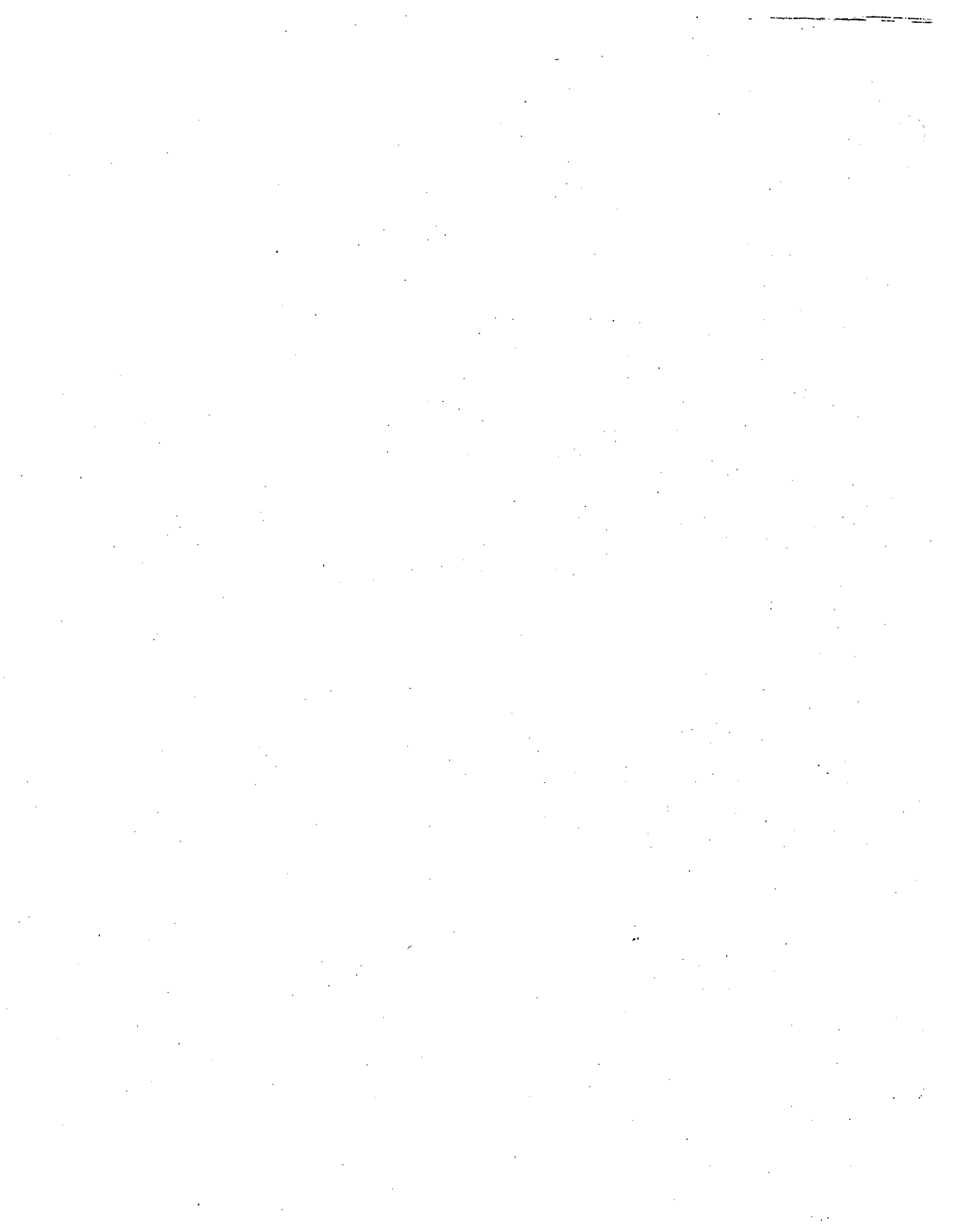


29. Smith, AH, Arroyo A, Guha Mazumder DN, Kosnett MJ, Hernandez A, Beeris M, Smith MT, More LE. Arsenic-induced skin lesions among Atacameño people in Northern Chile despite good nutrition and centuries of exposure. Submitted, 1999.

It has been suggested that the indigenous Atacameño people in Northern Chile might be protected from the health effects of arsenic in drinking water because of many centuries of exposure. Here we report on the first intensive investigation of arsenic-induced skin lesions in this population. Eleven families were selected from the village of Chiu Chiu which is supplied with water containing between 750 and 800  $\mu\text{g/L}$  of inorganic arsenic. For comparison, 8 families were also selected from a village where the water contains around 10  $\mu\text{g/L}$ . After being transported to the nearest city so that assessment could be done blind as to drinking water source, participants were examined by four physicians with experience in studying arsenic-induced lesions. Four of the six men from the exposed village who had been drinking the contaminated water for more than 20 years were diagnosed with skin lesions due to arsenic, but no women were found to have definite lesions. A 13 year old girl was found to have definite skin pigmentation changes due to arsenic, and a 19 year old boy had both pigmentation changes and keratoses on the palms and soles. Family interviews identified a wide range of fruit and vegetable consumption among affected participants, plus weekly intake of red meat and chicken. However, the prevalence of skin lesions found among men and children was as high or higher than reported with corresponding arsenic drinking water concentrations in both Taiwan and West Bengal, India, populations in which extensive malnutrition has been thought to increase susceptibility.

*Last updated August 17, 1999*



# **Screening For Environmental Concerns At Sites With Contaminated Soil and Groundwater**

## **Volume 1: Summary Tier 1 Lookup Tables**

Prepared by:

**California Regional Water Quality Control Board  
San Francisco Bay Region  
1515 Clay Street, Suite 1400  
Oakland, California 94612**

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(updated 9/4/03)**

Contact:

Roger D. Brewer, Ph.D.  
Associate Engineering Geologist  
Telephone: 1-510-622-2374  
E-mail: rdb@rb2.swrcb.ca.gov

OR

Sampath Rangarajan  
Water Resources Control Engineer  
Telephone: 1-510-622-2381  
E-mail: sr@rb2.swrcb.ca.gov

California Regional Water Quality Control Board  
San Francisco Bay  
1515 Clay Street, Suite 1400  
Oakland, California 94612

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# 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 ESLs replace screening levels presented in the previous edition of this document, entitled *Application of Risk-Based Screening Levels (RBSLs) And Decision Making to Sites With Impacted Soil and Groundwater* (December 2001). The change in terminology from "Risk-Based" screening levels to "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 toxicological 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, however, 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," RWQCBSF 1995) of the San Francisco Bay Area Regional Water Quality Control Board (RWQCB). These goals include:

#### Surface Water and Groundwater:

- Protection of drinking water resources;
- Protection of aquatic habitats;
- Protection against adverse nuisance conditions.

#### Soil:

- Protection of human health;
- Protection of groundwater;
- Protection of terrestrial biota;
- Protection against adverse nuisance conditions.

The ESLs are presented in a series of four 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 from those used to develop the Tier 1 ESLs are described in a more traditional, "Tier 3" risk assessment. The Tier 1 methodology can, however, 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. ESLs presented for chemicals that are known to be highly biodegradable in the environment may in particular be overly conservative for use as final cleanup levels (e.g., many petroleum-related compounds). 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 differ drastically from those assumed in development of the ESLs (e.g., mine sites, landfills, etc., with excessively 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 or marine shoreline or sites that otherwise contain or border 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 Toxic 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

### 1.1 Purpose

Preparation of detailed environmental risk assessments for sites impacted 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. Correlative 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, however, generally indicate that additional investigation and evaluation of potential environmental concerns is warranted.

The introductory text of this document is kept intentionally brief with a focus on the use of the ERLs rather than technical details about their derivation. The latter is provided in the appendices of Volume 2.

### 1.2 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 impacted groundwater in the Tier 1 indoor-air impact model or use of an approved, alternative target risk level for direct-exposure concerns. 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 impacted media. Consideration of the methodologies and potential environmental concerns discussed in this document is still encouraged, however. This will help increase the comprehensiveness and consistency of Tier 3 risk assessments as well as expedite their preparation and review.

### **1.3 Comparison To Existing Screening Levels**

Both Region IX of the U.S. Environmental Protection Agency (USEPA 2002) and the City of Oakland (Oakland 2000) have prepared lookup tables of Environmental Screening Levels for soil and water. The lookup tables presented in this document represent an expansion of this work to reflect the broader scope of environmental concerns put forth in the Regional Water Quality Control Board (RWQCB) Basin Plan (RWQCBSF 1995). Differences and similarities between the ESL document and lookup tables prepared by the other programs are summarized below.

#### **1.3.1 USEPA Region IX PRGs**

The U.S. Environmental Protection Agency (USEPA) Region IX "Preliminary Remediation Goals" or "PRGs" are intended to address human health concerns regarding direct exposure with impacted soils (USEPA 2002). The equations used to develop the USEPA 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 1996a). 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 USEPA Region IX document, the PRGs are intended to address human direct-exposure with impacted soil and "...do not consider impact to groundwater or address ecological concerns." (USEPA 2002). Expansion of the USEPA 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).

Use of the USEPA Region IX PRGs in the RWQCB lookup tables is discussed further in Section 3.2 of Appendix 1. A copy of the PRG background document is provided in Appendix 2.

### 1.3.2 City of Oakland Screening Levels

A brief comparison of the RWQCB and the City of Oakland approaches to the development of environmental screening levels is provided in Table 1-1. 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](http://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 RWQCB's jurisdiction.

The RWQCB 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, however, due to its highly-developed, urban setting

### 1.3.3 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 in general reflect drinking water or surface water goals of the time, although some are clearly out-of-date (e.g. trichloroethylene STLC value of 204 mg/L). TTLC values were derived by simply multiplying the STLC value by ten (organic substances) or one hundred (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, however, 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 impacted 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.

#### 1.3.4 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 Permissible Exposure Levels (PELs) for indoor air are intended for use in controlled, industrial work areas where employees are aware of potential health hazards associated with the chemicals they are using and are trained to take proper precautions and minimize exposure (NIOSH 2003). OSHA PELs are **not** appropriate for use at commercial/industrial sites where the chemical is not currently being used. This includes sites affected by the migration of offsite releases (e.g., via emissions from a moving plume of contaminated groundwater). Indoor-air protection goals for these sites should be based on long-term (chronic) health risk to workers. Such risk-based goals levels are typically much more stringent than OSHA PELs.

For example, the current OSHA PEL for trichloroethylene (TCE) is 678,000  $\mu\text{g}/\text{m}^3$  (100 ppmv, NIOSH 2003). Comparable risk-based screening levels for uncontrolled, commercial/industrial settings included in this document fall between 2.0  $\mu\text{g}/\text{m}^3$  and 10  $\mu\text{g}/\text{m}^3$  (carcinogenic effects vs noncarcinogenic effects, respectively; refer to Table E and Appendix 1, Table E-3). The PEL is applicable to work areas where TCE is being used and the employees have been properly trained to minimize exposure. The risk-based goals are applicable to all other areas.

#### 1.3.5 RWQCB Basin Plan

The RWQCB Basin Plan ("Basin Plan") presents generic soil screening levels of 1.0 mg/kg total volatile organic compounds (VOCs) and 10 mg/kg semi-volatile organic compounds (SVOCs, RWQCBSF 1995). The Basin Plan states that the need to develop chemical-specific screening is to be evaluated on a site-by-site basis. As can be inferred from the detailed ESLs provided in Appendix 1, the Basin Plan screening level for total VOCs is probably adequate to overly conservative for gasoline-range petroleum fuel mixtures at most sites. Chemical-specific ESLs for benzene and MTBE are less than 1 mg/kg, due to their human toxicity and/or mobility in soil. The prevalence of less toxic and mobile VOCs in gasoline-range fuel mixtures (e.g., toluene, ethylbenzene, xylenes, etc.), however, would generally ensure that a total VOC screening level of 1 mg/kg adequately addresses concerns regarding these compounds in the absence of chemical-specific ESLs. The total VOC screening level is in all likelihood overly conservative for



most heavier fuel mixtures that lack significant amounts of benzene and MTBE (e.g., diesel fuel).

For direct-exposure, human health concerns, the Basin Plan screening level of 1 mg/kg for total VOCs as presented in the Basin Plan is adequate to marginally over-conservative for the most commonly detected chlorinated solvents (e.g., tetrachloroethylene, trichloroethane, trichloroethylene, etc.). From a modeling perspective, the screening level may be somewhat under-conservative for potential leaching and groundwater protection concerns (e.g., see Appendix 1, Table G). The model used to generate screening levels for leaching of chemicals from soil conservatively assumes, however, that the impacted soil was situated within one meter of groundwater. At the vast majority of sites where this is the actual case, groundwater has already been impacted by the main mass of chemicals and direct monitoring provides a more accurate evaluation of leaching impacts. For sites where impacted soil is situated greater than 10 meters from groundwater, model-generated screening levels developed by other agencies suggest that a screening level of 1 mg/kg (or more) may be adequate for chlorinated VOCs (e.g., HIDO 1995).

The Basin Plan screening level of 10 mg/kg for total semi-volatile organic compounds (SVOCs) is probably overly conservative for these compounds for groundwater protection purposes. For soils impacted with carcinogenic SVOCs, the Basin Plan screening level has traditionally been used in conjunction with human-health screening levels presented in the USEPA PRGs. The PRGs are also referenced in this document although with some modifications.

The Basin Plan references a total petroleum hydrocarbon (TPH) soil screening level of 100 mg/kg for the protection of drinking water resources. A similar screening level was developed for use in this document. As noted in the lookup tables and discussed in Appendix 1, however, this screening level is considered to be overly conservative for heavy, residual fuels (fuel oil #6, motor oil, etc.) as well as for use at sites that do not pose a direct threat to drinking water or surface water resources.

## **1.4 Chemicals Not Listed In Lookup Tables**

The lookup tables list 100-plus chemicals most commonly found at sites with impacted 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 RWQCB 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 (refer to Section 3.0).

## 1.5 Limitations

The Tier 1 ESLs presented in the lookup tables are NOT required, 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 impacted sites in developed areas. As discussed in Chapter 3, however, 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 with less than 3.0m (ten feet) of low permeability soils (clay, silt, etc.) between impacted groundwater and the ground surface (including potential downgradient areas; applies only to use of groundwater screening levels for sites with low permeability, vadose-zone soils);
- Sites with high rainfall and subsequent high surface water infiltration rates (i.e., infiltration >28 inches (720mm) per year),
- Sites where inorganic chemicals (e.g., metals) are potentially mobile in leachate due to soil or groundwater conditions different than 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 (refer also to discussion of screening levels in Appendix 1). 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 highly biodegradable in the environment may in particular be overly 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 impacted 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 RWQCB.

Soil ESLs do not consider potential water- or wind-related erosion and deposition of contaminants in a sensitive ecological habitat. 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 RWQCB *Erosion and Sediment Control Field Manual* provides practical information on the mitigation of erosion and runoff concerns.

It is conceivable that soil, 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 exceptionally 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). As discussed in Appendix 1, conservative target risks are used in part to address these uncertainties.

Table 1-1. Comparison of RWQCB and Oakland Risk-Based Approaches

		RWQCB	<sup>1</sup> Oakland
<b>General Approach</b>	Tiers	One tier of look-up tables. Includes separate screening levels for indoor air concerns based on soil type.	Two tiers of look-up tables: Tier 1 table applicable at any Oakland site; Tier 2 tables (3) account for site-specific soil types (Merritt Sands, sandy silts, and clayey silts) and alternate target risk. Tier 3 spreadsheets provided.
	Target Cancer Risk Level	10 <sup>-6</sup>	10 <sup>-6</sup> for Tier 1; 10 <sup>-5</sup> for Tier 2.
	Target Noncancer Hazard Quotient	0.2 (with option for site specific adjustment)	1.0 (with requirement to address cumulative risk as necessary)
	Ceiling/Nuisance Levels	"Ceiling levels" to address gross contamination concerns, nuisances, free-product mobility, and general resource quality	No "ceiling levels"; recommends removal of mobile or potentially-mobile free product.
	Total Petroleum Hydrocarbons	Screening levels for TPH included	No TPH screening levels.
<b>Soil Pathways</b>	Definition of "Shallow" Soils	0-3 meters below ground surface.	0-1 meter below ground surface.
	Direct Exposure, Inhalation of Volatiles	USEPA PRG model (USEPA 2002). Assumes "infinite" source thickness for volatile organic compounds.	ASTM (1995) model. Assumes infinite source unless mass balance conditions violated based on 1.0 m thick source.
	Ecological Concerns	Screening levels for terrestrial biota included (shallow soils only).	Recommends site-specific analysis when significant ecological habitats are threatened.
	Deep Soils	Direct-exposure soil screening levels for Construction/ Trench Worker exposure scenario.	No screening levels for this scenario; recommends a site-specific analysis as warranted.
<b>Groundwater</b>	Leaching Model	Employs the SESOIL model.	Employs the ASTM (1995) model.
	Leaching of Inorganic Compounds	No soil screening levels; recommends laboratory tests.	Soil screening levels for inorganic compounds, based on a neutral pH.
	Surface Water Protection	Groundwater screening levels for the ecological and aesthetic protection of surface water.	Screening levels for recreational use of groundwater and surface water. Recommends site-specific analysis of ecological and aesthetic concerns as warranted.
<b>Indoor Air</b>	Thickness of Soil Source	Assumes five meters. Recommends site-specific analysis as warranted.	Assumes "infinite" source thickness.
	Convective Flow	Incorporates convective flow in indoor-air impact model.	Does not incorporate convective flow (i.e., assumes no pressure differential) in indoor-air impact model.
	Surface Soil Screening Levels	Includes screening levels for protection of indoor air for both surface and subsurface soils.	Recommends site-specific analysis and controls for shallow soils (<1m) and use of screening levels for deeper soils.
	Soil Gas	Includes screening levels for soil gas.	Not included.

