E+00	Drinking Water Toxicity	5.0E+04	4.0E+00	-	
1,1-Biphenyl	5.0E-01	Ceiling Value	5.0E-01	3.5E+02	-	
Bis(2-chloroethyl) ether	3.2E-02	Drinking Water Toxicity	3.6E+02	3.2E-02	-	1.4E+00
Bis(2-chloroisopropyl) ether	1.4E-02	Drinking Water Toxicity	3.2E+02	1.4E-02	-	1.7E+05
Bis(2-ethylhexyl) phthalate	4.0E+00	Drinking Water Toxicity	6.5E+02	4.0E+00	-	5.9E+00
Boron	1.0E+03	Drinking Water Toxicity	5.0E+04	1.0E+03	-	
Bromodichloromethane	1.0E+02	Drinking Water Toxicity	5.0E+04	1.0E+02	-	
Bromoform (Tribromomethane)	1.0E+02	Drinking Water Toxicity	5.1E+02	1.0E+02	-	3.6E+02
Bromomethane	9.8E+00	Drinking Water Toxicity	5.0E+04	9.8E+00	-	4.0E+03
Cadmium	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00	-	
Carbon tetrachloride	5.0E-01	Drinking Water Toxicity	5.2E+02	5.0E-01	-	4.4E+00
Chlordane	5.9E-04	Bioaccumulation/Human Consumption	2.5E+00	1.0E-01	-	5.9E-04
p-Chloroaniline	2.8E+01	Drinking Water Toxicity	5.0E+04	2.8E+01	-	
Chlorobenzene	5.0E+01	Ceiling Value	5.0E+01	7.0E+01	-	2.1E+04
Chloroethane	1.2E+01	Drinking Water Toxicity	1.6E+01	1.2E+01	-	
Chloroform	7.0E+01	Drinking Water Toxicity	2.4E+03	7.0E+01	-	4.7E+02
Chloromethane	1.8E+02	Drinking Water Toxicity	5.0E+04	1.8E+02	-	
2-Chlorophenol	1.8E-01	Ceiling Value	1.8E-01	3.5E+01	-	4.0E+02
Chromium (total)	5.0E+01	Drinking Water Toxicity	5.0E+04	5.0E+01	-	
Chromium III	5.0E+04	Ceiling Value	5.0E+04	2.0E+05	-	

Table F-2a. Surface Water Screening Levels
Fresh Water Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-3	Drinking Water (Toxicity) Table F-3	Fresh Water Aquatic Habitat Goal (Chronic Toxicity) Table F-4a	Bioaccumulation and Human Consumption Table F-4d
Chromium VI	2.1E+01	Drinking Water Toxicity	5.0E+04	2.1E+01	-	
Chrysene	4.9E-02	Bioaccumulation/Human Consumption	8.0E-01	4.8E+00	-	4.9E-02
Cobalt	1.4E+02	Drinking Water Toxicity	5.0E+04	1.4E+02	-	
Copper	1.0E+03	Ceiling Value	1.0E+03	1.3E+03	-	
Cyanide	1.5E+02	Drinking Water Toxicity	1.7E+02	1.5E+02	-	2.2E+05
Dibenz(a,h)anthracene	4.8E-03	Drinking Water Toxicity	2.5E-01	4.8E-03	-	4.9E-02
Dibromochloromethane	4.6E+01	Bioaccumulation/Human Consumption	5.0E+04	1.0E+02	-	4.6E+01
1,2-dibromo-3-chloropropane	2.0E-01	Drinking Water Toxicity	1.0E+01	2.0E-01	-	
1,2-Dibromoethane	5.0E-02	Drinking Water Toxicity	5.0E+04	5.0E-02	-	
1,2-Dichlorobenzene	1.0E+01	Ceiling Value	1.0E+01	6.0E+02	-	1.7E+04
1,3-Dichlorobenzene	2.1E+02	Drinking Water Toxicity	5.0E+04	2.1E+02	-	2.6E+03
1,4-Dichlorobenzene	5.0E+00	Ceiling Value, Drinking Water Toxicity	5.0E+00	5.0E+00	-	2.6E+03
3,3-Dichlorobenzidine	2.9E-02	Drinking Water Toxicity	1.6E+03	2.9E-02	-	7.7E-02
Dichlorodiphenyldichloroethane (DDD)	8.4E-04	Bioaccumulation/Human Consumption	8.0E+01	1.5E-01	-	8.4E-04
Dichlorodiphenyldichloroethene (DDE)	5.9E-04	Bioaccumulation/Human Consumption	2.0E+01	1.0E-01	-	5.9E-04
Dichlorodiphenyltrichloroethane (DDT)	5.9E-04	Bioaccumulation/Human Consumption	1.5E+00	1.0E-01	-	5.9E-04
1,1-Dichloroethane	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00	-	
1,2-Dichloroethane	5.0E-01	Drinking Water Toxicity	7.0E+03	5.0E-01	-	9.9E+01
1,1-Dichloroethene	3.2E+00	Bioaccumulation/Human Consumption	1.5E+03	6.0E+00	-	3.2E+00
cis -1,2-Dichloroethene	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00	-	
trans -1,2-Dichloroethene	1.0E+01	Drinking Water Toxicity	2.6E+02	1.0E+01	-	1.4E+05
2,4-Dichlorophenol	3.0E-01	Ceiling Value	3.0E-01	2.1E+01	-	7.9E+02
1,2-Dichloropropane	5.0E+00	Drinking Water Toxicity	1.0E+01	5.0E+00	-	3.9E+01
1,3-Dichloropropene	5.0E-01	Drinking Water Toxicity	5.0E+04	5.0E-01	-	1.7E+03
Dieldrin	1.4E-04	Bioaccumulation/Human Consumption	4.1E+01	2.2E-03	-	1.4E-04
Diethyl phthalate	5.6E+03	Drinking Water Toxicity	5.0E+04	5.6E+03	-	1.2E+54
Dimethyl phthalate	5.0E+04	Ceiling Value	5.0E+04	7.0E+04	-	2.9E+06
2,4-Dimethylphenol	1.0E+02	Drinking Water Toxicity	4.0E+02	1.0E+02	-	2.3E+03
2,4-Dinitrophenol	1.4E+02	Drinking Water Toxicity	5.0E+04	1.4E+02	-	1.4E+04
2,4-Dinitrotoluene	5.1E-02	Drinking Water Toxicity	5.0E+04	5.1E-02	-	9.1E+00
1,4-Dioxane	3.0E+00	Drinking Water Toxicity	5.0E+04	3.0E+00	-	
Dioxin (2,3,7,8-TCDD)	1.4E-08	Bioaccumulation/Human Consumption	7.0E+03	3.0E-05	-	1.4E-08
Endosulfan	4.2E+01	Drinking Water Toxicity	7.5E+01	4.2E+01	-	2.4E+02

Table F-2a. Surface Water Screening Levels
Fresh Water Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-3	Drinking Water (Toxicity) Table F-3	Fresh Water Aquatic Habitat Goal (Chronic Toxicity) Table F-4a	Bioaccumulation and Human Consumption Table F-4d
Endrin	8.1E-01	Bioaccumulation/Human Consumption	4.1E+01	2.0E+00	-	8.1E-01
Ethylbenzene	3.0E+01	Ceiling Value	3.0E+01	3.0E+02	-	2.9E+04
Fluoranthene	1.3E+02	Ceiling Value	1.3E+02	2.8E+02	-	3.7E+02
Fluorene	2.8E+02	Drinking Water Toxicity	9.5E+02	2.8E+02	-	1.4E+04
Heptachlor	2.1E-04	Bioaccumulation/Human Consumption	2.0E+01	1.0E-02	-	2.1E-04
Heptachlor epoxide	1.1E-04	Bioaccumulation/Human Consumption	1.8E+02	1.0E-02	-	1.1E-04
Hexachlorobenzene	7.7E-04	Bioaccumulation/Human Consumption	5.5E+01	1.0E+00	-	7.7E-04
Hexachlorobutadiene	4.5E-01	Drinking Water Toxicity	6.0E+00	4.5E-01	-	5.0E+01
γ-Hexachlorocyclohexane (Lindane)	6.3E-02	Bioaccumulation/Human Consumption	3.5E+03	2.0E-01	-	6.3E-02
Hexachloroethane	9.0E-01	Drinking Water Toxicity	1.0E+01	9.0E-01	-	8.9E+00
Indeno(1,2,3-c,d)pyrene	4.8E-02	Drinking Water Toxicity	2.7E-01	4.8E-02	-	4.9E-02
Lead	1.5E+01	Drinking Water Toxicity	5.0E+04	1.5E+01	-	
Mercury (elemental)	5.1E-02	Bioaccumulation/Human Consumption	5.0E+04	2.0E+00	-	5.1E-02
Methoxychlor	2.0E+01	Ceiling Value	2.0E+01	4.0E+01	-	
Methylene chloride	5.0E+00	Drinking Water Toxicity	9.1E+03	5.0E+00	-	1.6E+03
Methyl ethyl ketone	4.2E+03	Drinking Water Toxicity	8.4E+03	4.2E+03	-	
Methyl isobutyl ketone	1.2E+02	Drinking Water Toxicity	1.3E+03	1.2E+02	-	
Methyl mercury	7.0E-01	Drinking Water Toxicity	5.0E+04	7.0E-01	-	
2-Methylnaphthalene	1.0E+01	Ceiling Value	1.0E+01	2.8E+01	-	
tert-Butyl methyl ether	5.0E+00	Ceiling Value	5.0E+00	1.3E+01	-	
Molybdenum	3.5E+01	Drinking Water Toxicity	5.0E+04	3.5E+01	-	
Naphthalene	1.7E+01	Drinking Water Toxicity	2.1E+01	1.7E+01	-	
Nickel	1.0E+02	Drinking Water Toxicity	5.0E+04	1.0E+02	-	4.6E+03
Pentachlorophenol	1.0E+00	Drinking Water Toxicity	3.0E+01	1.0E+00	-	8.2E+00
Perchlorate	6.0E+00	Drinking Water Toxicity	5.0E+04	6.0E+00	-	
Phenanthrene	2.1E+02	Drinking Water Toxicity	4.1E+02	2.1E+02	-	
Phenol	5.0E+00	Ceiling Value	5.0E+00	4.2E+03	-	4.6E+06
Polychlorinated biphenyls (PCBs)	1.7E-04	Bioaccumulation/Human Consumption	1.6E+01	5.0E-01	-	1.7E-04
Pyrene	6.8E+01	Ceiling Value	6.8E+01	4.2E+02	-	1.1E+04
Selenium	5.0E+01	Drinking Water Toxicity	5.0E+04	5.0E+01	-	
Silver	3.5E+01	Drinking Water Toxicity	1.0E+02	3.5E+01	-	
Styrene	1.0E+01	Ceiling Value	1.0E+01	1.0E+02	-	
tert-Butyl alcohol		Drinking Water Toxicity	5.0E+04		-	

Table F-2a. Surface Water Screening Levels
Fresh Water Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Ceiling Value (Taste & Odors, etc.) Table I-3	Drinking Water (Toxicity) Table F-3	Fresh Water Aquatic Habitat Goal (Chronic Toxicity) Table F-4a	Bioaccumulation and Human Consumption Table F-4d
1,1,1,2-Tetrachloroethane	1.3E+00	Drinking Water Toxicity	5.0E+04	1.3E+00	-	
1,1,2,2-Tetrachloroethane	1.0E+00	Drinking Water Toxicity	5.0E+02	1.0E+00	-	1.1E+01
Tetrachloroethene	5.0E+00	Drinking Water Toxicity	1.7E+02	5.0E+00	-	8.9E+00
Thallium	2.0E+00	Drinking Water Toxicity	5.0E+04	2.0E+00	-	6.3E+00
Toluene	4.0E+01	Ceiling Value	4.0E+01	1.5E+02	-	2.0E+05
Toxaphene	7.5E-04	Bioaccumulation/Human Consumption	1.4E+02	3.0E+00	-	7.5E-04
TPH (gasolines)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02	-	
TPH (middle distillates)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02	-	
TPH (residual fuels)	1.0E+02	Ceiling Value	1.0E+02	2.1E+02	-	
1,2,4-Trichlorobenzene	5.0E+00	Drinking Water Toxicity	3.0E+03	5.0E+00	-	
1,1,1-Trichloroethane	2.0E+02	Drinking Water Toxicity	9.7E+02	2.0E+02	-	
1,1,2-Trichloroethane	5.0E+00	Drinking Water Toxicity	5.0E+04	5.0E+00	-	4.2E+01
Trichloroethene	5.0E+00	Drinking Water Toxicity	3.1E+02	5.0E+00	-	8.1E+01
2,4,5-Trichlorophenol	2.0E+02	Ceiling Value	2.0E+02	7.0E+02	-	3.6E+03
2,4,6-Trichlorophenol	7.0E-01	Drinking Water Toxicity	1.0E+02	7.0E-01	-	6.5E+00
Vanadium	1.5E+01	Drinking Water Toxicity	5.0E+04	1.5E+01	-	
Vinyl chloride	5.0E-01	Drinking Water Toxicity	3.4E+03	5.0E-01	-	5.3E+02
Xylenes	2.0E+01	Ceiling Value	2.0E+01	1.8E+03	-	
Zinc	5.0E+03	Ceiling Value	5.0E+03	5.0E+03	-	

Notes:

1. Lowest of ceiling value, drinking water goal, aquatic habitat goal, and bioaccumulation goal.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
Ceiling Level: Odor threshold, 1/2 solubility or 50000 ug/L maximum, whichever is lower. Intended to limit nuisances and general resource degradation.
Review of aquatic ecotoxicty data for ethanol underway. Based on preliminary review of available data, chronic toxicity screening levels likely to be significantly greater than ceiling level of 50,000 ug/L (refer to USEPA 2003b, ECOTOX database).

Table F-2b. Surface Water Screening Levels\
Marine Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Marine Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Acenaphthene	2.0E+01	Ceiling Level	2.0E+01	-	2.7E+03
Acenaphthylene	2.0E+03	Ceiling Level	2.0E+03	-	
Acetone	2.0E+04	Ceiling Level	2.0E+04	-	
Aldrin	1.4E-04	Bioaccumulation/Human Consumption	8.5E+00	-	1.4E-04
Anthracene	2.2E+01	Ceiling Level	2.2E+01	-	1.1E+05
Antimony	4.3E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.3E+03
Arsenic	1.4E-01	Bioaccumulation/Human Consumption	5.0E+04	-	1.4E-01
Barium	5.0E+04	Ceiling Level	5.0E+04	-	
Benzene	7.1E+01	Bioaccumulation/Human Consumption	2.0E+03	-	7.1E+01
Benzo(a)anthracene	4.9E-02	Bioaccumulation/Human Consumption	5.0E+00	-	4.9E-02
Benzo(b)fluoranthene	4.9E-02	Bioaccumulation/Human Consumption	7.0E+00	-	4.9E-02
Benzo(k)fluoranthene	4.9E-02	Bioaccumulation/Human Consumption	4.0E-01	-	4.9E-02
Benzo(g,h,i)perylene	1.3E-01	Ceiling Level	1.3E-01	-	
Benzo(a)pyrene	4.9E-02	Bioaccumulation/Human Consumption	1.9E+00	-	4.9E-02
Beryllium	5.0E+04	Ceiling Level	5.0E+04	-	
1,1-Biphenyl	5.0E-01	Ceiling Level	5.0E-01	-	
Bis(2-chloroethyl) ether	1.4E+00	Bioaccumulation/Human Consumption	3.6E+02	-	1.4E+00
Bis(2-chloroisopropyl) ether	3.2E+02	Ceiling Level	3.2E+02	-	1.7E+05
Bis(2-ethylhexyl) phthalate	5.9E+00	Bioaccumulation/Human Consumption	6.5E+02	-	5.9E+00
Boron	5.0E+04	Ceiling Level	5.0E+04	-	
Bromodichloromethane	5.0E+04	Ceiling Level	5.0E+04	-	
Bromoform (Tribromomethane)	3.6E+02	Bioaccumulation/Human Consumption	5.1E+02	-	3.6E+02
Bromomethane	4.0E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.0E+03
Cadmium	5.0E+04	Ceiling Level	5.0E+04	-	
Carbon tetrachloride	4.4E+00	Bioaccumulation/Human Consumption	5.2E+02	-	4.4E+00
Chlordane	5.9E-04	Bioaccumulation/Human Consumption	2.5E+00	-	5.9E-04
p-Chloroaniline	5.0E+04	Ceiling Level	5.0E+04	-	
Chlorobenzene	5.0E+01	Ceiling Level	5.0E+01	-	2.1E+04
Chloroethane	1.6E+01	Ceiling Level	1.6E+01	-	
Chloroform	4.7E+02	Bioaccumulation/Human Consumption	2.4E+03	-	4.7E+02
Chloromethane	5.0E+04	Ceiling Level	5.0E+04	-	
2-Chlorophenol	1.8E-01	Ceiling Level	1.8E-01	-	4.0E+02
Chromium (total)	5.0E+04	Ceiling Level	5.0E+04	-	
Chromium III	5.0E+04	Ceiling Level	5.0E+04	-	

Table F-2b. Surface Water Screening Levels\
Marine Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Marine Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Chromium VI	5.0E+04	Ceiling Level	5.0E+04	-	
Chrysene	4.9E-02	Bioaccumulation/Human Consumption	8.0E-01	-	4.9E-02
Cobalt	5.0E+04	Ceiling Level	5.0E+04	-	
Copper	5.0E+04	Ceiling Level	5.0E+04	-	
Cyanide	1.7E+02	Ceiling Level	1.7E+02	-	2.2E+05
Dibenz(a,h)anthracene	4.9E-02	Bioaccumulation/Human Consumption	2.5E-01	-	4.9E-02
Dibromochloromethane	4.6E+01	Bioaccumulation/Human Consumption	5.0E+04	-	4.6E+01
1,2-dibromo-3-chloropropane	1.0E+01	Ceiling Level	1.0E+01	-	
1,2-Dibromoethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,2-Dichlorobenzene	1.0E+01	Ceiling Level	1.0E+01	-	1.7E+04
1,3-Dichlorobenzene	2.6E+03	Bioaccumulation/Human Consumption	5.0E+04	-	2.6E+03
1,4-Dichlorobenzene	1.1E+01	Ceiling Level	1.1E+01	-	2.6E+03
3,3-Dichlorobenzidine	7.7E-02	Bioaccumulation/Human Consumption	1.6E+03	-	7.7E-02
Dichlorodiphenyldichloroethane (DDD)	8.4E-04	Bioaccumulation/Human Consumption	8.0E+01	-	8.4E-04
Dichlorodiphenyldichloroethene (DDE)	5.9E-04	Bioaccumulation/Human Consumption	2.0E+01	-	5.9E-04
Dichlorodiphenyltrichloroethane (DDT)	5.9E-04	Bioaccumulation/Human Consumption	1.5E+00	-	5.9E-04
1,1-Dichloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,2-Dichloroethane	9.9E+01	Bioaccumulation/Human Consumption	2.0E+04	-	9.9E+01
1,1-Dichloroethene	3.2E+00	Bioaccumulation/Human Consumption	1.5E+03	-	3.2E+00
cis -1,2-Dichloroethene	5.0E+04	Ceiling Level	5.0E+04	-	
trans -1,2-Dichloroethene	2.6E+02	Ceiling Level	2.6E+02	-	1.4E+05
2,4-Dichlorophenol	3.0E-01	Ceiling Level	3.0E-01	-	7.9E+02
1,2-Dichloropropane	1.0E+01	Ceiling Level	1.0E+01	-	3.9E+01
1,3-Dichloropropene	1.7E+03	Bioaccumulation/Human Consumption	5.0E+04	-	1.7E+03
Dieldrin	1.4E-04	Bioaccumulation/Human Consumption	4.1E+01	-	1.4E-04
Diethyl phthalate	5.0E+04	Ceiling Level	5.0E+04	-	1.2E+54
Dimethyl phthalate	5.0E+04	Ceiling Level	5.0E+04	-	2.9E+06
2,4-Dimethylphenol	4.0E+02	Ceiling Level	4.0E+02	-	2.3E+03
2,4-Dinitrophenol	1.4E+04	Bioaccumulation/Human Consumption	5.0E+04	-	1.4E+04
2,4-Dinitrotoluene	9.1E+00	Bioaccumulation/Human Consumption	5.0E+04	-	9.1E+00
1,4-Dioxane	5.0E+04	Ceiling Level	5.0E+04	-	
Dioxin (2,3,7,8-TCDD)	1.4E-08	Bioaccumulation/Human Consumption	7.0E+03	-	1.4E-08
Endosulfan	7.5E+01	Ceiling Level	7.5E+01	-	2.4E+02

Table F-2b. Surface Water Screening Levels\
Marine Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Marine Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Endrin	8.1E-01	Bioaccumulation/Human Consumption	4.1E+01	-	8.1E-01
Ethylbenzene	3.0E+01	Ceiling Level	3.0E+01	-	2.9E+04
Fluoranthene	1.3E+02	Ceiling Level	1.3E+02	-	3.7E+02
Fluorene	9.5E+02	Ceiling Level	9.5E+02	-	1.4E+04
Heptachlor	2.1E-04	Bioaccumulation/Human Consumption	2.0E+01	-	2.1E-04
Heptachlor epoxide	1.1E-04	Bioaccumulation/Human Consumption	1.8E+02	-	1.1E-04
Hexachlorobenzene	7.7E-04	Bioaccumulation/Human Consumption	5.5E+01	-	7.7E-04
Hexachlorobutadiene	6.0E+00	Ceiling Level	6.0E+00	-	5.0E+01
γ-Hexachlorocyclohexane (Lindane)	6.3E-02	Bioaccumulation/Human Consumption	3.5E+03	-	6.3E-02
Hexachloroethane	8.9E+00	Bioaccumulation/Human Consumption	1.0E+01	-	8.9E+00
Indeno(1,2,3-c,d)pyrene	4.9E-02	Bioaccumulation/Human Consumption	2.7E-01	-	4.9E-02
Lead	5.0E+04	Ceiling Level	5.0E+04	-	
Mercury (elemental)	5.1E-02	Bioaccumulation/Human Consumption	5.0E+04	-	5.1E-02
Methoxychlor	2.0E+01	Ceiling Level	2.0E+01	-	
Methylene chloride	1.6E+03	Bioaccumulation/Human Consumption	9.1E+03	-	1.6E+03
Methyl ethyl ketone	8.4E+03	Ceiling Level	8.4E+03	-	
Methyl isobutyl ketone	1.3E+03	Ceiling Level	1.3E+03	-	
Methyl mercury	5.0E+04	Ceiling Level	5.0E+04	-	
2-Methylnaphthalene	1.0E+01	Ceiling Level	1.0E+01	-	
tert-Butyl methyl ether	1.8E+02	Ceiling Level	1.8E+02	-	
Molybdenum	5.0E+04	Ceiling Level	5.0E+04	-	
Naphthalene	2.1E+01	Ceiling Level	2.1E+01	-	
Nickel	4.6E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.6E+03
Pentachlorophenol	8.2E+00	Bioaccumulation/Human Consumption	5.9E+02	-	8.2E+00
Perchlorate	5.0E+04	Ceiling Level	5.0E+04	-	
Phenanthrene	4.1E+02	Ceiling Level	4.1E+02	-	
Phenol	7.9E+03	Ceiling Level	7.9E+03	-	4.6E+06
Polychlorinated biphenyls (PCBs)	1.7E-04	Bioaccumulation/Human Consumption	1.6E+01	-	1.7E-04
Pyrene	6.8E+01	Ceiling Level	6.8E+01	-	1.1E+04
Selenium	5.0E+04	Ceiling Level	5.0E+04	-	
Silver	5.0E+04	Ceiling Level	5.0E+04	-	
Styrene	1.1E+01	Ceiling Level	1.1E+01	-	
tert-Butyl alcohol	5.0E+04	Ceiling Level	5.0E+04	-	

Table F-2b. Surface Water Screening Levels\
Marine Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.) Table I-4	Marine Aquatic Habitat Goal (Chronic Toxicity) Table F-4a	Bioaccumulation and Human Consumption Table F-4d
1,1,1,2-Tetrachloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,1,2,2-Tetrachloroethane	1.1E+01	Bioaccumulation/Human Consumption	5.0E+02	-	1.1E+01
Tetrachloroethene	8.9E+00	Bioaccumulation/Human Consumption	3.0E+02	-	8.9E+00
Thallium	6.3E+00	Bioaccumulation/Human Consumption	5.0E+04	-	6.3E+00
Toluene	4.0E+01	Ceiling Level	4.0E+01	-	2.0E+05
Toxaphene	7.5E-04	Bioaccumulation/Human Consumption	1.4E+02	-	7.5E-04
TPH (gasolines)	5.0E+03	Ceiling Level	5.0E+03	-	
TPH (middle distillates)	2.5E+03	Ceiling Level	2.5E+03	-	
TPH (residual fuels)	2.5E+03	Ceiling Level	2.5E+03	-	
1,2,4-Trichlorobenzene	3.0E+03	Ceiling Level	3.0E+03	-	
1,1,1-Trichloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,1,2-Trichloroethane	4.2E+01	Bioaccumulation/Human Consumption	5.0E+04	-	4.2E+01
Trichloroethene	8.1E+01	Bioaccumulation/Human Consumption	1.0E+04	-	8.1E+01
2,4,5-Trichlorophenol	2.0E+02	Ceiling Level	2.0E+02	-	3.6E+03
2,4,6-Trichlorophenol	6.5E+00	Bioaccumulation/Human Consumption	1.0E+02	-	6.5E+00
Vanadium	5.0E+04	Ceiling Level	5.0E+04	-	
Vinyl chloride	5.3E+02	Bioaccumulation/Human Consumption	3.4E+03	-	5.3E+02
Xylenes	5.3E+02	Ceiling Level	5.3E+02	-	
Zinc	5.0E+04	Ceiling Level	5.0E+04	-	

Notes:

1. Lowest of Ceiling Value, aquatic habitat goal, and bioaccumulation goal.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
Ceiling Level: Odor threshold, 1/2 solubility or 50000 ug/L maximum, whichever is lower. Intended to limit nuisances and general resource degradation.
Review of aquatic ecotoxicty data for ethanol underway. Based on preliminary review of available data, chronic toxicity screening levels likely to be significantly greater than ceiling level of 50,000 ug/L (refer to USEPA 2003b, ECOTOX database).

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Acenaphthene	2.0E+01	Ceiling Level	2.0E+01	-	2.7E+03
Acenaphthylene	2.0E+03	Ceiling Level	2.0E+03	-	
Acetone	2.0E+04	Ceiling Level	2.0E+04	-	
Aldrin	1.4E-04	Bioaccumulation/Human Consumption	8.5E+00	-	1.4E-04
Anthracene	2.2E+01	Ceiling Level	2.2E+01	-	1.1E+05
Antimony	4.3E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.3E+03
Arsenic	1.4E-01	Bioaccumulation/Human Consumption	5.0E+04	-	1.4E-01
Barium	5.0E+04	Ceiling Level	5.0E+04	-	
Benzene	7.1E+01	Bioaccumulation/Human Consumption	2.0E+03	-	7.1E+01
Benzo(a)anthracene	4.9E-02	Bioaccumulation/Human Consumption	5.0E+00	-	4.9E-02
Benzo(b)fluoranthene	4.9E-02	Bioaccumulation/Human Consumption	7.0E+00	-	4.9E-02
Benzo(k)fluoranthene	4.9E-02	Bioaccumulation/Human Consumption	4.0E-01	-	4.9E-02
Benzo(g,h,i)perylene	1.3E-01	Ceiling Level	1.3E-01	-	
Benzo(a)pyrene	4.9E-02	Bioaccumulation/Human Consumption	1.9E+00	-	4.9E-02
Beryllium	5.0E+04	Ceiling Level	5.0E+04	-	
1,1-Biphenyl	5.0E-01	Ceiling Level	5.0E-01	-	
Bis(2-chloroethyl) ether	1.4E+00	Bioaccumulation/Human Consumption	3.6E+02	-	1.4E+00
Bis(2-chloroisopropyl) ether	3.2E+02	Ceiling Level	3.2E+02	-	1.7E+05
Bis(2-ethylhexyl) phthalate	5.9E+00	Bioaccumulation/Human Consumption	6.5E+02	-	5.9E+00
Boron	5.0E+04	Ceiling Level	5.0E+04	-	
Bromodichloromethane	5.0E+04	Ceiling Level	5.0E+04	-	
Bromoform (Tribromomethane)	3.6E+02	Bioaccumulation/Human Consumption	5.1E+02	-	3.6E+02
Bromomethane	4.0E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.0E+03
Cadmium	5.0E+04	Ceiling Level	5.0E+04	-	
Carbon tetrachloride	4.4E+00	Bioaccumulation/Human Consumption	5.2E+02	-	4.4E+00
Chlordane	5.9E-04	Bioaccumulation/Human Consumption	2.5E+00	-	5.9E-04
p-Chloroaniline	5.0E+04	Ceiling Level	5.0E+04	-	
Chlorobenzene	5.0E+01	Ceiling Level	5.0E+01	-	2.1E+04
Chloroethane	1.6E+01	Ceiling Level	1.6E+01	-	
Chloroform	4.7E+02	Bioaccumulation/Human Consumption	2.4E+03	-	4.7E+02
Chloromethane	5.0E+04	Ceiling Level	5.0E+04	-	
2-Chlorophenol	1.8E-01	Ceiling Level	1.8E-01	-	4.0E+02
Chromium (total)	5.0E+04	Ceiling Level	5.0E+04	-	
Chromium III	5.0E+04	Ceiling Level	5.0E+04	-	

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Chromium VI	5.0E+04	Ceiling Level	5.0E+04	-	
Chrysene	4.9E-02	Bioaccumulation/Human Consumption	8.0E-01	-	4.9E-02
Cobalt	5.0E+04	Ceiling Level	5.0E+04	-	
Copper	5.0E+04	Ceiling Level	5.0E+04	-	
Cyanide	1.7E+02	Ceiling Level	1.7E+02	-	2.2E+05
Dibenz(a,h)anthracene	4.9E-02	Bioaccumulation/Human Consumption	2.5E-01	-	4.9E-02
Dibromochloromethane	4.6E+01	Bioaccumulation/Human Consumption	5.0E+04	-	4.6E+01
1,2-dibromo-3-chloropropane	1.0E+01	Ceiling Level	1.0E+01	-	
1,2-Dibromoethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,2-Dichlorobenzene	1.0E+01	Ceiling Level	1.0E+01	-	1.7E+04
1,3-Dichlorobenzene	2.6E+03	Bioaccumulation/Human Consumption	5.0E+04	-	2.6E+03
1,4-Dichlorobenzene	1.1E+01	Ceiling Level	1.1E+01	-	2.6E+03
3,3-Dichlorobenzidine	7.7E-02	Bioaccumulation/Human Consumption	1.6E+03	-	7.7E-02
Dichlorodiphenyldichloroethane (DDD)	8.4E-04	Bioaccumulation/Human Consumption	8.0E+01	-	8.4E-04
Dichlorodiphenyldichloroethene (DDE)	5.9E-04	Bioaccumulation/Human Consumption	2.0E+01	-	5.9E-04
Dichlorodiphenyltrichloroethane (DDT)	5.9E-04	Bioaccumulation/Human Consumption	1.5E+00	-	5.9E-04
1,1-Dichloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,2-Dichloroethane	9.9E+01	Bioaccumulation/Human Consumption	2.0E+04	-	9.9E+01
1,1-Dichloroethene	3.2E+00	Bioaccumulation/Human Consumption	1.5E+03	-	3.2E+00
cis -1,2-Dichloroethene	5.0E+04	Ceiling Level	5.0E+04	-	
trans -1,2-Dichloroethene	2.6E+02	Ceiling Level	2.6E+02	-	1.4E+05
2,4-Dichlorophenol	3.0E-01	Ceiling Level	3.0E-01	-	7.9E+02
1,2-Dichloropropane	1.0E+01	Ceiling Level	1.0E+01	-	3.9E+01
1,3-Dichloropropene	1.7E+03	Bioaccumulation/Human Consumption	5.0E+04	-	1.7E+03
Dieldrin	1.4E-04	Bioaccumulation/Human Consumption	4.1E+01	-	1.4E-04
Diethyl phthalate	5.0E+04	Ceiling Level	5.0E+04	-	1.2E+54
Dimethyl phthalate	5.0E+04	Ceiling Level	5.0E+04	-	2.9E+06
2,4-Dimethylphenol	4.0E+02	Ceiling Level	4.0E+02	-	2.3E+03
2,4-Dinitrophenol	1.4E+04	Bioaccumulation/Human Consumption	5.0E+04	-	1.4E+04
2,4-Dinitrotoluene	9.1E+00	Bioaccumulation/Human Consumption	5.0E+04	-	9.1E+00
1,4-Dioxane	5.0E+04	Ceiling Level	5.0E+04	-	
Dioxin (2,3,7,8-TCDD)	1.4E-08	Bioaccumulation/Human Consumption	7.0E+03	-	1.4E-08
Endosulfan	7.5E+01	Ceiling Level	7.5E+01	-	2.4E+02

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Endrin	8.1E-01	Bioaccumulation/Human Consumption	4.1E+01	-	8.1E-01
Ethylbenzene	3.0E+01	Ceiling Level	3.0E+01	-	2.9E+04
Fluoranthene	1.3E+02	Ceiling Level	1.3E+02	-	3.7E+02
Fluorene	9.5E+02	Ceiling Level	9.5E+02	-	1.4E+04
Heptachlor	2.1E-04	Bioaccumulation/Human Consumption	2.0E+01	-	2.1E-04
Heptachlor epoxide	1.1E-04	Bioaccumulation/Human Consumption	1.8E+02	-	1.1E-04
Hexachlorobenzene	7.7E-04	Bioaccumulation/Human Consumption	5.5E+01	-	7.7E-04
Hexachlorobutadiene	6.0E+00	Ceiling Level	6.0E+00	-	5.0E+01
γ-Hexachlorocyclohexane (Lindane)	6.3E-02	Bioaccumulation/Human Consumption	3.5E+03	-	6.3E-02
Hexachloroethane	8.9E+00	Bioaccumulation/Human Consumption	1.0E+01	-	8.9E+00
Indeno(1,2,3-c,d)pyrene	4.9E-02	Bioaccumulation/Human Consumption	2.7E-01	-	4.9E-02
Lead	5.0E+04	Ceiling Level	5.0E+04	-	
Mercury (elemental)	5.1E-02	Bioaccumulation/Human Consumption	5.0E+04	-	5.1E-02
Methoxychlor	2.0E+01	Ceiling Level	2.0E+01	-	
Methylene chloride	1.6E+03	Bioaccumulation/Human Consumption	9.1E+03	-	1.6E+03
Methyl ethyl ketone	8.4E+03	Ceiling Level	8.4E+03	-	
Methyl isobutyl ketone	1.3E+03	Ceiling Level	1.3E+03	-	
Methyl mercury	5.0E+04	Ceiling Level	5.0E+04	-	
2-Methylnaphthalene	1.0E+01	Ceiling Level	1.0E+01	-	
tert-Butyl methyl ether	1.8E+02	Ceiling Level	1.8E+02	-	
Molybdenum	5.0E+04	Ceiling Level	5.0E+04	-	
Naphthalene	2.1E+01	Ceiling Level	2.1E+01	-	
Nickel	4.6E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.6E+03
Pentachlorophenol	8.2E+00	Bioaccumulation/Human Consumption	5.9E+02	-	8.2E+00
Perchlorate	5.0E+04	Ceiling Level	5.0E+04	-	
Phenanthrene	4.1E+02	Ceiling Level	4.1E+02	-	
Phenol	7.9E+03	Ceiling Level	7.9E+03	-	4.6E+06
Polychlorinated biphenyls (PCBs)	1.7E-04	Bioaccumulation/Human Consumption	1.6E+01	-	1.7E-04
Pyrene	6.8E+01	Ceiling Level	6.8E+01	-	1.1E+04
Selenium	5.0E+04	Ceiling Level	5.0E+04	-	
Silver	5.0E+04	Ceiling Level	5.0E+04	-	
Styrene	1.1E+01	Ceiling Level	1.1E+01	-	
tert-Butyl alcohol	5.0E+04	Ceiling Level	5.0E+04	-	

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
1,1,1,2-Tetrachloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,1,2,2-Tetrachloroethane	1.1E+01	Bioaccumulation/Human Consumption	5.0E+02	-	1.1E+01
Tetrachloroethene	8.9E+00	Bioaccumulation/Human Consumption	3.0E+02	-	8.9E+00
Thallium	6.3E+00	Bioaccumulation/Human Consumption	5.0E+04	-	6.3E+00
Toluene	4.0E+01	Ceiling Level	4.0E+01	-	2.0E+05
Toxaphene	7.5E-04	Bioaccumulation/Human Consumption	1.4E+02	-	7.5E-04
TPH (gasolines)	5.0E+03	Ceiling Level	5.0E+03	-	
TPH (middle distillates)	2.5E+03	Ceiling Level	2.5E+03	-	
TPH (residual fuels)	2.5E+03	Ceiling Level	2.5E+03	-	
1,2,4-Trichlorobenzene	3.0E+03	Ceiling Level	3.0E+03	-	
1,1,1-Trichloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,1,2-Trichloroethane	4.2E+01	Bioaccumulation/Human Consumption	5.0E+04	-	4.2E+01
Trichloroethene	8.1E+01	Bioaccumulation/Human Consumption	1.0E+04	-	8.1E+01
2,4,5-Trichlorophenol	2.0E+02	Ceiling Level	2.0E+02	-	3.6E+03
2,4,6-Trichlorophenol	6.5E+00	Bioaccumulation/Human Consumption	1.0E+02	-	6.5E+00
Vanadium	5.0E+04	Ceiling Level	5.0E+04	-	
Vinyl chloride	5.3E+02	Bioaccumulation/Human Consumption	3.4E+03	-	5.3E+02
Xylenes	5.3E+02	Ceiling Level	5.3E+02	-	
Zinc	5.0E+04	Ceiling Level	5.0E+04	-	

Notes:

***Estuary Habitats: Mixed freshwater/marine water habitats.**

1. Lowest of Ceiling Value, aquatic habitat goal, and bioaccumulation goal.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Ceiling Level: Odor threshold, 1/2 solubility or 50000 ug/L maximum, whichever is lower. Intended to limit nuisances and general resource degradation.