1. Oakland Risk-Based Corrective Action: Technical Background Document: City of Oakland, Environmental Services Division, January 2000 (and updates), [www.oaklanddpw.com/urprogram](http://www.oaklanddpw.com/urprogram).

# 2

## Tier 1 Lookup Tables

### 2.1 Organization of 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 an impacted 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 represents 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," RWQCBSF 1995), prepared by the San Francisco Bay Area Regional Water Quality Control Board (RWQCB). 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 habitats (discharges to surface water);
- Protection against nuisance concerns (odors, etc.) and general resource degradation.

#### Soil Quality:

- Protection of human health
  - Direct/indirect exposure to impacted 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 the purpose of this document, "soil" refers to any un lithified material in the vadose 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 is correlative 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 impacted 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 Tier ESL tables presented in Volume 1 of 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 provided in Appendix 1 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 tetrachloroethylene (PCE) is presented in Figure 2 (surface soils, drinking water resource threatened, unrestricted land use desired). A more detailed discussion of this example is provided in Appendix 1.

## 2.2 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, where all chemicals of potential concern have been identified. 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 impacted 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 2.3). Next, determine the depth below ground surface to the top of impacted soil (see Section 2.4). 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, "Unrestricted Land Use Permitted" or "Commercial/Industrial Land Use Only". Screening levels for unrestricted land used are considered to be adequate for residential use of a property. **For evaluation of commercial/industrial properties, it is highly 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 to these purposes only (see Section 2.9).

### **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 impacted soil. Correlative screening levels for surface water are also provided. Replace ESLs with naturally occurring, background concentrations of chemicals of concern (e.g., arsenic) or laboratory method reporting levels if higher (see Section 2.8).

### **Step 7: Determine Extent of Impacted Soil and/or Groundwater**

Using the selected ESLs, determine the extent of impacted 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 (see Appendix 1, Section 6.2). 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 sites where an adequate number of data points are available, the use of statistical methods to estimate more site-specific exposure point concentrations and evaluate environmental risks may be appropriate. The exposure point concentration is generally selected as the lesser of the maximum-detected concentration and the 95% upper confidence interval of the arithmetic mean of sample data. Guidance for the estimation of exposure point concentrations, use of "non-detect" data, and other issues is provided in the CalEPA 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 1996a), among other sources. As discussed in these documents, sample data collected outside of impacted areas should generally not be included in estimation of exposure point concentrations. **For residential land use scenarios, sample data should be averaged over no more than a 1,000 ft<sup>2</sup> area.**

### **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 (see Section 2.11). Decisions for or against additional actions should always be made in conjunction with guidance from the overseeing regulatory agency.

Note that impacts to soil and water from petroleum mixtures are 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 1996a):

#### **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
- dibenzo(a,h)anthracene
- fluoranthene
- fluorene
- indeno(1,2,3)pyrene
- naphthalene
- phenanthrene
- pyrene

The TPH ESLs should be used in conjunction with ESLs for these chemicals. As discussed in Appendix 1, the "middle distillates" category of TPH includes diesel fuel kerosene, stoddard solvent, home heating fuel, jet fuel and similar petroleum mixtures. "Residual fuels" includes heavy petroleum products such as No. 6 fuel oil ("Bunker C"), lubricating oils, "waste oils" and asphalts. Soil and groundwater impacted 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.

## **2.3 Groundwater Beneficial Use**

As stated in the San Francisco Bay Region *Water Quality Control Plan* ("Basin Plan", RWQCBSF 1995), "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 RWQCB 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. This is discussed in greater detail in Chapters 2 and 3 of Appendix 1.

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 RWQCB 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 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% sand-size (or larger) material or more than 30% 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 impacted soil. For chemicals that are especially toxic to aquatic life (e.g., several long-chain hydrocarbons, pesticides and heavy metals), however, screening levels for sites that threaten drinking water resources may be driven by surface water/aquatic habitat protection concerns. This is discussed in more detail in Appendix 1.

## 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 1996a) and is regarded as the maximum, likely depth that impacted soil could at some point in the future be excavated and left exposed at the surface 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 correlative ESLs for shallow soils (e.g., compare PCB ESLs in Tables A and C). For chemicals that are easily leached from soil or potentially emitted to the air as a volatile gas, however, groundwater and indoor-air protection concerns usually drive selection of the final ESL regardless of the depth of the impacted soil. This is the case for several of the highly volatile, chlorinated organic compounds. As a result, correlative shallow and deep soil ESLs are identical (e.g., compare trichloroethylene ESLs in Tables A and C).

If impacted soil extends across the three-meter dividing line between 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 2.9, however, the pros and cons 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 (refer to Chapter 3), 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 impacted 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 (e.g., refer to DTSC 2002). ESLs listed under this category incorporate conservative assumptions regarding long-term, frequent exposure of children and adults to impacted soils in a residential setting (see Appendices 1, Section 3.2 and Appendix 2). 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 seriously 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 2.9.

**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-impacted 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, with the addition of screening levels for the potential bioaccumulation of chemicals in aquatic organisms and subsequent human consumption of these organisms. Locally, the areas north of the Dumbarton Bridge and west of the Richmond-San Rafael Bridge are considered to be marine. 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.

For the purposes of the Tier 1 lookup tables, it is assumed that impacted or potentially impacted 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 (refer also to Appendix 1).

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 impacted 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, however, 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 impacted 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 impacted 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 impacted groundwater. This may be especially true for groundwater impacted with highly sorptive (lipophilic) chemicals, including heavy petroleum products.

Potential erosion and runoff of surface soils from impacted sites may also need to be considered, particularly at sites impacted 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 Indoor-Air Impact Concerns

Volatile chemicals can be emitted from contaminated soil or groundwater and intrude overlying buildings, impacting the quality of indoor air. Heating systems, basements, and strong winds can exacerbate this problem by reducing the internal air pressure and creating a "vacuum effect" that enhances the advective flow of vapors out of the underlying soil and into the building. Additional information on subsurface vapor intrusion into buildings is provided in the USEPA document *User's Guide For The Johnson and Ettinger (1991) Model For Subsurface Vapor Intrusion Into Buildings* (USEPA 2000; refer also to Appendix 1).

The direct collection and analysis of indoor air samples would seem to be an easy way to evaluate this concern. Identification of the source of impacts is complicated, however, by the presence of the same chemicals in many household goods (aerosol sprays, dry-cleaned clothing, cleaners, etc.). In addition, plumes of groundwater impacted with volatile chemicals are known to extend over significant areas and comprehensive testing of every structure over the plume is not practical.

As an alternative, the comparison of site groundwater, soil gas and soil data to conservative screening levels for indoor air concerns is recommended. Screening levels incorporated into this document are based on scientific models for vapor intrusion into buildings as well as a growing body of data from actual field investigations. A detailed discussion of the screening levels is presented in Appendix 1. The following three-phase, sequential approach is recommended for initial evaluation of potential indoor-air impact concerns at sites where shallow groundwater has been impacted by volatile chemicals:

- 1) Compare groundwater data to appropriate screening levels for indoor air concerns (see Table E-1a of Appendix 1).

- 2) For areas over the plume where groundwater screening levels for indoor-air concerns are approached or exceeded, collect shallow soil gas samples under (preferred) or adjacent to buildings and compare results to soil-gas screening levels for this concern (refer to Table E in this volume or Table E-2 in Appendix 1).
- 3) At buildings soil-gas screening levels for indoor-air concerns are approached or exceeded, collect indoor-air samples and compare results to indoor-air screening levels (refer to Table E in this volume or Table E-3 in Appendix 1).

For sites where the vapor permeability of shallow soils has not been evaluated, screening levels for groundwater overlain by highly permeable vadose-zone soils should be used. Imported fill material or disturbed native soils should be considered to be highly permeable unless site-specific data indicates otherwise.

Unless inhibited by very high water tables or other obstacles, soil gas samples should be collected immediately beneath the foundations of existing buildings (e.g., "subslab" or in crawl spaces) or three to five feet below ground surface in open areas where buildings may be constructed in the future. Soil gas samples collected from depths less than three feet are currently considered unreliable due to the increased potential to draw in ambient, surface air. If site-specific modeling of vapor flow rates or indoor-air impacts is to be carried out, the collection of additional geotechnical data at the time soil gas samples are collected should be considered (soil grain-size analysis, moisture content, vapor permeability, etc.).

Soil screening levels for potential indoor-air concerns are incorporated into the summary tables of this volume and presented separately in Table E-1b of Appendix 1. At sites where minor releases of volatile chemicals have occurred (e.g., restricted spills around underground tank fill ports), direct comparison of soil screening levels to site data is generally acceptable. If screening levels are exceeded, a similar approach to that outlined above for impacted groundwater is recommended. The restricted size of soil samples and the difficulty in predicting vapor-phase concentrations of chemicals from soil data limits the use of this data as a stand-alone tool for evaluating indoor-air concerns. **At sites where significant releases of volatile chemicals have occurred, the direct use of soil gas data in conjunction with soil data is strongly recommended.**

Guidance on the collection of indoor air and soil gas samples is provided in the following documents, among other sources:

- *Indoor Air Sampling And Evaluation Guide* (2002): Massachusetts Department of Environmental Protection, Office of Research and Standards, WSC Policy #02-430; <http://www.state.ma.us/dep/bwsc/finalpoi.htm>;

- *Soil Gas Advisory* (January 2003): Department of Toxic Substances Control and Los Angeles Regional Water Quality Control Board; [http://www.dtsc.ca.gov/PolicyAndProcedures/SiteCleanup/SMBR\\_ADV\\_activesoilgasinvst.pdf](http://www.dtsc.ca.gov/PolicyAndProcedures/SiteCleanup/SMBR_ADV_activesoilgasinvst.pdf).

Additional information on the intrusion of subsurface vapors into buildings will be incorporated into this document as available. Individuals are encouraged to provide comments and suggestions to the contacts listed in the front of this document at anytime.

## 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. Potential examples include the soil health-based ESLs for dioxin (e.g., 0.0000045 mg/kg for residential exposure).

Background concentrations of metals in soils are presented in the summary lookup tables in cases where they exceed screening levels for human health and environmental concerns. This is particularly an issue for arsenic and thallium in Bay area soils. For example, typical mean background concentrations of arsenic in Bay area soils ranges from approximately 5 mg/kg to 20 mg/kg, with some soils containing up to 40+ mg/kg arsenic (LBNL 2002). These concentrations are well above the health-based, direct-exposure goals for arsenic in soil of 0.39 mg/kg (residential exposure) and 1.6 mg/kg (commercial/industrial exposure) presented in the appendices.

For use in this document, an assumed background level of 5.5 mg/kg arsenic was substituted for toxicity-based goals in the lookup table if higher than the later. A background concentration of 58 mg/kg total chromium in soil is also assumed in the lookup tables. Note that background levels of total chromium can be significantly higher (>1,000 mg/kg) in soils developed over mafic and ultramafic rocks in the Bay area. Refer also to Appendix 1, Section 3.2.4 for additional discussion of this issue.

Figure 4 suggests steps that could be taken when evaluating a site for potential arsenic impacts. The natural background concentration of a chemical in soil or groundwater can vary significantly 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 1996a). Sources of background metal concentration in soils in California include the University of California-Riverside report *Background Concentrations of Trace and Major Elements in California Soils* (UCR 1996) and the Lawrence Berkeley



Laboratory document *Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory* (LBNL 2002).

A similar approach should be taken for total chromium. Additional review of background total chromium concentrations in soil should be carried out at sites where the screening level of 58 mg/kg is exceeded. If reported levels of total chromium still appear to exceed anticipated site-specific background levels, then soil samples should be tested for Cr VI and Cr III. Data should be compared to screening levels for these specific species of chromium and action taken as needed.

## 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. For example, the screening level for polychlorinated biphenyls (PCBs) in surface soils is 0.22 mg/kg in residential areas but up to 7.0 mg/kg (at target risk of  $10^{-5}$ ) for commercial/industrial areas. Even higher levels of PCBs could potentially be allowed to remain in place onsite provided that adequate controls to mitigate potential exposure are put into effect (e.g., permanent cap, protection of groundwater, etc.).

The use of final cleanup levels less stringent than those appropriate for unrestricted land use will, however, 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 impacted soil will remain isolated below the ground surface "for eternity". For single-family, residential areas, future disturbance of soil situated greater than three meters is generally considered to be unlikely (CalEPA 1996a) and use of the ESLs for deep soil below this depth without restrictions may be reasonable (see Section 2.4). During the redevelopment of properties for commercial/industrial or high-density residential use, however, excavation and removal of soils from depths in excess of five or even ten 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, impacted soils

at properties where the subsurface ESLs (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 impacted 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 the soils in fact meet 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 unexpectedly become desirable for other use in the future (e.g., residential, school day care, health care, etc.). **Assumptions that impacted soil at a property will remain isolated at shallow depths under pavement, buildings or some other type of "cap" should likewise be avoided if at all possible.** 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 effects 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 noncarcinogenic health effects. A summary of example target health effects for the chemicals listed in the lookup tables is provided in Appendix 1 (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 ("systemic") health effects are present. This is based on a combination of conservative exposure assumptions and target risk factors in direct-exposure models. Refer to Appendix 1, Section 1.3, for additional discussion of this subject.

## 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 unrestricted land use to evaluate need for formal covenants to the deed; see Section 2.9).**

### 2. Summary of Site Investigation:

- Identify all types of impacted 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)?
- Is the thickness of vadose-zone soils impacted by volatile organic compounds greater than three meters (10 feet, see Section 1.5 and Appendix 1);
- Have more than three carcinogens or five chemicals with similar noncarcinogenic health effects been identified (see Section 2.10)?

- Other issues as applicable to the site.
4. Soil and Groundwater Categorization (see Sections 2.3 and 2.4):
- State the regulatory beneficial use of impacted or potentially impacted 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 impacted soil as applicable to the lookup tables (e.g., soil stratigraphy, soil texture and permeability, depth to and thickness of impacted soil, etc.).
5. Exposure Point Concentrations (see Section 2.2, Step 7):
- Identify maximum concentrations of chemicals present in impacted media.
  - Describe how alternative exposure point concentrations were determined (e.g., 95% UCLs), if proposed, and provide supporting data. **For residential land use scenarios, sample data should be averaged over no more than a 1,000 ft<sup>2</sup> area.**
  - Discuss the need to evaluate groundwater data with respect to surface water standards for potential bioaccumulation of chemicals in aquatic organisms ("Elevated threat to surface water body"), 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 2.8).
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 (presented in Volume 1) and discuss general results.
  - If desired or recommended, compare site data to detailed ESLs for individual environmental concerns (presented in Volume 2, Appendix 1) and discuss specific, potential environmental concerns present at site.
7. Conclusions (see Section 2.9):
- 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 at 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.

**TABLE B: SHALLOW SOIL ( $\leq 3$ M BGS) - WATER IS NOT  
A CURRENT OR POTENTIAL SOURCE OF  
DRINKING WATER**

**Notes:**

- Always compare final soil data for commercial/industrial sites to residential ESLs and evaluate need for formal land-use restrictions (see Section 2.9).
- Assumption that groundwater is not a current or potential source of drinking water should be approved by overseeing regulatory agency prior to use of this table (see Section 2.3).

**TABLE A. ENVIRONMENTAL SCREENING LEVELS (ESLs)**  
**Shallow Soils (<3m bgs)**  
**Groundwater IS Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
ACENAPHTHENE	1.6E+01	1.6E+01	2.0E+01
ACENAPHTHYLENE	1.3E+01	1.3E+01	3.0E+01
ACETONE	2.4E-01	2.4E-01	7.0E+02
ALDRIN	2.9E-02	1.0E-01	2.0E-03
ANTHRACENE	2.8E+00	2.8E+00	7.3E-01
ANTIMONY	6.3E+00	4.0E+01	6.0E+00
ARSENIC	5.5E+00	5.5E+00	3.6E+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	2.7E-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	2.7E+01	2.7E+01	1.0E-01
BENZO(a)PYRENE	3.8E-02	1.3E-01	1.4E-02
BERYLLIUM	4.0E+00	8.0E+00	2.7E+00
BIPHENYL, 1,1-	6.5E-01	6.5E-01	5.0E-01
BIS(2-CHLOROETHYL)ETHER	1.8E-04	1.8E-04	1.4E-02
BIS(2-CHLOROISOPROPYL)ETHER	5.4E-03	5.4E-03	5.0E-01
BIS(2-ETHYLHEXYL)PHTHALATE	6.6E+01	6.6E+01	4.0E+00
BORON	1.6E+00	2.0E+00	1.6E+00
BROMODICHLOROMETHANE	1.2E-02	3.9E-02	1.0E+02
BROMOFORM	2.2E+00	2.2E+00	1.0E+02
BROMOMETHANE	2.2E-01	3.9E-01	9.8E+00
CADMIUM	1.7E+00	7.4E+00	2.2E+00
CARBON TETRACHLORIDE	1.2E-02	3.5E-02	5.0E-01
CHLORDANE	4.4E-01	1.7E+00	4.0E-03
CHLOROANILINE, p-	5.3E-02	5.3E-02	5.0E+00
CHLOROBENZENE	1.5E+00	1.5E+00	2.5E+01
CHLOROETHANE	6.3E-01	8.5E-01	1.2E+01
CHLOROFORM	9.8E-02	2.7E-01	1.0E+02
CHLOROMETHANE	2.9E-01	4.2E-01	2.7E+00
CHLOROPHENOL, 2-	1.2E-02	1.2E-02	1.8E-01
CHROMIUM (Total)	5.8E+01	5.8E+01	5.0E+01
CHROMIUM III	7.5E+02	7.5E+02	1.8E+02
CHROMIUM VI	1.8E+00	1.8E+00	1.1E+01
CHRYSENE	3.8E+00	1.3E+01	2.9E-01
COBALT	4.0E+01	8.0E+01	3.0E+00
COPPER	2.3E+02	2.3E+02	3.1E+00
CYANIDE (Free)	1.0E+02	5.0E+02	1.0E+00
DIBENZO(a,h)ANTHTRACENE	1.1E-01	3.8E-01	8.5E-03
DIBROMOCHLOROMETHANE	1.9E-02	5.8E-02	1.0E+02
1,2-DIBROMO-3-CHLOROPROPANE	1.1E-03	1.1E-03	2.0E-01
DIBROMOETHANE, 1,2-	3.3E-04	3.3E-04	5.0E-02
DICHLOROBENZENE, 1,2-	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 PARAMETER	<sup>1</sup> Shallow Soil		<sup>2</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/Industrial Land Use Only (mg/kg)	
DICHLOROBENZENE, 1,3-	7.2E-01	7.2E-01	6.3E+00
DICHLOROBENZENE, 1,4-	4.7E-02	1.3E-01	5.0E+00
DICHLOROBENZIDINE, 3,3-	7.7E-03	7.7E-03	2.9E-02
DICHLORODIPHENYLDICHLOROETHANE (DDD)	2.4E+00	1.0E+01	1.0E-03
DICHLORODIPHENYLDICHLOROETHYLENE (DDE)	1.7E+00	4.0E+00	1.0E-03
DICHLORODIPHENYLTRICHLOROETHANE (DDT)	1.7E+00	4.0E+00	1.0E-03
DICHLOROETHANE, 1,1-	2.0E-01	2.0E-01	5.0E+00
DICHLOROETHANE, 1,2-	4.5E-03	4.5E-03	5.0E-01
DICHLOROETHYLENE, 1,1-	1.0E+00	1.0E+00	6.0E+00
DICHLOROETHYLENE, Cis 1,2-	1.9E-01	1.9E-01	6.0E+00
DICHLOROETHYLENE, Trans 1,2-	6.7E-01	6.7E-01	1.0E+01
DICHLOROPHENOL, 2,4-	3.0E-01	3.0E-01	3.0E-01
DICHLOROPROPANE, 1,2-	5.2E-02	1.2E-01	5.0E+00
DICHLOROPROPENE, 1,3-	3.3E-02	5.9E-02	5.0E-01
DIELDRIN	2.3E-03	2.3E-03	1.9E-03
DIETHYLPHTHALATE	3.5E-02	3.5E-02	1.5E+00
DIMETHYLPHTHALATE	3.5E-02	3.5E-02	1.5E+00
DIMETHYLPHENOL, 2,4-	6.7E-01	6.7E-01	1.0E+02
DINITROPHENOL, 2,4-	4.0E-02	4.0E-02	1.4E+01
DINITROTOLUENE, 2,4-	8.5E-04	8.5E-04	1.1E-01
1,4 DIOXANE	1.8E-03	1.8E-03	3.0E+00
DIOXIN (2,3,7,8-TCDD)	4.5E-06	1.8E-05	5.0E-06
ENDOSULFAN	4.6E-03	4.6E-03	8.7E-03
ENDRIN	6.5E-04	6.5E-04	2.3E-03
ETHYLBENZENE	3.3E+00	3.3E+00	3.0E+01
FLUORANTHENE	4.0E+01	4.0E+01	8.0E+00
FLUORENE	8.9E+00	8.9E+00	3.9E+00
HEPTACHLOR	1.4E-02	1.4E-02	3.8E-03
HEPTACHLOR EPOXIDE	1.5E-02	1.5E-02	3.8E-03
HEXACHLOROBENZENE	2.7E-01	9.6E-01	1.0E+00
HEXACHLOROBUTADIENE	1.0E+00	1.0E+00	2.1E-01
HEXACHLOROCYCLOHEXANE (gamma) LINDANE	4.9E-02	4.9E-02	8.0E-02
HEXACHLOROETHANE	2.4E+00	2.4E+00	7.0E-01
INDENO(1,2,3-cd)PYRENE	3.8E-01	1.3E+00	2.9E-02
LEAD	2.0E+02	7.5E+02	2.5E+00
MERCURY	2.5E+00	1.0E+01	1.2E-02
METHOXYCHLOR	1.9E+01	1.9E+01	1.9E-02
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	1.0E+01	3.0E-03
METHYLNAPHTHALENE (total 1- & 2-)	2.5E-01	2.5E-01	2.1E+00
METHYL TERT BUTYL 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 PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
NAPHTHALENE	4.2E+00	4.2E+00	2.1E+01
NICKEL	1.5E+02	1.5E+02	8.2E+00
PENTACHLOROPHENOL	4.4E+00	5.0E+00	1.0E+00
PERCHLORATE	7.0E-03	7.0E-03	7.0E-01
PHENANTHRENE	1.1E+01	1.1E+01	4.6E+00
PHENOL	7.6E-02	7.6E-02	5.0E+00
POLYCHLORINATED BIPHENYLS (PCBs)	2.2E-01	7.4E-01	1.4E-02
PYRENE	8.5E+01	8.5E+01	2.0E+00
SELENIUM	1.0E+01	1.0E+01	5.0E+00
SILVER	2.0E+01	4.0E+01	1.9E-01
STYRENE	1.5E+00	1.5E+00	1.0E+01
tert-BUTYL ALCOHOL	7.3E-02	7.3E-02	1.2E+01
TETRACHLOROETHANE, 1,1,1,2-	2.4E-02	2.4E-02	1.3E+00
TETRACHLOROETHANE, 1,1,2,2-	9.0E-03	1.8E-02	1.0E+00
TETRACHLOROETHYLENE	8.8E-02	2.5E-01	5.0E+00
THALLIUM	1.0E+00	1.3E+01	2.0E+00
TOLUENE	2.9E+00	2.9E+00	4.0E+01
TOXAPHENE	4.2E-04	4.2E-04	2.0E-04
TPH (gasolines)	1.0E+02	1.0E+02	1.0E+02
TPH (middle distillates)	1.0E+02	1.0E+02	1.0E+02
TPH (residual fuels)	5.0E+02	1.0E+03	1.0E+02
TRICHLOROBENZENE, 1,2,4-	7.6E+00	7.6E+00	2.5E+01
TRICHLOROETHANE, 1,1,1-	7.8E+00	7.8E+00	6.2E+01
TRICHLOROETHANE, 1,1,2-	3.3E-02	7.0E-02	5.0E+00
TRICHLOROETHYLENE	2.6E-01	4.6E-01	5.0E+00
TRICHLOROPHENOL, 2,4,5-	1.8E-01	1.8E-01	1.1E+01
TRICHLOROPHENOL, 2,4,6-	1.7E-01	1.7E-01	5.0E-01
VANADIUM	1.1E+02	2.0E+02	1.5E+01
VINYL CHLORIDE	6.7E-03	1.9E-02	5.0E-01
XYLENES	1.5E+00	1.5E+00	1.3E+01
ZINC	6.0E+02	6.0E+02	8.1E+01

**TABLE A. ENVIRONMENTAL SCREENING LEVELS (ESLs)  
Shallow Soils (<3m bgs)  
Groundwater IS Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/Industrial Land Use Only (mg/kg)	
Electrical Conductivity (mS/cm, USEPA Method 120.1 MOD)	2.0	4.0	not applicable
Sodium Adsorption Ratio	5.0	12	not applicable

**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.
- Source of soil ESLs: Refer to Appendix 1, Tables A-1 and A-2.
- Source of groundwater ESLs: Refer to Appendix 1, Table F-1a.
- Soil data should be reported on dry-weight basis (see Appendix 1, Section 6.2).
- 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-impacted soil. See Section 2.6 and Table E.
- 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 (refer to Section 2.6 and Appendix 1, Table F-1a).
- Aquatic habitat goals for bioaccumulation concerns not considered in selection of groundwater goals (refer to Section 2.7). Refer to appendices for summary of ESL components.
- TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.). See Volume 1, Section 2.2 and Appendix 1, Chapter 5.

**TABLE B. ENVIRONMENTAL SCREENING LEVELS (ESLs)**  
**Shallow Soils (<3m bgs)**  
**Groundwater IS NOT a Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/Industrial Land Use Only (mg/kg)	
ACENAPHTHENE	1.9E+01	1.9E+01	2.3E+01
ACENAPHTHYLENE	1.3E+01	1.3E+01	3.0E+01
ACETONE	5.0E-01	5.0E-01	1.5E+03
ALDRIN	2.9E-02	1.0E-01	1.3E-01
ANTHRACENE	2.8E+00	2.8E+00	7.3E-01
ANTIMONY	6.3E+00	4.0E+01	3.0E+01
ARSENIC	5.5E+00	5.5E+00	3.6E+01
BARIIUM	7.5E+02	1.5E+03	1.0E+03
BENZENE	1.8E-01	3.8E-01	4.6E+01
BENZO(a)ANTHRACENE	3.8E-01	1.3E+00	2.7E-02
BENZO(b)FLUORANTHENE	3.8E-01	1.3E+00	2.9E-02
BENZO(k)FLUORANTHENE	3.8E-01	1.3E+00	4.0E-01
BENZO(g,h,i)PERYLENE	2.7E+01	2.7E+01	1.0E-01
BENZO(a)PYRENE	3.8E-02	1.3E-01	1.4E-02
BERYLLIUM	4.0E+00	8.0E+00	2.7E+00
BIPHENYL, 1,1-	6.5E+00	6.5E+00	5.0E+00
BIS(2-CHLOROETHYL)ETHER	4.0E-03	1.3E-02	6.1E+01
BIS(2-CHLOROISOPROPYL)ETHER	6.6E-01	6.6E-01	6.1E+01
BIS(2-ETHYLHEXYL)PHTHALATE	1.6E+02	5.3E+02	3.2E+01
BORON	1.6E+00	2.0E+00	1.6E+00
BROMODICHLOROMETHANE	1.2E-02	3.9E-02	1.6E+02
BROMOFORM	6.1E+01	6.9E+01	3.2E+03
BROMOMETHANE	2.2E-01	5.1E-01	1.6E+02
CADMIUM	1.7E+00	7.4E+00	2.2E+00
CARBON TETRACHLORIDE	1.2E-02	3.5E-02	9.5E+00
CHLORDANE	4.4E-01	1.7E+00	4.0E-03
CHLOROANILINE, p-	5.3E-02	5.3E-02	5.0E+00
CHLOROBENZENE	1.5E+00	1.5E+00	2.5E+01
CHLOROETHANE	6.3E-01	8.5E-01	1.2E+01
CHLOROFORM	9.8E-02	2.7E-01	3.4E+02
CHLOROMETHANE	2.9E-01	8.1E-01	1.7E+02
CHLOROPHENOL, 2-	1.2E-01	1.2E-01	1.8E+00
CHROMIUM (Total)	5.8E+01	5.8E+01	1.8E+02
CHROMIUM III	7.5E+02	7.5E+02	1.8E+02
CHROMIUM VI	1.8E+00	1.8E+00	1.1E+01
CHRYSENE	3.8E+00	1.3E+01	3.5E-01
COBALT	4.0E+01	8.0E+01	3.0E+00
COPPER	2.3E+02	2.3E+02	3.1E+00
CYANIDE (Free)	1.0E+02	5.0E+02	1.0E+00
DIBENZO(a,h)ANTHTRACENE	1.1E-01	3.8E-01	2.5E-01
DIBROMOCHLOROMETHANE	1.9E-02	5.8E-02	1.8E+02

**TABLE B. ENVIRONMENTAL SCREENING LEVELS (ESLs)**  
**Shallow Soils (≤3m bgs)**  
**Groundwater IS NOT a Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/Industrial Land Use Only (mg/kg)	
1,2-DIBROMO-3-CHLOROPROPANE	1.1E-03	1.1E-03	2.0E-01
DIBROMOETHANE, 1,2-	7.3E-03	2.1E-02	1.6E+02
DICHLOROBENZENE, 1,2-	1.6E+00	1.6E+00	1.4E+01
DICHLOROBENZENE, 1,3-	3.2E+00	7.4E+00	6.5E+01
DICHLOROBENZENE, 1,4-	4.7E-02	1.3E-01	1.5E+01
DICHLOROBENZIDINE, 3,3-	4.0E-01	1.4E+00	2.5E+02
DICHLORODIPHENYLDICHLOROETHANE (DDD)	2.4E+00	1.0E+01	1.0E-03
DICHLORODIPHENYLDICHLOROETHYLENE (DDE)	1.7E+00	4.0E+00	1.0E-03
DICHLORODIPHENYLTRICHLOROETHANE (DDT)	1.7E+00	4.0E+00	1.0E-03
DICHLOROETHANE, 1,1-	3.3E-01	9.1E-01	4.7E+01
DICHLOROETHANE, 1,2-	2.5E-02	6.9E-02	2.0E+02
DICHLOROETHYLENE, 1,1-	4.3E+00	4.3E+00	2.5E+01
DICHLOROETHYLENE, Cis 1,2-	1.6E+00	3.6E+00	5.9E+02
DICHLOROETHYLENE, Trans 1,2-	3.1E+00	7.3E+00	5.9E+02
DICHLOROPHENOL, 2,4-	3.0E+00	3.0E+00	3.0E+00
DICHLOROPROPANE, 1,2-	5.2E-02	1.5E-01	1.0E+02
DICHLOROPROPENE, 1,3-	3.3E-02	9.1E-02	4.9E+01
DIELDRIN	2.3E-03	2.3E-03	1.9E-03
DIETHYLPHTHALATE	3.5E-02	3.5E-02	1.5E+00
DIMETHYLPHTHALATE	3.5E-02	3.5E-02	1.5E+00
DIMETHYLPHENOL, 2,4-	7.4E-01	7.4E-01	1.1E+02
DINITROPHENOL, 2,4-	2.1E-01	2.1E-01	7.5E+01
DINITROTOLUENE, 2,4-	8.6E-01	8.6E-01	1.2E+02
1,4 DIOXANE	1.8E+01	3.0E+01	5.0E+04
DIOXIN (2,3,7,8-TCDD)	4.5E-06	1.8E-05	5.0E-06
ENDOSULFAN	4.6E-03	4.6E-03	8.7E-03
ENDRIN	6.5E-04	6.5E-04	2.3E-03
ETHYLBENZENE	4.7E+00	1.3E+01	2.9E+02
FLUORANTHENE	4.0E+01	4.0E+01	8.0E+00
FLUORENE	8.9E+00	8.9E+00	3.9E+00
HEPTACHLOR	1.4E-02	1.4E-02	3.8E-03
HEPTACHLOR EPOXIDE	1.5E-02	1.5E-02	3.8E-03
HEXACHLOROBENZENE	2.7E-01	9.6E-01	3.7E+00
HEXACHLOROBUTADIENE	3.7E+00	2.2E+01	4.7E+00
HEXACHLOROCYCLOHEXANE (gamma) LINDANE	4.9E-02	4.9E-02	8.0E-02
HEXACHLOROETHANE	1.2E+01	4.1E+01	1.2E+01
INDENO(1,2,3-cd)PYRENE	3.8E-01	1.3E+00	2.9E-02
LEAD	2.0E+02	7.5E+02	2.5E+00
MERCURY	2.5E+00	1.0E+01	1.2E-02
METHOXYCHLOR	1.9E+01	1.9E+01	1.9E-02
METHYLENE CHLORIDE	5.2E-01	1.5E+00	2.2E+03