Review of aquatic ecotoxicty data for ethanol underway. Based on preliminary review of available data, chronic toxicity screening levels likely to be significantly greater than ceiling level of 50,000 ug/L (refer to USEPA 2003b, ECOTOX database).

Table F-3. Summary of Drinking Water Screening Levels
(µg/L)

Chemical	Final Screening Level	Basis	Cal Primary MCL	Other CalEPA Criteria	Reference	*Risk-Based Goals	Basis
Acenaphthene	4.2E+02	Noncarcinogenic Effects				4.2E+02	Noncarcinogenic Effects
Acenaphthylene	2.1E+02	Noncarcinogenic Effects				2.1E+02	Noncarcinogenic Effects
Acetone	6.3E+03	Noncarcinogenic Effects				6.3E+03	Noncarcinogenic Effects
Aldrin	2.0E-03	Cal DHS AL		2.0E-03	Cal DHS AL	2.1E-03	Carcinogenic Effects
Anthracene	2.1E+03	Noncarcinogenic Effects				2.1E+03	Noncarcinogenic Effects
Antimony	6.0E+00	Cal Primary MCL	6.0E+00	2.0E+01	Cal OEHHA PHG	2.8E+00	Noncarcinogenic Effects
Arsenic	5.0E+01	Cal Primary MCL	5.0E+01			2.3E-02	Carcinogenic Effects
Barium	1.0E+03	Cal Primary MCL	1.0E+03	2.0E+03	Cal OEHHA PHG	1.4E+03	Noncarcinogenic Effects
Benzene	1.0E+00	Cal Primary MCL	1.0E+00	1.5E-01	Cal OEHHA PHG	3.5E-01	Carcinogenic Effects
Benzo(a)anthracene	2.9E-02	Carcinogenic Effects				2.9E-02	Carcinogenic Effects
Benzo(b)fluoranthene	2.9E-02	Carcinogenic Effects				2.9E-02	Carcinogenic Effects
Benzo(k)fluoranthene	2.9E-02	Carcinogenic Effects				2.9E-02	Carcinogenic Effects
Benzo(g,h,i)perylene	2.1E+02	Noncarcinogenic Effects				2.1E+02	Noncarcinogenic Effects
Benzo(a)pyrene	2.0E-01	Cal Primary MCL	2.0E-01			2.9E-03	Carcinogenic Effects
Beryllium	4.0E+00	Cal Primary MCL	4.0E+00			1.4E+01	Noncarcinogenic Effects
1,1-Biphenyl	3.5E+02	Noncarcinogenic Effects				3.5E+02	Noncarcinogenic Effects
Bis(2-chloroethyl) ether	3.2E-02	Carcinogenic Effects				3.2E-02	Carcinogenic Effects
Bis(2-chloroisopropyl) ether	1.4E-02	Carcinogenic Effects				1.4E-02	Carcinogenic Effects
Bis(2-ethylhexyl) phthalate	4.0E+00	Cal Primary MCL	4.0E+00			2.5E+00	Carcinogenic Effects
Boron	1.0E+03	Cal DHS AL		1.0E+03	Cal DHS AL	1.4E+03	Noncarcinogenic Effects
Bromodichloromethane	1.0E+02	Cal Primary MCL	1.0E+02			5.6E-01	Carcinogenic Effects
Bromoform (Tribromomethane)	1.0E+02	Cal Primary MCL	1.0E+02			4.4E+00	Carcinogenic Effects
Bromomethane	9.8E+00	Noncarcinogenic Effects				9.8E+00	Noncarcinogenic Effects
Cadmium	5.0E+00	Cal Primary MCL	5.0E+00	7.0E-02	Cal OEHHA PHG	9.2E-02	Carcinogenic Effects
Carbon tetrachloride	5.0E-01	Cal Primary MCL	5.0E-01	1.0E-01	Cal OEHHA PHG	2.3E-01	Carcinogenic Effects
Chlordane	1.0E-01	Cal Primary MCL	1.0E-01	3.0E-02	Cal OEHHA PHG	2.7E-02	Carcinogenic Effects
p-Chloroaniline	2.8E+01	Noncarcinogenic Effects				2.8E+01	Noncarcinogenic Effects
Chlorobenzene	7.0E+01	Cal Primary MCL	7.0E+01	2.0E+02	Cal OEHHA PHG	1.4E+02	Noncarcinogenic Effects
Chloroethane	1.2E+01	Carcinogenic Effects				1.2E+01	Carcinogenic Effects
Chloroform	7.0E+01	Cal Primary MCL	7.0E+01			1.1E+00	Carcinogenic Effects
Chloromethane	1.8E+02	Noncarcinogenic Effects				1.8E+02	Noncarcinogenic Effects
2-Chlorophenol	3.5E+01	Noncarcinogenic Effects				3.5E+01	Noncarcinogenic Effects
Chromium (total)	5.0E+01	Cal Primary MCL	5.0E+01			-	-
Chromium III	2.0E+05	Cal OEHHA PHG		2.0E+05	Cal OEHHA PHG	1.1E+04	Noncarcinogenic Effects
Chromium VI	2.1E+01	Noncarcinogenic Effects				2.1E+01	Noncarcinogenic Effects

Table F-3. Summary of Drinking Water Screening Levels
(µg/L)

Chemical	Final Screening Level	Basis	Cal Primary MCL	Other CalEPA Criteria	Reference	*Risk-Based Goals	Basis
Chrysene	4.8E+00	Carcinogenic Effects				4.8E+00	Carcinogenic Effects
Cobalt	1.4E+02	Noncarcinogenic Effects				1.4E+02	Noncarcinogenic Effects
Copper	1.3E+03	Cal Primary MCL	1.3E+03	1.7E+02	Cal OEHHA PHG	2.8E+03	Noncarcinogenic Effects
Cyanide	1.5E+02	Cal Primary MCL	1.5E+02	1.5E+02	Cal OEHHA PHG	1.4E+02	Noncarcinogenic Effects
Dibenz(a,h)anthracene	4.8E-03	Carcinogenic Effects				4.8E-03	Carcinogenic Effects
Dibromochloromethane	1.0E+02	Cal Primary MCL	1.0E+02			4.2E-01	Carcinogenic Effects
1,2-dibromo-3-chloropropane	2.0E-01	Cal Primary MCL	2.0E-01	1.7E-03	Cal OEHHA PHG	5.0E-03	Carcinogenic Effects
1,2-Dibromoethane	5.0E-02	Cal Primary MCL	5.0E-02			9.7E-03	Carcinogenic Effects
1,2-Dichlorobenzene	6.0E+02	Cal Primary MCL	6.0E+02	6.0E+02	Cal OEHHA PHG	6.3E+02	Noncarcinogenic Effects
1,3-Dichlorobenzene	2.1E+02	Noncarcinogenic Effects				2.1E+02	Noncarcinogenic Effects
1,4-Dichlorobenzene	5.0E+00	Cal Primary MCL	5.0E+00	6.0E+00	Cal OEHHA PHG	1.5E+00	Carcinogenic Effects
3,3-Dichlorobenzidine	2.9E-02	Carcinogenic Effects				2.9E-02	Carcinogenic Effects
Dichlorodiphenyldichloroethane (DDD)	1.5E-01	Carcinogenic Effects				1.5E-01	Carcinogenic Effects
Dichlorodiphenyldichloroethene (DDE)	1.0E-01	Carcinogenic Effects				1.0E-01	Carcinogenic Effects
Dichlorodiphenyltrichloroethane (DDT)	1.0E-01	Carcinogenic Effects				1.0E-01	Carcinogenic Effects
1,1-Dichloroethane	5.0E+00	Cal Primary MCL	5.0E+00			6.1E+00	Carcinogenic Effects
1,2-Dichloroethane	5.0E-01	Cal Primary MCL	5.0E-01	4.0E-01	Cal OEHHA PHG	3.8E-01	Carcinogenic Effects
1,1-Dichloroethene	6.0E+00	Cal Primary MCL	6.0E+00	1.0E+01	Cal OEHHA PHG	5.8E-02	Carcinogenic Effects
cis -1,2-Dichloroethene	6.0E+00	Cal Primary MCL	6.0E+00	1.0E+02	Cal OEHHA PHG	7.0E+01	Noncarcinogenic Effects
trans -1,2-Dichloroethene	1.0E+01	Cal Primary MCL	1.0E+01	6.0E+01	Cal OEHHA PHG	1.4E+02	Noncarcinogenic Effects
2,4-Dichlorophenol	2.1E+01	Noncarcinogenic Effects				2.1E+01	Noncarcinogenic Effects
1,2-Dichloropropane	5.0E+00	Cal Primary MCL	5.0E+00	5.0E-01	Cal OEHHA PHG	5.1E-01	Carcinogenic Effects
1,3-Dichloropropene	5.0E-01	Cal Primary MCL	5.0E-01	2.0E-01	Cal OEHHA PHG	3.5E-01	Carcinogenic Effects
Dieldrin	2.2E-03	Carcinogenic Effects				2.2E-03	Carcinogenic Effects
Diethyl phthalate	5.6E+03	Noncarcinogenic Effects				5.6E+03	Noncarcinogenic Effects
Dimethyl phthalate	7.0E+04	Noncarcinogenic Effects				7.0E+04	Noncarcinogenic Effects
2,4-Dimethylphenol	1.0E+02	Cal DHS AL		1.0E+02	Cal DHS AL	1.4E+02	Noncarcinogenic Effects
2,4-Dinitrophenol	1.4E+02	Noncarcinogenic Effects				1.4E+02	Noncarcinogenic Effects
2,4-Dinitrotoluene	5.1E-02	Carcinogenic Effects				5.1E-02	Carcinogenic Effects
1,4-Dioxane	3.0E+00	Cal OEHHA PHG		3.0E+00	Cal OEHHA PHG	1.3E+00	Carcinogenic Effects
Dioxin (2,3,7,8-TCDD)	3.0E-05	Cal Primary MCL	3.0E-05			2.7E-07	Carcinogenic Effects
Endosulfan	4.2E+01	Noncarcinogenic Effects				4.2E+01	Noncarcinogenic Effects
Endrin	2.0E+00	Cal Primary MCL	2.0E+00	1.8E+00	Cal OEHHA PHG	2.1E+00	Noncarcinogenic Effects
Ethylbenzene	3.0E+02	Cal Primary MCL	3.0E+02	3.0E+02	Cal OEHHA PHG	7.0E+02	Noncarcinogenic Effects
Fluoranthene	2.8E+02	Noncarcinogenic Effects				2.8E+02	Noncarcinogenic Effects

Table F-3. Summary of Drinking Water Screening Levels
(µg/L)

Chemical	Final Screening Level	Basis	Cal Primary MCL	Other CalEPA Criteria	Reference	*Risk-Based Goals	Basis
Fluorene	2.8E+02	Noncarcinogenic Effects				2.8E+02	Noncarcinogenic Effects
Heptachlor	1.0E-02	Cal Primary MCL	1.0E-02	8.0E-03	Cal OEHHA PHG	7.8E-03	Carcinogenic Effects
Heptachlor epoxide	1.0E-02	Cal Primary MCL	1.0E-02	6.0E-03	Cal OEHHA PHG	3.8E-03	Carcinogenic Effects
Hexachlorobenzene	1.0E+00	Cal Primary MCL	1.0E+00			2.2E-02	Carcinogenic Effects
Hexachlorobutadiene	4.5E-01	Carcinogenic Effects				4.5E-01	Carcinogenic Effects
γ-Hexachlorocyclohexane (Lindane)	2.0E-01	Cal Primary MCL	2.0E-01			2.1E+00	Noncarcinogenic Effects
Hexachloroethane	9.0E-01	Carcinogenic Effects				9.0E-01	Carcinogenic Effects
Indeno(1,2,3-c,d)pyrene	4.8E-02	Carcinogenic Effects				4.8E-02	Carcinogenic Effects
Lead	1.5E+01	Cal Primary MCL	1.5E+01	2.0E+00	Cal OEHHA PHG	-	Noncarcinogenic Effects
Mercury (elemental)	2.0E+00	Cal Primary MCL	2.0E+00	1.2E+00	Cal OEHHA PHG	6.0E-01	Noncarcinogenic Effects
Methoxychlor	4.0E+01	Cal Primary MCL	4.0E+01	3.0E+01	Cal OEHHA PHG		
Methylene chloride	5.0E+00	Cal Primary MCL	5.0E+00	4.0E+00	Cal OEHHA PHG	2.5E+00	Carcinogenic Effects
Methyl ethyl ketone	4.2E+03	Noncarcinogenic Effects				4.2E+03	Noncarcinogenic Effects
Methyl isobutyl ketone	1.2E+02	Cal DHS AL		1.2E+02	Cal DHS AL	6.0E+03	Noncarcinogenic Effects
Methyl mercury	7.0E-01	Noncarcinogenic Effects				7.0E-01	Noncarcinogenic Effects
2-Methylnaphthalene	2.8E+01	Noncarcinogenic Effects				2.8E+01	Noncarcinogenic Effects
tert-Butyl methyl ether	1.3E+01	Cal Primary MCL	1.3E+01	1.3E+01	Cal OEHHA PHG	3.8E+01	Carcinogenic Effects
Molybdenum	3.5E+01	Noncarcinogenic Effects				3.5E+01	Noncarcinogenic Effects
Naphthalene	1.7E+01	Cal DHS AL		1.7E+01	Cal DHS AL	1.4E+02	Noncarcinogenic Effects
Nickel	1.0E+02	Cal Primary MCL	1.0E+02	1.2E+01	Cal OEHHA PHG	1.4E+02	Noncarcinogenic Effects
Pentachlorophenol	1.0E+00	Cal Primary MCL	1.0E+00	4.0E-01	Cal OEHHA PHG	2.9E-01	Carcinogenic Effects
Perchlorate	6.0E+00	Cal Primary MCL	6.0E+00	6.0E+00	Cal OEHHA PHG	4.9E+00	Noncarcinogenic Effects
Phenanthrene	2.1E+02	Noncarcinogenic Effects				2.1E+02	Noncarcinogenic Effects
Phenol	4.2E+03	Cal DHS AL		4.2E+03	Cal DHS AL	2.1E+03	Noncarcinogenic Effects
Polychlorinated biphenyls (PCBs)	5.0E-01	Cal Primary MCL	5.0E-01			7.0E-03	Carcinogenic Effects
Pyrene	4.2E+02	Noncarcinogenic Effects				4.2E+02	Noncarcinogenic Effects
Selenium	5.0E+01	Cal Primary MCL	5.0E+01			3.5E+01	Noncarcinogenic Effects
Silver	3.5E+01	Noncarcinogenic Effects				3.5E+01	Noncarcinogenic Effects
Styrene	1.0E+02	Cal Primary MCL	1.0E+02			1.4E+03	Noncarcinogenic Effects
tert-Butyl alcohol							
1,1,1,2-Tetrachloroethane	1.3E+00	Carcinogenic Effects				1.3E+00	Carcinogenic Effects
1,1,2,2-Tetrachloroethane	1.0E+00	Cal Primary MCL	1.0E+00			1.8E-01	Carcinogenic Effects
Tetrachloroethene	5.0E+00	Cal Primary MCL	5.0E+00	6.0E-02	Cal OEHHA PHG	6.5E-02	Carcinogenic Effects
Thallium	2.0E+00	Cal Primary MCL	2.0E+00	1.0E-01	Cal OEHHA PHG	5.6E-01	Noncarcinogenic Effects
Toluene	1.5E+02	Cal Primary MCL	1.5E+02	1.5E+02	Cal OEHHA PHG	1.4E+03	Noncarcinogenic Effects

Table F-3. Summary of Drinking Water Screening Levels
(µg/L)

Chemical	Final Screening Level	Basis	Cal Primary MCL	Other CalEPA Criteria	Reference	*Risk-Based Goals	Basis
Toxaphene	3.0E+00	Cal Primary MCL	3.0E+00			2.9E-02	Carcinogenic Effects
TPH (gasolines)	2.1E+02	Noncarcinogenic Effects				2.1E+02	Noncarcinogenic Effects
TPH (middle distillates)	2.1E+02	Noncarcinogenic Effects				2.1E+02	Noncarcinogenic Effects
TPH (residual fuels)	2.1E+02	Noncarcinogenic Effects				2.1E+02	Noncarcinogenic Effects
1,2,4-Trichlorobenzene	5.0E+00	Cal Primary MCL	5.0E+00	5.0E+00	Cal OEHHA PHG	9.7E+00	Carcinogenic Effects
1,1,1-Trichloroethane	2.0E+02	Cal Primary MCL	2.0E+02	1.0E+03	Cal OEHHA PHG	2.0E+03	Noncarcinogenic Effects
1,1,2-Trichloroethane	5.0E+00	Cal Primary MCL	5.0E+00	2.0E-01	Cal OEHHA PHG	4.9E-01	Carcinogenic Effects
Trichloroethene	5.0E+00	Cal Primary MCL	5.0E+00	8.0E-01	Cal OEHHA PHG	2.1E+00	Noncarcinogenic Effects
2,4,5-Trichlorophenol	7.0E+02	Noncarcinogenic Effects				7.0E+02	Noncarcinogenic Effects
2,4,6-Trichlorophenol	7.0E-01	Noncarcinogenic Effects				7.0E-01	Noncarcinogenic Effects
Vanadium	1.5E+01	Cal DHS AL		1.5E+01	Cal DHS AL	7.0E+00	Noncarcinogenic Effects
Vinyl chloride	5.0E-01	Cal Primary MCL	5.0E-01	5.0E-02	Cal OEHHA PHG	2.3E-02	Carcinogenic Effects
Xylenes	1.8E+03	Cal Primary MCL	1.8E+03	1.8E+03	Cal OEHHA PHG	1.4E+03	Noncarcinogenic Effects
Zinc	5.0E+03	Cal Primary MCL	5.0E+03			2.1E+03	Noncarcinogenic Effects

Source (unless otherwise noted):
A Compilation of Water Quality Goals (August 2003 and updates), CalEPA RWQCB - Central Valley Region (CRWQCBCV 2003)

Notes:
Used for development of groundwater and soil screening levels.
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
Final health-based screening level for drinking water: Cal EPA Primary MCL or, in order of preference and availability, CalEPA Public Health Goal, Cal DHS Action Level and risk-based goal.
Cal DHS MCL: California EPA Department of Health Services Maximum Concentration Level.
OEHHA PHG: California Office of Environmental Health Hazard Assessment Public Health Goal.
Cal DHS AL: California Department of Health Services Action Level based on toxicity to humans.
*Risk-based goals calculated using Cal DHS model as presented in *A Compilation of Water Quality Goals* (August 2003).
Calculated goals for carcinogenic effects based on target excess cancer risk of 10^{-6} (see Chapter 2 of text).

Table F-4a. Summary of Selected Aquatic Habitat Goals
(µg/L)

	Aquatic Habitat Goals					
Chemical	**[1]Lowest Estuary Aquatic Habitat Goal**	**Basis**	**Lowest Freshwater Aquatic Habitat Goal**	**Basis**	**Lowest Marine Aquatic Habitat Goal**	**Basis**
Acenaphthene	-	-	-	-	-	-
Acenaphthylene	-	-	-	-	-	-
Acetone	-	-	-	-	-	-
Aldrin	-	-	-	-	-	-
Anthracene	-	-	-	-	-	-
Antimony	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-
Barium	-	-	-	-	-	-
Benzene	-	-	-	-	-	-
Benzo(a)anthracene	-	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	-	-
Benzo(a)pyrene	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-
1,1-Biphenyl	-	-	-	-	-	-
Bis(2-chloroethyl) ether	-	-	-	-	-	-
Bis(2-chloroisopropyl) ether	-	-	-	-	-	-
Bis(2-ethylhexyl) phthalate	-	-	-	-	-	-
Boron	-	-	-	-	-	-
Bromodichloromethane	-	-	-	-	-	-
Bromoform (Tribromomethane)	-	-	-	-	-	-
Bromomethane	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-
Carbon tetrachloride	-	-	-	-	-	-
Chlordane	-	-	-	-	-	-
p -Chloroaniline	-	-	-	-	-	-
Chlorobenzene	-	-	-	-	-	-
Chloroethane	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-
Chloromethane	-	-	-	-	-	-
2-Chlorophenol	-	-	-	-	-	-
Chromium (total)	-	-	-	-	-	-
Chromium III	-	-	-	-	-	-
Chromium VI	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-

Pending Revision

Table F-4a. Summary of Selected Aquatic Habitat Goals
(µg/L)

	Aquatic Habitat Goals					
Chemical	**[1]Lowest Estuary Aquatic Habitat Goal**	**Basis**	**Lowest Freshwater Aquatic Habitat Goal**	**Basis**	**Lowest Marine Aquatic Habitat Goal**	**Basis**
Copper	-	-	-	-	-	-
Cyanide	-	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-	-
Dibromochloromethane	-	-	-	-	-	-
1,2-dibromo-3-chloropropane	-	-	-	-	-	-
1,2-Dibromoethane	-	-	-	-	-	-
1,2-Dichlorobenzene	-	-	-	-	-	-
1,3-Dichlorobenzene	-	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-	-
3,3-Dichlorobenzidine	-	-	-	-	-	-
Dichlorodiphenyldichloroethane (DDD)	-	-	-	-	-	-
Dichlorodiphenyldichloroethene (DDE)	-	-	-	-	-	-
Dichlorodiphenyltrichloroethane (DDT)	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-
1,2-Dichloroethane	-	-	-	-	-	-
1,1-Dichloroethene	-	-	-	-	-	-
cis -1,2-Dichloroethene	-	-	-	-	-	-
trans -1,2-Dichloroethene	-	-	-	-	-	-
2,4-Dichlorophenol	-	-	-	-	-	-
1,2-Dichloropropane	-	-	-	-	-	-
1,3-Dichloropropene	-	-	-	-	-	-
Dieldrin	-	-	-	-	-	-
Diethyl phthalate	-	-	-	-	-	-
Dimethyl phthalate	-	-	-	-	-	-
2,4-Dimethylphenol	-	-	-	-	-	-
2,4-Dinitrophenol	-	-	-	-	-	-
2,4-Dinitrotoluene	-	-	-	-	-	-
1,4-Dioxane	-	-	-	-	-	-
Dioxin (2,3,7,8-TCDD)	-	-	-	-	-	-
Endosulfan	-	-	-	-	-	-
Endrin	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-
Fluoranthene	-	-	-	-	-	-
Fluorene	-	-	-	-	-	-
Heptachlor	-	-	-	-	-	-
Heptachlor epoxide	-	-	-	-	-	-
Hexachlorobenzene	-	-	-	-	-	-

Pending Revision

Table F-4a. Summary of Selected Aquatic Habitat Goals
(µg/L)

	Aquatic Habitat Goals					
Chemical	**[1]Lowest Estuary Aquatic Habitat Goal**	**Basis**	**Lowest Freshwater Aquatic Habitat Goal**	**Basis**	**Lowest Marine Aquatic Habitat Goal**	**Basis**
Hexachlorobutadiene	-	-	-	-	-	-
γ-Hexachlorocyclohexane (Lindane)	-	-	-	-	-	-
Hexachloroethane	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	-	-	-	-	-	-
Lead	-	-	-	-	-	-
Mercury (elemental)	-	-	-	-	-	-
Methoxychlor	-	-	-	-	-	-
Methylene chloride	-	-	-	-	-	-
Methyl ethyl ketone	-	-	-	-	-	-
Methyl isobutyl ketone	-	-	-	-	-	-
Methyl mercury	-	-	-	-	-	-
2-Methylnaphthalene	-	-	-	-	-	-
tert-Butyl methyl ether	-	-	-	-	-	-
Molybdenum	-	-	-	-	-	-
Naphthalene	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-
Perchlorate	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	-
Phenol	-	-	-	-	-	-
Polychlorinated biphenyls (PCBs)	-	-	-	-	-	-
Pyrene	-	-	-	-	-	-
Selenium	-	-	-	-	-	-
Silver	-	-	-	-	-	-
Styrene	-	-	-	-	-	-
tert-Butyl alcohol	-	-	-	-	-	-
1,1,1,2-Tetrachloroethane	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	-	-	-	-	-	-
Tetrachloroethene	-	-	-	-	-	-
Thallium	-	-	-	-	-	-
Toluene	-	-	-	-	-	-
Toxaphene	-	-	-	-	-	-
TPH (gasolines)	-	-	-	-	-	-
TPH (middle distillates)	-	-	-	-	-	-
TPH (residual fuels)	-	-	-	-	-	-
1,2,4-Trichlorobenzene	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-

Pending Revision

Table F-4a. Summary of Selected Aquatic Habitat Goals
(µg/L)

	Aquatic Habitat Goals					
Chemical	[1]Lowest Estuary Aquatic Habitat Goal	Basis	Lowest Freshwater Aquatic Habitat Goal	Basis	Lowest Marine Aquatic Habitat Goal	Basis
1,1,2-Trichloroethane	-	-	-	-	-	-
Trichloroethene	-	-	-	-	-	-
2,4,5-Trichlorophenol	-	-	-	-	-	-
2,4,6-Trichlorophenol	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Vinyl chloride	-	-	-	-	-	-
Xylenes	-	-	-	-	-	-
Zinc	-	-	-	-	-	-

Notes:

1. Lowest Estuary Goal = Lowest of Freshwater vs Marine chronic goals. Used for development of groundwater and soil screening levels.

Aquatic Habitat Goals: Addresses potential impact on freshwater or marine aquatic habitats. Final screening levels are lowest of marine and freshwater criteria.

See text for prioritization and selection of surface water quality screening levels. CTR HH criteria for potential bioaccumulation of chemicals in aquatic life considered in surface water screening levels only (refer to main text).

Drinking water goal substituted as aqautic habitat goal if later was not available (see text).

Review of aquatic ecotoxicty data for ethanol underway. Based on preliminary review of available data, chronic toxicity screening levels likely to be significantly greater than ceiling level of 50,000 ug/L (see Table I series). Refer to USEPA 2003b, ECOTOX database).

Methyl tert-Butyl Ether: Interim salt water CCC proposed by Region 2 Water Quality Control Board (RWQCBSF, 1998b)

TPH screening levels: Based on TPH screening levels published in RWQCB Board Orders. See footnotes for Table F-4b.

AWQC: Aquatic Water Quality Criteria
CCC: Criterion for Continuous Concentration
CMC: Criterion for Maximum Concentration
CTR: California (interim) Toxics Rule (in RWQCBCV 2000 and Federal Register 2000)
FCV: Final Chronic Value
FW: Freshwater
LOEL: Lowest Observed Effects Level
MOEE: Ontario Ministry of Environment and Energy (MOEE 1996)
PRG: USDOE Preliminary Remediation Goal for ecological concerns.
SW: Saltwater
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
USDOE: U. S. Department of Energy
USEPA: U.S. Environmental Protection Agency

Pending Revision

Table F-4b. Summary of California EPA Continuous and Maximum Aquatic Habitat Goals (µg/L)

	Freshwater			Saltwater		
Chemical	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**
Acenaphthene						
Acenaphthylene						
Acetone						
Aldrin		3.0E+00			1.3E+00	
Anthracene						
Antimony						
Arsenic	1.5E+02	3.4E+02	1.9E+02	3.6E+01	6.9E+01	3.6E+01
Barium						
Benzene						
Benzo(a)anthracene						
Benzo(b)fluoranthene						
Benzo(k)fluoranthene						
Benzo(g,h,i)perylene						
Benzo(a)pyrene						
Beryllium						
1,1-Biphenyl						
Bis(2-chloroethyl) ether						
Bis(2-chloroisopropyl) ether						
Bis(2-ethylhexyl) phthalate						
Boron						
Bromodichloromethane						
Bromoform (Tribromomethane)						
Bromomethane						
Cadmium		3.9E+00	1.1E+00	9.3E+00	4.2E+01	9.3E+00
Carbon tetrachloride						
Chlordane	4.3E-03	2.4E+00		4.0E-03	9.0E-02	
p-Chloroaniline						
Chlorobenzene						
Chloroethane						
Chloroform						
Chloromethane						
2-Chlorophenol						
Chromium (total)	1.8E+02	5.5E+02				
Chromium III	1.8E+02	5.5E+02				
Chromium VI	1.1E+01	1.6E+01	1.1E+01	5.0E+01	1.1E+03	5.0E+01

Table F-4b. Summary of California EPA Continuous and Maximum Aquatic Habitat Goals (µg/L)

	Freshwater			Saltwater		
Chemical	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**
Chrysene						
Cobalt						
Copper	9.0E+00	1.3E+01	6.5E+00	3.1E+00	4.8E+00	
Cyanide	5.2E+00	2.2E+01		1.0E+00	1.0E+00	
Dibenz(a,h)anthracene						
Dibromochloromethane						
1,2-dibromo-3-chloropropane						
1,2-Dibromoethane						
1,2-Dichlorobenzene						
1,3-Dichlorobenzene						
1,4-Dichlorobenzene						
3,3-Dichlorobenzidine						
Dichlorodiphenyldichloroethane (DDD)						
Dichlorodiphenyldichloroethene (DDE)						
Dichlorodiphenyltrichloroethane (DDT)	1.0E-03	1.1E+00		1.0E-03	1.3E-01	
1,1-Dichloroethane						
1,2-Dichloroethane						
1,1-Dichloroethene						
cis -1,2-Dichloroethene						
trans -1,2-Dichloroethene						
2,4-Dichlorophenol						
1,2-Dichloropropane						
1,3-Dichloropropene						
Dieldrin	5.6E-02	2.4E-01		1.9E-03	7.1E-01	
Diethyl phthalate						
Dimethyl phthalate						
2,4-Dimethylphenol						
2,4-Dinitrophenol						
2,4-Dinitrotoluene						
1,4-Dioxane						
Dioxin (2,3,7,8-TCDD)						
Endosulfan	5.6E-02	2.2E-01		8.7E-03	3.4E-02	
Endrin	3.6E-02	8.6E-02		2.3E-03	3.7E-02	
Ethylbenzene						
Fluoranthene						

Table F-4b. Summary of California EPA Continuous and Maximum Aquatic Habitat Goals (µg/L)

	Freshwater			Saltwater		
Chemical	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**
Fluorene						
Heptachlor	3.8E-03	5.2E-02		0.0036	5.3E-02	
Heptachlor epoxide	3.8E-03	5.2E-02		0.0036	5.3E-02	
Hexachlorobenzene						
Hexachlorobutadiene						
γ-Hexachlorocyclohexane (Lindane)		9.5E-01			1.6E-01	
Hexachloroethane						
Indeno(1,2,3-c,d)pyrene						
Lead	2.5E+00	6.5E+01	3.2E+00	8.1E+00	2.1E+02	5.6E+00
Mercury (elemental)			1.2E-02			2.5E-02
Methoxychlor						
Methylene chloride						
Methyl ethyl ketone						
Methyl isobutyl ketone						
Methyl mercury						
2-Methylnaphthalene						
tert-Butyl methyl ether	6.6E+04	1.2E+05		8.0E+03	1.4E+04	
Molybdenum						
Naphthalene						
Nickel	5.2E+01	4.7E+02		8.2E+00	7.4E+01	
Pentachlorophenol	1.5E+01	1.9E+01		7.9E+00	1.3E+01	
Perchlorate						
Phenanthrene						
Phenol						
Polychlorinated biphenyls (PCBs)	1.4E-02			3.0E-02		
Pyrene						
Selenium	5.0E+00			7.1E+01	2.9E+02	
Silver		3.4E+00			1.9E+00	
Styrene						
tert-Butyl alcohol						
1,1,1,2-Tetrachloroethane						
1,1,2,2-Tetrachloroethane						
Tetrachloroethene						
Thallium						
Toluene						

Table F-4b. Summary of California EPA Continuous and Maximum Aquatic Habitat Goals (µg/L)

	Freshwater			Saltwater		
Chemical	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**	**Criterion for Continuous Concentration**	**Criterion for Maximum Concentration**	**Region 2 Basin Plan**
Toxaphene	2.0E-04	7.3E-01		2.0E-04	2.1E-01	
TPH (gasolines)			5.0E+02			3.7E+03
TPH (middle distillates)			6.4E+02			
TPH (residual fuels)			6.4E+02			
1,2,4-Trichlorobenzene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethene						
2,4,5-Trichlorophenol						
2,4,6-Trichlorophenol						
Vanadium						
Vinyl chloride						
Xylenes						
Zinc	1.2E+02	1.2E+02		8.1E+01	9.0E+01	

References:
Primary sources: 1) 40 CFR Part 131: Water Quality Standards; Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California: Federal Register (May 18, 2000). 2) Interim California Toxics Rule, as summarized in A Compilation of Water Quality Goals (August 2003), CalEPA RWQCB - Central Valley Region (CRWQCBCV 2003).

Notes:
Used for development of groundwater and soil screening levels.
See text for prioritization and selection of surface water quality screening levels. Criteria for potential bioaccumulation of chemicals in aquatic organism and subsequent human consumption considered separately (refer to Table F-4d and main text).
CCC: Criterion for Continuous Concentration
CMC: Criterion for Maximum Concentration
Cadmium: CTR CMC value removed in 2004. Value shown is acute freshwater goal for cadmium presented in 1995 Basin Plan.
tert -Butyl Methyl Ether: Interim aquatic surface water criteria proposed by Region 2 Water Quality Control Board (RWQCBSF, 1998a).
TPH screening levels: Gasoline freshwater screening level based on studies carried out for Presidio of San Francisco (RWQCBSF 1998b). Gasoline screening level for saltwater and diesel and residual fuels screening levels in general based on studies carried out for San Francisco Airport (RWQCB 1999b). See Appendix 1 text.