**TABLE B. ENVIRONMENTAL SCREENING LEVELS (ESLs)**  
**Shallow Soils (<3m bgs)**  
**Groundwater IS NOT a Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/Industrial Land Use Only (mg/kg)	
METHYL ETHYL KETONE	1.3E+01	1.3E+01	1.4E+04
METHYL ISOBUTYL KETONE	3.9E+00	3.9E+00	1.7E+02
METHYL MERCURY	1.2E+00	1.0E+01	3.0E-03
METHYLNAPHTHALENE (total 1- & 2-)	2.5E-01	2.5E-01	2.1E+00
METHYL TERT BUTYL ETHER	2.0E+00	5.6E+00	1.8E+03
MOLYBDENUM	4.0E+01	4.0E+01	2.4E+02
NAPHTHALENE	4.5E+00	4.8E+00	2.4E+01
NICKEL	1.5E+02	1.5E+02	8.2E+00
PENTACHLOROPHENOL	4.4E+00	5.0E+00	7.9E+00
PERCHLORATE	1.2E+00	1.2E+00	6.0E+02
PHENANTHRENE	1.1E+01	1.1E+01	4.6E+00
PHENOL	1.9E+01	1.9E+01	1.3E+03
POLYCHLORINATED BIPHENYLS (PCBs)	2.2E-01	7.4E-01	1.4E-02
PYRENE	8.5E+01	8.5E+01	2.0E+00
SELENIUM	1.0E+01	1.0E+01	5.0E+00
SILVER	2.0E+01	4.0E+01	1.9E-01
STYRENE	1.5E+01	1.5E+01	1.0E+02
tert-BUTYL ALCOHOL	1.0E+02	1.1E+02	1.8E+04
TETRACHLOROETHANE, 1,1,1,2-	3.1E+00	7.2E+00	9.3E+02
TETRACHLOROETHANE, 1,1,2,2-	9.0E-03	2.5E-02	1.9E+02
TETRACHLOROETHYLENE	8.8E-02	2.5E-01	1.2E+02
THALLIUM	1.0E+00	1.3E+01	2.0E+01
TOLUENE	9.3E+00	9.3E+00	1.3E+02
TOXAPHENE	4.2E-04	4.2E-04	2.0E-04
TPH (gasolines)	1.0E+02	4.0E+02	5.0E+02
TPH (middle distillates)	5.0E+02	5.0E+02	6.4E+02
TPH (residual fuels)	5.0E+02	1.0E+03	6.4E+02
TRICHLOROETHANE, 1,2,4-	7.6E+00	7.6E+00	2.5E+01
TRICHLOROETHANE, 1,1,1-	7.8E+00	7.8E+00	6.2E+01
TRICHLOROETHANE, 1,1,2-	3.3E-02	9.1E-02	3.5E+02
TRICHLOROETHYLENE	2.6E-01	7.3E-01	3.6E+02
TRICHLOROPHENOL, 2,4,5-	1.8E-01	1.8E-01	1.1E+01
TRICHLOROPHENOL, 2,4,6-	6.9E+00	1.0E+01	4.9E+02
VANADIUM	1.1E+02	2.0E+02	1.9E+01

**TABLE B. ENVIRONMENTAL SCREENING LEVELS (ESLs)  
Shallow Soils ( $\leq 3$ m bgs)  
Groundwater IS NOT a Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
VINYL CHLORIDE	6.7E-03	1.9E-02	4.0E+00
XYLENES	1.5E+00	1.5E+00	1.3E+01
ZINC	6.0E+02	6.0E+02	8.1E+01
Electrical Conductivity (mS/cm, USEPA Method 120.1 MOD)	2.0	4.0	not applicable
Sodium Adsorption Ratio	5.0	12	not applicable

**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 marine or estuary surface water system.
- Source of soil ESLs: Refer to Appendix 1, Tables A-1 and A-2.  
Source of groundwater ESLs: Refer to Appendix 1, Table F-1b.  
Soil data should be reported on dry-weight basis (see Appendix 1, Section 6.2).  
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-impacted soil. See Section 2.6 and Table E.  
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 (refer to Section 2.6 and Appendix 1, Table F-1a).  
Aquatic habitat goals for bioaccumulation concerns not considered in selection of groundwater goals (refer to Section 2.7). Refer to appendices for summary of ESL components.  
TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.). See Volume 1, Section 2.2 and Appendix 1, Chapter 5.

**TABLE F: SURFACE WATER**

**TABLE F. ENVIRONMENTAL SCREENING LEVELS (ESLs)  
Surface Water Bodies**

CHEMICAL PARAMETER	SURFACE WATER SCREENING LEVELS		
	Freshwater (ug/L)	Marine (ug/L)	Estuarine (ug/L)
ACENAPHTHENE	2.0E+01	2.0E+01	2.0E+01
ACENAPHTHYLENE	3.0E+01	3.0E+01	3.0E+01
ACETONE	7.0E+02	1.5E+03	1.5E+03
ALDRIN	1.4E-04	1.4E-04	1.4E-04
ANTHRACENE	7.3E-01	7.3E-01	7.3E-01
ANTIMONY	6.0E+00	5.0E+02	5.0E+02
ARSENIC	1.4E-01	1.4E-01	1.4E-01
BARIUM	1.0E+03	1.0E+03	1.0E+03
BENZENE	1.0E+00	7.1E+01	7.1E+01
BENZO(a)ANTHRACENE	2.7E-02	2.7E-02	2.7E-02
BENZO(b)FLUORANTHENE	2.9E-02	2.9E-02	2.9E-02
BENZO(k)FLUORANTHENE	2.9E-02	4.9E-02	4.9E-02
BENZO(g,h,i)PERYLENE	1.0E-01	1.0E-01	1.0E-01
BENZO(a)PYRENE	1.4E-02	1.4E-02	1.4E-02
BERYLLIUM	2.7E+00	2.7E+00	2.7E+00
BIPHENYL, 1,1-	5.0E-01	5.0E-01	5.0E-01
BIS(2-CHLOROETHYL)ETHER	1.4E-02	1.4E+00	1.4E+00
BIS(2-CHLOROISOPROPYL)ETHER	5.0E-01	6.1E+01	6.1E+01
BIS(2-ETHYLHEXYL)PHTHALATE	4.0E+00	5.9E+00	5.9E+00
BORON	1.6E+00	1.6E+00	1.6E+00
BROMODICHLOROMETHANE	1.0E+02	3.2E+03	3.2E+03
BROMOFORM	1.0E+02	3.6E+02	3.6E+02
BROMOMETHANE	9.8E+00	3.2E+03	3.2E+03
CADMIUM	2.2E+00	9.3E+00	9.3E+00
CARBON TETRACHLORIDE	5.0E-01	4.4E+00	4.4E+00
CHLORDANE	5.9E-04	5.9E-04	5.9E-04
CHLOROANILINE, p-	5.0E+00	5.0E+00	5.0E+00
CHLOROBENZENE	2.5E+01	5.0E+01	5.0E+01
CHLOROETHANE	1.2E+01	1.2E+01	1.2E+01
CHLOROFORM	1.0E+02	4.7E+02	4.7E+02
CHLOROMETHANE	2.7E+00	3.2E+03	3.2E+03
CHLOROPHENOL, 2-	1.8E-01	1.8E-01	1.8E-01
CHROMIUM (Total)	5.0E+01	1.8E+02	1.8E+02
CHROMIUM III	1.8E+02	1.8E+02	1.8E+02
CHROMIUM VI	1.1E+01	5.0E+01	5.0E+01
CHRYSENE	4.9E-02	4.9E-02	4.9E-02
COBALT	3.0E+00	3.0E+00	3.0E+00
COPPER	9.0E+00	3.1E+00	3.1E+00
CYANIDE (Free)	5.2E+00	1.0E+00	1.0E+00
DIBENZO(a,h)ANTHRACENE	8.5E-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	2.0E-01	2.0E-01
DIBROMOETHANE, 1,2-	5.0E-02	1.4E+03	1.4E+03
DICHLOROBENZENE, 1,2-	1.0E+01	1.0E+01	1.0E+01
DICHLOROBENZENE, 1,3-	6.3E+00	6.5E+01	6.5E+01



**TABLE F. ENVIRONMENTAL SCREENING LEVELS (ESLs)  
Surface Water Bodies**

CHEMICAL PARAMETER	SURFACE WATER SCREENING LEVELS		
	Freshwater (ug/L)	Marine (ug/L)	Estuarine (ug/L)
DICHLOROBENZENE, 1,4-	5.0E+00	1.1E+01	1.1E+01
DICHLOROBENZIDINE, 3,3-	2.9E-02	7.7E-02	7.7E-02
DICHLORODIPHENYLDICHLOROETHANE (DDD)	8.4E-04	8.4E-04	8.4E-04
DICHLORODIPHENYLDICHLOROETHYLENE (DDE)	5.9E-04	5.9E-04	5.9E-04
DICHLORODIPHENYLTRICHLOROETHANE (DDT)	5.9E-04	5.9E-04	5.9E-04
DICHLOROETHANE, 1,1-	5.0E+00	4.7E+01	4.7E+01
DICHLOROETHANE, 1,2-	5.0E-01	9.9E+01	9.9E+01
DICHLOROETHYLENE, 1,1-	3.2E+00	3.2E+00	3.2E+00
DICHLOROETHYLENE, Cis 1,2-	6.0E+00	5.9E+02	5.9E+02
DICHLOROETHYLENE, Trans 1,2-	1.0E+01	2.6E+02	2.6E+02
DICHLOROPHENOL, 2,4-	3.0E-01	3.0E-01	3.0E-01
DICHLOROPROPANE, 1,2-	5.0E+00	1.0E+01	1.0E+01
DICHLOROPROPENE, 1,3-	5.0E-01	1.2E+02	1.2E+02
DIELDRIN	2.2E-03	1.9E-03	1.9E-03
DIETHYLPHthalate	1.5E+00	1.7E+00	1.7E+00
DIMETHYLPHthalate	1.5E+00	1.7E+00	1.7E+00
DIMETHYLPHENOL, 2,4-	1.0E+02	1.1E+02	1.1E+02
DINITROPHENOL, 2,4-	1.4E+01	7.5E+01	7.5E+01
DINITROTOLUENE, 2,4-	1.1E-01	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	5.6E-02	8.7E-03	8.7E-03
ENDRIN	3.6E-02	2.3E-03	2.3E-03
ETHYLBENZENE	3.0E+01	3.0E+01	3.0E+01
FLUORANTHENE	8.1E+00	8.0E+00	8.0E+00
FLUORENE	3.9E+00	3.9E+00	3.9E+00
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	2.1E-01	4.7E+00	4.7E+00
HEXACHLOROCYCLOHEXANE (gamma) LINDANE	6.3E-02	6.3E-02	6.3E-02
HEXACHLOROETHANE	7.0E-01	8.9E+00	8.9E+00
INDENO(1,2,3-cd)PYRENE	2.9E-02	2.9E-02	2.9E-02
LEAD	2.5E+00	8.1E+00	8.1E+00
MERCURY	5.1E-02	2.5E-02	2.5E-02
METHOXYCHLOR	1.9E-02	1.9E-02	1.9E-02
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	1.7E+02	1.7E+02
METHYL MERCURY	3.0E-03	3.0E-03	3.0E-03
METHYLNAPHTHALENE (total 1- & 2-)	2.1E+00	2.1E+00	2.1E+00
METHYL TERT BUTYL ETHER	5.0E+00	1.8E+02	1.8E+02
MOLYBDENUM	3.5E+01	2.4E+02	2.4E+02
NAPHTHALENE	2.1E+01	2.1E+01	2.1E+01
NICKEL	5.2E+01	8.2E+00	8.2E+00

**TABLE F. ENVIRONMENTAL SCREENING LEVELS (ESLs)  
Surface Water Bodies**

CHEMICAL PARAMETER	SURFACE WATER SCREENING LEVELS		
	Freshwater (ug/L)	Marine (ug/L)	Estuarine (ug/L)
PENTACHLOROPHENOL	1.0E+00	7.9E+00	7.9E+00
PERCHLORATE	7.0E-01	6.0E+02	6.0E+02
PHENANTHRENE	6.3E+00	4.6E+00	4.6E+00
PHENOL	5.0E+00	1.3E+03	1.3E+03
POLYCHLORINATED BIPHENYLS (PCBs)	1.7E-04	1.7E-04	1.7E-04
PYRENE	2.0E+00	2.0E+00	2.0E+00
SELENIUM	5.0E+00	7.1E+01	7.1E+01
SILVER	3.4E-01	1.9E-01	1.9E-01
STYRENE	1.0E+01	1.1E+01	1.1E+01
tert-BUTYL ALCOHOL	1.2E+01	1.8E+04	1.8E+04
TETRACHLOROETHANE, 1,1,1,2-	1.3E+00	9.3E+02	9.3E+02
TETRACHLOROETHANE, 1,1,2,2-	1.0E+00	1.1E+01	1.1E+01
TETRACHLOROETHYLENE	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	2.0E-04	2.0E-04	2.0E-04
TPH (gasolines)	1.0E+02	3.7E+03	3.7E+03
TPH (middle distillates)	1.0E+02	6.4E+02	6.4E+02
TPH (residual fuels)	1.0E+02	6.4E+02	6.4E+02
TRICHLOROBENZENE, 1,2,4-	2.5E+01	6.5E+01	6.5E+01
TRICHLOROETHANE, 1,1,1,-	6.2E+01	6.2E+01	6.2E+01
TRICHLOROETHANE, 1,1,2-	5.0E+00	4.2E+01	4.2E+01
TRICHLOROETHYLENE	5.0E+00	8.1E+01	8.1E+01
TRICHLOROPHENOL, 2,4,5-	6.3E+01	1.1E+01	1.1E+01
TRICHLOROPHENOL, 2,4,6-	5.0E-01	6.5E+00	6.5E+00
VANADIUM	1.5E+01	1.9E+01	1.9E+01
VINYL CHLORIDE	5.0E-01	5.3E+02	5.3E+02
XYLENES	1.3E+01	1.3E+01	1.3E+01
ZINC	1.2E+02	8.1E+01	8.1E+01

**TABLE F. ENVIRONMENTAL SCREENING LEVELS (ESLs)  
Surface Water Bodies**

CHEMICAL PARAMETER	SURFACE WATER SCREENING LEVELS		
	Freshwater (ug/L)	Marine (ug/L)	Estuarine (ug/L)
Electrical Conductivity (mS/cm, USEPA Method 120.1 MOD)	not applicable	not applicable	not applicable
Sodium Adsorption Ratio	not applicable	not applicable	not applicable
<p><b>Notes:</b></p> <p>1. Source of Freshwater ESLs: Refer to Appendix 1, Table F-2a</p> <p>2. Source of Marine ESLs: Refer to Appendix 1, Table F-2b.</p> <p>3. Source of Estuarine ESLs: Refer to Appendix 1, Table F-2c.</p> <p>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.). Refer to Section 2.7 of text for discussion.</p> <p>Estuarine screening levels lowest of freshwater and marine screening levels.</p> <p>TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.). See Section 2.2 and Appendix 1, Chapter 5.</p>			