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Acenaphthene	2.0E+01	Ceiling Level	2.0E+01	-	2.7E+03
Acenaphthylene	2.0E+03	Ceiling Level	2.0E+03	-	
Acetone	2.0E+04	Ceiling Level	2.0E+04	-	
Aldrin	1.4E-04	Bioaccumulation/Human Consumption	8.5E+00	-	1.4E-04
Anthracene	2.2E+01	Ceiling Level	2.2E+01	-	1.1E+05
Antimony	4.3E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.3E+03
Arsenic	1.4E-01	Bioaccumulation/Human Consumption	5.0E+04	-	1.4E-01
Barium	5.0E+04	Ceiling Level	5.0E+04	-	
Benzene	7.1E+01	Bioaccumulation/Human Consumption	2.0E+03	-	7.1E+01
Benzo(a)anthracene	4.9E-02	Bioaccumulation/Human Consumption	5.0E+00	-	4.9E-02
Benzo(b)fluoranthene	4.9E-02	Bioaccumulation/Human Consumption	7.0E+00	-	4.9E-02
Benzo(k)fluoranthene	4.9E-02	Bioaccumulation/Human Consumption	4.0E-01	-	4.9E-02
Benzo(g,h,i)perylene	1.3E-01	Ceiling Level	1.3E-01	-	
Benzo(a)pyrene	4.9E-02	Bioaccumulation/Human Consumption	1.9E+00	-	4.9E-02
Beryllium	5.0E+04	Ceiling Level	5.0E+04	-	
1,1-Biphenyl	5.0E-01	Ceiling Level	5.0E-01	-	
Bis(2-chloroethyl) ether	1.4E+00	Bioaccumulation/Human Consumption	3.6E+02	-	1.4E+00
Bis(2-chloroisopropyl) ether	3.2E+02	Ceiling Level	3.2E+02	-	1.7E+05
Bis(2-ethylhexyl) phthalate	5.9E+00	Bioaccumulation/Human Consumption	6.5E+02	-	5.9E+00
Boron	5.0E+04	Ceiling Level	5.0E+04	-	
Bromodichloromethane	5.0E+04	Ceiling Level	5.0E+04	-	
Bromoform (Tribromomethane)	3.6E+02	Bioaccumulation/Human Consumption	5.1E+02	-	3.6E+02
Bromomethane	4.0E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.0E+03
Cadmium	5.0E+04	Ceiling Level	5.0E+04	-	
Carbon tetrachloride	4.4E+00	Bioaccumulation/Human Consumption	5.2E+02	-	4.4E+00
Chlordane	5.9E-04	Bioaccumulation/Human Consumption	2.5E+00	-	5.9E-04
p-Chloroaniline	5.0E+04	Ceiling Level	5.0E+04	-	
Chlorobenzene	5.0E+01	Ceiling Level	5.0E+01	-	2.1E+04
Chloroethane	1.6E+01	Ceiling Level	1.6E+01	-	
Chloroform	4.7E+02	Bioaccumulation/Human Consumption	2.4E+03	-	4.7E+02
Chloromethane	5.0E+04	Ceiling Level	5.0E+04	-	
2-Chlorophenol	1.8E-01	Ceiling Level	1.8E-01	-	4.0E+02
Chromium (total)	5.0E+04	Ceiling Level	5.0E+04	-	
Chromium III	5.0E+04	Ceiling Level	5.0E+04	-	

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Chromium VI	5.0E+04	Ceiling Level	5.0E+04	-	
Chrysene	4.9E-02	Bioaccumulation/Human Consumption	8.0E-01	-	4.9E-02
Cobalt	5.0E+04	Ceiling Level	5.0E+04	-	
Copper	5.0E+04	Ceiling Level	5.0E+04	-	
Cyanide	1.7E+02	Ceiling Level	1.7E+02	-	2.2E+05
Dibenz(a,h)anthracene	4.9E-02	Bioaccumulation/Human Consumption	2.5E-01	-	4.9E-02
Dibromochloromethane	4.6E+01	Bioaccumulation/Human Consumption	5.0E+04	-	4.6E+01
1,2-dibromo-3-chloropropane	1.0E+01	Ceiling Level	1.0E+01	-	
1,2-Dibromoethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,2-Dichlorobenzene	1.0E+01	Ceiling Level	1.0E+01	-	1.7E+04
1,3-Dichlorobenzene	2.6E+03	Bioaccumulation/Human Consumption	5.0E+04	-	2.6E+03
1,4-Dichlorobenzene	1.1E+01	Ceiling Level	1.1E+01	-	2.6E+03
3,3-Dichlorobenzidine	7.7E-02	Bioaccumulation/Human Consumption	1.6E+03	-	7.7E-02
Dichlorodiphenyldichloroethane (DDD)	8.4E-04	Bioaccumulation/Human Consumption	8.0E+01	-	8.4E-04
Dichlorodiphenyldichloroethene (DDE)	5.9E-04	Bioaccumulation/Human Consumption	2.0E+01	-	5.9E-04
Dichlorodiphenyltrichloroethane (DDT)	5.9E-04	Bioaccumulation/Human Consumption	1.5E+00	-	5.9E-04
1,1-Dichloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,2-Dichloroethane	9.9E+01	Bioaccumulation/Human Consumption	2.0E+04	-	9.9E+01
1,1-Dichloroethene	3.2E+00	Bioaccumulation/Human Consumption	1.5E+03	-	3.2E+00
cis -1,2-Dichloroethene	5.0E+04	Ceiling Level	5.0E+04	-	
trans -1,2-Dichloroethene	2.6E+02	Ceiling Level	2.6E+02	-	1.4E+05
2,4-Dichlorophenol	3.0E-01	Ceiling Level	3.0E-01	-	7.9E+02
1,2-Dichloropropane	1.0E+01	Ceiling Level	1.0E+01	-	3.9E+01
1,3-Dichloropropene	1.7E+03	Bioaccumulation/Human Consumption	5.0E+04	-	1.7E+03
Dieldrin	1.4E-04	Bioaccumulation/Human Consumption	4.1E+01	-	1.4E-04
Diethyl phthalate	5.0E+04	Ceiling Level	5.0E+04	-	1.2E+54
Dimethyl phthalate	5.0E+04	Ceiling Level	5.0E+04	-	2.9E+06
2,4-Dimethylphenol	4.0E+02	Ceiling Level	4.0E+02	-	2.3E+03
2,4-Dinitrophenol	1.4E+04	Bioaccumulation/Human Consumption	5.0E+04	-	1.4E+04
2,4-Dinitrotoluene	9.1E+00	Bioaccumulation/Human Consumption	5.0E+04	-	9.1E+00
1,4-Dioxane	5.0E+04	Ceiling Level	5.0E+04	-	
Dioxin (2,3,7,8-TCDD)	1.4E-08	Bioaccumulation/Human Consumption	7.0E+03	-	1.4E-08
Endosulfan	7.5E+01	Ceiling Level	7.5E+01	-	2.4E+02

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
Endrin	8.1E-01	Bioaccumulation/Human Consumption	4.1E+01	-	8.1E-01
Ethylbenzene	3.0E+01	Ceiling Level	3.0E+01	-	2.9E+04
Fluoranthene	1.3E+02	Ceiling Level	1.3E+02	-	3.7E+02
Fluorene	9.5E+02	Ceiling Level	9.5E+02	-	1.4E+04
Heptachlor	2.1E-04	Bioaccumulation/Human Consumption	2.0E+01	-	2.1E-04
Heptachlor epoxide	1.1E-04	Bioaccumulation/Human Consumption	1.8E+02	-	1.1E-04
Hexachlorobenzene	7.7E-04	Bioaccumulation/Human Consumption	5.5E+01	-	7.7E-04
Hexachlorobutadiene	6.0E+00	Ceiling Level	6.0E+00	-	5.0E+01
γ-Hexachlorocyclohexane (Lindane)	6.3E-02	Bioaccumulation/Human Consumption	3.5E+03	-	6.3E-02
Hexachloroethane	8.9E+00	Bioaccumulation/Human Consumption	1.0E+01	-	8.9E+00
Indeno(1,2,3-c,d)pyrene	4.9E-02	Bioaccumulation/Human Consumption	2.7E-01	-	4.9E-02
Lead	5.0E+04	Ceiling Level	5.0E+04	-	
Mercury (elemental)	5.1E-02	Bioaccumulation/Human Consumption	5.0E+04	-	5.1E-02
Methoxychlor	2.0E+01	Ceiling Level	2.0E+01	-	
Methylene chloride	1.6E+03	Bioaccumulation/Human Consumption	9.1E+03	-	1.6E+03
Methyl ethyl ketone	8.4E+03	Ceiling Level	8.4E+03	-	
Methyl isobutyl ketone	1.3E+03	Ceiling Level	1.3E+03	-	
Methyl mercury	5.0E+04	Ceiling Level	5.0E+04	-	
2-Methylnaphthalene	1.0E+01	Ceiling Level	1.0E+01	-	
tert-Butyl methyl ether	1.8E+02	Ceiling Level	1.8E+02	-	
Molybdenum	5.0E+04	Ceiling Level	5.0E+04	-	
Naphthalene	2.1E+01	Ceiling Level	2.1E+01	-	
Nickel	4.6E+03	Bioaccumulation/Human Consumption	5.0E+04	-	4.6E+03
Pentachlorophenol	8.2E+00	Bioaccumulation/Human Consumption	5.9E+02	-	8.2E+00
Perchlorate	5.0E+04	Ceiling Level	5.0E+04	-	
Phenanthrene	4.1E+02	Ceiling Level	4.1E+02	-	
Phenol	7.9E+03	Ceiling Level	7.9E+03	-	4.6E+06
Polychlorinated biphenyls (PCBs)	1.7E-04	Bioaccumulation/Human Consumption	1.6E+01	-	1.7E-04
Pyrene	6.8E+01	Ceiling Level	6.8E+01	-	1.1E+04
Selenium	5.0E+04	Ceiling Level	5.0E+04	-	
Silver	5.0E+04	Ceiling Level	5.0E+04	-	
Styrene	1.1E+01	Ceiling Level	1.1E+01	-	
tert-Butyl alcohol	5.0E+04	Ceiling Level	5.0E+04	-	

Table F-2c. Surface Water Screening Levels
*Estuary Habitats
(µg/L)

Chemical	[1]Final Surface Water Screening Level	Basis	Gross Contamination Ceiling Value (Odors, etc.)	Estuary Aquatic Habitat Goal (Chronic Toxicity)	Bioaccumulation and Human Consumption
			Table I-4	Table F-4a	Table F-4d
1,1,1,2-Tetrachloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,1,2,2-Tetrachloroethane	1.1E+01	Bioaccumulation/Human Consumption	5.0E+02	-	1.1E+01
Tetrachloroethene	8.9E+00	Bioaccumulation/Human Consumption	3.0E+02	-	8.9E+00
Thallium	6.3E+00	Bioaccumulation/Human Consumption	5.0E+04	-	6.3E+00
Toluene	4.0E+01	Ceiling Level	4.0E+01	-	2.0E+05
Toxaphene	7.5E-04	Bioaccumulation/Human Consumption	1.4E+02	-	7.5E-04
TPH (gasolines)	5.0E+03	Ceiling Level	5.0E+03	-	
TPH (middle distillates)	2.5E+03	Ceiling Level	2.5E+03	-	
TPH (residual fuels)	2.5E+03	Ceiling Level	2.5E+03	-	
1,2,4-Trichlorobenzene	3.0E+03	Ceiling Level	3.0E+03	-	
1,1,1-Trichloroethane	5.0E+04	Ceiling Level	5.0E+04	-	
1,1,2-Trichloroethane	4.2E+01	Bioaccumulation/Human Consumption	5.0E+04	-	4.2E+01
Trichloroethene	8.1E+01	Bioaccumulation/Human Consumption	1.0E+04	-	8.1E+01
2,4,5-Trichlorophenol	2.0E+02	Ceiling Level	2.0E+02	-	3.6E+03
2,4,6-Trichlorophenol	6.5E+00	Bioaccumulation/Human Consumption	1.0E+02	-	6.5E+00
Vanadium	5.0E+04	Ceiling Level	5.0E+04	-	
Vinyl chloride	5.3E+02	Bioaccumulation/Human Consumption	3.4E+03	-	5.3E+02
Xylenes	5.3E+02	Ceiling Level	5.3E+02	-	
Zinc	5.0E+04	Ceiling Level	5.0E+04	-	

Notes:

***Estuary Habitats: Mixed freshwater/marine water habitats.**

1. Lowest of Ceiling Value, aquatic habitat goal, and bioaccumulation goal.

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Ceiling Level: Odor threshold, 1/2 solubility or 50000 ug/L maximum, whichever is lower. Intended to limit nuisances and general resource degradation.

Review of aquatic ecotoxicty data for ethanol underway. Based on preliminary review of available data, chronic toxicity screening levels likely to be significantly greater than ceiling level of 50,000 ug/L (refer to USEPA 2003b, ECOTOX database).

Table F-4d. Surface Water Quality Standards for Bioaccumulation and Human Consumption of Aquatic Organisms (µg/L)

Chemical	Selected Criteria	[1]California Toxics Rule	[2]USEPA NWQC
Acenaphthene	2.7E+03	2.7E+03	9.9E+02
Acenaphthylene			
Acetone			
Aldrin	1.4E-04	1.4E-04	5.0E-05
Anthracene	1.1E+05	1.1E+05	4.0E+04
Antimony	4.3E+03	4.3E+03	6.4E+02
Arsenic	1.4E-01		1.4E-01
Barium			
Benzene	7.1E+01	7.1E+01	5.1E+01
Benzo(a)anthracene	4.9E-02	4.9E-02	1.8E-02
Benzo(b)fluoranthene	4.9E-02	4.9E-02	1.8E-02
Benzo(k)fluoranthene	4.9E-02	4.9E-02	1.8E-02
Benzo(g,h,i)perylene			
Benzo(a)pyrene	4.9E-02	4.9E-02	1.8E-02
Beryllium			
1,1-Biphenyl			
Bis(2-chloroethyl) ether	1.4E+00	1.4E+00	5.3E-01
Bis(2-chloroisopropyl) ether	1.7E+05	1.7E+05	6.5E+04
Bis(2-ethylhexyl) phthalate	5.9E+00	5.9E+00	2.2E+00
Boron			
Bromodichloromethane			
Bromoform (Tribromomethane)	3.6E+02	3.6E+02	1.4E+02
Bromomethane	4.0E+03	4.0E+03	1.5E+03
Cadmium			
Carbon tetrachloride	4.4E+00	4.4E+00	1.6E+00
Chlordane	5.9E-04	5.9E-04	8.1E-04
p-Chloroaniline			
Chlorobenzene	2.1E+04	2.1E+04	2.1E+04
Chloroethane			
Chloroform	4.7E+02	4.7E+02	4.7E+02
Chloromethane			
2-Chlorophenol	4.0E+02	4.0E+02	1.5E+02
Chromium (total)			
Chromium III			
Chromium VI			
Chrysene	4.9E-02	4.9E-02	1.8E-02
Cobalt			

Table F-4d. Surface Water Quality Standards for Bioaccumulation and Human Consumption of Aquatic Organisms (µg/L)

Chemical	Selected Criteria	[1]California Toxics Rule	[2]USEPA NWQC
Copper			
Cyanide	2.2E+05	2.2E+05	2.2E+05
Dibenz(a,h)anthracene	4.9E-02	4.9E-02	1.8E-02
Dibromochloromethane	4.6E+01	4.6E+01	1.3E+01
1,2-dibromo-3-chloropropane			
1,2-Dibromoethane			
1,2-Dichlorobenzene	1.7E+04	1.7E+04	1.7E+04
1,3-Dichlorobenzene	2.6E+03	2.6E+03	9.6E+02
1,4-Dichlorobenzene	2.6E+03	2.6E+03	2.6E+03
3,3-Dichlorobenzidine	7.7E-02	7.7E-02	2.8E-02
Dichlorodiphenyldichloroethane (DDD)	8.4E-04	8.4E-04	3.1E-04
Dichlorodiphenyldichloroethene (DDE)	5.9E-04	5.9E-04	2.2E-04
Dichlorodiphenyltrichloroethane (DDT)	5.9E-04	5.9E-04	2.2E-04
1,1-Dichloroethane			
1,2-Dichloroethane	9.9E+01	9.9E+01	3.7E+01
1,1-Dichloroethene	3.2E+00	3.2E+00	3.2E+00
cis -1,2-Dichloroethene			
trans -1,2-Dichloroethene	1.4E+05	1.4E+05	1.4E+05
2,4-Dichlorophenol	7.9E+02	7.9E+02	2.9E+02
1,2-Dichloropropane	3.9E+01	3.9E+01	1.5E+01
1,3-Dichloropropene	1.7E+03	1.7E+03	1.7E+03
Dieldrin	1.4E-04	1.4E-04	5.4E-05
Diethyl phthalate	1.2E+54	1.2E+54	4.4E+04
Dimethyl phthalate	2.9E+06	2.9E+06	1.1E+06
2,4-Dimethylphenol	2.3E+03	2.3E+03	8.5E+02
2,4-Dinitrophenol	1.4E+04	1.4E+04	5.3E+03
2,4-Dinitrotoluene	9.1E+00	9.1E+00	3.4E+00
1,4-Dioxane			
Dioxin (2,3,7,8-TCDD)	1.4E-08	1.4E-08	5.1E-09
Endosulfan	2.4E+02	2.4E+02	8.9E+01
Endrin	8.1E-01	8.1E-01	8.1E-01
Ethylbenzene	2.9E+04	2.9E+04	2.9E+04
Fluoranthene	3.7E+02	3.7E+02	1.4E+02
Fluorene	1.4E+04	1.4E+04	5.3E+03
Heptachlor	2.1E-04	2.1E-04	7.9E-05
Heptachlor epoxide	1.1E-04	1.1E-04	3.9E-05
Hexachlorobenzene	7.7E-04	7.7E-04	2.9E-04

Table F-4d. Surface Water Quality Standards for Bioaccumulation and Human Consumption of Aquatic Organisms (µg/L)

Chemical	Selected Criteria	[1]California Toxics Rule	[2]USEPA NWQC
Hexachlorobutadiene	5.0E+01	5.0E+01	1.8E+01
γ-Hexachlorocyclohexane (Lindane)	6.3E-02	6.3E-02	6.3E-02
Hexachloroethane	8.9E+00	8.9E+00	3.3E+00
Indeno(1,2,3-c,d)pyrene	4.9E-02	4.9E-02	1.8E-02
Lead			
Mercury (elemental)	5.1E-02	5.1E-02	3.0E-01
Methoxychlor			
Methylene chloride	1.6E+03	1.6E+03	5.9E+02
Methyl ethyl ketone			
Methyl isobutyl ketone			
Methyl mercury			
2-Methylnaphthalene			
tert-Butyl methyl ether			
Molybdenum			
Naphthalene			
Nickel	4.6E+03	4.6E+03	4.6E+03
Pentachlorophenol	8.2E+00	8.2E+00	3.0E+00
Perchlorate			
Phenanthrene			
Phenol	4.6E+06	4.6E+06	1.7E+06
Polychlorinated biphenyls (PCBs)	1.7E-04	1.7E-04	6.4E-05
Pyrene	1.1E+04	1.1E+04	4.0E+03
Selenium			
Silver			
Styrene			
tert-Butyl alcohol			
1,1,1,2-Tetrachloroethane			
1,1,2,2-Tetrachloroethane	1.1E+01	1.1E+01	4.0E+00
Tetrachloroethene	8.9E+00	8.9E+00	3.3E+00
Thallium	6.3E+00	6.3E+00	6.3E+00
Toluene	2.0E+05	2.0E+05	2.0E+05
Toxaphene	7.5E-04	7.5E-04	2.8E-04
TPH (gasolines)			
TPH (middle distillates)			
TPH (residual fuels)			
1,2,4-Trichlorobenzene			
1,1,1-Trichloroethane			

Table F-4d. Surface Water Quality Standards for Bioaccumulation and Human Consumption of Aquatic Organisms (µg/L)

Chemical	Selected Criteria	[1]California Toxics Rule	[2]USEPA NWQC
1,1,2-Trichloroethane	4.2E+01	4.2E+01	1.6E+01
Trichloroethene	8.1E+01	8.1E+01	3.0E+01
2,4,5-Trichlorophenol	3.6E+03		3.6E+03
2,4,6-Trichlorophenol	6.5E+00	6.5E+00	
Vanadium			
Vinyl chloride	5.3E+02	5.3E+02	5.3E+02
Xylenes			
Zinc			

References:

1. 40 CFR Part 131: Water Quality Standards; Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California: Federal Register, May 18, 2000.
2. USEPA National Recommended Water Quality Criteria: 2002, EPA-822-R-02-047.

Notes:

California CTR goals considered for surface water (see Tables F-2 series) if available.
Addresses potential accumulation of chemical in aquatic organisms and subsequent consumption by humans.

Table F-5. Agricultural Water Quality Goals (µg/L)

Chemical	Agricultural Water Quality Goals
Acenaphthene	-
Acenaphthylene	-
Acetone	-
Aldrin	-
Anthracene	-
Antimony	-
Arsenic	1.0E+02
Barium	-
Benzene	-
Benzo(a)anthracene	-
Benzo(b)fluoranthene	-
Benzo(k)fluoranthene	-
Benzo(g,h,i)perylene	-
Benzo(a)pyrene	-
Beryllium	1.0E+02
1,1-Biphenyl	-
Bis(2-chloroethyl) ether	-
Bis(2-chloroisopropyl) ether	-
Bis(2-ethylhexyl) phthalate	-
Boron	7.0E+02
Bromodichloromethane	-
Bromoform (Tribromomethane)	-
Bromomethane	-
Cadmium	1.0E+01
Carbon tetrachloride	-
Chlordane	-
p-Chloroaniline	-
Chlorobenzene	-
Chloroethane	-
Chloroform	-
Chloromethane	-
2-Chlorophenol	-
Chromium (total)	-
Chromium III	-
Chromium VI	1.0E+02
Chrysene	-
Cobalt	5.0E+01
Copper	2.0E+02
Cyanide	-
Dibenz(a,h)anthracene	-
Dibromochloromethane	-
1,2-dibromo-3-chloropropane	-
1,2-Dibromoethane	-
1,2-Dichlorobenzene	-
1,3-Dichlorobenzene	-
1,4-Dichlorobenzene	-
3,3-Dichlorobenzidine	-
Dichlorodiphenyldichloroethane (DDD)	-
Dichlorodiphenyldichloroethene (DDE)	-
Dichlorodiphenyltrichloroethane (DDT)	-
1,1-Dichloroethane	-
1,2-Dichloroethane	-
1,1-Dichloroethene	-
cis-1,2-Dichloroethene	-

Table F-5. Agricultural Water Quality Goals (µg/L)

Chemical	Agricultural Water Quality Goals
trans -1,2-Dichloroethene	-
2,4-Dichlorophenol	-
1,2-Dichloropropane	-
1,3-Dichloropropene	-
Dieldrin	-
Diethyl phthalate	-
Dimethyl phthalate	-
2,4-Dimethylphenol	-
2,4-Dinitrophenol	-
2,4-Dinitrotoluene	-
1,4-Dioxane	-
Dioxin (2,3,7,8-TCDD)	-
Endosulfan	-
Endrin	-
Ethylbenzene	-
Fluoranthene	-
Fluorene	-
Heptachlor	-
Heptachlor epoxide	-
Hexachlorobenzene	-
Hexachlorobutadiene	-
γ-Hexachlorocyclohexane (Lindane)	-
Hexachloroethane	-
Indeno(1,2,3-c,d)pyrene	-
Lead	-
Mercury (elemental)	-
Methoxychlor	-
Methylene chloride	-
Methyl ethyl ketone	-
Methyl isobutyl ketone	-
Methyl mercury	-
2-Methylnaphthalene	-
tert -Butyl methyl ether	-
Molybdenum	1.0E+01
Naphthalene	-
Nickel	2.0E+02
Pentachlorophenol	-
Perchlorate	-
Phenanthrene	-
Phenol	-
Polychlorinated biphenyls (PCBs)	-
Pyrene	-
Selenium	2.0E+01
Silver	-
Styrene	-
tert -Butyl alcohol	-
1,1,1,2-Tetrachloroethane	-
1,1,2,2-Tetrachloroethane	-
Tetrachloroethene	-
Thallium	-
Toluene	-
Toxaphene	-
TPH (gasolines)	-

Table F-5. Agricultural Water Quality Goals (µg/L)

Chemical	Agricultural Water Quality Goals
TPH (middle distillates)	-
TPH (residual fuels)	-
1,2,4-Trichlorobenzene	-
1,1,1-Trichloroethane	-
1,1,2-Trichloroethane	-
Trichloroethene	-
2,4,5-Trichlorophenol	-
2,4,6-Trichlorophenol	-
Vanadium	1.0E+02
Vinyl chloride	-
Xylenes	-
Zinc	2.0E+03

References:
A Compiliation of Water Quality Goals (RWQCBCV 2003).

Notes:
Addresses use of water (including groundwater) for agricultural/irrigation purposes.

Table F-6. US EPA Region 9
Tap Water Goals
(µg/L)

Chemical	Tap Water Goal (NonCarcinogenic Effects)	Tap Water Goal (Carcinogenic Effects)
Acenaphthene	3.7E+02	
Acenaphthylene	1.8E+02	
Acetone	5.5E+03	
Aldrin	1.1E+00	4.0E-03
Anthracene	1.8E+03	
Antimony	1.5E+01	
Arsenic	1.1E+01	4.5E-02
Barium	7.3E+03	
Benzene	4.4E+01	1.1E-01
Benzo(a)anthracene	1.1E+03	5.6E-02
Benzo(b)fluoranthene	1.1E+03	5.6E-02
Benzo(k)fluoranthene	1.1E+03	5.6E-02
Benzo(g,h,i)perylene	1.1E+03	
Benzo(a)pyrene	1.1E+03	5.6E-03
Beryllium	7.3E+01	
1,1-Biphenyl	1.8E+03	
Bis(2-chloroethyl) ether		9.8E-03
Bis(2-chloroisopropyl) ether	2.4E+02	4.5E-03
Bis(2-ethylhexyl) phthalate	7.3E+02	4.8E+00
Boron	7.3E+03	
Bromodichloromethane	1.2E+02	1.8E-01
Bromoform (Tribromomethane)	7.3E+02	8.5E+00
Bromomethane	8.7E+00	
Cadmium	1.8E+01	1.8E-01
Carbon tetrachloride	2.0E+01	2.8E-02
Chlordane	1.8E+01	5.2E-02
p -Chloroaniline	1.5E+02	
Chlorobenzene	5.4E+02	
Chloroethane	2.1E+02	2.3E+01
Chloroform	2.3E+02	5.4E-01
Chloromethane	1.6E+02	
2-Chlorophenol	3.0E+01	
Chromium (total)		
Chromium III	5.5E+04	
Chromium VI	1.1E+02	
Chrysene	1.1E+03	9.2E+00
Cobalt	7.3E+02	
Copper	1.5E+04	
Cyanide	1.2E+02	
Dibenz(a,h)anthracene	1.1E+03	9.2E-03
Dibromochloromethane	7.3E+02	8.0E-01
1,2-dibromo-3-chloropropane		9.6E-03
1,2-Dibromoethane	1.8E+01	4.8E-03
1,2-Dichlorobenzene	3.7E+02	
1,3-Dichlorobenzene	1.8E+02	
1,4-Dichlorobenzene	6.6E+02	3.1E-01
3,3-Dichlorobenzidine		5.6E-02
Dichlorodiphenyldichloroethane (DDD)	1.8E+01	2.8E-01
Dichlorodiphenyldichloroethene (DDE)	1.8E+01	2.0E-01
Dichlorodiphenyltrichloroethane (DDT)	1.8E+01	2.0E-01
1,1-Dichloroethane	8.1E+02	2.0E+00
1,2-Dichloroethane	1.0E+01	1.2E-01
1,1-Dichloroethene	3.4E+02	4.6E-02
cis -1,2-Dichloroethene	6.1E+01	

Table F-6. US EPA Region 9
Tap Water Goals
(µg/L)

Chemical	Tap Water Goal (NonCarcinogenic Effects)	Tap Water Goal (Carcinogenic Effects)
trans-1,2-Dichloroethene	1.2E+02	
2,4-Dichlorophenol	1.1E+02	
1,2-Dichloropropane		2.8E-01
1,3-Dichloropropene	4.0E+01	1.8E-01
Dieldrin	1.8E+00	4.2E-03
Diethyl phthalate	2.9E+04	
Dimethyl phthalate	3.7E+05	
2,4-Dimethylphenol	7.3E+02	
2,4-Dinitrophenol	7.3E+02	
2,4-Dinitrotoluene	7.3E+01	9.9E-02
1,4-Dioxane		2.5E+00
Dioxin (2,3,7,8-TCDD)		5.2E-07
Endosulfan	2.2E+02	
Endrin	1.1E+01	
Ethylbenzene	1.3E+03	
Fluoranthene	1.5E+03	
Fluorene	2.4E+02	
Heptachlor	1.8E+01	1.5E-02
Heptachlor epoxide	4.7E-01	7.4E-03
Hexachlorobenzene	2.9E+01	4.2E-02
Hexachlorobutadiene	7.3E+00	8.6E-01
γ-Hexachlorocyclohexane (Lindane)	1.1E+01	
Hexachloroethane	3.7E+01	1.7E+00
Indeno(1,2,3-c,d)pyrene	1.1E+03	9.2E-02
Lead		
Mercury (elemental)	3.1E+00	
Methoxychlor		
Methylene chloride	6.0E+02	3.0E+00
Methyl ethyl ketone	7.1E+03	
Methyl isobutyl ketone	5.2E+03	
Methyl mercury	3.7E+00	
2-Methylnaphthalene	1.5E+02	
tert-Butyl methyl ether		1.2E+01
Molybdenum	1.8E+02	
Naphthalene	6.2E+00	#DIV/0!
Nickel	7.3E+02	
Pentachlorophenol	1.1E+02	5.6E-01
Perchlorate	2.6E+01	
Phenanthrene	1.8E+02	
Phenol	1.1E+04	
Polychlorinated biphenyls (PCBs)	7.3E-01	1.3E-02
Pyrene	2.2E+03	
Selenium	1.8E+02	
Silver	1.8E+02	
Styrene	1.5E+03	
tert-Butyl alcohol		
1,1,1,2-Tetrachloroethane	1.1E+03	4.2E-01
1,1,2,2-Tetrachloroethane	3.7E+02	5.5E-02
Tetrachloroethene	2.5E+02	1.0E-01
Thallium	2.9E+00	
Toluene	5.8E+02	
Toxaphene		5.6E-02
TPH (gasolines)	9.3E+01	

Table F-6. US EPA Region 9
Tap Water Goals
(µg/L)

Chemical	Tap Water Goal (NonCarcinogenic Effects)	Tap Water Goal (Carcinogenic Effects)
TPH (middle distillates)	9.3E+01	
TPH (residual fuels)	1.1E+03	
1,2,4-Trichlorobenzene	8.2E+00	1.9E+01
1,1,1-Trichloroethane	3.2E+03	
1,1,2-Trichloroethane	2.4E+01	1.9E-01
Trichloroethene	1.1E+01	1.4E+00
2,4,5-Trichlorophenol	6.1E+02	
2,4,6-Trichlorophenol	3.7E+00	6.1E+00
Vanadium	3.7E+01	
Vinyl chloride	7.2E+01	2.3E-02
Xylenes	2.0E+02	
Zinc	1.1E+04	

References:
Calculated using Tap Water equations in USEPA Region 9 Preliminary Remediation Goals document (USEPA 2004).

Notes:
Addresses use of water for drinking water and inhalation of volatile chemicals during showering.
Tap Water value for TBA calculated using PRG methodology (not in PRGs).
Target risk = 10˘. Target HQ = 1. Adjusted to CalEPA CSFs. See Appendix 2 for equations.

Table G: Soil Screening Levels for Leaching Concerns

					Target Groundwater Concentrations		Soil Leaching Screening Levels	
	Organic Carbon Coefficient (Koc)	Henry's Law Constant (H)	Dilution/ Atenuation Factor (DAF)	Saturation Limit	Target Groundwater Concentration (Drinking Water Resource) (Table F-1a)	Target Groundwater Concentration (NON-Drinking Water Resource) (Table F-1b)	Soil Leaching Screening Level (Drinking Water Resource)	Soil Leaching Screening Level (NON-Drinking Water Resource)
Chemical	(cm^3/g)	(atm-m^3/mole-^oK)		(mg/kg)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Acenaphthene	4.90E+03	1.55E-04	8.14E+02	1.3E+02	2.0E+01	2.0E+02	1.6E+01	1.6E+02
Acenaphthylene	2.50E+03	1.45E-03	4.24E+02	5.9E+01	2.1E+02	2.0E+03	8.9E+01	8.3E+02
Acetone	5.75E-01	3.88E-05	3.36E-01	1.0E+05	6.3E+03	5.0E+04	2.1E+00	1.7E+01
Aldrin	4.90E+04	4.96E-05	8.13E+03	5.0E+00	2.0E-03	8.5E+00	5.0E+00	6.9E+01
Anthracene	2.35E+04	6.50E-05	3.90E+03	6.1E+00	2.2E+01	2.2E+01	8.5E+01	8.5E+01
Antimony					6.0E+00	5.0E+04		
Arsenic					5.0E+01	5.0E+04		
Barium					1.0E+03	5.0E+04		
Benzene	5.90E+01	5.56E-03	4.43E+01	8.7E+02	1.0E+00	5.4E+02	4.4E-02	2.4E+01
Benzo(a)anthracene	2.00E+05	1.00E-06	3.32E+04	1.2E+01	2.9E-02	5.0E+00	1.2E+01	1.7E+02
Benzo(b)fluoranthene	5.50E+05	1.22E-05	9.13E+04	4.6E+01	2.9E-02	7.0E+00	4.6E+01	6.4E+02
Benzo(k)fluoranthene	5.50E+05	3.87E-05	9.13E+04	2.6E+00	2.9E-02	4.0E-01	2.7E+00	3.7E+01
Benzo(g,h,i)perylene	1.60E+06	1.44E-07	2.66E+05	2.5E+00	1.3E-01	1.3E-01	3.5E+01	3.5E+01
Benzo(a)pyrene	5.50E+06	4.90E-07	9.13E+05	1.3E+02	2.0E-01	1.9E+00	1.8E+02	1.7E+03
Beryllium					4.0E+00	5.0E+04		
1,1-Biphenyl	7.76E+03	3.00E-04	1.29E+03	3.5E+02	5.0E-01	5.0E+00	6.5E-01	6.5E+00
Bis(2-chloroethyl) ether	7.60E+01	1.80E-05	1.27E+01	9.6E+03	3.2E-02	6.5E+01	4.0E-04	8.2E-01
Bis(2-chloroisopropyl) ether	6.10E+01	1.13E-04	1.08E+01	7.9E+02	1.4E-02	3.2E+03	1.5E-04	3.5E+01
Bis(2-ethylhexyl) phthalate	1.00E+05	3.00E-07	1.66E+04	7.8E+02	4.0E+00	6.5E+02	7.8E+02	1.1E+04
Boron					1.0E+03	5.0E+04		
Bromodichloromethane	5.50E+01	1.60E-03	1.91E+01	3.0E+03	1.0E+02	1.7E+02	1.9E+00	3.2E+00
Bromoform (Tribromomethane)	1.10E+02	5.32E-04	2.16E+01	2.4E+03	1.0E+02	5.1E+03	2.2E+00	1.1E+02
Bromomethane	9.00E+00	6.24E-03	4.02E+01	3.1E+03	9.8E+00	5.8E+02	3.9E-01	2.3E+01
Cadmium					5.0E+00	5.0E+04		
Carbon tetrachloride	1.74E+02	3.04E-02	2.18E+02	1.1E+03	5.0E-01	9.3E+00	1.1E-01	2.0E+00
Chlordane	4.40E+04	4.79E-05	7.30E+03	1.5E+01	1.0E-01	2.5E+01	1.5E+01	1.8E+02
p-Chloroaniline	6.40E+01	3.31E-07	1.06E+01	1.3E+03	2.8E+01	5.0E+04	3.0E-01	5.3E+02
Chlorobenzene	2.19E+02	3.70E-03	5.93E+01	6.8E+02	5.0E+01	5.0E+02	3.0E+00	3.0E+01
Chloroethane	1.47E+01	1.10E-02	7.07E+01	1.6E+03	1.2E+01	1.6E+02	8.5E-01	1.1E+01
Chloroform	3.98E+01	3.67E-03	2.94E+01	2.9E+03	7.0E+01	3.3E+02	2.1E+00	9.8E+00
Chloromethane	3.50E+01	2.40E-02	1.55E+02	4.1E+03	4.1E+01	4.1E+01	6.4E+00	6.4E+00
2-Chlorophenol	3.98E+02	3.91E-04	6.85E+01	5.5E+04	1.8E-01	1.8E+00	1.2E-02	1.2E-01
Chromium (total)					5.0E+01	5.0E+04		
Chromium III					5.0E+04	5.0E+04		
Chromium VI					2.1E+01	5.0E+04		
Chrysene	4.00E+05	9.46E-05	6.64E+04	3.8E+00	8.0E-01	8.0E-01	5.3E+01	5.3E+01
Cobalt					1.4E+02	5.0E+04		
Copper					1.0E+03	5.0E+04		
Cyanide	1.70E+01	1.30E-04	3.63E+00	2.0E+05	1.5E+02	1.7E+03	5.4E-01	6.2E+00
Dibenz(a,h)anthracene	3.30E+06	7.30E-08	5.48E+05	9.9E+00	4.8E-03	2.5E-01	9.9E+00	1.4E+02

Table G: Soil Screening Levels for Leaching Concerns

					Target Groundwater Concentrations		Soil Leaching Screening Levels	
	Organic Carbon Coefficient (Koc)	Henry's Law Constant (H)	Dilution/ Atenuation Factor (DAF)	Saturation Limit	Target Groundwater Concentration (Drinking Water Resource) (Table F-1a)	Target Groundwater Concentration (NON-Drinking Water Resource) (Table F-1b)	Soil Leaching Screening Level (Drinking Water Resource)	Soil Leaching Screening Level (NON-Drinking Water Resource)
Chemical	(cm^3/g)	(atm-m^3/mole-^oK)		(mg/kg)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Dibromochloromethane	4.68E+02	8.50E-04	8.30E+01	1.3E+04	1.0E+02	1.7E+02	8.3E+00	1.4E+01
1,2-dibromo-3-chloropropane	1.30E+02	1.47E-04	2.25E+01	1.1E+03	2.0E-01	1.0E+02	4.5E-03	2.2E+00
1,2-Dibromoethane	2.81E+01	3.20E-04	6.65E+00	9.2E+02	5.0E-02	1.5E+02	3.3E-04	1.0E+00
1,2-Dichlorobenzene	6.17E+02	1.90E-03	1.14E+02	6.0E+02	1.0E+01	1.0E+02	1.1E+00	1.1E+01
1,3-Dichlorobenzene	6.17E+02	1.90E-03	1.14E+02	6.0E+02	2.1E+02	5.0E+04	2.4E+01	5.7E+03
1,4-Dichlorobenzene	6.17E+02	2.43E-03	1.18E+02	2.8E+02	5.0E+00	1.1E+02	5.9E-01	1.3E+01
3,3-Dichlorobenzidine	1.60E+03	8.33E-07	2.66E+02	3.0E+01	2.9E-02	1.6E+03	7.7E-03	4.1E+02
Dichlorodiphenyldichloroethane (DDD)	7.80E+05	7.96E-06	1.29E+05	7.5E+02	1.5E-01	8.0E+01	7.5E+02	1.0E+04
Dichlorodiphenyldichloroethene (DDE)	4.40E+06	6.80E-05	7.30E+05	1.1E+03	1.0E-01	2.0E+01	1.1E+03	1.5E+04
Dichlorodiphenyltrichloroethane (DDT)	2.40E+05	3.89E-05	3.98E+04	4.3E+00	1.0E-01	1.5E+00	4.3E+00	6.0E+01
1,1-Dichloroethane	3.16E+01	5.62E-03	4.01E+01	1.7E+03	5.0E+00	1.0E+03	2.0E-01	4.1E+01
1,2-Dichloroethane	1.74E+01	9.79E-04	8.97E+00	1.8E+03	5.0E-01	2.0E+02	4.5E-03	1.8E+00
1,1-Dichloroethene	5.89E+01	2.61E-02	1.72E+02	1.5E+03	6.0E+00	6.3E+03	1.0E+00	1.1E+03
cis -1,2-Dichloroethene	3.55E+01	4.08E-03	3.12E+01	1.2E+03	6.0E+00	6.2E+03	1.9E-01	1.9E+02
trans -1,2-Dichloroethene	5.25E+01	9.38E-03	6.69E+01	3.1E+03	1.0E+01	2.6E+03	6.7E-01	1.7E+02
2,4-Dichlorophenol	6.00E+03	2.80E-06	9.96E+02	1.6E+05	3.0E-01	3.0E+00	3.0E-01	3.0E+00
1,2-Dichloropropane	4.37E+01	2.80E-03	2.46E+01	1.1E+03	5.0E+00	1.0E+02	1.2E-01	2.5E+00
1,3-Dichloropropene	4.57E+01	1.77E-02	1.17E+02	1.4E+03	5.0E-01	5.3E+01	5.9E-02	6.2E+00
Dieldrin	7.40E+03	5.84E-05	1.23E+03	8.3E+00	2.2E-03	9.3E+01	2.7E-03	1.1E+02
Diethyl phthalate	1.40E+02	1.14E-06	2.32E+01	8.4E+02	5.6E+03	5.0E+04	1.3E+02	1.2E+03
Dimethyl phthalate	1.40E+02	1.05E-07	2.32E+01	4.7E+03	5.0E+04	5.0E+04	1.2E+03	1.2E+03
2,4-Dimethylphenol	4.00E+01	1.70E-05	6.75E+00	2.7E+03	1.0E+02	4.0E+03	6.7E-01	2.7E+01
2,4-Dinitrophenol	1.70E+01	6.45E-10	2.82E+00	1.1E+03	1.4E+02	5.0E+04	4.0E-01	1.4E+02
2,4-Dinitrotoluene	4.50E+01	4.50E-06	7.50E+00	1.0E+02	5.1E-02	5.0E+04	3.9E-04	3.7E+02
1,4-Dioxane	3.50E+00	3.00E-06	6.00E-01	1.2E+05	3.0E+00	5.0E+04	1.8E-03	3.0E+01
Dioxin (2,3,7,8-TCDD)		8.10E-05		1.1E+06	3.0E-05	7.0E+03		
Endosulfan	3.20E+03	1.00E-05	5.31E+02	2.9E+00	4.2E+01	7.5E+01	2.2E+01	4.0E+01
Endrin	1.70E+03	7.51E-06	2.82E+02	2.7E+00	2.0E+00	1.3E+02	5.6E-01	3.7E+01
Ethylbenzene	3.63E+02	7.88E-03	1.09E+02	4.0E+02	3.0E+01	3.0E+02	3.3E+00	3.3E+01
Fluoranthene	3.80E+04	6.50E-06	6.31E+03	6.0E+01	1.3E+02	1.3E+02	8.4E+02	8.4E+02
Fluorene	1.38E+04	7.70E-05	2.29E+03	1.6E+02	2.8E+02	9.5E+02	6.4E+02	2.2E+03
Heptachlor	2.20E+04	1.48E-03	3.66E+03	7.4E+00	1.0E-02	2.8E+01	3.7E-02	1.0E+02
Heptachlor epoxide	2.30E+04	3.16E-05	3.82E+03	4.8E+01	1.0E-02	1.8E+02	3.8E-02	6.7E+02
Hexachlorobenzene	1.20E+06	1.70E-03	1.99E+05	7.9E+02	1.0E+00	5.5E+01	7.9E+02	1.1E+04
Hexachlorobutadiene	2.90E+04	2.56E-02	4.97E+03	3.5E+02	4.5E-01	6.0E+01	2.2E+00	3.0E+02
γ-Hexachlorocyclohexane (Lindane)	3.70E+03	4.93E-07	6.14E+02	1.6E+02	2.0E-01	3.5E+03	1.2E-01	2.1E+03
Hexachloroethane	2.00E+04	9.85E-03	3.38E+03	6.0E+03	9.0E-01	1.0E+02	3.0E+00	3.4E+02
Indeno(1,2,3-c,d)pyrene	1.60E+06	6.95E-08	2.66E+05	5.1E+00	4.8E-02	2.7E-01	1.3E+01	7.0E+01
Lead					1.5E+01	5.0E+04		
Mercury (elemental)					2.0E+00	5.0E+04		

Table G: Soil Screening Levels for Leaching Concerns

					Target Groundwater Concentrations		Soil Leaching Screening Levels	
	Organic Carbon Coefficient (Koc)	Henry's Law Constant (H)	Dilution/ Atenuation Factor (DAF)	Saturation Limit	Target Groundwater Concentration (Drinking Water Resource) (Table F-1a)	Target Groundwater Concentration (NON-Drinking Water Resource) (Table F-1b)	Soil Leaching Screening Level (Drinking Water Resource)	Soil Leaching Screening Level (NON-Drinking Water Resource)
Chemical	(cm^3/g)	(atm-m^3/mole-^oK)		(mg/kg)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)
Methoxychlor	7.90E+04	1.58E-05	1.31E+04	1.9E+01	2.0E+01	2.0E+01	2.6E+02	2.6E+02
Methylene chloride	1.11E+01	2.19E-03	1.54E+01	2.4E+03	5.0E+00	2.4E+03	7.7E-02	3.7E+01
Methyl ethyl ketone	4.50E+00	2.74E-05	9.17E-01	3.4E+04	4.2E+03	5.0E+04	3.9E+00	4.6E+01
Methyl isobutyl ketone	1.34E+02	1.40E-04	2.31E+01	1.7E+04	1.2E+02	1.3E+04	2.8E+00	3.0E+02
Methyl mercury					7.0E-01	5.0E+04		
2-Methylnaphthalene	7.20E+02	2.90E-04	1.21E+02	1.1E+02	1.0E+01	1.0E+02	1.2E+00	1.2E+01
tert -Butyl methyl ether	6.00E+00	5.87E-04	4.64E+00	2.1E+04	5.0E+00	1.8E+03	2.3E-02	8.4E+00
Molybdenum					3.5E+01	5.0E+04		
Naphthalene	1.19E+03	4.83E-04	2.01E+02	2.2E+02	1.7E+01	2.1E+02	3.4E+00	4.2E+01
Nickel					1.0E+02	5.0E+04		
Pentachlorophenol	3.20E+04	2.80E-06	5.31E+03	2.7E+06	1.0E+00	5.9E+03	2.7E+06	2.7E+06
Perchlorate					6.0E+00	5.0E+04		
Phenanthrene	1.40E+04	3.93E-05	2.32E+03	6.9E+01	2.1E+02	4.1E+02	4.9E+02	9.5E+02
Phenol	9.10E+01	1.30E-06	1.51E+01	5.2E+04	5.0E+00	5.0E+04	7.6E-02	7.6E+02
Polychlorinated biphenyls (PCBs)	3.30E+04	5.20E-04	5.48E+03	6.3E+00	5.0E-01	1.6E+01	6.3E+00	8.8E+01
Pyrene	1.05E+05	1.10E-05	1.74E+04	8.5E+01	6.8E+01	6.8E+01	1.2E+03	1.2E+03
Selenium					5.0E+01	5.0E+04		
Silver					3.5E+01	5.0E+04		
Styrene	7.76E+02	2.75E-03	1.46E+02	1.5E+03	1.0E+01	1.1E+02	1.5E+00	1.6E+01
tert -Butyl alcohol	3.70E+01	1.17E-05	6.21E+00	3.2E+05		5.0E+04		3.1E+02
1,1,1,2-Tetrachloroethane	9.37E+01	3.45E-04	1.77E+01	2.0E+03	1.3E+00	5.0E+04	2.4E-02	8.8E+02
1,1,2,2-Tetrachloroethane	9.37E+01	3.45E-04	1.77E+01	2.0E+03	1.0E+00	1.9E+02	1.8E-02	3.4E+00
Tetrachloroethene	1.55E+02	1.84E-02	1.40E+02	2.3E+02	5.0E+00	1.2E+02	7.0E-01	1.7E+01
Thallium					2.0E+00	5.0E+04		
Toluene	1.82E+02	6.64E-03	7.14E+01	6.5E+02	4.0E+01	4.0E+02	2.9E+00	2.9E+01
Toxaphene	4.90E+03	2.10E-01	2.12E+03	9.3E+01	3.0E+00	1.4E+02	6.4E+00	3.0E+02
TPH (gasolines)	5.00E+03	7.20E-04	8.34E+02	4.5E+03	1.0E+02	5.0E+03	8.3E+01	4.2E+03
TPH (middle distillates)	5.00E+03	7.20E-04	8.34E+02	1.5E+02	1.0E+02	2.5E+03	8.3E+01	2.1E+03
TPH (residual fuels)				1.5E+02	1.0E+02	2.5E+03		
1,2,4-Trichlorobenzene	1.78E+03	1.42E-03	3.04E+02	3.2E+03	5.0E+00	2.5E+03	1.5E+00	7.7E+02
1,1,1-Trichloroethane	1.10E+02	1.72E-02	1.25E+02	1.2E+03	2.0E+02	5.0E+04	2.5E+01	6.3E+03
1,1,2-Trichloroethane	5.01E+01	9.13E-04	1.40E+01	1.8E+03	5.0E+00	3.5E+02	7.0E-02	4.8E+00
Trichloroethene	1.66E+02	1.03E-02	9.15E+01	1.3E+03	5.0E+00	5.3E+02	4.6E-01	4.9E+01
2,4,5-Trichlorophenol	8.90E+01	2.18E-04	1.61E+01	7.6E+02	2.0E+02	2.0E+03	3.2E+00	3.2E+01
2,4,6-Trichlorophenol	2.00E+03	4.00E-06	3.32E+02	9.7E+03	7.0E-01	1.0E+03	2.3E-01	3.3E+02
Vanadium					1.5E+01	5.0E+04		
Vinyl chloride	1.86E+01	2.70E-02	1.71E+02	1.2E+03	5.0E-01	3.8E+00	8.5E-02	6.6E-01
Xylenes	4.07E+02	7.34E-03	1.13E+02	4.2E+02	2.0E+01	5.3E+03	2.3E+00	6.0E+02
Zinc					5.0E+03	5.0E+04		

Table G: Soil Screening Levels for Leaching Concerns

					Target Groundwater Concentrations		Soil Leaching Screening Levels	
	Organic Carbon Coefficient (Koc)	Henry's Law Constant (H)	Dilution/ Atenuation Factor (DAF)	Saturation Limit	Target Groundwater Concentration (Drinking Water Resource) (Table F-1a)	Target Groundwater Concentration (NON-Drinking Water Resource) (Table F-1b)	Soil Leaching Screening Level (Drinking Water Resource)	Soil Leaching Screening Level (NON-Drinking Water Resource)
Chemical	(cm^3/g)	(atm-m^3/mole-^oK)		(mg/kg)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)

Notes:
Soil leaching equation from Ontario MOEE guidance (see text).
Groundwater Category Drinking Water Resource - protective of groundwater that is a source of drinking water AND protective of discharge of groundwater to a surface water and subsequent impact on aquatic life.
Groundwater Category NON-Drinking Water Resource - protective of discharge of impacted groundwater to surface water and subsequent impact on aquatic life.
#: Leaching model used considered to be excessively conservative for highly sorptive chemicals. For chemicals with koc values greater than 30,000 cm^3/g, theoretical soil saturation level ("sat") used in place of leaching model screening level if higher (see text). Soil saturation levels calculated using equation presented in USEPA Region 9 PRG guidance (USEPA 2004, see Appendix 2). Exceptions include bis(2-ethylhexyl)phthalate and pentachlorophenol (see text).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
Physical-Chemical constants for chemicals from USEPA Region 9 (USEPA 2004) or Ontario MOEE (MOEE 1996) when not available unless otherwise noted (see also Table J).
Physical-Chemical constants for TPH (gasolines and middle distillates) based on constants developed for C11 to C22 aromatic carbon range fraction by Massachusetts DEP and used to develop RBSLs for leaching of TPH in general from soil (MADEP 1997). Soil leaching level rounded to nearest hundred.
Target groundwater concentrations from Table F-1a and F-1b.
Target groundwater concentration and corresponding soil leaching levels for TPH based on criteria in Board Order 99-045 for San Francisco Airport (RWQCBSF,1999).
Screening Levels for TPH (gasolines) and TPH (middle distilates) rounded to nearest 100 mg/kg.
TPH (residual fuels) soil screening level for leaching from California Regional Water Board, Region 4 - drinking water protection, C23-C32 carbon range (RWQCBLA 1996).
Screening levels for perchlorate calculated using leaching equation in USEPA Soil Screening Guidance and assumed Dilution/Attenuation Factor of 20 (see text).

Table H-1. Criteria for Assignment of Soil Gross Contamination Ceiling Levels

Soil Category	Criteria	Gross Contamination Ceiling Level (mg/kg)
Surface Soils		
Residential/Parkland/Agricultural	Odor Index ≥ 100 OR no Odor Index and Vapor Pressure ≥ 1 Torr OR no data	100
	0.1 ≤ Odor Index < 100 OR no Odor Index and Vapor Pressure < 1 Torr	500
	Odor Index < 0.1 OR non-odorous chemical	1000
Industrial/Commercial	Odor Index ≥ 100 OR no Odor Index and Vapor Pressure ≥ 1 Torr OR no data	500
	0.1 ≤ Odor Index < 100 OR no Odor Index and Vapor Pressure < 1 Torr	1000
	Odor Index < 0.1 OR non-odorous chemical	2500
Subsurface Soils		
Residential/Parkland/Agricultural	Odor Index ≥ 100 OR no Odor Index and Vapor Pressure ≥ 1 Torr OR no data	500
	0.1 ≤ Odor Index < 100 OR no Odor Index and Vapor Pressure < 1 Torr	1000
	Odor Index < 0.1 OR non-odorous chemical	2500
Industrial/Commercial	Odor Index ≥ 100 OR no Odor Index and Vapor Pressure ≥ 1 Torr OR no data	1000
	0.1 ≤ Odor Index < 100 OR no Odor Index and Vapor Pressure < 1 Torr	2500
	Odor Index < 0.1 OR non-odorous chemical	5000

Modified from Ontario Ministry of Environment and Energy (MOEE 1996) and Massachusetts Department of Environmental Protection (MADEP 1994).

Table H-2. Components for Shallow Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
Acenaphthene	1.0E+03	2.5E+03	N/A	4.5E-03	5.13E+02	8.00E-02	5.63E-02
Acenaphthylene	5.0E+02	1.0E+03	N/A	2.9E-02	-	-	-
Acetone	5.0E+02	1.0E+03	1.0E+05	2.70E+02	3.09E+04	1.30E+01	2.08E+01
Aldrin	1.0E+03	2.5E+03	N/A	2.3E-05	2.63E+02	1.70E-02	1.35E-03
Anthracene	5.0E+02	1.0E+03	N/A	1.7E-05	-	-	-
Antimony	1.0E+03	2.5E+03	N/A	-	-	-	-
Arsenic	1.0E+03	2.5E+03	N/A	-	-	-	-
Barium	1.0E+03	2.5E+03	N/A	-	-	-	-
Benzene	5.0E+02	8.7E+02	8.7E+02	9.50E+01	4.89E+03	1.50E+00	6.33E+01
Benzo(a)anthracene	5.0E+02	1.0E+03	N/A	2.2E-08	-	-	-
Benzo(b)fluoranthene	5.0E+02	1.0E+03	N/A	5.0E-07	-	-	-
Benzo(k)fluoranthene	5.0E+02	1.0E+03	N/A	9.6E-11	-	-	-
Benzo(g,h,i)perylene	5.0E+02	1.0E+03	N/A	1.1E-10	-	-	-
Benzo(a)pyrene	5.0E+02	1.0E+03	N/A	5.6E-09	-	-	-
Beryllium	1.0E+03	2.5E+03	N/A	-	-	-	-
1,1-Biphenyl	5.0E+02	1.0E+03	N/A	5.00E-03	6.00E+01	9.50E-03	5.26E-01
Bis(2-chloroethyl) ether	5.0E+02	1.0E+03	9.6E+03	7.1E-01	2.87E+02	4.9E-02	1.45E+01
Bis(2-chloroisopropyl) ether	5.0E+02	7.9E+02	7.9E+02	8.5E-01	2.24E+03	3.20E-01	2.66E+00
Bis(2-ethylhexyl) phthalate	5.0E+02	1.0E+03	N/A	6.2E-08	-	-	-
Boron	no criteria	no critiera	N/A	-	-	-	-
Bromodichloromethane	1.0E+03	2.5E+03	3.0E+03	5.00E+01	1.10E+07	1.68E+03	2.98E-02
Bromoform (Tribromomethane)	5.0E+02	1.0E+03	N/A	5.60E+00	1.35E+04	1.30E+00	4.31E+00
Bromomethane	5.0E+02	1.0E+03	3.1E+03	1.42E+03	8.00E+04	2.00E+01	7.10E+01
Cadmium	1.0E+03	2.5E+03	N/A	-	-	-	-
Carbon tetrachloride	5.0E+02	1.0E+03	1.1E+03	1.13E+02	6.30E+04	1.00E+01	1.13E+01
Chlordane	1.0E+03	2.5E+03	N/A	1.0E-05	8.40E+00	4.92E-04	2.03E-02
p-Chloroaniline	1.0E+03	2.5E+03	N/A	1.0E-05	-	-	-
Chlorobenzene	5.0E+02	6.8E+02	6.8E+02	1.18E+01	1.00E+03	2.20E-01	5.36E+01
Chloroethane	5.0E+02	1.0E+03	1.6E+03	1.01E+03	3.80E+05	1.40E+02	7.20E+00
Chloroform	5.0E+02	1.0E+03	2.9E+03	1.60E+02	4.22E+05	8.50E+01	1.88E+00
Chloromethane	1.0E+02	5.0E+02	4.1E+03	4.30E+03	-	-	-
2-Chlorophenol	1.0E+02	5.0E+02	5.5E+04	1.42E+00	1.90E+01	3.60E-03	3.94E+02
Chromium (total)	1.0E+03	2.5E+03	N/A	-	-	-	-
Chromium III	1.0E+03	2.5E+03	N/A	-	-	-	-
Chromium VI	1.0E+03	2.5E+03	N/A	-	-	-	-
Chrysene	1.0E+03	2.5E+03	N/A	6.3E-07	-	-	-

Table H-2. Components for Shallow Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
Cobalt	1.0E+03	2.5E+03	N/A	-	-	-	-
Copper	1.0E+03	2.5E+03	N/A	-	-	-	-
Cyanide	1.0E+02	5.0E+02	N/A	6.20E+02	6.52E+02	5.80E-01	1.07E+03
Dibenz(a,h)anthracene	5.0E+02	1.0E+03	N/A	1.0E-10	-	-	-
Dibromochloromethane	1.0E+02	5.0E+02	N/A	7.60E+01	-	-	-
1,2-dibromo-3-chloropropane	5.0E+02	1.0E+03	N/A	8.00E-01	-	-	-
1,2-Dibromoethane	5.0E+02	1.0E+03	N/A	1.20E+01	2.00E+05	2.60E+01	4.62E-01
1,2-Dichlorobenzene	6.0E+02	6.0E+02	6.0E+02	1.50E+00	3.05E+05	5.00E+01	3.00E-02
1,3-Dichlorobenzene	1.0E+02	6.0E+02	6.0E+02	2.30E+00	-	-	-
1,4-Dichlorobenzene	5.0E+02	1.0E+03	N/A	1.80E+00	1.10E+03	1.80E-01	1.00E+01
3,3-Dichlorobenzidine	5.0E+02	1.0E+03	N/A	4.5E-09	-	-	-
Dichlorodiphenyldichloroethane (DDD)	5.0E+02	1.0E+03	N/A	1.0E-06	-	-	-
Dichlorodiphenyldichloroethene (DDE)	5.0E+02	1.0E+03	N/A	6.5E-06	-	-	-
Dichlorodiphenyltrichloroethane (DDT)	1.0E+03	2.5E+03	N/A	5.5E-06	-	-	-
1,1-Dichloroethane	5.0E+02	1.0E+03	1.7E+03	2.34E+02	1.25E+05	3.00E+01	7.80E+00
1,2-Dichloroethane	5.0E+02	1.0E+03	1.8E+03	7.90E+01	2.42E+03	5.90E-01	1.34E+02
1,1-Dichloroethene	5.0E+02	1.0E+03	1.5E+03	5.91E+02	2.00E+06	5.00E+02	1.18E+00
cis -1,2-Dichloroethene	1.0E+02	5.0E+02	1.2E+03	2.15E+02	-	-	-
trans -1,2-Dichloroethene	5.0E+02	1.0E+03	3.1E+03	3.31E+02	6.73E+04	1.70E+01	1.95E+01
2,4-Dichlorophenol	5.0E+02	1.0E+03	N/A	6.7E-02	1.40E+03	2.10E-01	3.19E-01
1,2-Dichloropropane	1.0E+02	5.0E+02	1.1E+03	4.20E+01	1.19E+03	2.50E-01	1.68E+02
1,3-Dichloropropene	5.0E+02	1.0E+03	1.4E+03	4.30E+01	4.16E+03	1.00E+00	4.30E+01
Dieldrin	1.0E+03	2.5E+03	N/A	1.8E-08	-	-	-
Diethyl phthalate	5.0E+02	1.0E+03	N/A	3.5E-04	-	-	-
Dimethyl phthalate	5.0E+02	1.0E+03	N/A	1.7E-03	-	-	-
2,4-Dimethylphenol	1.0E+02	5.0E+02	N/A	9.8E-02	1.00E+00	1.97E-04	4.97E+02
2,4-Dinitrophenol	5.0E+02	1.0E+03	N/A	1.5E-05	-	-	-
2,4-Dinitrotoluene	5.0E+02	1.0E+03	N/A	5.1E-03	-	-	-
1,4-Dioxane	5.0E+02	1.0E+03	N/A	3.70E+01	6.12E+05	1.70E+02	2.18E-01
Dioxin (2,3,7,8-TCDD)	no criteria	no criteria	N/A	-	-	-	-
Endosulfan	5.0E+02	1.0E+03	N/A	1.0E-05	-	-	-
Endrin	5.0E+02	1.0E+03	N/A	2.0E-07	-	-	-
Ethylbenzene	4.0E+02	4.0E+02	4.0E+02	1.00E+01	2.00E+03	4.50E-01	2.22E+01
Fluoranthene	5.0E+02	1.0E+03	N/A	5.0E-06	-	-	-
Fluorene	5.0E+02	1.0E+03	N/A	3.2E-04	-	-	-
Heptachlor	1.0E+03	2.5E+03	N/A	3.0E-04	3.00E+02	2.00E-02	1.50E-02

Table H-2. Components for Shallow Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
Heptachlor epoxide	1.0E+03	2.5E+03	N/A	2.6E-06	3.00E+02	1.90E-02	1.37E-04
Hexachlorobenzene	5.0E+02	1.0E+03	N/A	1.1E-05	-	-	-
Hexachlorobutadiene	5.0E+02	1.0E+03	N/A	1.50E-01	1.20E+04	1.10E+00	1.36E-01
γ-Hexachlorocyclohexane (Lindane)	5.0E+02	1.0E+03	N/A	9.4E-06	-	-	-
Hexachloroethane	5.0E+02	1.0E+03	N/A	2.1E-01	-	-	-
Indeno(1,2,3-c,d)pyrene	5.0E+02	1.0E+03	N/A	1.0E-06	-	-	-
Lead	1.0E+03	2.5E+03	N/A	-	-	-	-
Mercury (elemental)	5.0E+02	1.0E+03	N/A	2.0E-03	-	-	-
Methoxychlor	5.0E+02	1.0E+03	N/A	1.4E-06	-	-	-
Methylene chloride	5.0E+02	1.0E+03	2.4E+03	4.29E+02	5.60E+05	1.60E+02	2.68E+00
Methyl ethyl ketone	5.0E+02	1.0E+03	3.4E+04	1.00E+02	3.20E+04	1.10E+01	9.09E+00
Methyl isobutyl ketone	1.0E+02	5.0E+02	1.7E+04	1.00E+01	4.20E+02	1.00E-01	1.00E+02
Methyl mercury	1.0E+02	5.0E+02	N/A	-	-	-	-
2-Methylnaphthalene	5.0E+02	1.0E+03	N/A	6.8E-02	6.80E+01	1.15E-02	5.91E+00
tert-Butyl methyl ether	1.0E+02	5.0E+02	2.1E+04	2.45E+02	5.30E+02	1.30E-01	1.88E+03
Molybdenum	1.0E+03	2.5E+03	N/A	-	-	-	-
Naphthalene	5.0E+02	1.0E+03	N/A	8.2E-02	4.40E+02	8.40E-02	9.76E-01
Nickel	1.0E+03	2.5E+03	N/A	-	-	-	-
Pentachlorophenol	5.0E+02	1.0E+03	N/A	1.1E-04	-	-	-
Perchlorate	1.0E+03	2.5E+03	N/A	-	-	-	-
Phenanthrene	5.0E+02	1.0E+03	N/A	9.6E-04	5.50E+01	7.42E-03	1.29E-01
Phenol	5.0E+02	1.0E+03	N/A	3.50E-01	1.56E+02	4.00E-02	8.75E+00
Polychlorinated biphenyls (PCBs)	5.0E+02	1.0E+03	N/A	4.9E-04 to 6.7E-03	-	-	-
Pyrene	5.0E+02	1.0E+03	N/A	2.5E-06	-	-	-
Selenium	1.0E+03	2.5E+03	N/A	-	-	-	-
Silver	1.0E+03	2.5E+03	N/A	-	-	-	-
Styrene	5.0E+02	1.0E+03	1.5E+03	5.00E+00	1.36E+03	3.00E-01	1.67E+01
tert-Butyl alcohol	1.0E+02	5.0E+02	3.2E+05	4.20E+01	-	-	-
1,1,1,2-Tetrachloroethane	1.0E+02	5.0E+02	2.0E+03	1.20E+01	-	-	-
1,1,2,2-Tetrachloroethane	5.0E+02	1.0E+03	2.0E+03	4.00E+00	1.05E+04	1.50E+00	2.67E+00
Tetrachloroethene	2.3E+02	2.3E+02	2.3E+02	1.90E+01	3.17E+04	4.68E+00	4.06E+00
Thallium	1.0E+03	2.5E+03	N/A	-	-	-	-
Toluene	5.0E+02	6.5E+02	6.5E+02	2.80E+01	3.00E+04	8.00E+00	3.50E+00

Table H-2. Components for Shallow Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
Toxaphene	5.0E+02	1.0E+03	N/A	4.00E-01	-	-	-
TPH (gasolines)	1.0E+02	5.0E+02	4.5E+03	3.00E+02	1.00E+02	2.20E-02	1.36E+04
TPH (middle distillates)	1.0E+02	5.0E+02	1.5E+02	5.00E+00	1.00E+03	1.41E-02	3.55E+02
TPH (residual fuels)	5.0E+02	2.5E+03	N/A	-	-	-	-
1,2,4-Trichlorobenzene	5.0E+02	1.0E+03	N/A	2.9E-01	2.20E+04	2.96E+00	9.80E-02
1,1,1-Trichloroethane	5.0E+02	1.0E+03	1.2E+03	1.00E+02	6.51E+04	1.20E+01	8.33E+00
1,1,2-Trichloroethane	1.0E+02	5.0E+02	1.8E+03	2.25E+01	-	-	-
Trichloroethene	5.0E+02	8.2E+02	1.3E+03	7.70E+01	1.36E+06	2.49E+02	3.09E-01
2,4,5-Trichlorophenol	1.0E+02	5.0E+02	N/A	-	-	-	-
2,4,6-Trichlorophenol	5.0E+02	1.0E+03	N/A	1.2E-02	3.00E-01	3.60E-05	3.33E+02
Vanadium	1.0E+03	2.5E+03	N/A	-	-	-	-
Vinyl chloride	5.0E+02	1.0E+03	1.2E+03	2.58E+03	7.71E+05	2.94E+02	8.78E+00
Xylenes	4.2E+02	4.2E+02	4.2E+02	6.00E+00	4.41E+02	1.00E-01	6.00E+01
Zinc	1.0E+03	2.5E+03	N/A	-	-	-	-

Notes:

1. "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

Odor Index = VP/ORT in ppmv
Physical-chemical constants Ontario MOEE (MOEE 1996) except as noted.
Physical-chemical constants for cloroethane and chloromethane from ATSDR Toxicological Profiles (ATSDR 2001).
Odor Recognition Threshold in parts per million by volume (ppmv = (concentration in mg/m ^{3}) x (24/molecular weight)).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
Ceiling Level: Based on comparison of vapor pressure and odor index to Table H-1 or saturation limit, if lower.
Saturation limits calculated using equation in USEPA Region 9 PRG guidance (for chemicals that are liquid at ambient temperatures and pressures; refer to Appendix 2).
Odor Threshold for ethanol of 10 ppmv from U.S. Coast Guard Chemical Hazards Response Information System (USCG 1999).
Odor Threshold of 0.13 ppmv for MtBE from information in CaEPA Public Health Goal for MtBE (CalEPA 1999).
TPH VP values from NIOSH (2005); ORT values from ATSDR (2001a).
Ceiling Levels for TPH after guidance from Massachusetts Department of Environmental Protection (MADEP 1997a). Adjust as needed in field.

References for vapor pressure and odor threshold data (in order of use):

1. Ontario Ministry of Environment and Energy (MOEE 1996).
2. Massachusetts Department of Environmental Protection (MADEP 1994).
3. Agency for Toxic Substances and Disease Registry (ATSDR 2001).
4. Vapor Pressure for 1,4 Dioxane from "Solvent Stabilizers - White Paper" (Mohr 2001). Odor Threshold from US Department of Health and Human Services, National Toxicology Program (USDHHS, 2001).

Table H-3. Components for Deep Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
Acenaphthene	2.5E+03	5.0E+03	N/A	4.5E-03	5.13E+02	8.00E-02	5.63E-02
Acenaphthylene	1.0E+03	2.5E+03	N/A	2.9E-02	-	-	-
Acetone	1.0E+03	2.5E+03	1.0E+05	2.70E+02	3.09E+04	1.30E+01	2.08E+01
Aldrin	2.5E+03	5.0E+03	N/A	2.3E-05	2.63E+02	1.70E-02	1.35E-03
Anthracene	1.0E+03	2.5E+03	N/A	1.7E-05	-	-	-
Antimony	2.5E+03	5.0E+03	N/A	-	-	-	-
Arsenic	2.5E+03	5.0E+03	N/A	-	-	-	-
Barium	2.5E+03	5.0E+03	N/A	-	-	-	-
Benzene	8.7E+02	8.7E+02	8.7E+02	9.50E+01	4.89E+03	1.50E+00	6.33E+01
Benzo(a)anthracene	1.0E+03	2.5E+03	N/A	2.2E-08	-	-	-
Benzo(b)fluoranthene	1.0E+03	2.5E+03	N/A	5.0E-07	-	-	-
Benzo(k)fluoranthene	1.0E+03	2.5E+03	N/A	9.6E-11	-	-	-
Benzo(g,h,i)perylene	1.0E+03	2.5E+03	N/A	1.1E-10	-	-	-
Benzo(a)pyrene	1.0E+03	2.5E+03	N/A	5.6E-09	-	-	-
Beryllium	2.5E+03	5.0E+03	N/A	-	-	-	-
1,1-Biphenyl	1.0E+03	2.5E+03	N/A	5.00E-03	6.00E+01	9.50E-03	5.26E-01
Bis(2-chloroethyl) ether	1.0E+03	2.5E+03	9.6E+03	7.1E-01	2.87E+02	4.9E-02	1.45E+01
Bis(2-chloroisopropyl) ether	7.9E+02	7.9E+02	7.9E+02	8.5E-01	2.24E+03	3.20E-01	2.66E+00
Bis(2-ethylhexyl) phthalate	1.0E+03	2.5E+03	N/A	6.2E-08	-	-	-
Boron	no criteria	no criteria	N/A	-	-	-	-
Bromodichloromethane	2.5E+03	4.8E+03	3.0E+03	5.00E+01	1.10E+07	1.68E+03	2.98E-02
Bromoform (Tribromomethane)	1.0E+03	2.5E+03	N/A	5.60E+00	1.35E+04	1.30E+00	4.31E+00
Bromomethane	1.0E+03	2.5E+03	3.1E+03	1.42E+03	8.00E+04	2.00E+01	7.10E+01
Cadmium	2.5E+03	5.0E+03	N/A	-	-	-	-
Carbon tetrachloride	1.0E+03	1.1E+03	1.1E+03	1.13E+02	6.30E+04	1.00E+01	1.13E+01
Chlordane	2.5E+03	5.0E+03	N/A	1.0E-05	8.40E+00	4.92E-04	2.03E-02
p-Chloroaniline	2.5E+03	5.0E+03	N/A	1.0E-05	-	-	-
Chlorobenzene	6.8E+02	6.8E+02	6.8E+02	1.18E+01	1.00E+03	2.20E-01	5.36E+01
Chloroethane	1.0E+03	1.6E+03	1.6E+03	1.01E+03	3.80E+05	1.40E+02	7.20E+00
Chloroform	1.0E+03	2.5E+03	2.9E+03	1.60E+02	4.22E+05	8.50E+01	1.88E+00
Chloromethane	5.0E+02	1.0E+03	4.1E+03	4.30E+03	-	-	-
2-Chlorophenol	5.0E+02	1.0E+03	5.5E+04	1.42E+00	1.90E+01	3.60E-03	3.94E+02
Chromium (total)	2.5E+03	5.0E+03	N/A	-	-	-	-
Chromium III	2.5E+03	5.0E+03	N/A	-	-	-	-
Chromium VI	2.5E+03	5.0E+03	N/A	-	-	-	-
Chrysene	2.5E+03	5.0E+03	N/A	6.3E-07	-	-	-
Cobalt	2.5E+03	5.0E+03	N/A	-	-	-	-
Copper	2.5E+03	5.0E+03	N/A	-	-	-	-
Cyanide	5.0E+02	1.0E+03	N/A	6.20E+02	6.52E+02	5.80E-01	1.07E+03
Dibenz(a,h)anthracene	1.0E+03	2.5E+03	N/A	1.0E-10	-	-	-
Dibromochloromethane	5.0E+02	1.0E+03	N/A	7.60E+01	-	-	-
1,2-dibromo-3-chloropropane	1.0E+03	1.1E+03	N/A	8.00E-01	-	-	-
1,2-Dibromoethane	1.0E+03	2.5E+03	N/A	1.20E+01	2.00E+05	2.60E+01	4.62E-01