**TABLE A. ENVIRONMENTAL SCREENING LEVELS (ESLs)**  
**Shallow Soils ( $\leq 3$ m bgs)**  
**Groundwater IS Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
ACENAPHTHENE	1.6E+01	1.6E+01	2.0E+01
ACENAPHTHYLENE	1.3E+01	1.3E+01	3.0E+01
ACETONE	2.4E-01	2.4E-01	7.0E+02
ALDRIN	2.9E-02	1.0E-01	2.0E-03
ANTHRACENE	2.8E+00	2.8E+00	7.3E-01
ANTIMONY	6.3E+00	4.0E+01	6.0E+00
ARSENIC	5.5E+00	5.5E+00	3.6E+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	2.7E-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(p,h,i)PERYLENE	2.7E+01	2.7E+01	1.0E-01
BENZO(a)PYRENE	3.8E-02	1.3E-01	1.4E-02
BERYLLIUM	4.0E+00	8.0E+00	2.7E+00
BIPHENYL, 1,1-	6.5E-01	6.5E-01	5.0E-01
BIS(2-CHLOROETHYL)ETHER	1.8E-04	1.8E-04	1.4E-02
BIS(2-CHLOROISOPROPYL)ETHER	5.4E-03	5.4E-03	5.0E-01
BIS(2-ETHYLHEXYL)PHTHALATE	6.6E+01	6.6E+01	4.0E+00
BORON	1.6E+00	2.0E+00	1.6E+00
BROMODICHLOROMETHANE	1.2E-02	3.9E-02	1.0E+02
BROMOFORM	2.2E+00	2.2E+00	1.0E+02
BROMOMETHANE	2.2E-01	3.9E-01	9.8E+00
CADMIUM	1.7E+00	7.4E+00	2.2E+00
CARBON TETRACHLORIDE	1.2E-02	3.5E-02	5.0E-01
CHLORDANE	4.4E-01	1.7E+00	4.0E-03
CHLOROANILINE, p-	5.3E-02	5.3E-02	5.0E+00
CHLOROBENZENE	1.5E+00	1.5E+00	2.5E+01
CHLOROETHANE	6.3E-01	8.5E-01	1.2E+01
CHLOROFORM	9.8E-02	2.7E-01	1.0E+02
CHLOROMETHANE	2.9E-01	4.2E-01	2.7E+00
CHLOROPHENOL, 2-	1.2E-02	1.2E-02	1.8E-01
CHROMIUM (Total)	5.8E+01	5.8E+01	5.0E+01
CHROMIUM III	7.5E+02	7.5E+02	1.8E+02
CHROMIUM VI	1.8E+00	1.8E+00	1.1E+01
CHRYSENE	3.8E+00	1.3E+01	2.9E-01
COBALT	4.0E+01	8.0E+01	3.0E+00
COPPER	2.3E+02	2.3E+02	3.1E+00
CYANIDE (Free)	1.0E+02	5.0E+02	1.0E+00
DIBENZO(a,h)ANTHRACENE	1.1E-01	3.8E-01	8.5E-03
DIBROMOCHLOROMETHANE	1.9E-02	5.8E-02	1.0E+02
1,2-DIBROMO-3-CHLOROPROPANE	1.1E-03	1.1E-03	2.0E-01
DIBROMOETHANE, 1,2-	3.3E-04	3.3E-04	5.0E-02
DICHLOROBENZENE, 1,2-	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 PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/Industrial Land Use Only (mg/kg)	
DICHLOROBENZENE, 1,3-	7.2E-01	7.2E-01	6.3E+00
DICHLOROBENZENE, 1,4-	4.7E-02	1.3E-01	5.0E+00
DICHLOROBENZIDINE, 3,3-	7.7E-03	7.7E-03	2.9E-02
DICHLORODIPHENYLDICHLOROETHANE (DDD)	2.4E+00	1.0E+01	1.0E-03
DICHLORODIPHENYLDICHLOROETHYLENE (DDE)	1.7E+00	4.0E+00	1.0E-03
DICHLORODIPHENYLTRICHLOROETHANE (DDT)	1.7E+00	4.0E+00	1.0E-03
DICHLOROETHANE, 1,1-	2.0E-01	2.0E-01	5.0E+00
DICHLOROETHANE, 1,2-	4.5E-03	4.5E-03	5.0E-01
DICHLOROETHYLENE, 1,1-	1.0E+00	1.0E+00	6.0E+00
DICHLOROETHYLENE, Cis 1,2-	1.9E-01	1.9E-01	6.0E+00
DICHLOROETHYLENE, Trans 1,2-	6.7E-01	6.7E-01	1.0E+01
DICHLOROPHENOL, 2,4-	3.0E-01	3.0E-01	3.0E-01
DICHLOROPROPANE, 1,2-	5.2E-02	1.2E-01	5.0E+00
DICHLOROPROPENE, 1,3-	3.3E-02	5.9E-02	5.0E-01
DIELDRIN	2.3E-03	2.3E-03	1.9E-03
DIETHYLPHTHALATE	3.5E-02	3.5E-02	1.5E+00
DIMETHYLPHTHALATE	3.5E-02	3.5E-02	1.5E+00
DIMETHYLPHENOL, 2,4-	6.7E-01	6.7E-01	1.0E+02
DINITROPHENOL, 2,4-	4.0E-02	4.0E-02	1.4E+01
DINITROTOLUENE, 2,4-	8.5E-04	8.5E-04	1.1E-01
1,4 DIOXANE	1.8E-03	1.8E-03	3.0E+00
DIOXIN (2,3,7,8-TCDD)	4.5E-06	1.8E-05	5.0E-06
ENDOSULFAN	4.6E-03	4.6E-03	8.7E-03
ENDRIN	6.5E-04	6.5E-04	2.3E-03
ETHYLBENZENE	3.3E+00	3.3E+00	3.0E+01
FLUORANTHENE	4.0E+01	4.0E+01	8.0E+00
FLUORENE	8.9E+00	8.9E+00	3.9E+00
HEPTACHLOR	1.4E-02	1.4E-02	3.8E-03
HEPTACHLOR EPOXIDE	1.5E-02	1.5E-02	3.8E-03
HEXACHLOROBENZENE	2.7E-01	9.6E-01	1.0E+00
HEXACHLOROCYCLOHEXANE (gamma) LINDANE	1.0E+00	1.0E+00	2.1E-01
HEXACHLOROETHANE	4.9E-02	4.9E-02	8.0E-02
INDENO(1,2,3-cd)PYRENE	2.4E+00	2.4E+00	7.0E-01
LEAD	3.8E-01	1.3E+00	2.9E-02
MERCURY	2.0E+02	7.5E+02	2.5E+00
METHOXYCHLOR	2.5E+00	1.0E+01	1.2E-02
METHYLENE CHLORIDE	1.9E+01	1.9E+01	1.9E-02
METHYL ETHYL KETONE	7.7E-02	7.7E-02	5.0E+00
METHYL ISOBUTYL KETONE	3.9E+00	3.9E+00	4.2E+03
METHYL MERCURY	2.8E+00	2.8E+00	1.2E+02
METHYLNAPHTHALENE (total 1- & 2-)	1.2E+00	1.0E+01	3.0E-03
METHYL TERT BUTYL ETHER	2.5E-01	2.5E-01	2.1E+00
MOLYBDENUM	2.3E-02	2.3E-02	5.0E+00
	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 PARAMETER	<sup>1</sup> Shallow Soil		<sup>2</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/Industrial Land Use Only (mg/kg)	
NAPHTHALENE	4.2E+00	4.2E+00	2.1E+01
NICKEL	1.5E+02	1.5E+02	6.2E+00
PENTACHLOROPHENOL	4.4E+00	5.0E+00	1.0E+00
PERCHLORATE	7.0E-03	7.0E-03	7.0E-01
PHENANTHRENE	1.1E+01	1.1E+01	4.6E+00
PHENOL	7.6E-02	7.6E-02	5.0E+00
POLYCHLORINATED BIPHENYLS (PCBs)	2.2E-01	7.4E-01	1.4E-02
PYRENE	8.5E+01	8.5E+01	2.0E+00
SELENIUM	1.0E+01	1.0E+01	5.0E+00
SILVER	2.0E+01	4.0E+01	1.9E-01
STYRENE	1.5E+00	1.5E+00	1.0E+01
tert-BUTYL ALCOHOL	7.3E-02	7.3E-02	1.2E+01
TETRACHLOROETHANE, 1,1,1,2-	2.4E-02	2.4E-02	1.3E+00
TETRACHLOROETHANE, 1,1,2,2-	9.0E-03	1.8E-02	1.0E+00
TETRACHLOROETHYLENE	8.8E-02	2.5E-01	5.0E+00
THALLIUM	1.0E+00	1.3E+01	2.0E+00
TOLUENE	2.9E+00	2.9E+00	4.0E+01
TOXAPHENE	4.2E-04	4.2E-04	2.0E-04
TPH (gasolines)	1.0E+02	1.0E+02	1.0E+02
TPH (middle distillates)	1.0E+02	1.0E+02	1.0E+02
TPH (residual fuels)	5.0E+02	1.0E+03	1.0E+02
TRICHLOROETHANE, 1,2,4-	7.6E+00	7.6E+00	2.5E+01
TRICHLOROETHANE, 1,1,1-	7.8E+00	7.8E+00	6.2E+01
TRICHLOROETHANE, 1,1,2-	3.3E-02	7.0E-02	5.0E+00
TRICHLOROETHYLENE	2.6E-01	4.6E-01	5.0E+00
TRICHLOROPHENOL, 2,4,5-	1.8E-01	1.8E-01	1.1E+01
TRICHLOROPHENOL, 2,4,6-	1.7E-01	1.7E-01	5.0E-01
VANADIUM	1.1E+02	2.0E+02	1.5E+01
VINYL CHLORIDE	6.7E-03	1.9E-02	5.0E-01
XYLENES	1.5E+00	1.5E+00	1.3E+01
ZINC	6.0E+02	6.0E+02	8.1E+01

**TABLE A. ENVIRONMENTAL SCREENING LEVELS (ESLs)  
Shallow Soils ( $\leq 3$ m bgs)  
Groundwater IS Current or Potential Source of Drinking Water**

CHEMICAL PARAMETER	<sup>1</sup> Shallow Soil		<sup>3</sup> Groundwater (ug/L)
	<sup>2</sup> Residential Land Use (mg/kg)	Commercial/ Industrial Land Use Only (mg/kg)	
Electrical Conductivity (mS/cm, USEPA Method 120.1 MOD)	2.0	4.0	not applicable
Sodium Adsorption Ratio	5.0	12	not applicable

**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.
- Source of soil ESLs: Refer to Appendix 1, Tables A-1 and A-2.  
Source of groundwater ESLs: Refer to Appendix 1, Table F-1a.  
Soil data should be reported on dry-weight basis (see Appendix 1, Section 6.2).  
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-impacted soil. See Section 2.6 and Table E.  
Groundwater ESLs intended to 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 (refer to Section 2.6 and Appendix 1, Table F-1a).  
Aquatic habitat goals for bioaccumulation concerns not considered in selection of groundwater goals (refer to Section 2.7).  
Refer to appendices for summary of ESL components.  
TPH -Total Petroleum Hydrocarbons. TPH ESLs must be used in conjunction with ESLs for related chemicals (e.g., BTEX, PAHs, oxidizers, etc.). See Volume 1, Section 2.2 and Appendix 1, Chapter 5.



April 2004

SCH No. 2003031044

**PARAMOUNT REFINERY  
CLEAN FUELS PROJECT  
FINAL ENVIRONMENTAL IMPACT REPORT**

**Volume I: Final Environmental Impact Report**

**Executive Officer**  
Barry Wallerstein, D. Env.

**Deputy Executive Officer**  
**Planning, Rules, and Area Sources**  
Elaine Chang, DrPH

**Assistant Deputy Executive Officer**  
**Planning, Rule Development and Area Sources**  
Laki Tisopoulos, Ph.D., P.E.

**Planning and Rules Manager**  
**CEQA and Socioeconomic Analyses**  
Susan Nakamura

Submitted to:  
**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT**

Prepared by:  
**ENVIRONMENTAL AUDIT, INC.**

Reviewed by: James Koizumi - Air Quality Specialist  
Steve Smith, Ph.D. - Program Supervisor  
Barbara Baird - District Counsel

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#### EXECUTIVE OFFICER

BARRY WALLERSTEIN, D. Env.

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**Health Risk Assessment**

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**CHAPTER 5**  
**CUMULATIVE IMPACTS**

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**INTRODUCTION**  
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CHAPTER 5.0

CUMULATIVE IMPACTS

A. INTRODUCTION

CEQA Guidelines §15130(a) requires an EIR to discuss cumulative impacts of a project when the project's incremental effect is cumulative considerable, as defined in §15065(c). There are a number of projects proposed for development in the Paramount area that may contribute cumulative regional impacts to those generated by the Paramount Refinery's proposed project. These include reformulated fuels modifications planned by other petroleum refineries in Basin as well as other local projects. Figure 5-1 shows the locations of the six major southern California refineries. The reformulated fuels modifications are to be completed in order to supply reformulated gasoline as required by Executive Order D-5-99 and the resulting CARB RFG Phase 3 requirements. The discussion below lists projects which are reasonably expected to proceed in the foreseeable future, i.e., project information has been submitted to a public agency. Cumulative construction impacts were evaluated herein if the major portion of construction is expected to occur during the same construction period as Paramount's Clean Fuels project.

Public agencies were contacted to obtain information on projects in the Paramount area. Figure 5-2 identifies by number the location of each of the projects discussed below. The number is used to identify the related projects throughout the discussion of cumulative impacts. Localized impacts were assumed to include projects which would occur within the same timeframe as the Paramount's Clean Fuels project and which are in the Paramount area. These projects generally include the RFG Phase 3 project at the British Petroleum (formerly ARCO) refinery; the RFG Phase 3 project at the Conoco-Phillips (formerly Tosco) refinery; the RFG Phase 3 project at the Shell (formerly Equilon) refinery. Regional impacts were assumed to include projects throughout the Basin, e.g., all refineries.

Some of the impacts of the proposed Paramount project would primarily occur during the construction phase, e.g., traffic. Other impacts would primarily occur during the operational phase, e.g., hazards. Other impacts would occur during both phases, e.g., air quality.

B. LOCAL REFINERIES

1) Conoco-Phillips

The Conoco-Phillips Refinery (formerly Tosco and Unocal) is approximately 18 miles southwest of the Paramount Refinery. It consists of facilities at two locations (Wilmington and Carson) approximately three miles apart. The two integrated sites transfer raw, intermediate, and finished materials primarily by pipelines. Finished

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products are transferred from the Wilmington location via the Torrance Tank Farm pipeline to distribution terminals in the southern California area or to interstate pipelines. The RFG Phase 3 project will involve physical changes only to the Conoco-Phillips Wilmington Plant, located at 1660 W. Anaheim Street, Wilmington, California, 90745.

Conoco-Phillips proposed to modify existing process units at the Wilmington Plant in order to produce gasoline in compliance with CARB's Phase 3 requirements (SCAQMD, 2001). No new process units were proposed at the Refinery.

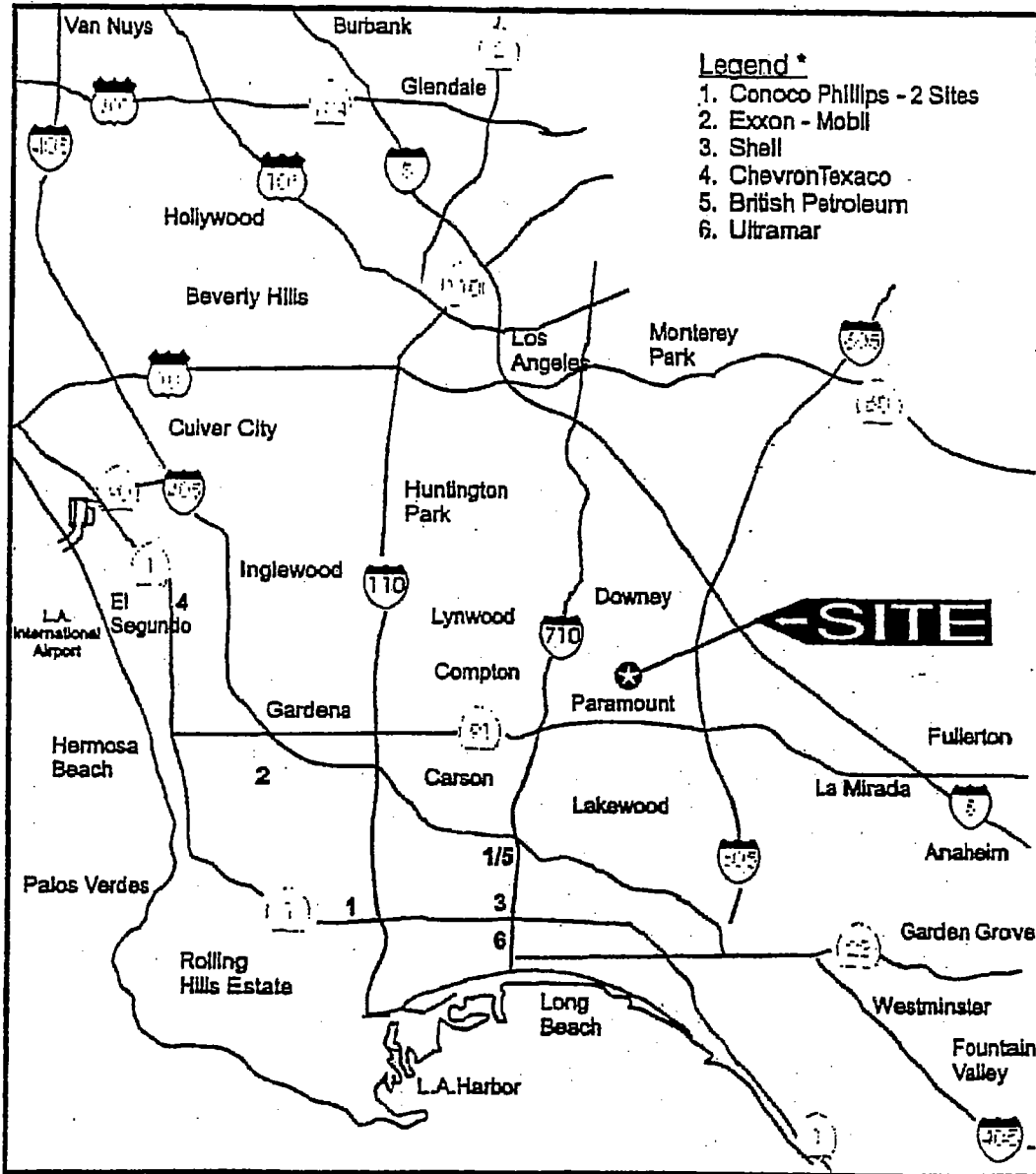
Modifications to the following units are proposed:

- Alkylation Unit (fractionation equipment, refrigeration compressor system, pumps, heaters and exchangers)
- Acid Plant (vapor recovery system)
- Butamer Unit (pumps)
- Catalytic Light Ends Fractionation Unit (fractionation equipment, pumps and piping)
- Rail Car Offloading Facilities
- Butane Storage Tank System
- Storage Tank System
- Utilities (the nitrogen, steam, water, condensate, electrical, hydrocarbon relief, and fresh/spent acid systems).

Associated modifications and additions to storage facilities, pipelines and support facilities are also expected (SCAQMD, 2001). The original CARB Phase 3 project was evaluated in the Final EIR (SCAQMD, SCH No. 2000091056, certified April 5, 2001). An Addendum to the April 5, 2001 Final EIR was prepared to include modifications to the Los Angeles Terminal including expansion of rail service at the terminal to include the unloading of ethanol (SCAQMD 2003b).

In addition to the CARB Phase 3 project, Conoco-Phillips has been issued permits for an Ethanol Import and Distribution Project. In order to produce gasoline without MTBE as required by the Governor's Executive Order and to remain compliant with state and federal reformulated fuel standards, Conoco-Phillips will replace MTBE with ethanol. This project is comprised of modifying existing facilities to permit ethanol to be received into the Marine Terminal for transshipment through the Wilmington Plant for ultimate blending into gasoline at existing, offsite marketing terminals. A Negative Declaration has been completed (SCAQMD, 2000b) and approved for this project. Because this project was found not to have any significant effect on the environment, no cumulative impacts are expected. The ConocoPhillips Refinery is located approximately fifteen miles from the Paramount Refinery so cumulative localized impacts are not expected to occur.

CHAPTER 5: CUMULATIVE IMPACTS



**Environmental Audit, Inc.**

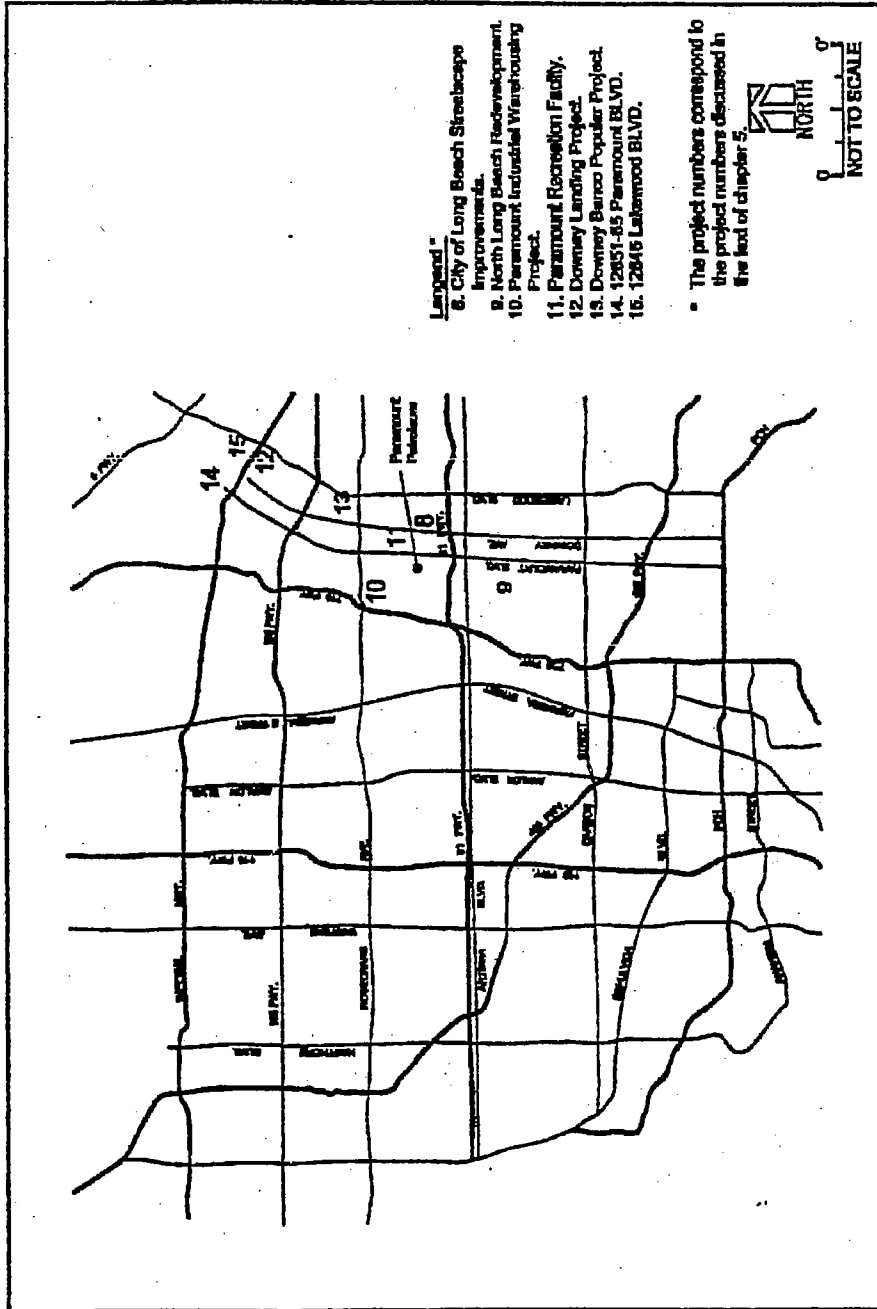
\* Project numbers correspond to the project numbers discussed in the text of Chapter 5.

REGIONAL MAP SHOWING REFINERIES



Figure 5.

Project No. 2150  
 No. 2150/REG/CRD



## 2) Exxon-Mobil

The Exxon-Mobil refinery is located at 3700 W. 190th Street in Torrance, about fourteen miles southwest of the Paramount Refinery. The RFG Phase 3 project includes modifications and/or additions to the following equipment:

- Light FCCU – Unsaturated Gas Plant Debutanizer
- Light HDC – Stabilizer, Gasoline Component Isolation Piping
- Deisobutanizer Tower – Butane Handling, KOH Tower
- Alky Feed – Hydrotreating
- Liquefied Petroleum Rail Facilities – Vessels, Loading and Additional Track
- Fuel Ethanol Storage – Tanks, Rail and Off-loading Facilities
- Gasoline Storage – Tanks
- FCC – Hydrotreater Reactors and Heater Modifications
- Alkylate – Additive Water Wash System and Merox System
- Sulfur Contamination Elimination – Overhead Compressor Modifications
- Light FCC Gasoline – Splitter Modifications
- Torrance Loading Rack (add fuel ethanol off-loading rack; modify vapor recovery unit, piping, and manifolds)
- Vernon Terminal (add rail car off-loading system, two truck off-loading areas, gasoline tank, lighting area and drainage system; modify rail spur, loading rack, vapor recovery unit, vapor destruction unit, and two storage tanks)
- Anaheim (Atwood) Terminal (add two truck off-loading areas, storage tank, lighting area and drainage system; modify truck rack)
- One new pentane sphere

Associated modifications and additions to storage facilities, pipelines and support facilities are also expected (SCAQMD, 2001a and SCAQMD 2003c). The Torrance refinery and loading rack, and the Vernon and Anaheim distribution terminals are located at least 10-15 miles from the Paramount Refinery so cumulative localized impacts are not expected to occur.

## 3) Shell

The Shell refinery (formerly Equilon and Texaco) is located at 2101 East Pacific Coast Highway, Wilmington and is sixteen miles south of the Paramount refinery. Shell's Wilmington Terminal is located adjacent to the southwestern portion of its Refinery at 1926 East Pacific Coast Highway, and the marine terminal is located on Mormon Island at Berths 167-169 within the Port of Los Angeles. The proposed project will also require changes to Shell's other southern California area distribution terminals located in Signal Hill, Carson, Van Nuys, and Colton/Rialto. The RFG Phase 3 project includes the following proposed modifications:

- Alkylation Unit (Contactor and Settler, refrigeration unit, exchangers/pumps, and effluent treating vessels)

- C4 Isomerization Unit (vessels, exchangers, pumps, piping, stabilizer, gas scrubber, and drier)
- Hydrotreater Unit No. 2 (Olefins Saturation Reactor, pretreatment reactor, charge pumps, heat exchangers, trays, stripper reboiler, and control valves)
- Hydrotreater Unit No. 4 (diesel side stripper, feed steam preheater, and heat exchangers)
- Hydrotreater Unit No. 1
- Catalytic Reforming Unit No. 2 (sulfur guard reactor)
- Fractionator Changes (HCU Main Fractionator, FCCU Debutanizer, Feed Prep Tower, Depentanizer, Alky Deisobutanizer, Alky Debutanizer and C4 Isomerization Deisobutanizer, and HCU Depropanizer)
- Refinery Storage Tank modifications
- Storage Tanks (at Wilmington, Carson, Signal Hill, Van Nuys, and Colton/Rialto Terminals)
- Pentane Sphere
- No. 2 (debutanizer tower)
- Flare
- Vapor Recovery Systems
- Carson Terminal (includes storage tanks modifications and a new truck loading rack)
- Lomita Terminal (includes an ethanol railcar unloading facility)
- Signal Hill Terminal (includes storage tank and truck loading rack modifications)
- Colton/Rialto Terminal (includes storage tank and truck loading rack modifications)
- Van Nuys Terminal (includes storage tank and truck loading rack modifications)
- Marine Terminal (includes storage tank modifications)
- Wilmington Terminal (includes storage tank and truck loading rack modifications)

Associated modifications and additions to storage facilities, pipelines and support facilities also are expected (SCAQMD, 2001b and SCAQMD 2002). The Shell refinery is located 16 miles south of the Paramount refinery. The Shell terminal in Signal Hill, is located at least eight miles from the Paramount Refinery and the Van Nuys and Colton/Rialto Terminals are located over 30 miles from the Paramount refinery. Localized cumulative impacts are not anticipated for any of these facilities because of the distance from the Paramount refinery.

#### 4) ChevronTexaco

The ChevronTexaco refinery (formerly Chevron) is located at 324 West El Segundo Boulevard in El Segundo, California, about 18 miles west of the Paramount refinery, which is a sufficient distance away to avoid cumulative localized impacts with the Paramount refinery. The ChevronTexaco refinery has proposed to make changes to the reconfiguration of the Refinery by modifying existing process operating units, constructing and installing new equipment, and providing additional ancillary facilities in order to produce the RFG Phase 3 reformulated gasolines (SCAQMD, 2001c). The proposed new refinery units include:

- Isomax Complex (distillation column, steam reboilers and overhead condensers)
- TAME Plant (steam reboilers and overhead condensers)

## CHAPTER 5: CUMULATIVE IMPACTS

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- Pentane Storage Sphere
- Pentane Sales (rail loading facilities and railcar storage area)
- TAME Unit (distillation column, reflux pumps, steam reboilers and overhead condensers)
- No. 1 Naphtha hydrotreater (under Option A: one furnace, compressors, exchangers, and pumps. Under Option B: compressors, exchangers, and pumps).
- FCCU Depropanizer
- FCCU Debutanizer
- FCCU Deethanizer (vessels, pumps and exchangers)
- FCCU Propylene Caustic Treating Facilities
- FCCU Butene Caustic Treating Facilities
- FCCU Amine Absorber
- FCCU Relief System (headers)
- FCCU Wet Gas Compressor Interstage System Upgrades (two exchangers and one vessel)
- Alkylation Plant (two contactors and an acid settler)
- Cooling Tower
- Trim coolers for existing Distillation Columns
- Iso-octene Plant (pressure vessels, exchangers and pumps)
- Two floating roof gasoline component storage tanks

Modifications to existing refinery units are proposed for the following:

- TAME Unit (Depentanizer column)
- No. 1 Naphtha hydrotreater (under Option A: modify one furnace; under Option B: modify two furnaces)
- Deethanizer (column)
- Relief Systems (vapor recovery facilities and flare)
- Main air blower rotor replacement
- Wet Gas Compressor
- Rotor and Gearbox Upgrade
- Recommission Existing Out-of-Service Deisobutanizer
- Retraining Distillation Columns
- MTBE storage tank

The proposed project also includes modifications to the ChevronTexaco Montebello Terminal (storage tank and loading rack modifications and a new ethanol railcar unloading facility), the Van Nuys Terminal (storage tank and loading rack modifications), and the Huntington Beach Terminal (storage tank and loading rack modifications).

Due to the distance separating the ChevronTexaco refinery and terminals from the Paramount refinery, no cumulative impacts are expected during the construction or operation of the proposed project.



### 5) British Petroleum

The British Petroleum (BP) Refinery (formerly ARCO), located at 1801 E. Sepulveda Boulevard in Carson, is approximately eleven miles south of the Paramount refinery. The BP Carson terminal is located at 2149 E. Sepulveda Boulevard; the Marine Terminal 2 is located at 1300 Pier B Street within the Port of Long Beach. The proposed RFG Phase 3 project will also require changes to BP's other southern California area distribution terminals located in South Gate, Rialto, Long Beach and Signal Hill. The BP refinery has proposed to make changes to the Refinery by modifying existing process operating units, constructing and installing new equipment, and providing additional ancillary facilities in order to produce the RFG Phase 3 reformulated gasolines (SCAQMD, 2001d). The proposed new refinery units include:

- FCCU Gasoline Fractionation (Option #1) – rerun bottoms splitter (splitter tower, heat exchangers, etc.)