Table H-3. Components for Deep Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
1,2-Dichlorobenzene	6.0E+02	6.0E+02	6.0E+02	1.50E+00	3.05E+05	5.00E+01	3.00E-02
1,3-Dichlorobenzene	6.0E+02	6.0E+02	6.0E+02	2.30E+00	-	-	-
1,4-Dichlorobenzene	1.0E+03	2.5E+03	N/A	1.80E+00	1.10E+03	1.80E-01	1.00E+01
3,3-Dichlorobenzidine	1.0E+03	2.5E+03	N/A	4.5E-09	-	-	-
Dichlorodiphenyldichloroethane (DDD)	1.0E+03	2.5E+03	N/A	1.0E-06	-	-	-
Dichlorodiphenyldichloroethene (DDE)	1.0E+03	2.5E+03	N/A	6.5E-06	-	-	-
Dichlorodiphenyltrichloroethane (DDT)	2.5E+03	5.0E+03	N/A	5.5E-06	-	-	-
1,1-Dichloroethane	1.0E+03	1.7E+03	1.7E+03	2.34E+02	1.25E+05	3.00E+01	7.80E+00
1,2-Dichloroethane	1.0E+03	1.8E+03	1.8E+03	7.90E+01	2.42E+03	5.90E-01	1.34E+02
1,1-Dichloroethene	1.0E+03	1.5E+03	1.5E+03	5.91E+02	2.00E+06	5.00E+02	1.18E+00
cis -1,2-Dichloroethene	5.0E+02	1.0E+03	1.2E+03	2.15E+02	-	-	-
trans -1,2-Dichloroethene	1.0E+03	2.5E+03	3.1E+03	3.31E+02	6.73E+04	1.70E+01	1.95E+01
2,4-Dichlorophenol	1.0E+03	2.5E+03	N/A	6.7E-02	1.40E+03	2.10E-01	3.19E-01
1,2-Dichloropropane	5.0E+02	1.0E+03	1.1E+03	4.20E+01	1.19E+03	2.50E-01	1.68E+02
1,3-Dichloropropene	1.0E+03	1.4E+03	1.4E+03	4.30E+01	4.16E+03	1.00E+00	4.30E+01
Dieldrin	2.5E+03	5.0E+03	N/A	1.8E-08	-	-	-
Diethyl phthalate	1.0E+03	2.5E+03	N/A	3.5E-04	-	-	-
Dimethyl phthalate	1.0E+03	2.5E+03	N/A	1.7E-03	-	-	-
2,4-Dimethylphenol	5.0E+02	1.0E+03	N/A	9.8E-02	1.00E+00	1.97E-04	4.97E+02
2,4-Dinitrophenol	1.0E+03	2.5E+03	N/A	1.5E-05	-	-	-
2,4-Dinitrotoluene	1.0E+03	2.5E+03	N/A	5.1E-03	-	-	-
1,4-Dioxane	1.0E+03	2.5E+03	N/A	3.70E+01	6.12E+05	1.70E+02	2.18E-01
Dioxin (2,3,7,8-TCDD)	no criteria	no criteria	N/A	-	-	-	-

Table H-3. Components for Deep Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
Endosulfan	1.0E+03	2.5E+03	N/A	1.0E-05	-	-	-
Endrin	1.0E+03	2.5E+03	N/A	2.0E-07	-	-	-
Ethylbenzene	4.0E+02	4.0E+02	4.0E+02	1.00E+01	2.00E+03	4.50E-01	2.22E+01
Fluoranthene	1.0E+03	2.5E+03	N/A	5.0E-06	-	-	-
Fluorene	1.0E+03	2.5E+03	N/A	3.2E-04	-	-	-
Heptachlor	2.5E+03	5.0E+03	N/A	3.0E-04	3.00E+02	2.00E-02	1.50E-02
Heptachlor epoxide	2.5E+03	5.0E+03	N/A	2.6E-06	3.00E+02	1.90E-02	1.37E-04
Hexachlorobenzene	1.0E+03	2.5E+03	N/A	1.1E-05	-	-	-
Hexachlorobutadiene	1.0E+03	2.5E+03	N/A	1.50E-01	1.20E+04	1.10E+00	1.36E-01
γ-Hexachlorocyclohexane (Lindane)	1.0E+03	2.5E+03	N/A	9.4E-06	-	-	-
Hexachloroethane	1.0E+03	2.5E+03	N/A	2.1E-01	-	-	-
Indeno(1,2,3-c,d)pyrene	1.0E+03	2.5E+03	N/A	1.0E-06	-	-	-
Lead	2.5E+03	5.0E+03	N/A	-	-	-	-
Mercury (elemental)	1.0E+03	2.5E+03	N/A	2.0E-03	-	-	-
Methoxychlor	1.0E+03	2.5E+03	N/A	1.4E-06	-	-	-
Methylene chloride	1.0E+03	2.4E+03	2.4E+03	4.29E+02	5.60E+05	1.60E+02	2.68E+00
Methyl ethyl ketone	1.0E+03	2.5E+03	3.4E+04	1.00E+02	3.20E+04	1.10E+01	9.09E+00
Methyl isobutyl ketone	5.0E+02	1.0E+03	1.7E+04	1.00E+01	4.20E+02	1.00E-01	1.00E+02
Methyl mercury	5.0E+02	1.0E+03	N/A	-	-	-	-
2-Methylnaphthalene	1.0E+03	2.5E+03	N/A	6.8E-02	6.80E+01	1.15E-02	5.91E+00
tert-Butyl methyl ether	5.0E+02	1.0E+03	2.1E+04	2.45E+02	5.30E+02	1.30E-01	1.88E+03
Molybdenum	2.5E+03	5.0E+03	N/A	-	-	-	-
Naphthalene	1.0E+03	2.5E+03	N/A	8.2E-02	4.40E+02	8.40E-02	9.76E-01
Nickel	2.5E+03	5.0E+03	N/A	-	-	-	-
Pentachlorophenol	1.0E+03	2.5E+03	N/A	1.1E-04	-	-	-
Perchlorate	2.5E+03	5.0E+03	N/A	-	-	-	-
Phenanthrene	1.0E+03	2.5E+03	N/A	9.6E-04	5.50E+01	7.42E-03	1.29E-01
Phenol	1.0E+03	2.5E+03	N/A	3.50E-01	1.56E+02	4.00E-02	8.75E+00
Polychlorinated biphenyls (PCBs)	1.0E+03	2.5E+03	N/A	4.9E-04 to 6.7E-03	-	-	-
Pyrene	1.0E+03	2.5E+03	N/A	2.5E-06	-	-	-
Selenium	2.5E+03	5.0E+03	N/A	-	-	-	-
Silver	2.5E+03	5.0E+03	N/A	-	-	-	-
Styrene	1.0E+03	1.5E+03	1.5E+03	5.00E+00	1.36E+03	3.00E-01	1.67E+01

Table H-3. Components for Deep Soil Gross Contamination Ceiling Levels (mg/kg)

Chemical	[1]Residential Gross Contamination Ceiling Level	Industrial/ Commercial Gross Contamination Ceiling Level	Soil Saturation Limit (mg/kg)	Vapor Pressure (VP) (Torr @ 20-30 °C)	50 Percentile Odor Recognition Threshold (ORT) (µg/m^3)	50 Percentile Odor Recognition Threshold (ORT) (ppmv)	Odor Index
tert-Butyl alcohol	5.0E+02	1.0E+03	3.2E+05	4.20E+01	-	-	-
1,1,1,2-Tetrachloroethane	5.0E+02	1.0E+03	2.0E+03	1.20E+01	-	-	-
1,1,2,2-Tetrachloroethane	1.0E+03	1.7E+03	2.0E+03	4.00E+00	1.05E+04	1.50E+00	2.67E+00
Tetrachloroethene	2.3E+02	2.3E+02	2.3E+02	1.90E+01	3.17E+04	4.68E+00	4.06E+00
Thallium	2.5E+03	5.0E+03	N/A	-	-	-	-
Toluene	6.5E+02	6.5E+02	6.5E+02	2.80E+01	3.00E+04	8.00E+00	3.50E+00
Toxaphene	1.0E+03	2.5E+03	N/A	4.00E-01	-	-	-
TPH (gasolines)	5.0E+03	5.0E+03	4.5E+03	3.00E+02	1.00E+02	2.20E-02	1.36E+04
TPH (middle distillates)	5.0E+03	5.0E+03	1.5E+02	5.00E+00	1.00E+03	1.41E-02	3.55E+02
TPH (residual fuels)	5.0E+03	5.0E+03	N/A	-	-	-	-
1,2,4-Trichlorobenzene	1.0E+03	2.5E+03	N/A	2.9E-01	2.20E+04	2.96E+00	9.80E-02
1,1,1-Trichloroethane	1.0E+03	1.2E+03	1.2E+03	1.00E+02	6.51E+04	1.20E+01	8.33E+00
1,1,2-Trichloroethane	5.0E+02	1.0E+03	1.8E+03	2.25E+01	-	-	-
Trichloroethene	1.0E+03	1.3E+03	1.3E+03	7.70E+01	1.36E+06	2.49E+02	3.09E-01
2,4,5-Trichlorophenol	5.0E+02	1.0E+03	N/A	-	-	-	-
2,4,6-Trichlorophenol	1.0E+03	2.5E+03	N/A	1.2E-02	3.00E-01	3.60E-05	3.33E+02
Vanadium	2.5E+03	5.0E+03	N/A	-	-	-	-
Vinyl chloride	1.0E+03	2.5E+03	1.2E+03	2.58E+03	7.71E+05	2.94E+02	8.78E+00
Xylenes	4.2E+02	4.2E+02	4.2E+02	6.00E+00	4.41E+02	1.00E-01	6.00E+01
Zinc	2.5E+03	5.0E+03	N/A	-	-	-	-

Notes:

1. "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

Odor Index = VP/ORT in ppm-v
Physical-chemical constants Ontario MOEE (MOEE 1996) except as noted.
Physical-chemical constants for cloroethane and chloromethane from ATSDR Toxicological Profiles (ATSDR 2001).
Odor Recognition Threshold in parts per million by volume (ppmv = (concentration in mg/m^3) x (24/molecular weight)).
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
Ceiling Level: Based on comparison of vapor pressure and odor index to Table H-1 or saturation limit, if lower.
Saturation limits calculated using equation in USEPA Region 9 PRG guidance (for chemicals that are liquid at ambient temperatures and pressures; refer to Appendix 2).
Odor Threshold for ethanol of 10 ppmv from U.S. Coast Guard Chemical Hazards Response Information System (USCG 1999).
Odor Threshold of 0.13 ppmv for MtBE from information in CaEPA Public Health Goal for MtBE (CalEPA 1999).
TPH VP values from NIOSH (2005); ORT values from ATSDR (2001a).
Ceiling Levels for TPH after guidance from Massachusetts Department of Environmental Protection (MADEP 1997a). Adjust as needed in field.

References for vapor pressure and odor threshold data (in order of use):

1. Ontario Ministry of Environment and Energy (MOEE 1996).
2. Massachusetts Department of Environmental Protection (MADEP 1994).
3. Agency for Toxic Substances and Disease Registry (ATSDR 2001).
4. National Library of Medicine, Hazardous Substances Data Bank (NLM 2000).
5. U.S. Department of Health and Human Services (NIOSH 2005).

Table I-1. Groundwater Ceiling Levels
(groundwater IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
Acenaphthene	2.0E+01	Taste & Odors	2.1E+03	2.0E+01	Ontario MOEE	5.0E+04
Acenaphthylene	2.0E+03	Solubility	2.0E+03	-	-	5.0E+04
Acetone	2.0E+04	Taste & Odors	5.0E+08	2.0E+04	Amoore & Hautala	5.0E+04
Aldrin	8.5E+00	Solubility	8.5E+00	1.7E+01	Ontario MOEE	5.0E+04
Anthracene	2.2E+01	Solubility	2.2E+01	-	-	5.0E+04
Antimony	5.0E+04	Upper Limit		-	-	5.0E+04
Arsenic	5.0E+04	Upper Limit		-	-	5.0E+04
Barium	5.0E+04	Upper Limit		-	-	5.0E+04
Benzene	1.7E+02	Taste & Odors	8.8E+05	1.7E+02	Amoore & Hautala	5.0E+04
Benzo(a)anthracene	5.0E+00	Solubility	5.0E+00	-	-	5.0E+04
Benzo(b)fluoranthene	7.0E+00	Solubility	7.0E+00	-	-	5.0E+04
Benzo(k)fluoranthene	4.0E-01	Solubility	4.0E-01	-	-	5.0E+04
Benzo(g,h,i)perylene	1.3E-01	Solubility	1.3E-01	-	-	5.0E+04
Benzo(a)pyrene	1.9E+00	Solubility	1.9E+00	-	-	5.0E+04
Beryllium	5.0E+04	Upper Limit		-	-	5.0E+04
1,1-Biphenyl	5.0E-01	Taste & Odors	3.8E+03	5.0E-01	Amoore & Hautala	5.0E+04
Bis(2-chloroethyl) ether	3.6E+02	Taste & Odors	8.6E+06	3.6E+02	Amoore & Hautala	5.0E+04
Bis(2-chloroisopropyl) ether	3.2E+02	Taste & Odors	8.5E+05	3.2E+02	Ontario MOEE	5.0E+04
Bis(2-ethylhexyl) phthalate	6.5E+02	Solubility	6.5E+02	-	-	5.0E+04
Boron	5.0E+04	Upper Limit		-	-	5.0E+04
Bromodichloromethane	5.0E+04	Upper Limit	3.4E+06	-	-	5.0E+04
Bromoform (Tribromomethane)	5.1E+02	Taste & Odors	1.6E+06	5.1E+02	Amoore & Hautala	5.0E+04
Bromomethane	5.0E+04	Upper Limit	7.6E+06	-	-	5.0E+04
Cadmium	5.0E+04	Upper Limit		-	-	5.0E+04
Carbon tetrachloride	5.2E+02	Taste & Odors	4.0E+05	5.2E+02	Amoore & Hautala	5.0E+04
Chlordane	2.5E+00	Taste & Odors	2.8E+01	2.5E+00	Ontario MOEE	5.0E+04
p-Chloroaniline	5.0E+04	Upper Limit	1.3E+06	-	-	5.0E+04
Chlorobenzene	5.0E+01	Taste & Odors	2.4E+05	5.0E+01	Amoore & Hautala	5.0E+04
Chloroethane	1.6E+01	Taste & Odors	2.9E+06	1.6E+01	Amoore & Hautala	5.0E+04
Chloroform	2.4E+03	Taste & Odors	4.0E+06	2.4E+03	Amoore & Hautala	5.0E+04
Chloromethane	5.0E+04	Upper Limit	4.1E+06		-	5.0E+04
2-Chlorophenol	1.8E-01	Taste & Odors	1.1E+07	1.8E-01	Ontario MOEE	5.0E+04
Chromium (total)	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium III	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium VI	5.0E+04	Upper Limit		-	-	5.0E+04
Chrysene	8.0E-01	Solubility	8.0E-01	-	-	5.0E+04
Cobalt	5.0E+04	Upper Limit		-	-	5.0E+04

Table I-1. Groundwater Ceiling Levels
(groundwater IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
Copper	1.0E+03	Taste & Odors		1.0E+03	CalDHS 2nd MCL	5.0E+04
Cyanide	1.7E+02	Taste & Odors	5.0E+08	1.7E+02	Amoore & Hautala	5.0E+04
Dibenz(a,h)anthracene	2.5E-01	Solubility	2.5E-01	-	-	5.0E+04
Dibromochloromethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
1,2-dibromo-3-chloropropane	1.0E+01	Taste & Odors	6.0E+05	1.0E+01	Amoore & Hautala	5.0E+04
1,2-Dibromoethane	5.0E+04	Upper Limit	1.7E+06	-	-	5.0E+04
1,2-Dichlorobenzene	1.0E+01	Taste & Odors	7.8E+04	1.0E+01	USEPA 2nd MCL	5.0E+04
1,3-Dichlorobenzene	5.0E+04	Upper Limit	7.8E+04	-	-	5.0E+04
1,4-Dichlorobenzene	5.0E+00	Taste & Odors	3.7E+04	5.0E+00	USEPA 2nd MCL	5.0E+04
3,3-Dichlorobenzidine	1.6E+03	Solubility	1.6E+03	-	-	5.0E+04
Dichlorodiphenyldichloroethane (DDD)	8.0E+01	Solubility	8.0E+01	-	-	5.0E+04
Dichlorodiphenyldichloroethene (DDE)	2.0E+01	Solubility	2.0E+01	-	-	5.0E+04
Dichlorodiphenyltrichloroethane (DDT)	1.5E+00	Solubility	1.5E+00	3.5E+02	Ontario MOEE	5.0E+04
1,1-Dichloroethane	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
1,2-Dichloroethane	7.0E+03	Taste & Odors	4.3E+06	7.0E+03	Amoore & Hautala	5.0E+04
1,1-Dichloroethene	1.5E+03	Taste & Odors	1.1E+06	1.5E+03	Amoore & Hautala	5.0E+04
cis -1,2-Dichloroethene	5.0E+04	Upper Limit	1.8E+06	-	-	5.0E+04
trans -1,2-Dichloroethene	2.6E+02	Taste & Odors	3.2E+06	2.6E+02	Amoore & Hautala	5.0E+04
2,4-Dichlorophenol	3.0E-01	Taste & Odors	2.3E+06	3.0E-01	Ontario MOEE	5.0E+04
1,2-Dichloropropane	1.0E+01	Taste & Odors	1.4E+06	1.0E+01	Ontario MOEE	5.0E+04
1,3-Dichloropropene	5.0E+04	Upper Limit	1.4E+06	-	-	5.0E+04
Dieldrin	4.1E+01	Taste & Odors	9.3E+01	4.1E+01	Ontario MOEE	5.0E+04
Diethyl phthalate	5.0E+04	Upper Limit	4.5E+05	-	-	5.0E+04
Dimethyl phthalate	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
2,4-Dimethylphenol	4.0E+02	Taste & Odors	3.9E+06	4.0E+02	Cal DHS AL	5.0E+04
2,4-Dinitrophenol	5.0E+04	Upper Limit	2.8E+06	-	-	5.0E+04
2,4-Dinitrotoluene	5.0E+04	Upper Limit	1.4E+05	-	-	5.0E+04
1,4-Dioxane	5.0E+04	Upper Limit	5.0E+08	2.3E+05	Amoore & Hautala	5.0E+04
Dioxin (2,3,7,8-TCDD)	7.0E+03	Solubility	7.0E+03	-	-	5.0E+04
Endosulfan	7.5E+01	Solubility	7.5E+01	-	-	5.0E+04
Endrin	4.1E+01	Taste & Odors	1.3E+02	4.1E+01	Ontario MOEE	5.0E+04
Ethylbenzene	3.0E+01	Taste & Odors	8.5E+04	3.0E+01	USEPA 2nd MCL	5.0E+04
Fluoranthene	1.3E+02	Solubility	1.3E+02	-	-	5.0E+04
Fluorene	9.5E+02	Solubility	9.5E+02	-	-	5.0E+04
Heptachlor	2.0E+01	Taste & Odors	2.8E+01	2.0E+01	Ontario MOEE	5.0E+04
Heptachlor epoxide	1.8E+02	Solubility	1.8E+02	-	-	5.0E+04
Hexachlorobenzene	5.5E+01	Solubility	5.5E+01	3.0E+03	Ontario MOEE	5.0E+04

Table I-1. Groundwater Ceiling Levels
(groundwater IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
Hexachlorobutadiene	6.0E+00	Taste & Odors	1.0E+03	6.0E+00	Ontario MOEE	5.0E+04
γ-Hexachlorocyclohexane (Lindane)	3.5E+03	Solubility	3.5E+03	1.2E+04	Ontario MOEE	5.0E+04
Hexachloroethane	1.0E+01	Taste & Odors	2.5E+04	1.0E+01	Amoore & Hautala	5.0E+04
Indeno(1,2,3-c,d)pyrene	2.7E-01	Solubility	2.7E-01	-	-	5.0E+04
Lead	5.0E+04	Upper Limit		-	-	5.0E+04
Mercury (elemental)	5.0E+04	Upper Limit		-	-	5.0E+04
Methoxychlor	2.0E+01	Solubility	2.0E+01	4.7E+03	Amoore & Hautala	5.0E+04
Methylene chloride	9.1E+03	Taste & Odors	6.6E+06	9.1E+03	Ontario MOEE	5.0E+04
Methyl ethyl ketone	8.4E+03	Taste & Odors	1.3E+08	8.4E+03	Amoore & Hautala	5.0E+04
Methyl isobutyl ketone	1.3E+03	Taste & Odors	9.5E+06	1.3E+03	Amoore & Hautala	5.0E+04
Methyl mercury	5.0E+04	Upper Limit		-	-	5.0E+04
2-Methylnaphthalene	1.0E+01	Taste & Odors	1.3E+04	1.0E+01	Ontario MOEE	5.0E+04
tert -Butyl methyl ether	5.0E+00	Taste & Odors	7.5E+07	5.0E+00	Cal DHS 2nd MCL	5.0E+04
Molybdenum	5.0E+04	Upper Limit		-	-	5.0E+04
Naphthalene	2.1E+01	Taste & Odors	1.6E+04	2.1E+01	Amoore & Hautala	5.0E+04
Nickel	5.0E+04	Upper Limit		-	-	5.0E+04
Pentachlorophenol	3.0E+01	Taste & Odors	7.0E+06	3.0E+01	Amoore & Hautala	5.0E+04
Perchlorate	5.0E+04	Upper Limit	1.0E+08	-	-	5.0E+04
Phenanthrene	4.1E+02	Solubility	4.1E+02	1.0E+03	Ontario MOEE	5.0E+04
Phenol	5.0E+00	Taste & Odors	4.0E+07	5.0E+00	Cal DHS AL	5.0E+04
Polychlorinated biphenyls (PCBs)	1.6E+01	Solubility	1.6E+01	-	-	5.0E+04
Pyrene	6.8E+01	Solubility	6.8E+01	-	-	5.0E+04
Selenium	5.0E+04	Upper Limit		-	-	5.0E+04
Silver	1.0E+02	Taste & Odors		1.0E+02	Cal DHS 2nd MCL	5.0E+04
Styrene	1.0E+01	Taste & Odors	1.6E+05	1.0E+01	USEPA 2nd MCL	5.0E+04
tert -Butyl alcohol	5.0E+04	Upper Limit	5.0E+08	-	-	5.0E+04
1,1,1,2-Tetrachloroethane	5.0E+04	Upper Limit	1.5E+06	-	-	5.0E+04
1,1,2,2-Tetrachloroethane	5.0E+02	Taste & Odors	1.5E+06	5.0E+02	Amoore & Hautala	5.0E+04
Tetrachloroethene	1.7E+02	Taste & Odors	1.0E+05	1.7E+02	Amoore & Hautala	5.0E+04
Thallium	5.0E+04	Upper Limit		-	-	5.0E+04
Toluene	4.0E+01	Taste & Odors	2.6E+05	4.0E+01	USEPA 2nd MCL	5.0E+04
Toxaphene	1.4E+02	Taste & Odors	1.5E+03	1.4E+02	USEPA 2nd MCL	5.0E+04
TPH (gasolines)	1.0E+02	Taste & Odors	7.5E+04	1.0E+02	USEPA SNARL	5.0E+04
TPH (middle distillates)	1.0E+02	Taste & Odors	2.5E+03	1.0E+02	USEPA SNARL	5.0E+04
TPH (residual fuels)	1.0E+02	Taste & Odors	2.5E+03	1.0E+02	USEPA SNARL	5.0E+04
1,2,4-Trichlorobenzene	3.0E+03	Taste & Odors	1.5E+05	3.0E+03	USEPA (1995)	5.0E+04
1,1,1-Trichloroethane	9.7E+02	Taste & Odors	6.7E+05	9.7E+02	Amoore & Hautala	5.0E+04

Table I-1. Groundwater Ceiling Levels
(groundwater IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
1,1,2-Trichloroethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
Trichloroethene	3.1E+02	Taste & Odors	5.5E+05	3.1E+02	Amoore & Hautala	5.0E+04
2,4,5-Trichlorophenol	2.0E+02	Taste & Odors	6.0E+05	2.0E+02	Ontario MOEE	5.0E+04
2,4,6-Trichlorophenol	1.0E+02	Taste & Odors	4.0E+05	1.0E+02	Ontario MOEE	5.0E+04
Vanadium	5.0E+04	Upper Limit		-	-	5.0E+04
Vinyl chloride	3.4E+03	Taste & Odors	1.4E+06	3.4E+03	Amoore & Hautala	5.0E+04
Xylenes	2.0E+01	Taste & Odors	8.1E+04	2.0E+01	USEPA 2nd MCL	5.0E+04
Zinc	5.0E+03	Taste & Odors		5.0E+03	Cal DHS 2nd MCL	5.0E+04

References:
Unless otherwise noted, criteria for drinking water taste and odor threshhold from summary in *A Compilation of Water Quality Goals* (RWQCBCV 2003) or Ontario MOEE if not available (MOEE 1996).
Upper limit of 50000 ug/L intended to limit general groundwater resource degradation (MOEE 1996).
1/2 solubility based on solubility constants in USEPA Region IX (USEPA 1998) or Ontario MOEE (MOEE 1996) if not available.

Notes:
Ceiling Level: lowest of 1/2 solubility, taste and odor threshhold and 50000 ug/L maximum level
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
TPH ceiling levels after Massachusetts DEP (MADEP 1997a).
TPH Taste and Odor Thresholds based on USEPA Suggested-No-Adverse-reaction (SNARL) level for TPH diesel.

Table I-2. Groundwater Gross Contamination Ceiling Levels
(groundwater IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
Acenaphthene	2.0E+02	Nuisance Odors	2.1E+03	2.0E+02	Ontario MOEE	5.0E+04
Acenaphthylene	2.0E+03	Solubility	2.0E+03	-	-	5.0E+04
Acetone	5.0E+04	Upper Limit	5.0E+08	200000	Ontario MOEE	5.0E+04
Aldrin	8.5E+00	Solubility	8.5E+00	170	Ontario MOEE	5.0E+04
Anthracene	2.2E+01	Solubility	2.2E+01	-	-	5.0E+04
Antimony	5.0E+04	Upper Limit			-	5.0E+04
Arsenic	5.0E+04	Upper Limit		-	-	5.0E+04
Barium	5.0E+04	Upper Limit		-	-	5.0E+04
Benzene	2.0E+04	Nuisance Odors	8.8E+05	2.0E+04	Ontario MOEE	5.0E+04
Benzo(a)anthracene	5.0E+00	Solubility	5.0E+00	-	-	5.0E+04
Benzo(b)fluoranthene	7.0E+00	Solubility	7.0E+00	-	-	5.0E+04
Benzo(k)fluoranthene	4.0E-01	Solubility	4.0E-01	-	-	5.0E+04
Benzo(g,h,i)perylene	1.3E-01	Solubility	1.3E-01	-	-	5.0E+04
Benzo(a)pyrene	1.9E+00	Solubility	1.9E+00	-	-	5.0E+04
Beryllium	5.0E+04	Upper Limit		-	-	5.0E+04
1,1-Biphenyl	5.0E+00	Nuisance Odors	3.8E+03	5.0E+00	Amoore & Hautala	5.0E+04
Bis(2-chloroethyl) ether	3.6E+03	Nuisance Odors	8.6E+06	3.6E+03	Amoore & Hautala	5.0E+04
Bis(2-chloroisopropyl) ether	3.2E+03	Nuisance Odors	8.5E+05	3.2E+03	Ontario MOEE	5.0E+04
Bis(2-ethylhexyl) phthalate	6.5E+02	Solubility	6.5E+02	-	-	5.0E+04
Boron	5.0E+04	Upper Limit		-	-	5.0E+04
Bromodichloromethane	5.0E+04	Upper Limit	3.4E+06	-	-	5.0E+04
Bromoform (Tribromomethane)	5.1E+03	Nuisance Odors	1.6E+06	5.1E+03	Ontario MOEE	5.0E+04
Bromomethane	5.0E+04	Upper Limit	7.6E+06	-	-	5.0E+04
Cadmium	5.0E+04	Upper Limit		-	-	5.0E+04
Carbon tetrachloride	5.2E+03	Nuisance Odors	4.0E+05	5.2E+03	Ontario MOEE	5.0E+04
Chlordane	2.5E+01	Nuisance Odors	2.8E+01	2.5E+01	Ontario MOEE	5.0E+04
p-Chloroaniline	5.0E+04	Upper Limit	1.3E+06	-	-	5.0E+04
Chlorobenzene	5.0E+02	Nuisance Odors	2.4E+05	5.0E+02	Ontario MOEE	5.0E+04
Chloroethane	1.6E+02	Nuisance Odors	2.9E+06	1.6E+02	Amoore & Hautala	5.0E+04
Chloroform	2.4E+04	Nuisance Odors	4.0E+06	2.4E+04	Ontario MOEE	5.0E+04
Chloromethane	5.0E+04	Upper Limit	4.1E+06	-	-	5.0E+04
2-Chlorophenol	1.8E+00	Nuisance Odors	1.1E+07	1.8E+00	Ontario MOEE	5.0E+04
Chromium (total)	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium III	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium VI	5.0E+04	Upper Limit		-	-	5.0E+04
Chrysene	8.0E-01	Solubility	8.0E-01	-	-	5.0E+04

Table I-2. Groundwater Gross Contamination Ceiling Levels
(groundwater IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
Cobalt	5.0E+04	Upper Limit		-	-	5.0E+04
Copper	5.0E+04	Upper Limit		-	-	5.0E+04
Cyanide	1.7E+03	Nuisance Odors	5.0E+08	1.7E+03	Ontario MOEE	5.0E+04
Dibenz(a,h)anthracene	2.5E-01	Solubility	2.5E-01	-	-	5.0E+04
Dibromochloromethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
1,2-dibromo-3-chloropropane	1.0E+02	Nuisance Odors	6.0E+05	1.0E+02	Amoore & Hautala	5.0E+04
1,2-Dibromoethane	5.0E+04	Upper Limit	1.7E+06	-	-	5.0E+04
1,2-Dichlorobenzene	1.0E+02	Nuisance Odors	7.8E+04	1.0E+02	Ontario MOEE	5.0E+04
1,3-Dichlorobenzene	5.0E+04	Upper Limit	7.8E+04	-	-	5.0E+04
1,4-Dichlorobenzene	1.1E+02	Nuisance Odors	3.7E+04	1.1E+02	Ontario MOEE	5.0E+04
3,3-Dichlorobenzidine	1.6E+03	Solubility	1.6E+03	-	-	5.0E+04
Dichlorodiphenyldichloroethane (DDD)	8.0E+01	Solubility	8.0E+01	-	-	5.0E+04
Dichlorodiphenyldichloroethene (DDE)	2.0E+01	Solubility	2.0E+01	-	-	5.0E+04
Dichlorodiphenyltrichloroethane (DDT)	1.5E+00	Solubility	1.5E+00	3.5E+03	Ontario MOEE	5.0E+04
1,1-Dichloroethane	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
1,2-Dichloroethane	5.0E+04	Upper Limit	4.3E+06	2.0E+05	Ontario MOEE	5.0E+04
1,1-Dichloroethene	1.5E+04	Nuisance Odors	1.1E+06	1.5E+04	Amoore & Hautala	5.0E+04
cis -1,2-Dichloroethene	5.0E+04	Upper Limit	1.8E+06	-	-	5.0E+04
trans -1,2-Dichloroethene	2.6E+03	Nuisance Odors	3.2E+06	2.6E+03	Ontario MOEE	5.0E+04
2,4-Dichlorophenol	3.0E+00	Nuisance Odors	2.3E+06	3.0E+00	Ontario MOEE	5.0E+04
1,2-Dichloropropane	1.0E+02	Nuisance Odors	1.4E+06	1.0E+02	Ontario MOEE	5.0E+04
1,3-Dichloropropene	5.0E+04	Upper Limit	1.4E+06	-	-	5.0E+04
Dieldrin	9.3E+01	Solubility	9.3E+01	4.1E+02	Ontario MOEE	5.0E+04
Diethyl phthalate	5.0E+04	Upper Limit	4.5E+05	-	-	5.0E+04
Dimethyl phthalate	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
2,4-Dimethylphenol	4.0E+03	Nuisance Odors	3.9E+06	4.0E+03	Ontario MOEE	5.0E+04
2,4-Dinitrophenol	5.0E+04	Upper Limit	2.8E+06	-	-	5.0E+04
2,4-Dinitrotoluene	5.0E+04	Upper Limit	1.4E+05	-	-	5.0E+04
1,4-Dioxane	5.0E+04	Upper Limit	5.0E+08	-	-	5.0E+04
Dioxin (2,3,7,8-TCDD)	7.0E+03	Solubility	7.0E+03	-	-	5.0E+04
Endosulfan	7.5E+01	Solubility	7.5E+01	-	-	5.0E+04
Endrin	1.3E+02	Solubility	1.3E+02	4.1E+02	Ontario MOEE	5.0E+04
Ethylbenzene	3.0E+02	Nuisance Odors	8.5E+04	3.0E+02	USEPA 2nd MCL	5.0E+04
Fluoranthene	1.3E+02	Solubility	1.3E+02	-	-	5.0E+04
Fluorene	9.5E+02	Solubility	9.5E+02	-	-	5.0E+04
Heptachlor	2.8E+01	Solubility	2.8E+01	2.0E+02	Ontario MOEE	5.0E+04

Table I-2. Groundwater Gross Contamination Ceiling Levels
(groundwater IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
Heptachlor epoxide	1.8E+02	Solubility	1.8E+02	-	-	5.0E+04
Hexachlorobenzene	5.5E+01	Solubility	5.5E+01	3.0E+04	Ontario MOEE	5.0E+04
Hexachlorobutadiene	6.0E+01	Nuisance Odors	1.0E+03	6.0E+01	Ontario MOEE	5.0E+04
γ-Hexachlorocyclohexane (Lindane)	3.5E+03	Solubility	3.5E+03	1.2E+05	Ontario MOEE	5.0E+04
Hexachloroethane	1.0E+02	Nuisance Odors	2.5E+04	1.0E+02	Ontario MOEE	5.0E+04
Indeno(1,2,3-c,d)pyrene	2.7E-01	Solubility	2.7E-01	-	-	5.0E+04
Lead	5.0E+04	Upper Limit		-	-	5.0E+04
Mercury (elemental)	5.0E+04	Upper Limit		-	-	5.0E+04
Methoxychlor	2.0E+01	Solubility	2.0E+01	4.7E+04	Ontario MOEE	5.0E+04
Methylene chloride	5.0E+04	Upper Limit	6.6E+06	9.1E+04	Ontario MOEE	5.0E+04
Methyl ethyl ketone	5.0E+04	Upper Limit	1.3E+08	8.4E+04	Amoore & Hautala	5.0E+04
Methyl isobutyl ketone	1.3E+04	Nuisance Odors	9.5E+06	1.3E+04	Amoore & Hautala	5.0E+04
Methyl mercury	5.0E+04	Upper Limit		-	-	5.0E+04
2-Methylnaphthalene	1.0E+02	Nuisance Odors	1.3E+04	1.0E+02	Ontario MOEE	5.0E+04
tert-Butyl methyl ether	1.8E+03	Nuisance Odors	7.5E+07	1.8E+03	CalDHS	5.0E+04
Molybdenum	5.0E+04	Upper Limit		-	-	5.0E+04
Naphthalene	2.1E+02	Nuisance Odors	1.6E+04	2.1E+02	Ontario MOEE	5.0E+04
Nickel	5.0E+04	Upper Limit		-	-	5.0E+04
Pentachlorophenol	5.9E+03	Nuisance Odors	7.0E+06	5.9E+03	Ontario MOEE	5.0E+04
Perchlorate	5.0E+04	Upper Limit	1.0E+08	-	-	5.0E+04
Phenanthrene	4.1E+02	Solubility	4.1E+02	1.0E+04	Ontario MOEE	5.0E+04
Phenol	5.0E+04	Upper Limit	4.0E+07	7.9E+04	Ontario MOEE	5.0E+04
Polychlorinated biphenyls (PCBs)	1.6E+01	Solubility	1.6E+01	-	-	5.0E+04
Pyrene	6.8E+01	Solubility	6.8E+01	-	-	5.0E+04
Selenium	5.0E+04	Upper Limit		-	-	5.0E+04
Silver	5.0E+04	Upper Limit		-	-	5.0E+04
Styrene	1.1E+02	Nuisance Odors	1.6E+05	1.1E+02	Ontario MOEE	5.0E+04
tert-Butyl alcohol	5.0E+04	Upper Limit	5.0E+08	-	-	5.0E+04
1,1,1,2-Tetrachloroethane	5.0E+04	Upper Limit	1.5E+06	-	-	5.0E+04
1,1,2,2-Tetrachloroethane	5.0E+03	Nuisance Odors	1.5E+06	5.0E+03	Ontario MOEE	5.0E+04
Tetrachloroethene	3.0E+03	Nuisance Odors	1.0E+05	3.0E+03	Ontario MOEE	5.0E+04
Thallium	5.0E+04	Upper Limit		-	-	5.0E+04
Toluene	4.0E+02	Nuisance Odors	2.6E+05	4.0E+02	Ontario MOEE	5.0E+04
Toxaphene	1.4E+02	Nuisance Odors	1.5E+03	1.4E+02	USEPA 2nd MCL	5.0E+04
TPH (gasolines)	5.0E+03	Nuisance Odors	7.5E+04	5.0E+03	MADEP	5.0E+04
TPH (middle distillates)	2.5E+03	Solubility	2.5E+03	5.0E+03	MADEP	5.0E+04

Table I-2. Groundwater Gross Contamination Ceiling Levels
(groundwater IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
TPH (residual fuels)	2.5E+03	Solubility	2.5E+03	5.0E+03	MADEP	5.0E+04
1,2,4-Trichlorobenzene	3.0E+04	Nuisance Odors	1.5E+05	3.0E+04	USEPA (1995)	5.0E+04
1,1,1-Trichloroethane	5.0E+04	Upper Limit	6.7E+05	5.0E+05	Ontario MOEE	5.0E+04
1,1,2-Trichloroethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
Trichloroethene	5.0E+04	Upper Limit	5.5E+05	1.0E+05	Ontario MOEE	5.0E+04
2,4,5-Trichlorophenol	2.0E+03	Nuisance Odors	6.0E+05	2.0E+03	Ontario MOEE	5.0E+04
2,4,6-Trichlorophenol	1.0E+03	Nuisance Odors	4.0E+05	1.0E+03	Ontario MOEE	5.0E+04
Vanadium	5.0E+04	Upper Limit		-	-	5.0E+04
Vinyl chloride	3.4E+04	Nuisance Odors	1.4E+06	3.4E+04	Ontario MOEE	5.0E+04
Xylenes	5.3E+03	Nuisance Odors	8.1E+04	5.3E+03	Ontario MOEE	5.0E+04
Zinc	5.0E+04	Upper Limit		-	-	5.0E+04

References:

Unless otherwise noted, criteria for nuisance odor threshhold from Ontario MOEE (MOEE 1996) OR data from Amoore and Hautala (1983) as presented in *A Compilation of Water Quality Goals* if not available *(RWQCBCV 2003).*

Upper limit of 50000 ug/L intended to limit general groundwater resource degradation (MOEE 1996).