Modifications to existing refinery units are proposed for the following:

- Light Hydro Unit (modify heat exchangers; new exchangers, piping pumps and control systems)
- Isomerization Sieve (convert unit to hydrotreater; modifications to heat exchangers, piping and control systems; new reactor, exchangers, pumps and control systems)
- No. 3 Reformer Fractionator and Overhead Condenser (piping and control systems; new pumps)
- Gasoline Fractionation Area (retraying, piping and control systems)
- FCCU Gasoline Fractionation (Option #2) – convert gasoline fractionation area depentanizer to a FCCU bottoms splitter (retraying; new exchangers, flash drum, and product cooling)
- North hydrogen plant (new feed drum, pump and vaporizer)
- MTBE Unit (Option #1) – convert into ISO Octene Unit (modify heat exchangers, piping and control systems; new reactive, steam heater and heat exchangers)
- MTBE Unit (Option #2) – convert into Selective Hydrogenation Unit (modify stripper, reboiler, piping and control systems; new heat exchangers)
- Cat Poly Unit – modify to a Dimerization Unit Hydrotreater reactor system (modify piping and control systems; new pumps, heat exchangers, vessels, piping and control systems)
- Mid-Barrel Unit – modify to a Gasoline Hydrotreater (modify feed and product piping, hydrogen supply system and heat exchanger, controls systems)
- Tank Farm – piping modifications
- Pentane railcar loading facility – modify for pentane off-loading (new repressurizing vaporizer system and two railcar spots)
- Propylene railcar loading facility – modify for butane off-loading.

Associated modifications and additions to distribution storage facilities, pipelines and support facilities also are expected (SCAQMD, 2001d). The BP Arco Refinery is located

## CHAPTER 5: CUMULATIVE IMPACTS

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about 11 miles from the Paramount Refinery, so cumulative localized impacts are not expected.

### 6) Ultramar Inc, Valero Refinery

The Ultramar refinery is located at 2042 East Anaheim Street in the Wilmington district of the City of Los Angeles. The Ultramar refinery is about 15 miles south of the Paramount Refinery. In order to produce the RFG Phase 3 project gasoline Ultramar has proposed both new and modified refinery units (SCAQMD, 2000c). The Ultramar's RFG Phase 3 project would include the following new refinery equipment:

- Merox Treater
- Sour Water Stripper - (storage tank, stripper and vapor recovery system)
- Storage Tanks
- Boiler
- Flare
- Cooling Tower

Modifications to the following refinery units were proposed:

- Fluid Catalytic Cracking Unit (FCCU) - (new Gas Concentration Unit Debutanizer, new primary absorber and stripper, new accumulators, pumps, reboiler, distillation columns, vessels and heat exchangers)
- Fluid Catalytic Cracking Unit Liquefied Gas Merox Unit - (new liquefied petroleum gas (LPG) dryer and Selective Hydrogenation Unit, convert existing dryer column to depropanizer)
- Light Ends Recovery Unit - (new debutanizer and depentanizer, convert existing depropanizer to recover butane in Butamer Unit; new vessels, pumps and fin-fans)
- Naphtha Hydrotreater Unit - (modify compressor, new heat exchangers and pumps)
- Olefin Treater - (convert to hydrotreater; new reactor, new stripper, new compressor, changes to piping and new catalyst)
- Gas Oil Hydrotreater - (new pumps, new compressors and modify heater)
- Platformer - (new compressor and depropanizer)
- Butamer Unit - (new column, new heat exchangers, vessels and pumps)
- Storage Tanks
- Flare System

Associated modifications and additions to storage facilities, pipelines and support facilities are also expected (SCAQMD, 2000c). The project also includes modification to existing storage tanks and new storage tanks at the Ultramar Marine Tank Farm, Olympic Tank Farm, and Marine Terminal. The Ultramar Refinery is located about 15 miles from the Paramount Refinery, so no localized cumulative impacts are expected.

**7) Third Party Terminals**

A number of petroleum companies use third party terminals to distribute their fuel to gasoline stations. The terminals include the Kinder Morgan Orange Terminal, and the Kinder Morgan Colton Terminal. The modifications to the Kinder Morgan Orange and Colton Terminals included the conversion of an existing fixed roof tank to an internal floating roof tank and a change in service of the tank from diesel to ethanol. In addition, new truck unloading racks were added to both the Orange and Colton Terminals.

**C. OTHER NEARBY PROJECTS**

Other proposed projects within the general vicinity of the Paramount Refinery are described below.

**City of Long Beach**

**8) Street Construction**

As part of the ongoing effort by the City of Long Beach to revitalize certain areas, a number of streetscape improvements have been proposed over the next three years. Streetscaping involves landscaping, widening of streets, sidewalk construction and repair, installation of lighting and signage, and construction of medians on streets. Several of these streetscaping activities are currently ongoing or will be conducted in the future within the vicinity of the Paramount Refinery, including the following:

- Atlantic Avenue to Artesia Blvd.
  - Artesia Blvd. - Downey Ave. to Obispo Ave.
  - Paramount Boulevard - 70<sup>th</sup> Street and Artesia Blvd.
  - Downey Avenue - 70<sup>th</sup> Street and Artesia Blvd.
- (Personal communication, Lee Mayfield, May 2003).

**9) North Long Beach Redevelopment Project Area**

North Long Beach covers an area of 7,540 acres of land. The majority of the land is within the Redevelopment project area and is located north of I-405 freeway. The area is bordered by the cities of Compton, Paramount and Lakewood. Many of the existing commercial properties in the area are in varying stages of physical deterioration and were built with substandard design and lack adequate parking.

The redevelopment of North Long Beach is already underway and is scheduled to be completed in approximately 2026. Part of the revitalization plan for the area includes converting declining commercial land uses to residential housing or other alternatives, and initiating streetscape improvements (Long Beach, City of, 2002).

**City of Paramount**

**10) Industrial Warehousing Project**

An industrial warehousing project located at the intersection of Garfield Avenue and Rosecrans Boulevard is projected to begin construction in approximately August 2004. This project will add 78,605 square feet of warehouse space and is scheduled to be completed within approximately six to eight weeks from commencement (Personal Communication, John Caver, May 2003 and November 2003).

**11) Recreation Facility**

The City of Paramount plans to build a new recreation center at Progress Park. Progress Park is located at 15500 Downey Ave. The 4,000-square-foot recreation center will replace a 1,400-square-foot preschool that was originally a house built in the 1940s. The new facility will be home to the City's preschool, the Park Pals after-school program, youth and adult recreation classes, the local girls softball league, as well as meetings and counseling sessions for GRIP (Gang Resistance in Paramount) and Neighborhood Watch. In addition, a plaza will be created and there will be extensive landscape and hardscape improvements to the park in the center's vicinity. Construction is scheduled to begin approximately, in April 2004. (Paramount, City of, Press Release, October 2002, Linda Benedetti-Leal and David Johnson, Paramount, City of, Recreation Department, November 2003).

**City of Downey**

**12) Downey Landing**

A mixed-use commercial and industrial complex is being proposed in the City of Downey which is located five miles north of the Paramount refinery. The site is bounded by Stewart and Gray roads on the north, Lakewood Boulevard and Clark Avenue on the west, Imperial Highway on the south, and Bellflower Boulevard on the east. The Downey Landing's proposal included multiple uses for 117 acres of the 160 acre site, including a 28-acre retail center that will occupy the northern portion, a movie/TV production studio complex for the central portion, and a business/technology park on the eastern portion. Kaiser Permanente plans a new hospital/medical office complex for 30 acres on the southern portion of the property. The proposed Kaiser Permanente project will include a six-story hospital and a four-story medical office building. The remaining 13 acres of the 160 acres will be reserved for a school/park/learning center.

The final Environmental Impact Report (EIR) (City of Downey, 2002) discusses the impact of the Specific Plan, and contains recommended mitigation measures designed to lessen the extent of identified impacts (City of Downey, 2002).

**13) Banco Popular Project**

The Banco Project is proposed for the northwest corner of the Rosecrans Avenue/Lakewood Boulevard intersection (13451 Lakewood Boulevard). The project site contains 15,577 square feet and; development will consist of one building containing a 1,200 square foot restaurant and a 2,013 square foot bank. A grading permit has been issued by the City of Downey for the project (Personal Communication Mark Selheim, May 2003).

**14) 12651-65 Paramount Boulevard**

A residential tract consisting of eight single-family residences is under construction at 12651-65 Paramount Boulevard (Personal Communication Mark Selheim, May 2003).

**15) 12645 Lakewood Boulevard**

A residential tract consisting of eight single-family residences is proposed for 12645 Lakewood Boulevard (Personal Communication Mark Selheim, May 2003).

**City of Bellflower**

**16) 91 Freeway Ramp Beautification**

Landscaping and decorative painting is being performed on the 91 Freeway on/off ramps at Bellflower Boulevard. (City of Bellflower, 2003).

**17) Town Center Plaza Project**

The Town Center Plaza project is part of the redevelopment plan to revitalize the downtown area of Bellflower. This project will span five acres and feature an outdoor stage, businesses and a train station that would connect to the Metrolink transit system. Environmental clearance is being sought for a two and one half mile bicycle path and walkway on what is currently a railroad track that is scheduled to be removed in the near future. This project is scheduled to begin construction approximately at the end of 2003. (City of Bellflower, 2003).

**D. AIR QUALITY**

**CONSTRUCTION IMPACTS**

Construction activities associated with CARB RFG Phase 3 projects at other refineries have or will be essentially completed prior to the commencement of construction activities at the Paramount Refinery. December 31, 2003 is the date when MTBE must be phased out of gasoline sold in California so most of the construction activities at other refineries and terminals have been or will be completed prior to construction of the

CHAPTER 5: CUMULATIVE IMPACTS

Paramount Clean Fuels project. No cumulative construction impacts are expected from other refinery projects.

Air quality impacts due to construction at the Paramount Refinery are considered to be less than significant. It is expected that construction activities associated with several other local projects will occur during the same timeframe as the proposed project including the Industrial Warehousing Project (No. 10), the Recreational Facility (No. 11), the Banco Popular Project (No. 13), and two residential developments (No. 14 and 15). Potential construction emissions have been estimated using the URBEMIS2002 Model. The default assumptions in the URBEMIS2002 Model (Yolo-Solano AQMD, 2003) were used since little information is available regarding these projects (see Appendix B for additional information).

TABLE 5-1  
**CUMULATIVE PROJECT  
 PEAK DAY CONSTRUCTION EMISSIONS<sup>(1)</sup>**  
 (lbs/day)

ACTIVITY	CO	VOC	NOx	SOx	PM10
Paramount Clean Fuels Project	308	32	76	6	118
Industrial Warehouse Project (No. 10)	11	133	1	<1	<1
Recreational Center Project (No. 11)	1	<1	<1	<1	<1
Banco Popular Project (No. 13)	<1	5	<1	<1	<1
Residential Development (No. 14 and 15)	2	66	4	0	<1
Cumulative Emissions	322	236	81	6	118
SCAQMD Thresholds	550	75	100	150	150
Cumulatively Significant (?)	NO	YES	NO	NO	NO

Table 5-1 summarizes the construction emissions of the related projects (projects within approximately one mile of the Refinery) with construction schedules that might coincide with construction of the Paramount Clean Fuels Project. On a cumulative basis, construction emissions would exceed the CEQA thresholds established by the SCAQMD for VOC, assuming the construction projects occur at the same time. Therefore, the cumulative air quality construction impacts are considered significant for VOC emissions. The cumulative air quality construction impacts are less than significant for CO, NOx, SOx and PM10.

**OPERATIONAL IMPACTS - CRITERIA POLLUTANTS**

The RFG Phase 3 projects at all of the local refineries will increase the criteria pollutants emitted from the refineries. Direct stationary emission sources are generally subject to regulation. The emissions associated with the cumulative CARB Phase 3 projects are shown in Table 5-2. The operation of the CARB Phase 3 projects are expected to exceed

SCAQMD thresholds for CO, VOC, NOx, SOx and PM10, so air quality impacts are significant. No localized increases in air emissions are expected because the refineries and terminals are located a sufficient distances from the Paramount Refinery (see Figure 5-1).

Cumulative impacts associated with other local projects could also occur during the operational phase. Operational emissions from projects other than Paramount are expected to be largely due to mobile source emissions. The operational emissions have been estimated in Table 5-2.

**TABLE 5-2**  
**CUMULATIVE PROJECT**  
**PEAK DAY OPERATIONAL EMISSIONS<sup>(1)</sup>**  
**(Pounds per day)**

SOURCE	CO	VOC	NOx	SOx	PM10
Ultramar CARB Phase 3 Project	514	156	2,164	2,678	287
ConocoPhillips Ethanol Import & Dist Project	9	-54 <sup>(1)</sup>	10	-	1
ConocoPhillips CARB RFG Phase 3	136	22	514	402	43
BP ARCO CARB Phase 3 Project	42	86	49	0	57
Shell CARB Phase 3 Project	2,213	482	2030	71	57
ExxonMobil CARB Phase 3 Project	29	288	138	12	103
ChevronTexaco CARB Phase 3 Project	393	347	3,103	2,498	843
Third Party Terminals	-	4	-	-	-
Paramount Clean Fuels Project	104	66	52	1	69
Industrial Warehouse Project (No. 10) <sup>(2)</sup>	76	7	10	<1	5
Recreational Center Project (No. 11) <sup>(2)</sup>	39	3	5	<1	3
Banco Popular Project (No. 13) <sup>(2)</sup>	109	9	14	<1	8
Residential Development (No. 14 and 15) <sup>(2)</sup>	80	25	5	<1	10
<b>Cumulative Emissions</b>	<b>3,744</b>	<b>1,441</b>	<b>8,094</b>	<b>5,662</b>	<b>1,486</b>
<b>SCAQMD Thresholds</b>	<b>550</b>	<b>55</b>	<b>55</b>	<b>150</b>	<b>150</b>
<b>Significant (?)</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>	<b>YES</b>

(1) Negative numbers represent emission reductions.

(2) Based on URBEMIS2002 Model, using default assumptions.

On a regional basis, RFG Phase 3 fuels produced by the refineries are expected to result in a reduction in emissions from mobile sources that utilize the reformulated fuels. Table 5-3 summarizes the expected statewide emission decreases from the mobile sources, which use the reformulated fuels. As a conservative approach, the statewide mobile source emissions reductions are not credited toward mitigation of cumulative impacts.

**TABLE 5-3**  
**CARB PHASE 3 EXPECTED STATEWIDE EMISSION CHANGES**  
**(Pounds per Day)**

POLLUTANT	1998 Average In-Use Fuel		Future Representative In-Use Fuel Based on Flat Limits		Difference
	2005	2010	2005	2010	2005
NO <sub>x</sub>	4,200	3,400	-33,200	-27,200	-37,400
Exhaust Hydrocarbons	-16.0	-9.3	-16.5	-9.6	-0.5
	-32,000	-18,600	-33,000	-19,200	-1,000
Evaporative Hydrocarbons	-28,800	-22,600	-28,800	-22,600	0
Total Hydrocarbons	-60,800	-41,200	-61,800	-41,800	-1,000

Negative numbers indicate emission reductions. Source: CARB, 1999

Air quality impacts associated with operation of the six RFG Phase 3 projects are considered significant since SCAQMD mass emissions thresholds are expected to be exceeded. Although operations will exceed the significance thresholds, there will be large regional benefits from the use of the reformulated fuels by mobile sources. Emissions of mobile sources will be reduced for NO<sub>x</sub> and VOCs counteracting the emissions being produced by the refineries and providing an environmental benefit. The emission reductions are expected to be far greater than the direct cumulative emissions from the refineries. In addition, the RFG Phase 3 compliant fuels are expected to result in a 7.2 percent reduction in potency-weighted emissions of toxic air contaminants from mobile sources using the fuel providing additional emissions benefits. Further, the diesel sulfur limit of 15 ppmw will help generate significant air quality benefits by enabling the effective performance of advanced diesel exhaust emissions control technologies that reduce emissions of ozone precursors (NO<sub>x</sub> and VOCs) and diesel particulate matter.

The cumulative operational emissions associated with projects in the Paramount area are expected to exceed SCAQMD thresholds for CO, VOC, NO<sub>x</sub>, SO<sub>x</sub> and PM<sub>10</sub>. Therefore, cumulative air quality impacts are significant.

#### OPERATIONAL IMPACTS - TOXIC AIR CONTAMINANTS

In order to determine the cumulative impacts of toxic air contaminants, the emissions from the implementation of the proposed project were analyzed. This is referred to as the post-project scenario and includes all the existing emission sources at the Paramount Refinery, plus the proposed modified emission sources associated with the revised reformulated fuels program. In addition, the potential cumulative impacts associated with the overlap of emissions from other refineries were addressed in the analysis provided below. The other cumulative projects (Projects 8-17) are not expected to emit toxic air contaminants during operations and, therefore, were not included in this analysis.