1/2 solubility based on solubility constants in USEPA Region 9 (USEPA 2004) or Ontario MOEE (MOEE 1996) if not available.

Odor threshold for MtBE based on average, upper range at which most subjects could smell MtBE in water (CalEPA 1999).

Vapor Pressure for ethanol from *Fate and Transport of Ethanol-Blended Gasoline in the Environment* (Ulrich 1999). Odor threshold from

Notes:

Nuisance Odor Thresholds assume ten-fold attenuation/dilution of chemical in groundwater upon discharge to surface water.

Ceiling Level: lowest of 1/2 solubility, odor/taste threshhold and 50000 ug/L maximum level (intended to limit general groundwater resource degradation).

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

TPH ceiling level after Massachusetts DEP (MADEP 1997a).

Table I-3. Surface Water Ceiling Levels
(surface water IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
Acenaphthene	2.0E+01	Taste & Odors	2.1E+03	2.0E+01	Ontario MOEE	5.0E+04
Acenaphthylene	2.0E+03	Solubility	2.0E+03	-	-	5.0E+04
Acetone	2.0E+04	Taste & Odors	5.0E+08	2.0E+04	Amoore & Hautala	5.0E+04
Aldrin	8.5E+00	Solubility	8.5E+00	1.7E+01	Ontario MOEE	5.0E+04
Anthracene	2.2E+01	Solubility	2.2E+01	-	-	5.0E+04
Antimony	5.0E+04	Upper Limit		-	-	5.0E+04
Arsenic	5.0E+04	Upper Limit		-	-	5.0E+04
Barium	5.0E+04	Upper Limit		-	-	5.0E+04
Benzene	1.7E+02	Taste & Odors	8.8E+05	1.7E+02	Amoore & Hautala	5.0E+04
Benzo(a)anthracene	5.0E+00	Solubility	5.0E+00	-	-	5.0E+04
Benzo(b)fluoranthene	7.0E+00	Solubility	7.0E+00	-	-	5.0E+04
Benzo(k)fluoranthene	4.0E-01	Solubility	4.0E-01	-	-	5.0E+04
Benzo(g,h,i)perylene	1.3E-01	Solubility	1.3E-01	-	-	5.0E+04
Benzo(a)pyrene	1.9E+00	Solubility	1.9E+00	-	-	5.0E+04
Beryllium	5.0E+04	Upper Limit		-	-	5.0E+04
1,1-Biphenyl	5.0E-01	Taste & Odors	3.8E+03	5.0E-01	Amoore & Hautala	5.0E+04
Bis(2-chloroethyl) ether	3.6E+02	Taste & Odors	8.6E+06	3.6E+02	Amoore & Hautala	5.0E+04
Bis(2-chloroisopropyl) ether	3.2E+02	Taste & Odors	8.5E+05	3.2E+02	Ontario MOEE	5.0E+04
Bis(2-ethylhexyl) phthalate	6.5E+02	Solubility	6.5E+02	-	-	5.0E+04
Boron	5.0E+04	Upper Limit		-	-	5.0E+04
Bromodichloromethane	5.0E+04	Upper Limit	3.4E+06	-	-	5.0E+04
Bromoform (Tribromomethane)	5.1E+02	Taste & Odors	1.6E+06	5.1E+02	Amoore & Hautala	5.0E+04
Bromomethane	5.0E+04	Upper Limit	7.6E+06	-	-	5.0E+04
Cadmium	5.0E+04	Upper Limit		-	-	5.0E+04
Carbon tetrachloride	5.2E+02	Taste & Odors	4.0E+05	5.2E+02	Amoore & Hautala	5.0E+04
Chlordane	2.5E+00	Taste & Odors	2.8E+01	2.5E+00	Ontario MOEE	5.0E+04
p -Chloroaniline	5.0E+04	Upper Limit	1.3E+06	-	-	5.0E+04
Chlorobenzene	5.0E+01	Taste & Odors	2.4E+05	5.0E+01	Amoore & Hautala	5.0E+04
Chloroethane	1.6E+01	Taste & Odors	2.9E+06	1.6E+01	Amoore & Hautala	5.0E+04
Chloroform	2.4E+03	Taste & Odors	4.0E+06	2.4E+03	Amoore & Hautala	5.0E+04
Chloromethane	5.0E+04	Upper Limit	4.1E+06		-	5.0E+04
2-Chlorophenol	1.8E-01	Taste & Odors	1.1E+07	1.8E-01	Ontario MOEE	5.0E+04
Chromium (total)	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium III	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium VI	5.0E+04	Upper Limit		-	-	5.0E+04
Chrysene	8.0E-01	Solubility	8.0E-01	-	-	5.0E+04
Cobalt	5.0E+04	Upper Limit		-	-	5.0E+04

Table I-3. Surface Water Ceiling Levels
(surface water IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
Copper	1.0E+03	Taste & Odors		1.0E+03	CalDHS 2nd MCL	5.0E+04
Cyanide	1.7E+02	Taste & Odors	5.0E+08	1.7E+02	Amoore & Hautala	5.0E+04
Dibenz(a,h)anthracene	2.5E-01	Solubility	2.5E-01	-	-	5.0E+04
Dibromochloromethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
1,2-dibromo-3-chloropropane	1.0E+01	Taste & Odors	6.0E+05	1.0E+01	Amoore & Hautala	5.0E+04
1,2-Dibromoethane	5.0E+04	Upper Limit	1.7E+06	-	-	5.0E+04
1,2-Dichlorobenzene	1.0E+01	Taste & Odors	7.8E+04	1.0E+01	USEPA 2nd MCL	5.0E+04
1,3-Dichlorobenzene	5.0E+04	Upper Limit	7.8E+04	-	-	5.0E+04
1,4-Dichlorobenzene	5.0E+00	Taste & Odors	3.7E+04	5.0E+00	USEPA 2nd MCL	5.0E+04
3,3-Dichlorobenzidine	1.6E+03	Solubility	1.6E+03	-	-	5.0E+04
Dichlorodiphenyldichloroethane (DDD)	8.0E+01	Solubility	8.0E+01	-	-	5.0E+04
Dichlorodiphenyldichloroethene (DDE)	2.0E+01	Solubility	2.0E+01	-	-	5.0E+04
Dichlorodiphenyltrichloroethane (DDT)	1.5E+00	Solubility	1.5E+00	3.5E+02	Ontario MOEE	5.0E+04
1,1-Dichloroethane	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
1,2-Dichloroethane	7.0E+03	Taste & Odors	4.3E+06	7.0E+03	Amoore & Hautala	5.0E+04
1,1-Dichloroethene	1.5E+03	Taste & Odors	1.1E+06	1.5E+03	Amoore & Hautala	5.0E+04
cis -1,2-Dichloroethene	5.0E+04	Upper Limit	1.8E+06	-	-	5.0E+04
trans -1,2-Dichloroethene	2.6E+02	Taste & Odors	3.2E+06	2.6E+02	Amoore & Hautala	5.0E+04
2,4-Dichlorophenol	3.0E-01	Taste & Odors	2.3E+06	3.0E-01	Ontario MOEE	5.0E+04
1,2-Dichloropropane	1.0E+01	Taste & Odors	1.4E+06	1.0E+01	Ontario MOEE	5.0E+04
1,3-Dichloropropene	5.0E+04	Upper Limit	1.4E+06	-	-	5.0E+04
Dieldrin	4.1E+01	Taste & Odors	9.3E+01	4.1E+01	Ontario MOEE	5.0E+04
Diethyl phthalate	5.0E+04	Upper Limit	4.5E+05	-	-	5.0E+04
Dimethyl phthalate	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
2,4-Dimethylphenol	4.0E+02	Taste & Odors	3.9E+06	4.0E+02	Cal DHS AL	5.0E+04
2,4-Dinitrophenol	5.0E+04	Upper Limit	2.8E+06	-	-	5.0E+04
2,4-Dinitrotoluene	5.0E+04	Upper Limit	1.4E+05	-	-	5.0E+04
1,4-Dioxane	5.0E+04	Upper Limit	5.0E+08	2.3E+05	Amoore & Hautala	5.0E+04
Dioxin (2,3,7,8-TCDD)	7.0E+03	Solubility	7.0E+03	-	-	5.0E+04
Endosulfan	7.5E+01	Solubility	7.5E+01	-	-	5.0E+04
Endrin	4.1E+01	Taste & Odors	1.3E+02	4.1E+01	Ontario MOEE	5.0E+04
Ethylbenzene	3.0E+01	Taste & Odors	8.5E+04	3.0E+01	USEPA 2nd MCL	5.0E+04
Fluoranthene	1.3E+02	Solubility	1.3E+02	-	-	5.0E+04
Fluorene	9.5E+02	Solubility	9.5E+02	-	-	5.0E+04
Heptachlor	2.0E+01	Taste & Odors	2.8E+01	2.0E+01	Ontario MOEE	5.0E+04
Heptachlor epoxide	1.8E+02	Solubility	1.8E+02	-	-	5.0E+04
Hexachlorobenzene	5.5E+01	Solubility	5.5E+01	3.0E+03	Ontario MOEE	5.0E+04

Table I-3. Surface Water Ceiling Levels
(surface water IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
Hexachlorobutadiene	6.0E+00	Taste & Odors	1.0E+03	6.0E+00	Ontario MOEE	5.0E+04
γ-Hexachlorocyclohexane (Lindane)	3.5E+03	Solubility	3.5E+03	1.2E+04	Ontario MOEE	5.0E+04
Hexachloroethane	1.0E+01	Taste & Odors	2.5E+04	1.0E+01	Amoore & Hautala	5.0E+04
Indeno(1,2,3-c,d)pyrene	2.7E-01	Solubility	2.7E-01	-	-	5.0E+04
Lead	5.0E+04	Upper Limit		-	-	5.0E+04
Mercury (elemental)	5.0E+04	Upper Limit		-	-	5.0E+04
Methoxychlor	2.0E+01	Solubility	2.0E+01	4.7E+03	Amoore & Hautala	5.0E+04
Methylene chloride	9.1E+03	Taste & Odors	6.6E+06	9.1E+03	Ontario MOEE	5.0E+04
Methyl ethyl ketone	8.4E+03	Taste & Odors	1.3E+08	8.4E+03	Amoore & Hautala	5.0E+04
Methyl isobutyl ketone	1.3E+03	Taste & Odors	9.5E+06	1.3E+03	Amoore & Hautala	5.0E+04
Methyl mercury	5.0E+04	Upper Limit		-	-	5.0E+04
2-Methylnaphthalene	1.0E+01	Taste & Odors	1.3E+04	1.0E+01	Ontario MOEE	5.0E+04
tert -Butyl methyl ether	5.0E+00	Taste & Odors	7.5E+07	5.0E+00	Cal DHS 2nd MCL	5.0E+04
Molybdenum	5.0E+04	Upper Limit		-	-	5.0E+04
Naphthalene	2.1E+01	Taste & Odors	1.6E+04	2.1E+01	Amoore & Hautala	5.0E+04
Nickel	5.0E+04	Upper Limit		-	-	5.0E+04
Pentachlorophenol	3.0E+01	Taste & Odors	7.0E+06	3.0E+01	Amoore & Hautala	5.0E+04
Perchlorate	5.0E+04	Upper Limit	1.0E+08	-	-	5.0E+04
Phenanthrene	4.1E+02	Solubility	4.1E+02	1.0E+03	Ontario MOEE	5.0E+04
Phenol	5.0E+00	Taste & Odors	4.0E+07	5.0E+00	Cal DHS AL	5.0E+04
Polychlorinated biphenyls (PCBs)	1.6E+01	Solubility	1.6E+01	-	-	5.0E+04
Pyrene	6.8E+01	Solubility	6.8E+01	-	-	5.0E+04
Selenium	5.0E+04	Upper Limit		-	-	5.0E+04
Silver	1.0E+02	Taste & Odors		1.0E+02	Cal DHS 2nd MCL	5.0E+04
Styrene	1.0E+01	Taste & Odors	1.6E+05	1.0E+01	USEPA 2nd MCL	5.0E+04
tert -Butyl alcohol	5.0E+04	Upper Limit	5.0E+08	-	-	5.0E+04
1,1,1,2-Tetrachloroethane	5.0E+04	Upper Limit	1.5E+06	-	-	5.0E+04
1,1,2,2-Tetrachloroethane	5.0E+02	Taste & Odors	1.5E+06	5.0E+02	Amoore & Hautala	5.0E+04
Tetrachloroethene	1.7E+02	Taste & Odors	1.0E+05	1.7E+02	Amoore & Hautala	5.0E+04
Thallium	5.0E+04	Upper Limit		-	-	5.0E+04
Toluene	4.0E+01	Taste & Odors	2.6E+05	4.0E+01	USEPA 2nd MCL	5.0E+04
Toxaphene	1.4E+02	Taste & Odors	1.5E+03	1.4E+02	USEPA 2nd MCL	5.0E+04
TPH (gasolines)	1.0E+02	Taste & Odors	7.5E+04	1.0E+02	USEPA SNARL	5.0E+04
TPH (middle distillates)	1.0E+02	Taste & Odors	2.5E+03	1.0E+02	USEPA SNARL	5.0E+04
TPH (residual fuels)	1.0E+02	Taste & Odors	2.5E+03	1.0E+02	USEPA SNARL	5.0E+04
1,2,4-Trichlorobenzene	3.0E+03	Taste & Odors	1.5E+05	3.0E+03	USEPA (1995)	5.0E+04
1,1,1-Trichloroethane	9.7E+02	Taste & Odors	6.7E+05	9.7E+02	Amoore & Hautala	5.0E+04

Table I-3. Surface Water Ceiling Levels
(surface water IS a current or potential source of drinking water)
(µg/L)

Chemical	Final Ceiling Level	Basis	Solubility (1/2)	Taste And Odor Threshold	Basis	Upper Limit
1,1,2-Trichloroethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
Trichloroethene	3.1E+02	Taste & Odors	5.5E+05	3.1E+02	Amoore & Hautala	5.0E+04
2,4,5-Trichlorophenol	2.0E+02	Taste & Odors	6.0E+05	2.0E+02	Ontario MOEE	5.0E+04
2,4,6-Trichlorophenol	1.0E+02	Taste & Odors	4.0E+05	1.0E+02	Ontario MOEE	5.0E+04
Vanadium	5.0E+04	Upper Limit		-	-	5.0E+04
Vinyl chloride	3.4E+03	Taste & Odors	1.4E+06	3.4E+03	Amoore & Hautala	5.0E+04
Xylenes	2.0E+01	Taste & Odors	8.1E+04	2.0E+01	USEPA 2nd MCL	5.0E+04
Zinc	5.0E+03	Taste & Odors		5.0E+03	Cal DHS 2nd MCL	5.0E+04

References:
Unless otherwise noted, criteria for drinking water taste and odor threshhold from summary in *A Compilation of Water Quality Goals* (RWQCBCV 2003) or Ontario MOEE if not available (MOEE 1996).
Upper limit of 50000 ug/L intended to limit general groundwater resource degradation (MOEE 1996).
1/2 solubility based on solubility constants in USEPA Region 9 (USEPA 2004) or Ontario MOEE (MOEE 1996) if not available.

Notes:
Ceiling Level: lowest of 1/2 solubility, taste and odor threshhold and 50000 ug/L maximum level
TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.
TPH ceiling levels after Massachusetts DEP (MADEP 1997a).
TPH Taste and Odor Thresholds based on USEPA Suggested-No-Adverse-reaction (SNARL) level for TPH diesel.

Table I-4. Surface Water Gross Contamination Ceiling Levels
(surface water IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
Acenaphthene	2.0E+01	Nuisance Odors	2.1E+03	2.0E+01	Ontario MOEE	5.0E+04
Acenaphthylene	2.0E+03	Solubility	2.0E+03	-	-	5.0E+04
Acetone	2.0E+04	Nuisance Odors	5.0E+08	2.0E+04	Ontario MOEE	5.0E+04
Aldrin	8.5E+00	Solubility	8.5E+00	1.7E+01	Ontario MOEE	5.0E+04
Anthracene	2.2E+01	Solubility	2.2E+01	-	-	5.0E+04
Antimony	5.0E+04	Upper Limit		-	-	5.0E+04
Arsenic	5.0E+04	Upper Limit		-	-	5.0E+04
Barium	5.0E+04	Upper Limit		-	-	5.0E+04
Benzene	2.0E+03	Nuisance Odors	8.8E+05	2.0E+03	Ontario MOEE	5.0E+04
Benzo(a)anthracene	5.0E+00	Solubility	5.0E+00	-	-	5.0E+04
Benzo(b)fluoranthene	7.0E+00	Solubility	7.0E+00	-	-	5.0E+04
Benzo(k)fluoranthene	4.0E-01	Solubility	4.0E-01	-	-	5.0E+04
Benzo(g,h,i)perylene	1.3E-01	Solubility	1.3E-01	-	-	5.0E+04
Benzo(a)pyrene	1.9E+00	Solubility	1.9E+00	-	-	5.0E+04
Beryllium	5.0E+04	Upper Limit		-	-	5.0E+04
1,1-Biphenyl	5.0E-01	Nuisance Odors	3.8E+03	5.0E-01	Amoore & Hautala	5.0E+04
Bis(2-chloroethyl) ether	3.6E+02	Nuisance Odors	8.6E+06	3.6E+02	Amoore & Hautala	5.0E+04
Bis(2-chloroisopropyl) ether	3.2E+02	Nuisance Odors	8.5E+05	3.2E+02	Ontario MOEE	5.0E+04
Bis(2-ethylhexyl) phthalate	6.5E+02	Solubility	6.5E+02	-	-	5.0E+04
Boron	5.0E+04	Upper Limit		-	-	5.0E+04
Bromodichloromethane	5.0E+04	Upper Limit	3.4E+06	-	-	5.0E+04
Bromoform (Tribromomethane)	5.1E+02	Nuisance Odors	1.6E+06	5.1E+02	Ontario MOEE	5.0E+04
Bromomethane	5.0E+04	Upper Limit	7.6E+06	-	-	5.0E+04
Cadmium	5.0E+04	Upper Limit		-	-	5.0E+04
Carbon tetrachloride	5.2E+02	Nuisance Odors	4.0E+05	5.2E+02	Ontario MOEE	5.0E+04
Chlordane	2.5E+00	Nuisance Odors	2.8E+01	2.5E+00	Ontario MOEE	5.0E+04
p-Chloroaniline	5.0E+04	Upper Limit	1.3E+06	-	-	5.0E+04
Chlorobenzene	5.0E+01	Nuisance Odors	2.4E+05	5.0E+01	Ontario MOEE	5.0E+04
Chloroethane	1.6E+01	Nuisance Odors	2.9E+06	1.6E+01	Amoore & Hautala	5.0E+04
Chloroform	2.4E+03	Nuisance Odors	4.0E+06	2.4E+03	Ontario MOEE	5.0E+04
Chloromethane	5.0E+04	Upper Limit	4.1E+06	-	-	5.0E+04
2-Chlorophenol	1.8E-01	Nuisance Odors	1.1E+07	1.8E-01	Ontario MOEE	5.0E+04
Chromium (total)	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium III	5.0E+04	Upper Limit		-	-	5.0E+04
Chromium VI	5.0E+04	Upper Limit		-	-	5.0E+04
Chrysene	8.0E-01	Solubility	8.0E-01	-	-	5.0E+04

Table I-4. Surface Water Gross Contamination Ceiling Levels
(surface water IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
Cobalt	5.0E+04	Upper Limit		-	-	5.0E+04
Copper	5.0E+04	Upper Limit		-	-	5.0E+04
Cyanide	1.7E+02	Nuisance Odors	5.0E+08	1.7E+02	Ontario MOEE	5.0E+04
Dibenz(a,h)anthracene	2.5E-01	Solubility	2.5E-01	-	-	5.0E+04
Dibromochloromethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
1,2-dibromo-3-chloropropane	1.0E+01	Nuisance Odors	6.0E+05	1.0E+01	Amoore & Hautala	5.0E+04
1,2-Dibromoethane	5.0E+04	Upper Limit	1.7E+06	-	-	5.0E+04
1,2-Dichlorobenzene	1.0E+01	Nuisance Odors	7.8E+04	1.0E+01	Ontario MOEE	5.0E+04
1,3-Dichlorobenzene	5.0E+04	Upper Limit	7.8E+04	-	-	5.0E+04
1,4-Dichlorobenzene	1.1E+01	Nuisance Odors	3.7E+04	1.1E+01	Ontario MOEE	5.0E+04
3,3-Dichlorobenzidine	1.6E+03	Solubility	1.6E+03	-	-	5.0E+04
Dichlorodiphenyldichloroethane (DDD)	8.0E+01	Solubility	8.0E+01	-	-	5.0E+04
Dichlorodiphenyldichloroethene (DDE)	2.0E+01	Solubility	2.0E+01	-	-	5.0E+04
Dichlorodiphenyltrichloroethane (DDT)	1.5E+00	Solubility	1.5E+00	3.5E+02	Ontario MOEE	5.0E+04
1,1-Dichloroethane	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
1,2-Dichloroethane	2.0E+04	Nuisance Odors	4.3E+06	2.0E+04	Ontario MOEE	5.0E+04
1,1-Dichloroethene	1.5E+03	Nuisance Odors	1.1E+06	1.5E+03	Amoore & Hautala	5.0E+04
cis -1,2-Dichloroethene	5.0E+04	Upper Limit	1.8E+06	-	-	5.0E+04
trans -1,2-Dichloroethene	2.6E+02	Nuisance Odors	3.2E+06	2.6E+02	Ontario MOEE	5.0E+04
2,4-Dichlorophenol	3.0E-01	Nuisance Odors	2.3E+06	3.0E-01	Ontario MOEE	5.0E+04
1,2-Dichloropropane	1.0E+01	Nuisance Odors	1.4E+06	1.0E+01	Ontario MOEE	5.0E+04
1,3-Dichloropropene	5.0E+04	Upper Limit	1.4E+06	-	-	5.0E+04
Dieldrin	4.1E+01	Nuisance Odors	9.3E+01	4.1E+01	Ontario MOEE	5.0E+04
Diethyl phthalate	5.0E+04	Upper Limit	4.5E+05	-	-	5.0E+04
Dimethyl phthalate	5.0E+04	Upper Limit	2.5E+06	-	-	5.0E+04
2,4-Dimethylphenol	4.0E+02	Nuisance Odors	3.9E+06	4.0E+02	Ontario MOEE	5.0E+04
2,4-Dinitrophenol	5.0E+04	Upper Limit	2.8E+06	-	-	5.0E+04
2,4-Dinitrotoluene	5.0E+04	Upper Limit	1.4E+05	-	-	5.0E+04
1,4-Dioxane	5.0E+04	Upper Limit	5.0E+08	-	-	5.0E+04
Dioxin (2,3,7,8-TCDD)	7.0E+03	Solubility	7.0E+03	-	-	5.0E+04
Endosulfan	7.5E+01	Solubility	7.5E+01	-	-	5.0E+04
Endrin	4.1E+01	Nuisance Odors	1.3E+02	4.1E+01	Ontario MOEE	5.0E+04
Ethylbenzene	3.0E+01	Nuisance Odors	8.5E+04	3.0E+01	USEPA 2nd MCL	5.0E+04
Fluoranthene	1.3E+02	Solubility	1.3E+02	-	-	5.0E+04
Fluorene	9.5E+02	Solubility	9.5E+02	-	-	5.0E+04
Heptachlor	2.0E+01	Nuisance Odors	2.8E+01	2.0E+01	Ontario MOEE	5.0E+04

Table I-4. Surface Water Gross Contamination Ceiling Levels
(surface water IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
Heptachlor epoxide	1.8E+02	Solubility	1.8E+02	-	-	5.0E+04
Hexachlorobenzene	5.5E+01	Solubility	5.5E+01	3.0E+03	Ontario MOEE	5.0E+04
Hexachlorobutadiene	6.0E+00	Nuisance Odors	1.0E+03	6.0E+00	Ontario MOEE	5.0E+04
γ-Hexachlorocyclohexane (Lindane)	3.5E+03	Solubility	3.5E+03	1.2E+04	Ontario MOEE	5.0E+04
Hexachloroethane	1.0E+01	Nuisance Odors	2.5E+04	1.0E+01	Ontario MOEE	5.0E+04
Indeno(1,2,3-c,d)pyrene	2.7E-01	Solubility	2.7E-01	-	-	5.0E+04
Lead	5.0E+04	Upper Limit		-	-	5.0E+04
Mercury (elemental)	5.0E+04	Upper Limit		-	-	5.0E+04
Methoxychlor	2.0E+01	Solubility	2.0E+01	4.7E+03	Ontario MOEE	5.0E+04
Methylene chloride	9.1E+03	Nuisance Odors	6.6E+06	9.1E+03	Ontario MOEE	5.0E+04
Methyl ethyl ketone	8.4E+03	Nuisance Odors	1.3E+08	8.4E+03	Amoore & Hautala	5.0E+04
Methyl isobutyl ketone	1.3E+03	Nuisance Odors	9.5E+06	1.3E+03	Amoore & Hautala	5.0E+04
Methyl mercury	5.0E+04	Upper Limit		-	-	5.0E+04
2-Methylnaphthalene	1.0E+01	Nuisance Odors	1.3E+04	1.0E+01	Ontario MOEE	5.0E+04
tert-Butyl methyl ether	1.8E+02	Nuisance Odors	7.5E+07	1.8E+02	CalDHS	5.0E+04
Molybdenum	5.0E+04	Upper Limit		-	-	5.0E+04
Naphthalene	2.1E+01	Nuisance Odors	1.6E+04	2.1E+01	Ontario MOEE	5.0E+04
Nickel	5.0E+04	Upper Limit		-	-	5.0E+04
Pentachlorophenol	5.9E+02	Nuisance Odors	7.0E+06	5.9E+02	Ontario MOEE	5.0E+04
Perchlorate	5.0E+04	Upper Limit	1.0E+08	-	-	5.0E+04
Phenanthrene	4.1E+02	Solubility	4.1E+02	1.0E+03	Ontario MOEE	5.0E+04
Phenol	7.9E+03	Nuisance Odors	4.0E+07	7.9E+03	Ontario MOEE	5.0E+04
Polychlorinated biphenyls (PCBs)	1.6E+01	Solubility	1.6E+01	-	-	5.0E+04
Pyrene	6.8E+01	Solubility	6.8E+01	-	-	5.0E+04
Selenium	5.0E+04	Upper Limit		-	-	5.0E+04
Silver	5.0E+04	Upper Limit		-	-	5.0E+04
Styrene	1.1E+01	Nuisance Odors	1.6E+05	1.1E+01	Ontario MOEE	5.0E+04
tert-Butyl alcohol	5.0E+04	Upper Limit	5.0E+08	-	-	5.0E+04
1,1,1,2-Tetrachloroethane	5.0E+04	Upper Limit	1.5E+06	-	-	5.0E+04
1,1,2,2-Tetrachloroethane	5.0E+02	Nuisance Odors	1.5E+06	5.0E+02	Ontario MOEE	5.0E+04
Tetrachloroethene	3.0E+02	Nuisance Odors	1.0E+05	3.0E+02	Ontario MOEE	5.0E+04
Thallium	5.0E+04	Upper Limit		-	-	5.0E+04
Toluene	4.0E+01	Nuisance Odors	2.6E+05	4.0E+01	Ontario MOEE	5.0E+04
Toxaphene	1.4E+02	Nuisance Odors	1.5E+03	1.4E+02	USEPA 2nd MCL	5.0E+04
TPH (gasolines)	5.0E+03	Nuisance Odors	7.5E+04	5.0E+03	MADEP	5.0E+04
TPH (middle distillates)	2.5E+03	Solubility	2.5E+03	5.0E+03	MADEP	5.0E+04

Table I-4. Surface Water Gross Contamination Ceiling Levels
(surface water IS NOT a current or potential source of drinking water)
(µg/L)

Chemical	Final Gross Contamination Ceiling Level	Basis	Solubility (1/2)	Nuisance Odor Threshold	Basis	Upper Limit
TPH (residual fuels)	2.5E+03	Solubility	2.5E+03	5.0E+03	MADEP	5.0E+04
1,2,4-Trichlorobenzene	3.0E+03	Nuisance Odors	1.5E+05	3.0E+03	USEPA (1995)	5.0E+04
1,1,1-Trichloroethane	5.0E+04	Nuisance Odors	6.7E+05	5.0E+04	Ontario MOEE	5.0E+04
1,1,2-Trichloroethane	5.0E+04	Upper Limit	2.2E+06	-	-	5.0E+04
Trichloroethene	1.0E+04	Nuisance Odors	5.5E+05	1.0E+04	Ontario MOEE	5.0E+04
2,4,5-Trichlorophenol	2.0E+02	Nuisance Odors	6.0E+05	2.0E+02	Ontario MOEE	5.0E+04
2,4,6-Trichlorophenol	1.0E+02	Nuisance Odors	4.0E+05	1.0E+02	Ontario MOEE	5.0E+04
Vanadium	5.0E+04	Upper Limit		-	-	5.0E+04
Vinyl chloride	3.4E+03	Nuisance Odors	1.4E+06	3.4E+03	Ontario MOEE	5.0E+04
Xylenes	5.3E+02	Nuisance Odors	8.1E+04	5.3E+02	Ontario MOEE	5.0E+04
Zinc	5.0E+04	Upper Limit		-	-	5.0E+04

References:

Unless otherwise noted, criteria for nuisance odor threshhold from Ontario MOEE (MOEE 1996, minus groundwater-to-surface water dilution factor) OR data from Amoore and Hautala (1983) as presented in *A Compilation of Water Quality Goals* if not available (RWQCBCV 2003).

Upper limit of 50000 µg/L intended to limit general groundwater resource degradation (MOEE 1996).

1/2 solubility based on solubility constants in USEPA Region 9 (USEPA 2004) or Ontario MOEE (MOEE 1996) if not available.

Odor threshold for MtBE based on average, upper range at which most subjects could smell MtBE in water (CalEPA 1999).

Notes:

Nuisance Odor Thresholds assume no attenuation/dilution of chemical in surface water.

Ceiling Level: lowest of 1/2 solubility, odor/taste threshhold and 50000 ug/L maximum level (intended to limit general groundwater resource degradation).

TPH -Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

TPH ceiling level after Massachusetts DEP (MADEP 1997a).

Table J. Physical-Chemical and Toxicity Values Used in Models

Chemical	Molecular Weight (g/mole)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's Law constant H (atm-m^3/mol)	Henry's Law constant H' (unitless)	Skin Absorption Factor ABS (unitless)	Oral Cancer Slope Factor SF_o $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer Slope Factor SF_i $(mg/kg\text{-}day)^{-1}$	Oral Dose Reference RfD_o (mg/kg-day)	Inhalation Dose Reference RfD_i (mg/kg-day)
Acenaphthene	154	4.9E+03	4.2E-02	7.7E-06	4.2E+00	1.6E-04	6.4E-03	0.1			6.0E-02	6.0E-02
Acenaphthylene	152	2.5E+03			3.9E+00	1.5E-03	5.9E-02	0.1			3.0E-02	3.0E-02
Acetone	58	5.8E-01	1.2E-01	1.1E-05	1.0E+06	3.9E-05	1.6E-03	0.1			9.0E-01	9.0E-01
Aldrin	365	4.9E+04			1.7E-02	5.0E-05	2.0E-03	0.05	1.7E+01	1.7E+01	3.0E-05	3.0E-05
Anthracene	178	2.4E+04	3.2E-02	7.7E-06	4.3E-02	6.5E-05	2.7E-03	0.1			3.0E-01	3.0E-01
Antimony	122							0.01			4.0E-04	
Arsenic	75							0.04	1.5E+00	1.5E+01	3.0E-04	
Barium	137							0.01			2.0E-01	1.4E-04
Benzene	78	5.9E+01	8.8E-02	9.8E-06	1.8E+03	5.6E-03	2.3E-01	0.1	1.0E-01	1.0E-01	4.0E-03	8.6E-03
Benzo(a)anthracene	228	2.0E+05			1.0E-02	1.0E-06	4.1E-05	0.13	1.2E+00	3.9E-01	3.0E-02	3.0E-02
Benzo(b)fluoranthene	252	5.5E+05			1.4E-02	1.2E-05	5.0E-04	0.13	1.2E+00	3.9E-01	3.0E-02	3.0E-02
Benzo(k)fluoranthene	252	5.5E+05			8.0E-04	3.9E-05	1.6E-03	0.13	1.2E+00	3.9E-01	3.0E-02	3.0E-02
Benzo(g,h,i)perylene	276	1.6E+06			2.6E-04	1.4E-07	5.9E-06	0.13			3.0E-02	3.0E-02
Benzo(a)pyrene	252	5.5E+06			3.8E-03	4.9E-07	2.0E-05	0.13	1.2E+01	3.9E+00	3.0E-02	3.0E-02
Beryllium	9							0.01		8.4E+00	2.0E-03	5.7E-06
1,1-Biphenyl	150	7.8E+03	4.0E-02	8.2E-06	7.5E+00	3.0E-04	1.2E-02	0.1			5.0E-02	
Bis(2-chloroethyl) ether	142	7.6E+01	6.9E-02	7.5E-06	1.7E+04	1.8E-05	7.4E-04	0.1	1.1E+00	1.2E+00		
Bis(2-chloroisopropyl) ether	171	6.1E+01	6.3E-02	6.4E-06	1.7E+03	1.1E-04	4.6E-03	0.1	2.5E+00	2.5E+00	4.0E-02	4.0E-02
Bis(2-ethylhexyl) phthalate	391	1.0E+05			1.3E+00	3.0E-07	1.2E-05	0.1	1.4E-02	8.4E-03	2.0E-02	2.2E-02
Boron	11							0.1			2.0E-01	5.7E-03
Bromodichloromethane	164	5.5E+01	3.0E-02	1.1E-05	6.7E+03	1.6E-03	6.6E-02	0.1	6.2E-02	6.2E-02	2.0E-02	2.0E-02
Bromoform (Tribromomethane)	253	1.1E+02			3.2E+03	5.3E-04	2.2E-02	0.1	7.9E-03	3.9E-03	2.0E-02	2.0E-02
Bromomethane	95	9.0E+00	7.3E-02	1.2E-05	1.5E+04	6.2E-03	2.6E-01	0.1			1.4E-03	1.4E-03
Cadmium	112							0.001	3.8E-01	1.5E+01	5.0E-04	
Carbon tetrachloride	154	1.7E+02	7.8E-02	8.8E-06	7.9E+02	3.0E-02	1.2E+00	0.1	1.5E-01	4.6E-01	7.0E-04	1.1E-02
Chlordane	410	4.4E+04			5.6E-02	4.8E-05	2.0E-03	0.04	1.3E+00	1.2E+00	5.0E-04	2.0E-04
p-Chloroaniline	128	6.4E+01			2.6E+03	3.3E-07	1.4E-05	0.1			4.0E-03	
Chlorobenzene	113	2.2E+02	7.3E-02	8.7E-06	4.7E+02	3.7E-03	1.5E-01	0.1			2.0E-02	2.9E-01
Chloroethane	65	1.5E+01	1.0E-01	1.2E-05	5.7E+03	1.1E-02	4.5E-01	0.1	2.9E-03		4.0E-01	2.9E-02
Chloroform	119	4.0E+01	1.0E-01	1.0E-05	7.9E+03	3.7E-03	1.5E-01	0.1	3.1E-02	1.9E-02	1.0E-02	8.6E-02
Chloromethane	51	3.5E+01	1.1E-01	6.5E-06	8.2E+03	2.4E-02	9.8E-01	0.1			2.6E-02	2.6E-02
2-Chlorophenol	132	4.0E+02	5.0E-01	9.5E-06	2.2E+04	3.9E-04	1.6E-02	0.1			5.0E-03	5.0E-03
Chromium (total)	52											
Chromium III	52							0.01			1.5E+00	
Chromium VI	52							0.01		5.3E+02	3.0E-03	2.9E-08
Chrysene	228	4.0E+05	2.5E-02	6.2E-06	1.6E-03	9.5E-05	3.9E-03	0.13	7.3E-03	3.1E-03	3.0E-02	3.0E-02
Cobalt	59							0.01		9.8E+00	2.0E-02	5.7E-06
Copper	64							0.01			4.0E-01	
Cyanide	26	1.7E+01	1.8E-01	1.8E-05	1.0E+06	1.3E-04	5.3E-03	0.1			2.0E-02	2.0E-02
Dibenz(a,h)anthracene	278	3.3E+06			5.0E-04	7.3E-08	3.0E-06	0.13	7.3E+00	3.1E+00	3.0E-02	3.0E-02
Dibromochloromethane	208	4.7E+02	9.6E-02	1.0E-05	4.4E+03	8.5E-04	3.5E-02	0.1	8.4E-02		2.0E-02	
1,2-dibromo-3-chloropropane	236	1.3E+02	2.1E-02	7.0E-06	1.2E+03	1.5E-04	6.0E-03	0.1	7.0E+00	6.7E+00		5.7E-05
1,2-Dibromoethane	188	2.8E+01	7.3E-02	8.1E-06	3.4E+03	3.2E-04	1.3E-02	0.1	3.6E+00	2.1E+00	9.0E-03	2.6E-03
1,2-Dichlorobenzene	147	6.2E+02	6.9E-02	7.9E-06	1.6E+02	1.9E-03	7.8E-02	0.1			9.0E-02	5.7E-02
1,3-Dichlorobenzene	147	6.2E+02	6.9E-02	7.9E-06	1.6E+02	1.9E-03	7.8E-02	0.1			3.0E-02	3.0E-02
1,4-Dichlorobenzene	147	6.2E+02	6.9E-02	7.9E-06	7.4E+01	2.4E-03	1.0E-01	0.1	2.4E-02	3.9E-02	3.0E-02	2.3E-01
3,3-Dichlorobenzidine	253	1.6E+03			3.1E+00	8.3E-07	3.4E-05	0.1	1.2E+00	1.1E+00		
Dichlorodiphenyldichloroethane (DDD)	331	7.8E+05			1.6E-01	8.0E-06	3.3E-04	0.05	2.4E-01	2.4E-01	5.0E-04	5.0E-04
Dichlorodiphenyldichloroethene (DDE)	329	4.4E+06			4.0E-02	6.8E-05	2.8E-03	0.05	3.4E-01	3.4E-01	5.0E-04	5.0E-04
Dichlorodiphenyltrichloroethane (DDT)	355	2.4E+05			3.0E-03	3.9E-05	1.6E-03	0.05	3.4E-01	3.4E-01	5.0E-04	5.0E-04

Table J. Physical-Chemical and Toxicity Values Used in Models

Chemical	Molecular Weight (g/mole)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's Law constant H (atm-m^3/mol)	Henry's Law constant H' (unitless)	Skin Absorption Factor ABS (unitless)	Oral Cancer Slope Factor SF_o $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer Slope Factor SF_i $(mg/kg\text{-}day)^{-1}$	Oral Dose Reference RfD_o (mg/kg-day)	Inhalation Dose Reference RfD_i (mg/kg-day)
1,1-Dichloroethane	99	3.2E+01	7.4E-02	1.1E-05	5.1E+03	5.6E-03	2.3E-01	0.1	5.7E-03	5.6E-03	1.0E-01	1.4E-01
1,2-Dichloroethane	99	1.7E+01	1.0E-01	9.9E-06	8.5E+03	9.8E-04	4.0E-02	0.1	9.1E-02	9.1E-02	2.0E-02	1.4E-03
1,1-Dichloroethene	97	5.9E+01	9.0E-02	1.0E-05	2.3E+03	2.6E-02	1.1E+00	0.1	6.0E-01	1.8E-01	5.0E-02	5.7E-02
cis-1,2-Dichloroethene	97	3.6E+01	7.4E-02	1.1E-05	3.5E+03	4.1E-03	1.7E-01	0.1			1.0E-02	1.0E-02
trans-1,2-Dichloroethene	97	5.3E+01	7.1E-02	1.2E-05	6.3E+03	9.4E-03	3.8E-01	0.1			2.0E-02	2.0E-02
2,4-Dichlorophenol	163	6.0E+03			4.5E+03	2.8E-06	1.1E-04	0.1			3.0E-03	3.0E-03
1,2-Dichloropropane	113	4.4E+01	7.8E-02	8.7E-06	2.8E+03	2.8E-03	1.1E-01	0.1	6.8E-02	3.5E-02		1.1E-03
1,3-Dichloropropene	111	4.6E+01	6.3E-02	1.0E-05	2.8E+03	1.8E-02	7.3E-01	0.1	1.0E-01	5.6E-02	3.0E-02	5.7E-03
Dieldrin	381	7.4E+03			1.9E-01	5.8E-05	2.4E-03	0.05	1.6E+01	1.6E+01	5.0E-05	5.0E-05
Diethyl phthalate	222	1.4E+02			9.0E+02	1.1E-06	4.7E-05	0.1			8.0E-01	8.0E-01
Dimethyl phthalate	194	1.4E+02			5.0E+03	1.1E-07	4.3E-06	0.1			1.0E+01	1.0E+01
2,4-Dimethylphenol	122	4.0E+01	5.8E-02	8.7E-06	7.9E+03	1.7E-05	7.0E-04	0.1			2.0E-02	
2,4-Dinitrophenol	184	1.7E+01			5.6E+03	6.5E-10	2.6E-08	0.1			2.0E-02	2.0E-03
2,4-Dinitrotoluene	182	4.5E+01			2.7E+02	4.5E-06	1.8E-04	0.1	6.8E-01	3.1E-01	2.0E-03	2.0E-03
1,4-Dioxane	88	3.5E+00			1.0E+06	3.0E-06	1.2E-04	0.1	2.7E-02	2.7E-02		8.6E-01
Dioxin (2,3,7,8-TCDD)	322	1.3E+07			1.4E+01	8.1E-05	3.3E-03	0.02	1.3E+05	1.3E+05		
Endosulfan	407	3.2E+03			1.5E-01	1.0E-05	4.1E-04	0.1			6.0E-03	6.0E-03
Endrin	381	1.7E+03			2.6E-01	7.5E-06	3.1E-04	0.05			3.0E-04	3.0E-04
Ethylbenzene	106	3.6E+02	7.5E-02	7.8E-06	1.7E+02	7.9E-03	3.2E-01	0.1			1.0E-01	2.9E-01
Fluoranthene	202	3.8E+04			2.7E-01	6.5E-06	2.7E-04	0.13			4.0E-02	4.0E-02
Fluorene	166	1.4E+04	6.1E-02	7.9E-06	1.9E+00	7.7E-05	3.2E-03	0.1			4.0E-02	4.0E-02
Heptachlor	373	2.2E+04			5.6E-02	1.5E-03	6.1E-02	0.05	4.5E+00	4.6E+00	5.0E-04	5.0E-04
Heptachlor epoxide	389	2.3E+04			3.5E-01	3.2E-05	1.3E-03	0.1	9.1E+00	9.1E+00	1.3E-05	1.3E-05
Hexachlorobenzene	285	1.2E+06			1.1E-01	1.7E-03	7.0E-02	0.1	1.6E+00	1.6E+00	8.0E-04	8.0E-04
Hexachlorobutadiene	261	2.9E+04			2.0E+00	2.6E-02	1.0E+00	0.1	7.8E-02	7.8E-02	2.0E-04	2.0E-04
γ-Hexachlorocyclohexane (Lindane)	291	3.7E+03			7.0E+00	4.9E-07	2.0E-05	0.05			3.0E-04	
Hexachloroethane	237	2.0E+04			5.0E+01	9.9E-03	4.0E-01	0.1	3.9E-02	3.9E-02	1.0E-03	1.0E-03
Indeno(1,2,3-c,d)pyrene	276	1.6E+06			5.3E-04	7.0E-08	2.8E-06	0.13	7.3E-01	3.1E-01	3.0E-02	3.0E-02
Lead	207							0.01				
Mercury (elemental)	201							0.1			8.6E-05	2.6E-05
Methoxychlor	347	7.9E+04			4.0E-02	1.6E-05	6.5E-04	0.05				
Methylene chloride	85	1.1E+01	1.0E-01	1.2E-05	1.3E+04	2.2E-03	9.0E-02	0.1	1.4E-02	1.6E-03	6.0E-02	1.1E-01
Methyl ethyl ketone	72	4.5E+00	9.0E-02	9.8E-06	2.7E+05	2.7E-05	1.1E-03	0.1			6.0E-01	1.4E+00
Methyl isobutyl ketone	100	1.3E+02	7.5E-02	7.8E-06	1.9E+04	1.4E-04	5.7E-03	0.1			8.6E-01	8.6E-01
Methyl mercury	216							0.1			1.0E-04	
2-Methylnaphthalene	142	7.2E+02	5.9E-02	7.5E-06	2.6E+01	2.9E-04	1.2E-02	0.1			4.0E-03	
tert-Butyl methyl ether	88	6.0E+00	8.0E-02	1.0E-05	1.5E+05	5.9E-04	2.4E-02	0.1	9.1E-04	9.1E-04		8.6E-01
Molybdenum	96							0.01			5.0E-03	
Naphthalene	128	1.2E+03	5.9E-02	7.5E-06	3.1E+01	4.8E-04	2.0E-02	0.1		1.2E-01	2.0E-02	8.6E-04
Nickel	59							0.0002			2.0E-02	1.4E-05
Pentachlorophenol	266	3.2E+04			1.4E+04	2.8E-06	1.1E-04	0.25	1.2E-01	1.6E-02	3.0E-03	
Perchlorate	100				2.0E+05			0.01			7.0E-04	
Phenanthrene	178	1.4E+04			8.2E-01	3.9E-05		0.1			3.0E-02	3.0E-02
Phenol	94	9.1E+01			8.0E+04	1.3E-06	5.3E-05	0.1			3.0E-01	
Polychlorinated biphenyls (PCBs)	327 (ave)	3.3E+04			3.2E-02	5.2E-04	2.1E-02	0.14	5.0E+00	2.0E+00	2.0E-05	2.0E-05
Pyrene	202	1.1E+05	2.7E-02	7.2E-06	1.4E-01	1.1E-05	4.5E-04	0.1			6.0E-02	3.0E-02
Selenium	79							0.01			5.0E-03	
Silver	47							0.01			5.0E-03	
Styrene	104	7.8E+02	7.1E-02	8.0E-06	3.1E+02	2.8E-03	1.1E-01	0.1			2.0E-01	2.6E-01
tert-Butyl alcohol	74	3.7E+01	9.0E-02	9.1E-06	1.0E+06	1.2E-05	4.8E-04	0.1				

Table J. Physical-Chemical and Toxicity Values Used in Models

Chemical	Molecular Weight (g/mole)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Pure component water solubility, S (mg/L)	Henry's Law constant H (atm-m^3/mol)	Henry's Law constant H' (unitless)	Skin Absorption Factor ABS (unitless)	Oral Cancer Slope Factor SF_o $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer Slope Factor SF_i $(mg/kg\text{-}day)^{-1}$	Oral Dose Reference RfD_o (mg/kg-day)	Inhalation Dose Reference RfD_i (mg/kg-day)
1,1,1,2-Tetrachloroethane	168	9.4E+01	7.1E-02	7.9E-06	3.0E+03	3.5E-04	1.4E-02	0.1	2.6E-02	2.7E-02	3.0E-02	
1,1,2,2-Tetrachloroethane	168	9.4E+01	7.1E-02	7.9E-06	3.0E+03	3.5E-04	1.4E-02	0.1	2.0E-01	2.0E-01	6.0E-02	6.0E-02
Tetrachloroethene	166	1.6E+02	7.2E-02	8.2E-06	2.0E+02	1.8E-02	7.5E-01	0.1	5.4E-01	2.1E-02	1.0E-02	1.1E-01
Thallium	204							0.01			8.0E-05	
Toluene	92	1.8E+02	8.7E-02	8.6E-06	5.3E+02	6.6E-03	2.7E-01	0.1			2.0E-01	8.6E-02
Toxaphene	414	4.9E+03			3.0E+00	2.1E-01	8.6E+00	0.05	1.2E+00	1.2E+00		
TPH (gasolines)	108	5.0E+03	7.0E-02	7.8E-06	1.5E+02	7.2E-04	3.0E-02	0.1			3.0E-02	1.4E-02
TPH (middle distillates)	170	5.0E+03	7.0E-02	7.8E-06	5.0E+00	7.2E-04	3.0E-02	0.1			3.0E-02	1.4E-02
TPH (residual fuels)		5.0E+03			5.0E+00			0.05			3.0E-02	1.4E-02
1,2,4-Trichlorobenzene	180	1.8E+03	3.0E-02	8.2E-06	3.0E+02	1.4E-03	5.8E-02	0.1	3.6E-03		1.0E-02	1.1E-03
1,1,1-Trichloroethane	133	1.1E+02	7.8E-02	8.8E-06	1.3E+03	1.7E-02	7.1E-01	0.1			2.8E-01	6.3E-01
1,1,2-Trichloroethane	133	5.0E+01	7.8E-02	8.8E-06	4.4E+03	9.1E-04	3.7E-02	0.1	7.2E-02	5.6E-02	4.0E-03	4.0E-03
Trichloroethene	131	1.7E+02	7.9E-02	9.1E-06	1.1E+03	1.0E-02	4.2E-01	0.1	1.3E-02	7.0E-03	3.0E-04	1.7E-01
2,4,5-Trichlorophenol	198	8.9E+01	2.9E-02	7.0E-06	1.2E+03	2.2E-04	8.9E-03	0.1			1.0E-01	1.0E-01
2,4,6-Trichlorophenol	198	2.0E+03			8.0E+02	4.0E-06	1.6E-04	0.1	1.1E-02	1.1E-02	1.0E-04	
Vanadium	51							0.01			1.0E-03	
Vinyl chloride	63	1.9E+01	1.1E-01	1.2E-06	2.8E+03	2.7E-02	1.1E+00	0.1	1.5E+00	2.7E-01	3.0E-03	2.9E-02
Xylenes	106	4.1E+02	7.0E-02	7.8E-06	1.6E+02	7.3E-03	3.0E-01	0.1			2.0E-01	2.9E-02
Zinc	65							0.01			3.0E-01	

Notes:

Physical state of chemical at ambient conditions (V - volatile, NV - nonvolatile, S - solid, L - liquid, G - gas).

Chemical considered to be "volatile" if Henry's Law constant (atm m^3/mole) >0.00001 and molecular weight <200.

Dibromochloromethane, dibromochloropropane and pyrene considered volatile for purposes of modeling (USEPA 2002).

TPH -Total Petroleum Hydrocarbons. RfD values from MADEP 2002. See text for discussion of different TPH categories.

Physical-chemical constants and ABS values from (in orderor preference): OEHHA 2004, USEPA Region 9 (USEPA 2004) or Ontario MOEE (MOEE 1996), except as noted. OEHHA screening numbers for arsenic and dioxin equate to ABS values of 0.01 and 0.02 (used above), versus 0.04 and 0.002 as noted in OEHHA document.

Physical-chemical constants for polychlorinated biphenyls and toxaphene from ATSDR 2001a. PCB solubility from MOEE (1996).

Physical-chemical constants for 1,4 Dioxane from "Solvent Stabilizers - White Paper" (Mohr 2001).

Cancer Slope Factors from OEHHA 2004 and CalEPA 2003 where available (marked by "*"); otherwise from USEPA as presented in Region 9 PRGs (USEPA 2004). Reference dose factors from OEHHA 2004; otherwise as presented in USEPA Region 9 PRGs.

Physical-chemical values for MtBE from *Assessment and Management of MtBE Impacted Sites* (RWQCB 2001). Oral cancer slope factor from OEHHA (CalEPA 1999b).

Physical-chemicals and toxicity constants for xylenes based on *m*-xylene.

Diffusivity constants for methylnaphthalene not available. Constants presented based on naphthalene.

RfDs for acenaphthylene, methylnaphthylene, and phenanthrene based on fluorene; RfDs for benzo(g,h,i)perylene based on fluoranthene (after MADEP 1994

Table K-1. Direct Exposure Soil Screening Levels
[1]Residential Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens [2](HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Acenaphthene	5.2E+02	noncarcinogenic effects	-	5.2E+02	2.6E+03	N/A
Acenaphthylene	3.7E+02	noncarcinogenic effects	-	3.7E+02	1.8E+03	N/A
Acetone	2.6E+03	noncarcinogenic effects	-	2.6E+03	1.3E+04	1.0E+05
Aldrin	3.2E-02	carcinogenic effects	3.2E-02	4.1E-01	2.1E+00	N/A
Anthracene	3.3E+03	noncarcinogenic effects	-	3.3E+03	1.7E+04	N/A
Antimony	6.1E+00	noncarcinogenic effects	-	6.1E+00	3.0E+01	N/A
Arsenic	3.8E-01	carcinogenic effects	3.8E-01	4.2E+00	2.1E+01	N/A
Barium	2.9E+03	noncarcinogenic effects	-	2.9E+03	1.4E+04	N/A
Benzene	1.2E-01	carcinogenic effects	1.2E-01	4.6E+00	2.3E+01	8.7E+02
Benzo(a)anthracene	3.8E-01	carcinogenic effects	3.8E-01	3.4E+02	1.7E+03	N/A
Benzo(b)fluoranthene	3.8E-01	carcinogenic effects	3.8E-01	3.4E+02	1.7E+03	N/A
Benzo(k)fluoranthene	3.8E-01	carcinogenic effects	3.8E-01	3.4E+02	1.7E+03	N/A
Benzo(g,h,i)perylene	3.4E+02	noncarcinogenic effects	-	3.4E+02	1.7E+03	N/A
Benzo(a)pyrene	3.8E-02	carcinogenic effects	3.8E-02	3.4E+02	1.7E+03	N/A
Beryllium	3.0E+01	noncarcinogenic effects	1.1E+03	3.0E+01	1.5E+02	N/A
1,1-Biphenyl	6.1E+02	noncarcinogenic effects	-	6.1E+02	3.1E+03	N/A
Bis(2-chloroethyl) ether	1.4E-01	carcinogenic effects	1.4E-01	-	-	9.6E+03
Bis(2-chloroisopropyl) ether	3.2E-02	carcinogenic effects	3.2E-02	1.3E+02	6.6E+02	7.9E+02
Bis(2-ethylhexyl) phthalate	3.5E+01	carcinogenic effects	3.5E+01	2.4E+02	1.2E+03	N/A
Boron	2.4E+03	noncarcinogenic effects	-	2.4E+03	1.2E+04	N/A
Bromodichloromethane	5.6E-01	carcinogenic effects	5.6E-01	3.1E+01	1.5E+02	3.0E+03
Bromoform (Tribromomethane)	6.1E+01	carcinogenic effects	6.1E+01	2.4E+02	1.2E+03	N/A
Bromomethane	6.9E-01	noncarcinogenic effects	-	6.9E-01	3.5E+00	3.1E+03
Cadmium	1.7E+00	carcinogenic effects	1.7E+00	7.8E+00	3.9E+01	N/A
Carbon tetrachloride	2.0E-02	carcinogenic effects	2.0E-02	3.1E+00	1.6E+01	1.1E+03
Chlordane	4.4E-01	carcinogenic effects	4.4E-01	7.0E+00	3.5E+01	N/A
p-Chloroaniline	4.9E+01	noncarcinogenic effects	-	4.9E+01	2.4E+02	N/A
Chlorobenzene	1.4E+02	noncarcinogenic effects	-	1.4E+02	7.0E+02	6.8E+02
Chloroethane	1.0E+01	noncarcinogenic effects	1.7E+02	1.0E+01	5.1E+01	1.6E+03
Chloroform	6.7E-01	carcinogenic effects	6.7E-01	3.6E+01	1.8E+02	2.9E+03
Chloromethane	7.6E+00	noncarcinogenic effects	-	7.6E+00	3.8E+01	4.1E+03
2-Chlorophenol	7.4E+00	noncarcinogenic effects	-	7.4E+00	3.7E+01	5.5E+04
Chromium (total)	-	-	-	-	-	N/A
Chromium III	2.3E+04	noncarcinogenic effects	-	2.3E+04	1.1E+05	N/A
Chromium VI	9.4E+00	noncarcinogenic effects	1.7E+01	9.4E+00	4.7E+01	N/A
Chrysene	6.2E+01	carcinogenic effects	6.2E+01	3.4E+02	1.7E+03	N/A

Table K-1. Direct Exposure Soil Screening Levels
[1]Residential Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens [2](HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Cobalt	2.7E+02	noncarcinogenic effects	9.1E+02	2.7E+02	1.3E+03	N/A
Copper	6.1E+03	noncarcinogenic effects	-	6.1E+03	3.0E+04	N/A
Cyanide	3.4E+01	noncarcinogenic effects	-	3.4E+01	1.7E+02	N/A
Dibenz(a,h)anthracene	6.2E-02	carcinogenic effects	6.2E-02	3.4E+02	1.7E+03	N/A
Dibromochloromethane	5.8E+00	carcinogenic effects	5.8E+00	2.4E+02	1.2E+03	N/A
1,2-dibromo-3-chloropropane	6.9E-02	carcinogenic effects	6.9E-02	2.4E+04	1.2E+05	N/A
1,2-Dibromoethane	1.9E-02	carcinogenic effects	1.9E-02	5.2E+00	2.6E+01	N/A
1,2-Dichlorobenzene	1.3E+02	noncarcinogenic effects	-	1.3E+02	6.4E+02	6.0E+02
1,3-Dichlorobenzene	6.3E+01	noncarcinogenic effects	-	6.3E+01	3.1E+02	6.0E+02
1,4-Dichlorobenzene	1.2E+00	carcinogenic effects	1.2E+00	2.1E+02	1.1E+03	N/A
3,3-Dichlorobenzidine	4.0E-01	carcinogenic effects	4.0E-01	-	-	N/A
Dichlorodiphenyldichloroethane (DDD)	2.3E+00	carcinogenic effects	2.3E+00	6.9E+00	3.4E+01	N/A
Dichlorodiphenyldichloroethene (DDE)	1.6E+00	carcinogenic effects	1.6E+00	6.9E+00	3.4E+01	N/A
Dichlorodiphenyltrichloroethane (DDT)	1.6E+00	carcinogenic effects	1.6E+00	6.9E+00	3.4E+01	N/A
1,1-Dichloroethane	2.2E+00	carcinogenic effects	2.2E+00	7.7E+01	3.9E+02	1.7E+03
1,2-Dichloroethane	2.2E-01	carcinogenic effects	2.2E-01	1.4E+00	6.8E+00	1.8E+03
1,1-Dichloroethene	4.1E-02	carcinogenic effects	4.1E-02	1.9E+01	9.6E+01	1.5E+03
cis -1,2-Dichloroethene	6.4E+00	noncarcinogenic effects	-	6.4E+00	3.2E+01	1.2E+03
trans -1,2-Dichloroethene	1.0E+01	noncarcinogenic effects	-	1.0E+01	5.1E+01	3.1E+03
2,4-Dichlorophenol	3.7E+01	noncarcinogenic effects	-	3.7E+01	1.8E+02	N/A
1,2-Dichloropropane	4.6E-01	carcinogenic effects	4.6E-01	9.1E-01	4.6E+00	1.1E+03
1,3-Dichloropropene	1.7E-01	carcinogenic effects	1.7E-01	2.5E+00	1.3E+01	1.4E+03
Dieldrin	3.4E-02	carcinogenic effects	3.4E-02	6.9E-01	3.4E+00	N/A
Diethyl phthalate	9.8E+03	noncarcinogenic effects	-	9.8E+03	4.9E+04	N/A
Dimethyl phthalate	1.2E+05	noncarcinogenic effects	-	1.2E+05	6.1E+05	N/A
2,4-Dimethylphenol	2.4E+02	noncarcinogenic effects	-	2.4E+02	1.2E+03	N/A
2,4-Dinitrophenol	2.4E+02	noncarcinogenic effects	-	2.4E+02	1.2E+03	N/A
2,4-Dinitrotoluene	7.1E-01	carcinogenic effects	7.1E-01	2.4E+01	1.2E+02	N/A
1,4-Dioxane	1.8E+01	carcinogenic effects	1.8E+01	3.5E+08	1.8E+09	N/A
Dioxin (2,3,7,8-TCDD)	4.6E-06	carcinogenic effects	4.6E-06	-	-	N/A
Endosulfan	7.3E+01	noncarcinogenic effects	-	7.3E+01	3.7E+02	N/A
Endrin	4.1E+00	noncarcinogenic effects	-	4.1E+00	2.1E+01	N/A
Ethylbenzene	2.3E+02	noncarcinogenic effects	-	2.3E+02	1.1E+03	4.0E+02
Fluoranthene	4.6E+02	noncarcinogenic effects	-	4.6E+02	2.3E+03	N/A
Fluorene	4.1E+02	noncarcinogenic effects	-	4.1E+02	2.0E+03	N/A
Heptachlor	1.2E-01	carcinogenic effects	1.2E-01	6.9E+00	3.4E+01	N/A

Table K-1. Direct Exposure Soil Screening Levels
[1]Residential Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens [2](HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Heptachlor epoxide	5.3E-02	carcinogenic effects	5.3E-02	1.6E-01	7.9E-01	N/A
Hexachlorobenzene	3.0E-01	carcinogenic effects	3.0E-01	9.8E+00	4.9E+01	N/A
Hexachlorobutadiene	2.4E+00	noncarcinogenic effects	6.2E+00	2.4E+00	1.2E+01	N/A
γ-Hexachlorocyclohexane (Lindane)	4.1E+00	noncarcinogenic effects	-	4.1E+00	2.1E+01	N/A
Hexachloroethane	1.2E+01	noncarcinogenic effects	1.2E+01	1.2E+01	6.1E+01	N/A
Indeno(1,2,3-c,d)pyrene	6.2E-01	carcinogenic effects	6.2E-01	3.4E+02	1.7E+03	N/A
Lead	2.6E+02	noncarcinogenic effects	-	2.6E+02	2.6E+02	N/A
Mercury (elemental)	1.0E+00	noncarcinogenic effects	-	1.0E+00	5.2E+00	N/A
Methoxychlor	-	-	-	-	-	N/A
Methylene chloride	6.9E+00	carcinogenic effects	6.9E+00	6.8E+01	3.4E+02	2.4E+03
Methyl ethyl ketone	3.8E+03	noncarcinogenic effects	-	3.8E+03	1.9E+04	3.4E+04
Methyl isobutyl ketone	2.9E+03	noncarcinogenic effects	-	2.9E+03	1.5E+04	1.7E+04
Methyl mercury	1.2E+00	noncarcinogenic effects	-	1.2E+00	6.1E+00	N/A
2-Methylnaphthalene	4.9E+01	noncarcinogenic effects	-	4.9E+01	2.4E+02	N/A
tert -Butyl methyl ether	2.9E+01	carcinogenic effects	2.9E+01	1.1E+03	5.6E+03	2.1E+04
Molybdenum	7.6E+01	noncarcinogenic effects	-	7.6E+01	3.8E+02	N/A
Naphthalene	1.3E+00	carcinogenic effects	1.3E+00	6.1E+00	3.1E+01	N/A
Nickel	3.0E+02	noncarcinogenic effects	-	3.0E+02	1.5E+03	N/A
Pentachlorophenol	3.0E+00	carcinogenic effects	3.0E+00	2.8E+01	1.4E+02	N/A
Perchlorate	1.1E+01	noncarcinogenic effects	-	1.1E+01	5.3E+01	N/A
Phenanthrene	3.7E+02	noncarcinogenic effects	-	3.7E+02	1.8E+03	N/A
Phenol	3.7E+03	noncarcinogenic effects	-	3.7E+03	1.8E+04	N/A
Polychlorinated biphenyls (PCBs)	8.9E-02	carcinogenic effects	8.9E-02	2.2E-01	1.1E+00	N/A
Pyrene	7.3E+02	noncarcinogenic effects	-	7.3E+02	3.7E+03	N/A
Selenium	7.6E+01	noncarcinogenic effects	-	7.6E+01	3.8E+02	N/A
Silver	7.6E+01	noncarcinogenic effects	-	7.6E+01	3.8E+02	N/A
Styrene	4.8E+02	noncarcinogenic effects	-	4.8E+02	2.4E+03	1.5E+03
tert -Butyl alcohol	3.2E+05	saturation limit	-	-	-	3.2E+05
1,1,1,2-Tetrachloroethane	2.0E+00	carcinogenic effects	2.0E+00	3.7E+02	1.8E+03	2.0E+03
1,1,2,2-Tetrachloroethane	2.6E-01	carcinogenic effects	2.6E-01	1.4E+02	6.8E+02	2.0E+03
Tetrachloroethene	3.4E-01	carcinogenic effects	3.4E-01	4.0E+01	2.0E+02	2.3E+02
Thallium	1.2E+00	noncarcinogenic effects	-	1.2E+00	6.1E+00	N/A
Toluene	6.3E+01	noncarcinogenic effects	-	6.3E+01	3.1E+02	6.5E+02
Toxaphene	4.6E-01	carcinogenic effects	4.6E-01	-	-	N/A
TPH (gasolines)	1.1E+02	noncarcinogenic effects	-	1.1E+02	5.4E+02	4.5E+03
TPH (middle distillates)	1.1E+02	noncarcinogenic effects	-	1.1E+02	5.4E+02	1.5E+02

Table K-1. Direct Exposure Soil Screening Levels
[1]Residential Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens [2](HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
TPH (residual fuels)	4.1E+02	noncarcinogenic effects	-	4.1E+02	2.1E+03	N/A
1,2,4-Trichlorobenzene	7.8E+00	noncarcinogenic effects	1.3E+02	7.8E+00	3.9E+01	N/A
1,1,1-Trichloroethane	2.7E+02	noncarcinogenic effects	-	2.7E+02	1.4E+03	1.2E+03
1,1,2-Trichloroethane	4.9E-01	carcinogenic effects	4.9E-01	5.0E+00	2.5E+01	1.8E+03
Trichloroethene	1.9E+00	carcinogenic effects	1.9E+00	3.5E+00	1.8E+01	1.3E+03
2,4,5-Trichlorophenol	3.7E+02	noncarcinogenic effects	-	3.7E+02	1.9E+03	N/A
2,4,6-Trichlorophenol	1.2E+00	noncarcinogenic effects	4.4E+01	1.2E+00	6.1E+00	N/A
Vanadium	1.5E+01	noncarcinogenic effects	-	1.5E+01	7.6E+01	N/A
Vinyl chloride	2.1E-02	carcinogenic effects	2.1E-02	6.8E+00	3.4E+01	1.2E+03
Xylenes	3.1E+01	noncarcinogenic effects	-	3.1E+01	1.5E+02	4.2E+02
Zinc	4.6E+03	noncarcinogenic effects	-	4.6E+03	2.3E+04	N/A

Primary source: USEPA Region 9 Preliminary Remediation Goals (PRGs, USEPA 2004), modified as noted below. See text for discussion.

Notes:

1. "Residential" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.).

See text for equations and assumptions used in models.

Final screening level is lowest of individual screening levels for carcinogenic effects and noncarcinogenic effects (based on HQ=0.2).

workers if lower (see Table K-3). Saturation limit used as upper limit for volatile organic compounds that are liquid at ambient conditions (see text).

Carcinogens: Based on target cancer risk of 10^{-6}; modified with respect to CalEPA/OEHHA slope factors when available (marked by "*"). Screening levels for PCBs based on updated USEPA slope factors as presented in USEPA Region 9 Preliminary Remediation Goals document (USEPA 2004).

Noncarcinogens: Adjusted to target hazard quotient of 0.2 for use in tables for all chemicals. Screening levels based on hazard quotient of 1.0 provided for reference.

Saturation: Theoretical soil saturation level in the absence of free product; calculated for volatile organic compounds that are liquids under ambient conditions (refer to Table J).

TPH:Total Petroleum Hydrocarbons. See text for discussion of different TPH categories. Direct exposure screening levels after Massachusetts Department of Environmental Protection (see text).

Direct-exposure screening level for lead from Office of Human Hazard Evaluation CHHSLs (CalEPA 2004b).

Table K-2. Direct Exposure Soil Screening Levels
Commerical/Industrial Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens (HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Acenaphthene	3.3E+03	noncarcinogenic effects	-	3.3E+03	1.6E+04	N/A
Acenaphthylene	3.7E+03	noncarcinogenic effects	-	3.7E+03	1.8E+04	N/A
Acetone	1.0E+04	noncarcinogenic effects	-	1.0E+04	5.1E+04	1.0E+05
Aldrin	1.3E-01	carcinogenic effects	1.3E-01	4.6E+00	2.3E+01	N/A
Anthracene	2.8E+04	noncarcinogenic effects	-	2.8E+04	1.4E+05	N/A
Antimony	7.7E+01	noncarcinogenic effects	-	7.7E+01	3.8E+02	N/A
Arsenic	1.5E+00	carcinogenic effects	1.5E+00	4.9E+01	2.4E+02	N/A
Barium	3.2E+04	noncarcinogenic effects	-	3.2E+04	1.6E+05	N/A
Benzene	2.6E-01	carcinogenic effects	2.6E-01	1.6E+01	8.0E+01	8.7E+02
Benzo(a)anthracene	1.3E+00	carcinogenic effects	1.3E+00	3.3E+03	1.7E+04	N/A
Benzo(b)fluoranthene	1.3E+00	carcinogenic effects	1.3E+00	3.3E+03	1.7E+04	N/A
Benzo(k)fluoranthene	1.3E+00	carcinogenic effects	1.3E+00	3.3E+03	1.7E+04	N/A
Benzo(g,h,i)perylene	3.3E+03	noncarcinogenic effects	-	3.3E+03	1.7E+04	N/A
Benzo(a)pyrene	1.3E-01	carcinogenic effects	1.3E-01	3.3E+03	1.7E+04	N/A
Beryllium	3.7E+02	noncarcinogenic effects	2.2E+03	3.7E+02	1.8E+03	N/A
1,1-Biphenyl	6.2E+03	noncarcinogenic effects	-	6.2E+03	3.1E+04	N/A
Bis(2-chloroethyl) ether	3.5E-01	carcinogenic effects	3.5E-01	-	-	9.6E+03
Bis(2-chloroisopropyl) ether	7.4E-02	carcinogenic effects	7.4E-02	5.3E+02	2.6E+03	7.9E+02
Bis(2-ethylhexyl) phthalate	1.2E+02	carcinogenic effects	1.2E+02	2.5E+03	1.2E+04	N/A
Boron	2.5E+04	noncarcinogenic effects	-	2.5E+04	1.2E+05	N/A
Bromodichloromethane	1.2E+00	carcinogenic effects	1.2E+00	1.1E+02	5.5E+02	3.0E+03
Bromoform (Tribromomethane)	2.2E+02	carcinogenic effects	2.2E+02	2.5E+03	1.2E+04	N/A
Bromomethane	2.3E+00	noncarcinogenic effects	-	2.3E+00	1.2E+01	3.1E+03
Cadmium	7.4E+00	carcinogenic effects	7.4E+00	1.0E+02	5.1E+02	N/A
Carbon tetrachloride	4.4E-02	carcinogenic effects	4.4E-02	1.4E+01	6.8E+01	1.1E+03
Chlordane	1.7E+00	carcinogenic effects	1.7E+00	8.1E+01	4.0E+02	N/A
p-Chloroaniline	4.9E+02	noncarcinogenic effects	-	4.9E+02	2.5E+03	N/A
Chlorobenzene	6.8E+02	saturation limit	-	7.5E+02	3.7E+03	6.8E+02
Chloroethane	3.4E+01	noncarcinogenic effects	5.9E+02	3.4E+01	1.7E+02	1.6E+03
Chloroform	1.4E+00	carcinogenic effects	1.4E+00	1.5E+02	7.4E+02	2.9E+03
Chloromethane	2.5E+01	noncarcinogenic effects	-	2.5E+01	1.3E+02	4.1E+03
2-Chlorophenol	2.6E+01	noncarcinogenic effects	-	2.6E+01	1.3E+02	5.5E+04
Chromium (total)	-	-	-	-	-	N/A

Table K-2. Direct Exposure Soil Screening Levels
Commerical/Industrial Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens (HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Chromium III	2.9E+05	noncarcinogenic effects	-	2.9E+05	1.4E+06	N/A
Chromium VI	3.6E+01	carcinogenic effects	3.6E+01	3.6E+01	1.8E+02	N/A
Chrysene	2.1E+02	carcinogenic effects	2.1E+02	3.3E+03	1.7E+04	N/A
Cobalt	1.9E+03	carcinogenic effects	1.9E+03	2.6E+03	1.3E+04	N/A
Copper	7.7E+04	noncarcinogenic effects	-	7.7E+04	3.8E+05	N/A
Cyanide	1.2E+02	noncarcinogenic effects	-	1.2E+02	6.1E+02	N/A
Dibenz(a,h)anthracene	2.1E-01	carcinogenic effects	2.1E-01	3.3E+03	1.7E+04	N/A
Dibromochloromethane	2.1E+01	carcinogenic effects	2.1E+01	2.5E+03	1.2E+04	N/A
1,2-dibromo-3-chloropropane	2.5E-01	carcinogenic effects	2.5E-01	7.7E+04	3.8E+05	N/A
1,2-Dibromoethane	4.2E-02	carcinogenic effects	4.2E-02	1.8E+01	8.8E+01	N/A
1,2-Dichlorobenzene	4.5E+02	noncarcinogenic effects	-	4.5E+02	2.3E+03	6.0E+02
1,3-Dichlorobenzene	2.3E+02	noncarcinogenic effects	-	2.3E+02	1.2E+03	6.0E+02
1,4-Dichlorobenzene	2.6E+00	carcinogenic effects	2.6E+00	1.1E+03	5.7E+03	N/A
3,3-Dichlorobenzidine	1.4E+00	carcinogenic effects	1.4E+00	-	-	N/A
Dichlorodiphenyldichloroethane (DDD)	9.0E+00	carcinogenic effects	9.0E+00	7.7E+01	3.8E+02	N/A
Dichlorodiphenyldichloroethene (DDE)	6.3E+00	carcinogenic effects	6.3E+00	7.7E+01	3.8E+02	N/A
Dichlorodiphenyltrichloroethane (DDT)	6.3E+00	carcinogenic effects	6.3E+00	7.7E+01	3.8E+02	N/A
1,1-Dichloroethane	4.7E+00	carcinogenic effects	4.7E+00	2.6E+02	1.3E+03	1.7E+03
1,2-Dichloroethane	4.8E-01	carcinogenic effects	4.8E-01	4.5E+00	2.2E+01	1.8E+03
1,1-Dichloroethene	8.8E-02	carcinogenic effects	8.8E-02	6.4E+01	3.2E+02	1.5E+03
cis -1,2-Dichloroethene	2.2E+01	noncarcinogenic effects	-	2.2E+01	1.1E+02	1.2E+03
trans -1,2-Dichloroethene	3.4E+01	noncarcinogenic effects	-	3.4E+01	1.7E+02	3.1E+03
2,4-Dichlorophenol	3.7E+02	noncarcinogenic effects	-	3.7E+02	1.8E+03	N/A
1,2-Dichloropropane	1.0E+00	carcinogenic effects	1.0E+00	3.0E+00	1.5E+01	1.1E+03
1,3-Dichloropropene	3.6E-01	carcinogenic effects	3.6E-01	8.3E+00	4.2E+01	1.4E+03
Dieldrin	1.3E-01	carcinogenic effects	1.3E-01	7.7E+00	3.8E+01	N/A
Diethyl phthalate	9.8E+04	noncarcinogenic effects	-	9.8E+04	4.9E+05	N/A
Dimethyl phthalate	1.2E+06	noncarcinogenic effects	-	1.2E+06	6.2E+06	N/A
2,4-Dimethylphenol	2.5E+03	noncarcinogenic effects	-	2.5E+03	1.2E+04	N/A
2,4-Dinitrophenol	2.5E+03	noncarcinogenic effects	-	2.5E+03	1.2E+04	N/A
2,4-Dinitrotoluene	2.5E+00	carcinogenic effects	2.5E+00	2.5E+02	1.2E+03	N/A
1,4-Dioxane	6.4E+01	carcinogenic effects	6.4E+01	1.2E+09	5.8E+09	N/A
Dioxin (2,3,7,8-TCDD)	1.9E-05	carcinogenic effects	1.9E-05	-	-	N/A

Table K-2. Direct Exposure Soil Screening Levels
Commerical/Industrial Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens (HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Endosulfan	7.4E+02	noncarcinogenic effects	-	7.4E+02	3.7E+03	N/A
Endrin	4.6E+01	noncarcinogenic effects	-	4.6E+01	2.3E+02	N/A
Ethylbenzene	4.0E+02	saturation limit	-	8.4E+02	4.2E+03	4.0E+02
Fluoranthene	4.4E+03	noncarcinogenic effects	-	4.4E+03	2.2E+04	N/A
Fluorene	3.0E+03	noncarcinogenic effects	-	3.0E+03	1.5E+04	N/A
Heptachlor	4.8E-01	carcinogenic effects	4.8E-01	7.7E+01	3.8E+02	N/A
Heptachlor epoxide	1.9E-01	carcinogenic effects	1.9E-01	1.6E+00	8.0E+00	N/A
Hexachlorobenzene	1.1E+00	carcinogenic effects	1.1E+00	9.8E+01	4.9E+02	N/A
Hexachlorobutadiene	2.2E+01	carcinogenic effects	2.2E+01	2.5E+01	1.2E+02	N/A
γ-Hexachlorocyclohexane (Lindane)	4.6E+01	noncarcinogenic effects	-	4.6E+01	2.3E+02	N/A
Hexachloroethane	4.4E+01	carcinogenic effects	4.4E+01	1.2E+02	6.2E+02	N/A
Indeno(1,2,3-c,d)pyrene	2.1E+00	carcinogenic effects	2.1E+00	3.3E+03	1.7E+04	N/A
Lead	7.5E+02	noncarcinogenic effects	-	7.5E+02	7.5E+02	N/A
Mercury (elemental)	1.1E+01	noncarcinogenic effects	-	1.1E+01	5.3E+01	N/A
Methoxychlor	-	-	-	-	-	N/A
Methylene chloride	1.6E+01	carcinogenic effects	1.6E+01	2.4E+02	1.2E+03	2.4E+03
Methyl ethyl ketone	1.9E+04	noncarcinogenic effects	-	1.9E+04	9.6E+04	3.4E+04
Methyl isobutyl ketone	1.2E+04	noncarcinogenic effects	-	1.2E+04	5.9E+04	1.7E+04
Methyl mercury	1.2E+01	noncarcinogenic effects	-	1.2E+01	6.2E+01	N/A
2-Methylnaphthalene	4.9E+02	noncarcinogenic effects	-	4.9E+02	2.5E+03	N/A
tert-Butyl methyl ether	6.4E+01	carcinogenic effects	6.4E+01	3.7E+03	1.8E+04	2.1E+04
Molybdenum	9.6E+02	noncarcinogenic effects	-	9.6E+02	4.8E+03	N/A
Naphthalene	2.8E+00	carcinogenic effects	2.8E+00	2.0E+01	1.0E+02	N/A
Nickel	3.4E+03	noncarcinogenic effects	-	3.4E+03	1.7E+04	N/A
Pentachlorophenol	9.0E+00	carcinogenic effects	9.0E+00	2.3E+02	1.2E+03	N/A
Perchlorate	1.3E+02	noncarcinogenic effects	-	1.3E+02	6.7E+02	N/A
Phenanthrene	3.7E+03	noncarcinogenic effects	-	3.7E+03	1.8E+04	N/A
Phenol	3.7E+04	noncarcinogenic effects	-	3.7E+04	1.8E+05	N/A
Polychlorinated biphenyls (PCBs)	3.0E-01	carcinogenic effects	3.0E-01	2.1E+00	1.1E+01	N/A
Pyrene	7.4E+03	noncarcinogenic effects	-	7.4E+03	3.7E+04	N/A
Selenium	9.6E+02	noncarcinogenic effects	-	9.6E+02	4.8E+03	N/A
Silver	9.6E+02	noncarcinogenic effects	-	9.6E+02	4.8E+03	N/A
Styrene	1.5E+03	saturation limit	-	1.8E+03	9.0E+03	1.5E+03

Table K-2. Direct Exposure Soil Screening Levels
Commerical/Industrial Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens (HQ = 0.2) (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
tert -Butyl alcohol	3.2E+05	saturation limit	-	-	-	3.2E+05
1,1,1,2-Tetrachloroethane	4.4E+00	carcinogenic effects	4.4E+00	3.7E+03	1.8E+04	2.0E+03
1,1,2,2-Tetrachloroethane	5.8E-01	carcinogenic effects	5.8E-01	5.0E+02	2.5E+03	2.0E+03
Tetrachloroethene	8.5E-01	carcinogenic effects	8.5E-01	1.7E+02	8.4E+02	2.3E+02
Thallium	1.5E+01	noncarcinogenic effects	-	1.5E+01	7.7E+01	N/A
Toluene	2.1E+02	noncarcinogenic effects	-	2.1E+02	1.0E+03	6.5E+02
Toxaphene	1.8E+00	carcinogenic effects	1.8E+00	-	-	N/A
TPH (gasolines)	4.5E+02	noncarcinogenic effects	-	4.5E+02	2.2E+03	4.5E+03
TPH (middle distillates)	1.5E+02	saturation limit	-	4.5E+02	2.2E+03	1.5E+02
TPH (residual fuels)	4.6E+03	noncarcinogenic effects	-	4.6E+03	2.3E+04	N/A
1,2,4-Trichlorobenzene	2.7E+01	noncarcinogenic effects	4.8E+02	2.7E+01	1.3E+02	N/A
1,1,1-Trichloroethane	9.4E+02	noncarcinogenic effects	-	9.4E+02	4.7E+03	1.2E+03
1,1,2-Trichloroethane	1.1E+00	carcinogenic effects	1.1E+00	1.7E+01	8.7E+01	1.8E+03
Trichloroethene	4.0E+00	carcinogenic effects	4.0E+00	3.3E+01	1.7E+02	1.3E+03
2,4,5-Trichlorophenol	1.5E+03	noncarcinogenic effects	-	1.5E+03	7.6E+03	N/A
2,4,6-Trichlorophenol	1.2E+01	noncarcinogenic effects	1.6E+02	1.2E+01	6.2E+01	N/A
Vanadium	1.9E+02	noncarcinogenic effects	-	1.9E+02	9.6E+02	N/A
Vinyl chloride	4.7E-02	carcinogenic effects	4.7E-02	2.5E+01	1.3E+02	1.2E+03
Xylenes	1.0E+02	noncarcinogenic effects	-	1.0E+02	5.1E+02	4.2E+02
Zinc	5.8E+04	noncarcinogenic effects	-	5.8E+04	2.9E+05	N/A

Primary source: USEPA Region 9 Preliminary Remediation Goals (PRGs, USEPA 2004), modified as noted below. See text for discussion.

Notes:

See text for equations and assumptions used in models.

Final screening level is lowest of individual screening levels for carcinogenic effects and noncarcinogenic effects (based on HQ=0.2)

Saturation limit used as upper limit for volatile organic compounds that are liquid at ambient conditions (see text).

Carcinogens: Based on target cancer risk of 10^{-6}; modified with respect to CalEPA/OEHHA slope factors when available (marked by "*"). Screening levels for PCBs based on updated USEPA slope factors as presented in USEPA Region IX Preliminary Remediation Goals document (USEPA 2004).

Noncarcinogens: Adjusted to target hazard quotient of 0.2 for use in tables for all chemicals. Screening levels based on hazard quotient of 1.0 provided for reference.

Saturation: Theoretical soil saturation level in the absence of free product; calculated for volatile organic compounds that are liquids under ambient conditions (refer to Table J).

TPH:Total Petroleum Hydrocarbons.

Direct-exposure screening level for lead from USEPA Region 9 Preliminary Remediation Goals document (USEPA 2004).

Table K-3. Direct Exposure Soil Screening Levels
Construction/Trench Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens HQ = 0.2 (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Acenaphthene	1.8E+04	noncarcinogenic effects	-	1.8E+04	9.2E+04	N/A
Acenaphthylene	1.2E+04	noncarcinogenic effects	-	1.2E+04	6.0E+04	N/A
Acetone	1.0E+05	noncarcinogenic effects	-	1.0E+05	5.1E+05	1.0E+05
Aldrin	1.5E+00	carcinogenic effects	1.5E+00	1.6E+01	7.8E+01	N/A
Anthracene	1.1E+05	noncarcinogenic effects	-	1.1E+05	5.6E+05	N/A
Antimony	2.8E+02	noncarcinogenic effects	-	2.8E+02	1.4E+03	N/A
Arsenic	1.4E+01	carcinogenic effects	1.4E+01	1.7E+02	8.5E+02	N/A
Barium	2.6E+03	noncarcinogenic effects	-	2.6E+03	1.3E+04	N/A
Benzene	1.1E+01	carcinogenic effects	1.1E+01	1.8E+02	9.2E+02	8.7E+02
Benzo(a)anthracene	1.5E+01	carcinogenic effects	1.5E+01	1.1E+04	5.3E+04	N/A
Benzo(b)fluoranthene	1.5E+01	carcinogenic effects	1.5E+01	1.1E+04	5.3E+04	N/A
Benzo(k)fluoranthene	1.5E+01	carcinogenic effects	1.5E+01	1.1E+04	5.3E+04	N/A
Benzo(g,h,i)perylene	1.1E+04	noncarcinogenic effects	-	1.1E+04	5.3E+04	N/A
Benzo(a)pyrene	1.5E+00	carcinogenic effects	1.5E+00	1.1E+04	5.3E+04	N/A
Beryllium	9.8E+01	noncarcinogenic effects	1.1E+02	9.8E+01	4.9E+02	N/A
1,1-Biphenyl	2.0E+04	noncarcinogenic effects	-	2.0E+04	1.0E+05	N/A
Bis(2-chloroethyl) ether	9.6E+00	carcinogenic effects	9.6E+00	-	-	9.6E+03
Bis(2-chloroisopropyl) ether	2.5E+00	carcinogenic effects	2.5E+00	5.1E+03	2.5E+04	7.9E+02
Bis(2-ethylhexyl) phthalate	1.4E+03	carcinogenic effects	1.4E+03	8.0E+03	4.0E+04	N/A
Boron	4.6E+04	noncarcinogenic effects	-	4.6E+04	2.3E+05	N/A
Bromodichloromethane	4.9E+01	carcinogenic effects	4.9E+01	1.2E+03	6.1E+03	3.0E+03
Bromoform (Tribromomethane)	2.6E+03	carcinogenic effects	2.6E+03	8.0E+03	4.0E+04	N/A
Bromomethane	2.8E+01	noncarcinogenic effects	-	2.8E+01	1.4E+02	3.1E+03
Cadmium	3.9E+01	carcinogenic effects	3.9E+01	3.8E+02	1.9E+03	N/A
Carbon tetrachloride	1.9E+00	carcinogenic effects	1.9E+00	1.2E+02	5.9E+02	1.1E+03
Chlordane	2.1E+01	carcinogenic effects	2.1E+01	2.6E+02	1.3E+03	N/A
p-Chloroaniline	1.6E+03	noncarcinogenic effects	-	1.6E+03	8.2E+03	N/A
Chlorobenzene	6.8E+02	saturation limit	-	5.1E+03	2.5E+04	6.8E+02
Chloroethane	4.2E+02	noncarcinogenic effects	7.0E+03	4.2E+02	2.1E+03	1.6E+03
Chloroform	6.0E+01	carcinogenic effects	6.0E+01	1.4E+03	7.0E+03	2.9E+03
Chloromethane	3.1E+02	noncarcinogenic effects	-	3.1E+02	1.5E+03	4.1E+03
2-Chlorophenol	2.9E+02	noncarcinogenic effects	-	2.9E+02	1.5E+03	5.5E+04
Chromium (total)	-	-	-	-	-	N/A

Table K-3. Direct Exposure Soil Screening Levels
Construction/Trench Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens HQ = 0.2 (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Chromium III	1.1E+06	noncarcinogenic effects	-	1.1E+06	5.3E+06	N/A
Chromium VI	5.3E-01	noncarcinogenic effects	1.8E+00	5.3E-01	2.6E+00	N/A
Chrysene	2.4E+03	carcinogenic effects	2.4E+03	1.1E+04	5.3E+04	N/A
Cobalt	9.4E+01	carcinogenic effects	9.4E+01	1.0E+02	5.2E+02	N/A
Copper	2.8E+05	noncarcinogenic effects	-	2.8E+05	1.4E+06	N/A
Cyanide	1.3E+03	noncarcinogenic effects	-	1.3E+03	6.7E+03	N/A
Dibenz(a,h)anthracene	2.4E+00	carcinogenic effects	2.4E+00	1.1E+04	5.3E+04	N/A
Dibromochloromethane	2.4E+02	carcinogenic effects	2.4E+02	8.2E+03	4.1E+04	N/A
1,2-dibromo-3-chloropropane	2.9E+00	carcinogenic effects	2.9E+00	1.1E+03	5.3E+03	N/A
1,2-Dibromoethane	1.5E+00	carcinogenic effects	1.5E+00	2.1E+02	1.1E+03	N/A
1,2-Dichlorobenzene	6.0E+02	saturation limit	-	5.1E+03	2.5E+04	6.0E+02
1,3-Dichlorobenzene	6.0E+02	saturation limit	-	2.5E+03	1.2E+04	6.0E+02
1,4-Dichlorobenzene	1.0E+02	carcinogenic effects	1.0E+02	7.7E+03	3.9E+04	N/A
3,3-Dichlorobenzidine	1.7E+01	carcinogenic effects	1.7E+01	-	-	N/A
Dichlorodiphenyldichloroethane (DDD)	1.1E+02	carcinogenic effects	1.1E+02	2.6E+02	1.3E+03	N/A
Dichlorodiphenyldichloroethene (DDE)	7.6E+01	carcinogenic effects	7.6E+01	2.6E+02	1.3E+03	N/A
Dichlorodiphenyltrichloroethane (DDT)	7.6E+01	carcinogenic effects	7.6E+01	2.6E+02	1.3E+03	N/A
1,1-Dichloroethane	2.0E+02	carcinogenic effects	2.0E+02	3.1E+03	1.6E+04	1.7E+03
1,2-Dichloroethane	2.0E+01	carcinogenic effects	2.0E+01	5.5E+01	2.8E+02	1.8E+03
1,1-Dichloroethene	3.6E+00	carcinogenic effects	3.6E+00	7.8E+02	3.9E+03	1.5E+03
cis -1,2-Dichloroethene	2.6E+02	noncarcinogenic effects	-	2.6E+02	1.3E+03	1.2E+03
trans -1,2-Dichloroethene	4.1E+02	noncarcinogenic effects	-	4.1E+02	2.1E+03	3.1E+03
2,4-Dichlorophenol	1.2E+03	noncarcinogenic effects	-	1.2E+03	6.0E+03	N/A
1,2-Dichloropropane	3.7E+01	noncarcinogenic effects	4.0E+01	3.7E+01	1.9E+02	1.1E+03
1,3-Dichloropropene	1.5E+01	carcinogenic effects	1.5E+01	1.0E+02	5.2E+02	1.4E+03
Dieldrin	1.6E+00	carcinogenic effects	1.6E+00	2.6E+01	1.3E+02	N/A
Diethyl phthalate	3.2E+05	noncarcinogenic effects	-	3.2E+05	1.6E+06	N/A
Dimethyl phthalate	4.0E+06	noncarcinogenic effects	-	4.0E+06	2.0E+07	N/A
2,4-Dimethylphenol	8.2E+03	noncarcinogenic effects	-	8.2E+03	4.1E+04	N/A
2,4-Dinitrophenol	6.7E+03	noncarcinogenic effects	-	6.7E+03	3.3E+04	N/A
2,4-Dinitrotoluene	3.0E+01	carcinogenic effects	3.0E+01	8.0E+02	4.0E+03	N/A
1,4-Dioxane	7.4E+02	carcinogenic effects	7.4E+02	1.6E+07	7.9E+07	N/A
Dioxin (2,3,7,8-TCDD)	2.4E-04	carcinogenic effects	2.4E-04	-	-	N/A

Table K-3. Direct Exposure Soil Screening Levels
Construction/Trench Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens HQ = 0.2 (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
Endosulfan	2.4E+03	noncarcinogenic effects	-	2.4E+03	1.2E+04	N/A
Endrin	1.6E+02	noncarcinogenic effects	-	1.6E+02	7.8E+02	N/A
Ethylbenzene	4.0E+02	saturation limit	-	8.9E+03	4.4E+04	4.0E+02
Fluoranthene	1.4E+04	noncarcinogenic effects	-	1.4E+04	7.0E+04	N/A
Fluorene	1.4E+04	noncarcinogenic effects	-	1.4E+04	7.0E+04	N/A
Heptachlor	5.8E+00	carcinogenic effects	5.8E+00	2.6E+02	1.3E+03	N/A
Heptachlor epoxide	2.2E+00	carcinogenic effects	2.2E+00	5.2E+00	2.6E+01	N/A
Hexachlorobenzene	1.2E+01	carcinogenic effects	1.2E+01	3.2E+02	1.6E+03	N/A
Hexachlorobutadiene	8.0E+01	noncarcinogenic effects	2.6E+02	8.0E+01	4.0E+02	N/A
γ-Hexachlorocyclohexane (Lindane)	1.6E+02	noncarcinogenic effects	-	1.6E+02	8.0E+02	N/A
Hexachloroethane	4.0E+02	noncarcinogenic effects	5.1E+02	4.0E+02	2.0E+03	N/A
Indeno(1,2,3-c,d)pyrene	2.4E+01	carcinogenic effects	2.4E+01	1.1E+04	5.3E+04	N/A
Lead	7.5E+02	noncarcinogenic effects	-	7.5E+02	7.5E+02	N/A
Mercury (elemental)	3.3E+01	noncarcinogenic effects	-	3.3E+01	1.6E+02	N/A
Methoxychlor	-	-	-	-	-	N/A
Methylene chloride	5.2E+02	carcinogenic effects	5.2E+02	2.7E+03	1.4E+04	2.4E+03
Methyl ethyl ketone	3.4E+04	saturation limit	-	1.4E+05	7.0E+05	3.4E+04
Methyl isobutyl ketone	1.7E+04	saturation limit	-	1.1E+05	5.6E+05	1.7E+04
Methyl mercury	4.1E+01	noncarcinogenic effects	-	4.1E+01	2.0E+02	N/A
2-Methylnaphthalene	1.6E+03	noncarcinogenic effects	-	1.6E+03	8.2E+03	N/A
tert -Butyl methyl ether	2.6E+03	carcinogenic effects	2.6E+03	4.6E+04	2.3E+05	2.1E+04
Molybdenum	3.6E+03	noncarcinogenic effects	-	3.6E+03	1.8E+04	N/A
Naphthalene	1.3E+02	carcinogenic effects	1.3E+02	2.5E+02	1.2E+03	N/A
Nickel	2.6E+02	noncarcinogenic effects	-	2.6E+02	1.3E+03	N/A
Pentachlorophenol	9.9E+01	carcinogenic effects	9.9E+01	7.2E+02	3.6E+03	N/A
Perchlorate	5.0E+02	noncarcinogenic effects	-	5.0E+02	2.5E+03	N/A
Phenanthrene	1.2E+04	noncarcinogenic effects	-	1.2E+04	6.0E+04	N/A
Phenol	1.2E+05	noncarcinogenic effects	-	1.2E+05	6.1E+05	N/A
Polychlorinated biphenyls (PCBs)	3.4E+00	carcinogenic effects	3.4E+00	6.7E+00	3.4E+01	N/A
Pyrene	2.3E+04	noncarcinogenic effects	-	2.3E+04	1.2E+05	N/A
Selenium	3.6E+03	noncarcinogenic effects	-	3.6E+03	1.8E+04	N/A
Silver	3.6E+03	noncarcinogenic effects	-	3.6E+03	1.8E+04	N/A
Styrene	1.5E+03	saturation limit	-	1.9E+04	9.3E+04	1.5E+03

Table K-3. Direct Exposure Soil Screening Levels
Construction/Trench Worker Exposure Scenario

Chemical	Final Screening Level (mg/kg)	Basis	Carcinogens (Risk = 10^{-6}) (mg/kg)	Noncarcinogens HQ = 0.2 (mg/kg)	Noncarcinogens (HQ = 1.0) (mg/kg)	Saturation (mg/kg)
tert -Butyl alcohol	3.2E+05	saturation limit	-	-	-	3.2E+05
1,1,1,2-Tetrachloroethane	1.7E+02	carcinogenic effects	1.7E+02	1.2E+04	6.1E+04	2.0E+03
1,1,2,2-Tetrachloroethane	2.2E+01	carcinogenic effects	2.2E+01	5.3E+03	2.6E+04	2.0E+03
Tetrachloroethene	2.2E+01	carcinogenic effects	2.2E+01	1.5E+03	7.6E+03	2.3E+02
Thallium	5.7E+01	noncarcinogenic effects	-	5.7E+01	2.8E+02	N/A
Toluene	6.5E+02	saturation limit	-	2.6E+03	1.3E+04	6.5E+02
Toxaphene	2.2E+01	carcinogenic effects	2.2E+01	-	-	N/A
TPH (gasolines)	4.2E+03	noncarcinogenic effects	-	4.2E+03	2.1E+04	4.5E+03
TPH (middle distillates)	1.5E+02	saturation limit	-	4.2E+03	2.1E+04	1.5E+02
TPH (residual fuels)	1.5E+04	noncarcinogenic effects	-	1.5E+04	7.5E+04	N/A
1,2,4-Trichlorobenzene	3.1E+02	noncarcinogenic effects	5.7E+03	3.1E+02	1.6E+03	N/A
1,1,1-Trichloroethane	1.2E+03	saturation limit	-	1.1E+04	5.5E+04	1.2E+03
1,1,2-Trichloroethane	4.3E+01	carcinogenic effects	4.3E+01	2.0E+02	9.9E+02	1.8E+03
Trichloroethene	1.2E+02	noncarcinogenic effects	1.7E+02	1.2E+02	6.0E+02	1.3E+03
2,4,5-Trichlorophenol	1.4E+04	noncarcinogenic effects	-	1.4E+04	7.1E+04	N/A
2,4,6-Trichlorophenol	4.1E+01	noncarcinogenic effects	1.8E+03	4.1E+01	2.0E+02	N/A
Vanadium	7.1E+02	noncarcinogenic effects	-	7.1E+02	3.6E+03	N/A
Vinyl chloride	1.9E+00	carcinogenic effects	1.9E+00	2.6E+02	1.3E+03	1.2E+03
Xylenes	4.2E+02	saturation limit	-	1.2E+03	6.2E+03	4.2E+02
Zinc	2.1E+05	noncarcinogenic effects	-	2.1E+05	1.1E+06	N/A

Primary source: USEPA Region 9 Preliminary Remediation Goals (PRGs, USEPA 2004), modified as noted below. See text for discussion.

Notes:

See text for equations and assumptions used in models.

Final screening level is lowest of individual screening levels for carcinogenic effects and noncarcinogenic effects (based on HQ=0.2) or screening level for construction/trench workers if lower (see Table K-3). Saturation limit used as upper limit for volatile organic compounds that are liquid at ambient conditions (see text).

Carcinogens: Based on target cancer risk of 10^{-6}; modified with respct to CalEPA/OEHHA slope factors when available (marked by "*"). Screening levels for PCBs based on updated USEPA slope factors as presented in USEPA Region 9 Preliminary Remediation Goals document (USEPA 2004).

Noncarcinogens: Adjusted to target hazard quotient of 0.2 for use in tables for all chemicals. Screening levels based on hazard quotient of 1.0 provided for reference

Saturation: Theoretical soil saturation level in the absence of free product; calculated for volatile organic compounds that are liquids under ambient conditions (refer to Table J).

TPH:Total Petroleum Hydrocarbons. See text for discussion of different TPH categories.

Table L. Target Organs and Chronic Health Effects
(For general reference only. Not intended to be comprehensive. Refer to original documents for additional information.)

Chemical	Target Organs And Health Effects													
	[a]Carcinogen	[b]Alimentary Tract	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	[c]Skin	Other
Acenaphthene	NA	5,6						4					4	
Acenaphthylene	D						5,6	4					4	
Acetone	D	5,6					3		5,6					
Aldrin	B2	6								3				
Anthracene	D							4					4	
Antimony	D		4			3,4	5,7				4	1,3,4		hair loss (4)
Arsenic	A	3,4,6	1,2,4	1,2,3,4			3,4,6			1,2,3,4			1,3,4,6	
Barium	D		4				5		6		5			hypertension (6)
Benzene	A	3		1,2,4			1,2,3,4	3		1,2				
Benzo(a)anthracene	B2							4					4	No chronic toxicity factors.
Benzo(b)fluoranthene	B2							4					4	No chronic toxicity factors.
Benzo(k)fluoranthene	B2							4					4	No chronic toxicity factors.
Benzo(g,h,i)perylene	D	5,6					5,6	4	5,6				4	
Benzo(a)pyrene	B2							4			3		4	No chronic toxicity factors.
Beryllium	B1	1,6						2	1			1,2,3,4,6	3	
1,1-Biphenyl	D	3							6	3				
Bis(2-chloroethyl) ether	B2									4	4			No chronic toxicity factors.
Bis(2-chloroisopropyl) ether	NA						6							
Bis(2-ethylhexyl) phthalate	NA	7												No chronic toxicity factors.
Boron	D										4,6	5		
Bromodichloromethane	B2	4							4,6					
Bromoform (Tribromomethane)	B2	3,4,6							4	3,4				
Bromomethane	D	3,5,6	3	1,2					3,4	1,2,3,4		1,2,3,4,5,6		
Cadmium	B1								1,2,3,4,5,6			1,2,3,4		bone loss (1,4)
Carbon tetrachloride	B2	1,2,4,6		1,2					4	1,2				
Chlordane	B2	3,4,6						3,5		4				
p-Chloroaniline	NA	3,6						5	3				3	
Chlorobenzene	D	1,2,3,5,6					3		1,2,3,4,5	3	1,2			
Chloroethane	B	1,2		1,2,4										
Chloroform	B2	1,2,3,4,6		1,2					1,2,3,4					
Chloromethane	C/D			4						3	3,4			
2-Chlorophenol	D	1,4		1							1,5,6			
Chromium (total)	-													

Table L. Target Organs and Chronic Health Effects
(For general reference only. Not intended to be comprehensive. Refer to original documents for additional information.)

Chemical	Target Organs And Health Effects													
	[a]Carcinogen	[b]Alimentary Tract	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	[c]Skin	Other
Chromium III	D												3	
Chromium VI	A						1				2	1,6		
Chrysene	B2							4					4	No chronic toxicity factors.
Cobalt	NA		3									3	3	hearing (3)
Copper	D											1,4	3	
Cyanide	D		1,4		1,4,6		4			1,5,6		4		
Dibenz(a,h)anthracene	B2							4					3,4	
Dibromochloromethane	C	6												
1,2-dibromo-3-chloropropane		1		1					3		1,3,4,5,6	1		
1,2-Dibromoethane	B2			4							4	1,3		
1,2-Dichlorobenzene	D	3							3				3	
1,3-Dichlorobenzene	D	3							3					
1,4-Dichlorobenzene	C	1,2,3,6					3		1,2,3	1,2	6	1,2		
3,3-Dichlorobenzidine	B2	3												No chronic toxicity factors.
Dichlorodiphenyldichloroethane (DDD)	B2													No chronic toxicity factors.
Dichlorodiphenyldichloroethene (DDE)	B2													No chronic toxicity factors.
Dichlorodiphenyltrichloroethane (DDT)	B2	3,4,6								3	3			
1,1-Dichloroethane	C	3							3,4,5,7					
1,2-Dichloroethane	B2	1,2												
1,1-Dichloroethene	C/D	1,2,3,4,5,6							3	4		4		
cis -1,2-Dichloroethene	D	4					4,5,7							
trans -1,2-Dichloroethene	D	4					5,6					4		
2,4-Dichlorophenol	E							5						
1,2-Dichloropropane	B2	3					3					5		
1,3-Dichloropropene	B2	6										4		
Dieldrin	B2	6								3				
Diethyl phthalate	D			6							4			
Dimethyl phthalate	D													
2,4-Dimethylphenol	NA						5,6			5,6				
2,4-Dinitrophenol	NA					3,6				3				
2,4-Dinitrotoluene	B2	6	3				3			3,6				
1,4-Dioxane	B2	1,2	1,2						1,2					
Dioxin (2,3,7,8-TCDD)	NA	1,2,4		1,2,4	1,2,4		1,2	4			1,2,4	1,2,4	4	No chronic toxicity factors.

Table L. Target Organs and Chronic Health Effects
(For general reference only. Not intended to be comprehensive. Refer to original documents for additional information.)

Chemical	Target Organs And Health Effects													
	[a]Carcinogen	[b]Alimentary Tract	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	[c]Skin	Other
Endosulfan	NA	4		4,6			6	4	4,5,6	4,6	4			
Endrin	D	5,6		4					6	5				
Ethylbenzene	D	1,2,5,6		1,2,4,6	1,2				1,2,5,6	3	3		3	
Fluoranthene	D	5,6					5,6	4	5,6				4	
Fluorene	D						5,6	4					4	
Heptachlor	B2	6								7				
Heptachlor epoxide	B2	6								7				
Hexachlorobenzene	B2	1,3,4,6			4		4	4	4	3,4	3			bones (4)
Hexachlorobutadiene	C	4							4				3	
γ-Hexachlorocyclohexane (Lindane)	NA	1,3,6							1,3,6					
Hexachloroethane	C	3,4							3,4,6					
Indeno(1,2,3-c,d)pyrene	B2							4					4	No chronic toxicity factors.
Lead	B2	3,7	7	3,7			3,7	3,7	3,7	3,7	7			
Mercury (elemental)	D			4				1	1,3	1,2,3,5,6				
Methoxychlor	D	3		6					3	3	3,5,6			
Methylene chloride	B2	3,6	1,2						3	1,2				
Methyl ethyl ketone	D			6							1,3			
Methyl isobutyl ketone	NA									7				
Methyl mercury	C			6						1,6				
2-Methylnaphthalene	C						5,6	4					4	
tert-Butyl methyl ether	NA	1,2,6				1,2			1,2,6					
Molybdenum	D						6							
Naphthalene	B2					3	3	4				1,2,6	4	
Nickel	A/D	1,6					1,2		6			1,2,3	3	
Pentachlorophenol	B2	1,3,4,6		1,4			4	4	3,6	3,4	1	3,4		
Perchlorate					8		3							
Phenanthrene	D						5,6	4					4	
Phenol	D	1,2,3	1,2	4,6					1,2,3	1,2	5			
Polychlorinated biphenyls (PCBs)	B2	1,3,4		1,4	4	6	4	1,4,6			1,3,4		4	
Pyrene	D							4	5,6					
Selenium	D	1,2,3,6	1,2				6			1,2		1,3	3,4,6	Selenosis (4,6)
Silver	D												3,4,6	
Styrene	C	4,5,6					5,6			1,2,3,5,6		3	3	

Table L. Target Organs and Chronic Health Effects
(For general reference only. Not intended to be comprehensive. Refer to original documents for additional information.)

Chemical	Target Organs And Health Effects													
	[a]Carcinogen	[b]Alimentary Tract	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	[c]Skin	Other
tert-Butyl alcohol														No chronic toxicity factors.
1,1,1,2-Tetrachloroethane	C	6							6					
1,1,2,2-Tetrachloroethane	C	3,4								3,4				
Tetrachloroethene	NA	1,2,3,6							1,2,3					
Thallium	D	3	3			3	6			3,4	3,4		3	
Toluene	D	5,6		1,2,4					5,6	1,2,3,6	3	1,2,6		
Toxaphene	B2	4			4			4	4					
TPH (gasolines)	-													
TPH (middle distillates)	-													
TPH (residual fuels)	-													
1,2,4-Trichlorobenzene	D				5,6									
1,1,1-Trichloroethane	D	3,7								1,2				
1,1,2-Trichloroethane	C	6					7						3	
Trichloroethene	A	3,4,7		4,7		1,2	4	7	3,4,7	1,2,3,4				
2,4,5-Trichlorophenol	NA	1,3,5,6		1					3,5,6		1			
2,4,6-Trichlorophenol	B2	3												
Vanadium	D	4							4			3,4		

Table L. Target Organs and Chronic Health Effects
(For general reference only. Not intended to be comprehensive. Refer to original documents for additional information.)

Chemical	Target Organs And Health Effects													
	[a]Carcinogen	[b]Alimentary Tract	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	[c]Skin	Other
Vinyl chloride	A	1,3,4,6		1,4			3,4	4		4	1,4		3	No chronic toxicity factors.
Xylenes	D									1,2,3,4,5,6		1,2		
Zinc	D		1		4		1,2,4,5,6					1		

Notes:

a. Carcinogen type from RWQCBCV 2001; ORNL 2001 (see classification below).

b. Includes gastro-intestinal tract, liver, spleen, gall bladder, etc.

c. Includes skin sensitization but not general dermatitus or defatting of skin.

Perchlorate: Chronic effects as summarized in California DHS Perchlorate Action Level supporting documernt (CalDHS 2001).

Carcinogen Classification

A: Human carcinogen

B: Probable human carcinogen (B1: limited human evidence; B2 Sufficient evidence in animals and inadequate or no evidence in humans)

C: Possible human carcinogen

D: Not classifiable as to human carcinogenicity

E: Evidence of noncarcinogenicity for humans

NA: Carcinogen classification information not available

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8. For additional online references, see also: Hazardous Substances (On-line) Database: U.S. National Library of Medicine, Toxicology Data Network, http://toxnet.nlm.nih.gov