A comprehensive air dispersion modeling analysis and a Health Risk Assessment (HRA) were performed for the projected refinery emissions following completion of the proposed project. This section discusses the results of the air dispersion modeling and health risk assessment. The procedures used to complete the projected HRA are the same as those used to complete the baseline HRA (see Chapter 3, Air Quality). The HRA is contained in Volume II, which should be consulted for further details.

#### **Hazard Identification**

The list of TACs evaluated in the post-project scenario is the same as those identified in the baseline assessment (see Table 3-6).

#### **Emission Estimations and Sources**

The estimated mass emissions of toxic air contaminants were based on a combination of the baseline emissions and engineering estimates that reflect operation of the proposed project. For further details on the emission estimates see Chapter 4, Air Quality and Volume II.

#### **HRA Methodology**

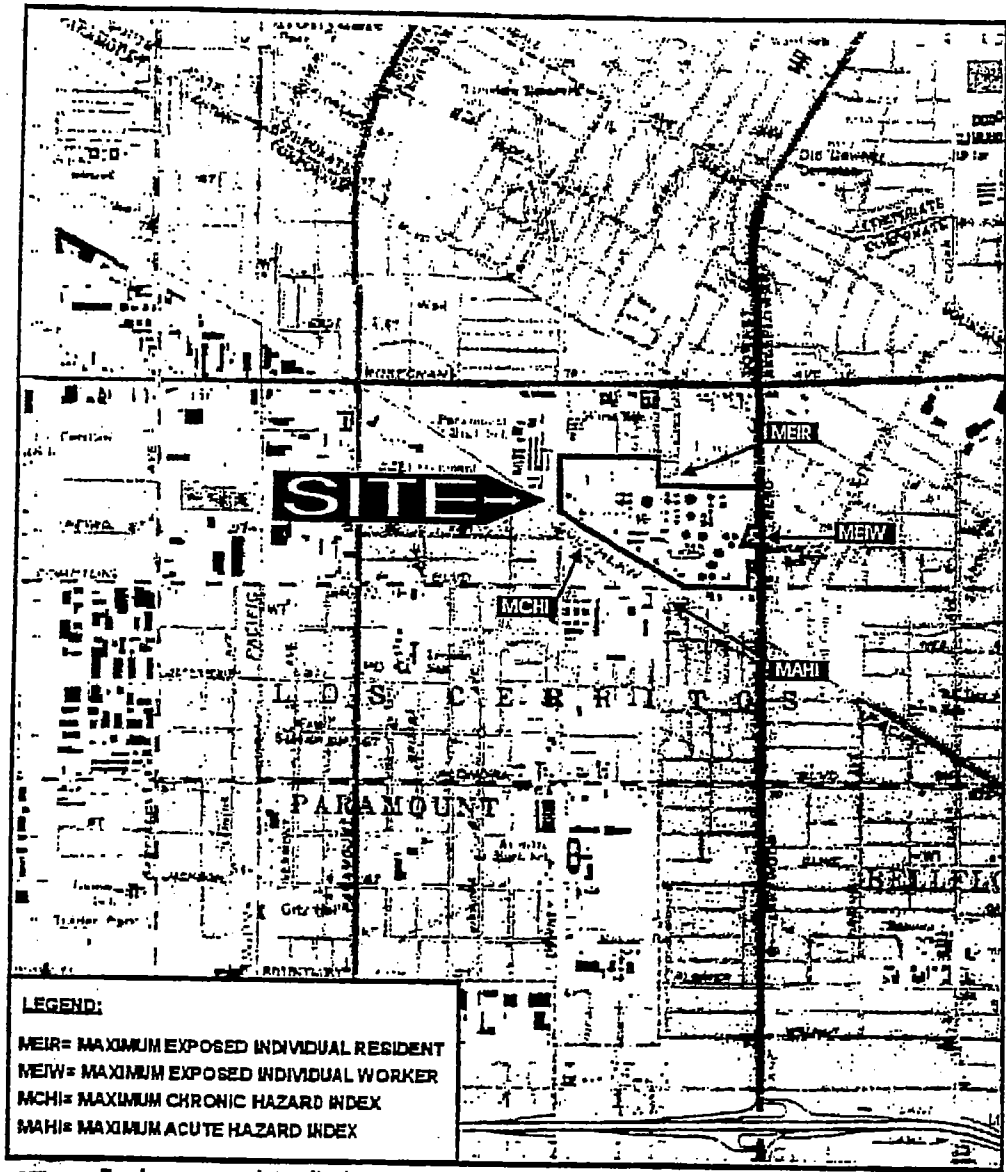
The source parameters for the post-project scenario were used as input to the ISCST3 model to determine unitized ground-level concentrations. The output from the ISCST3 model was combined with estimated emissions for each TAC in the ACE2588 model. The ACE2588 model calculated the health risks associated with the post-project scenario. The ISCST3 model used the same assumptions as the baseline model for receptor grids, meteorological data, and so forth. The ACE2588 model used the same assumptions for the post-project scenario as the baseline model for multi-pathway analysis, pathways to exposures, and default exposure assumptions. The model was used to identify the MEIW and MEIR for the post-project scenario. The ACE2588 model calculated both carcinogenic and non-carcinogenic health impacts.

#### **Post-Project HRA Results - Carcinogenic Health Impacts**

##### **Maximum Exposed Individual Worker**

The predicted maximum cancer risk at the MEIW area due to exposure to projected post-project emissions was calculated to be 2.15E-06 or two per million. The location of the MEIW is the same as that for the baseline scenario and is shown in Figure 5-3. Table 5-4 shows major source contributions to the MEIW. Emissions from Fugitives - Northeast Tank Farms account for about 45 percent of the MEIW cancer risk. Emissions of benzene are responsible for about 75 percent of the MEIW risk (see Table 5-5). The cancer risk at the MEIW does not exceed the cancer risk significance threshold in Table 4-1 and is less than significant.

CHAPTER 5: CUMULATIVE IMPACTS



**EA** Environmental Audit, Inc.

PROJECT MAXIMUM IMPACT LOCATIONS  
14700 Downey Avenue  
Paramount, California

Figure 4-1

Project No. 2150  
14700 Downey Ave. Impact Location

TABLE 5-4

EMISSION SOURCE CONTRIBUTION TO CANCER RISK FOR  
POST-PROJECT SCENARIO MEIW

Source No.	Source Name	Percent Contribution
100	Fugitives for Northeast Tank Farm	45.0
111	Heaters H303-306	9.2
130	Fugitives for HDS Units	6.3
89	Fugitives for Crude Unit 1	4.2
92	Fugitives for Jet Fuel Area	3.6
90	Fugitives for Crude Unit 2	3.6
101	Fugitives for Northwest Tank Farm	3.0
116	Fugitives for New BenSat/Isom Unit	2.9
114	COGEN	1.7
102	Fugitives for North-Central Tank Farm	1.1
41	Tank 12502	1.0
19	Flare	1.0

TABLE 5-5

TAC CONTRIBUTION TO CANCER RISK FOR  
POST-PROJECT SCENARIO MEIW

Toxic Air Contaminant	Cancer Risk	Percent Contribution
Acetaldehyde	4.42E-10	<0.1
Arsenic	1.22E-08	0.6
Benzene	1.58E-06	74.8
1,3-Butadiene	3.81E-09	0.2
Cadmium	1.65E-08	0.8
Carbon Tetrachloride	2.14E-12	<0.1
Chloroform	2.10E-13	<0.1
Chromium (Hex)	1.16E-07	5.5
Ethylene Dibromide	4.36E-12	<0.1
Ethylene Dichloride	7.22E-13	<0.1
Formaldehyde	1.20E-08	0.6
Lead	2.66E-11	<0.1
Methylene Chloride	2.77E-14	<0.1
Nickel	8.75E-10	<0.1
Perchloroethylene	1.26E-09	0.4
PAHs	3.61E-07	17.10
Propylene Oxide	2.03E-16	<0.1
Styrene	4.20E-13	<0.1
Vinyl Chloride	1.61E-12	<0.1
Total	2.10E-06	

**Maximum Exposed Individual Resident**

The predicted maximum cancer risk at the MEIR area due to exposure to projected post-project emissions was calculated to be 9.81E-06 or about ten per million. The location of the MEIR is east of the Refinery and is shown in Figure 5-3. Table 5-6 shows major source contributions to the MEIR. Emissions from Fugitives - HDS Unit account for about 21 percent of the MEIR risk (see Table 5-6). Emissions of benzene are responsible for about 60 percent of the MEIR risk (see Table 5-7).

TABLE 5-6

EMISSION SOURCE CONTRIBUTION TO CANCER RISK FOR  
POST-PROJECT SCENARIO MEIR

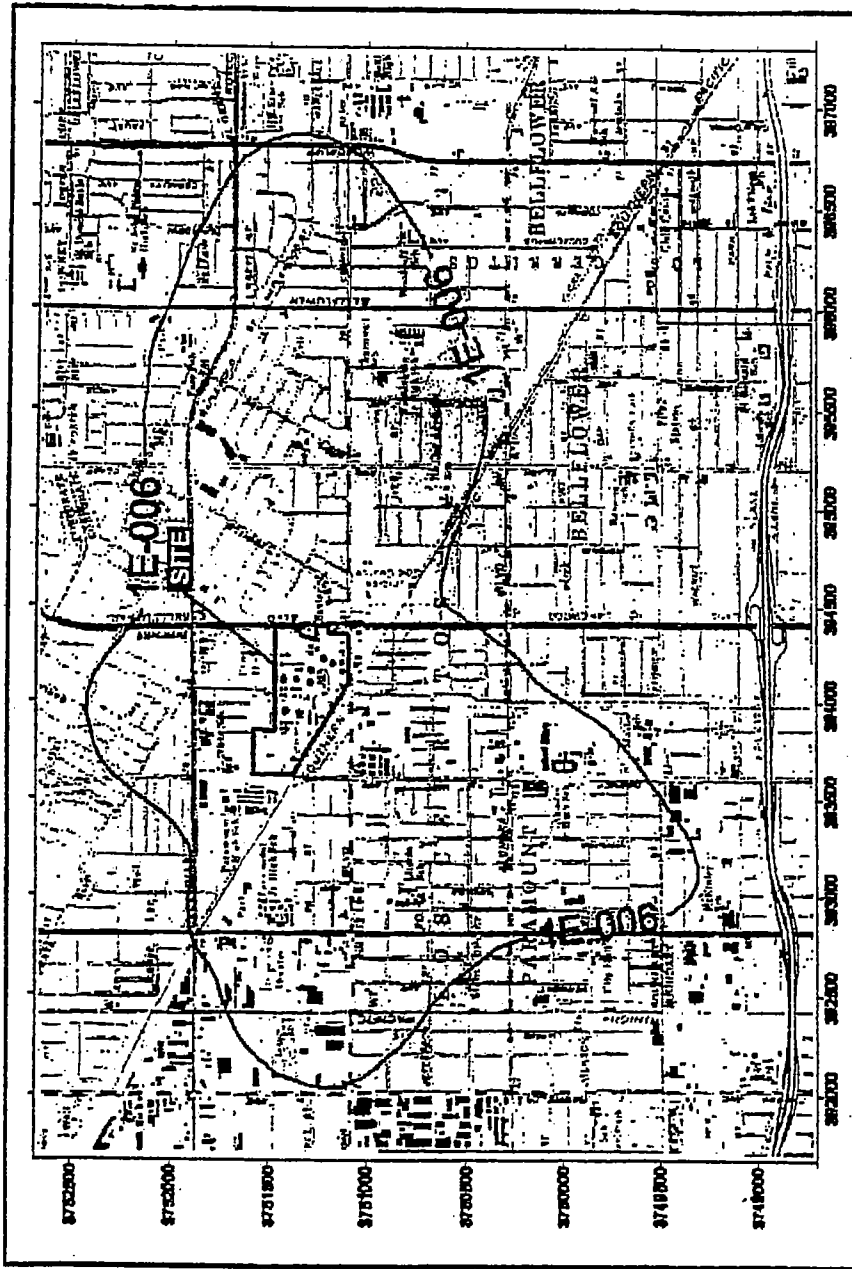
Source No.	Source Name	Percent Contribution
100	Fugitives for Northeast Tank Farm	21.0
89	Fugitives for Crude Unit 1	11.1
111	Heaters H303-306	10.0
90	Fugitives for Crude Unit 2	7.9
130	Fugitives for HDS Units	5.7
92	Fugitives for Jet Fuel Area	4.6
114	COGEN	2.9
101	Fugitives for Northwest Tank Farm	2.8
5	Heater H-601	2.6
116	Fugitives for New BenSat/Isom Unit	2.3
1	Heater H-801	2.2
2	Heater H-802	2.1
4	Heater H-860	1.6
6	Heater H-602	1.4
104	Fugitives for North-Central Tank Farm	1.3
112	Heater H501	1.2
19	Flare	1.2
18	Heater H-907	1.1

TABLE 5-7

TAC CONTRIBUTION TO CANCER RISK FOR  
POST-PROJECT SCENARIO MEIR

Toxic Air Contaminant	Cancer Risk	Percent Contribution
Acetaldehyde	3.35E-09	<0.1
Arsenic	8.92E-08	0.9
Benzene	5.88E-06	59.9
1,3-Butadiene	2.89E-08	0.3
Cadmium	1.20E-07	1.2
Carbon Tetrachloride	1.62E-11	<0.1
Chloroform	1.59E-12	<0.1
Chromium (Hex)	8.50E-07	8.7
Ethylene Dibromide	3.30E-11	<0.1
Ethylene Dichloride	5.46E-12	<0.1
Formaldehyde	9.04E-08	0.9
Lead	2.01E-10	<0.1
Methylene Chloride	2.10E-13	<0.1
Nickel	6.41E-09	0.1
Perechloroethylene	4.63E-08	0.5
PAHs	2.70E-06	27.5
Propylene Oxide	1.59E-15	<0.1
Styrene	3.18E-12	<0.1
Vinyl Chloride	1.22E-11	<0.1
<b>Total</b>	<b>9.81E-06</b>	

The one per million-cancer risk isopleth for the post-project scenario is shown in Figure 5-3. This isopleth was calculated based on the same assumptions used to calculate the residential cancer risk including a 70-year exposure and multi-pathway assumption. The cancer risk at the MEIR does not exceed the cancer risk significance threshold in Table 4-1 of ten per million and is less than significant. The post project cancer risk is reduced as a result of the project. The reduction is due to the reduced benzene content in products and process streams in order to meet CARB Phase 3 requirements, and the overall reduction of benzene at the facility by the addition of the benzene saturation and isomerization unit, which converts benzene to less toxic components.



N  
Figure 5-4

ONE IN A MILLION  
POST-PROJECT CANCER RISK ISOFLETH  
PARAMOUNT PETROLEUM CORPORATION  
PARAMOUNT, CALIFORNIA

Environmental Audit, Inc.



Project No. 2150

## CHAPTER 5: CUMULATIVE IMPACTS

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### Cancer Burden

The cancer burden for the area surrounding the Paramount Refinery was calculated using the same assumptions as the baseline cancer burden calculations. The total excess cancer burden within the area of influence was predicted to be 0.122 and 0.0054 for the residential and occupational populations, respectively. (See Volume II for further details.) The combined excess cancer risk was predicted to be 0.127. The cancer burden does not exceed the cancer risk significance threshold in Table 4-1 and is less than significant.

### Sensitive Receptors

The maximum cancer risk to a sensitive receptor was estimated to be  $7.64E-06$  or approximately eight per million at the Baxter Elementary School. This risk estimate is conservative as it is based on a 70-year continuous exposure period. The cancer risk at the sensitive receptors does not exceed the cancer risk significance threshold in Table 4-1 and is less than significant.

### Post-Project HRA Results - Non-Carcinogenic Health Impacts

#### Acute Hazard Index

The highest total acute hazard index for any single toxicological endpoint was estimated to be 0.014, at an occupational receptor, for the respiratory system, primarily due to exposure to hydrogen sulfide (44 percent). The acute hazard index does not exceed the significance threshold in Table 4-1 and is less than significant.

#### Chronic Hazard Index

The highest chronic hazard index for any single toxicological endpoint was estimated to be 0.031, at an occupational receptor, for the respiratory system, primarily due to exposure to benzene (39 percent) and formaldehyde (23 percent). The chronic hazard index does not exceed the significance threshold in Table 4-1 and is less than significant.

The cumulative impacts associated with the post-project scenario would be below the significance criteria for cancer risk at the MEIW and the MEIR for the chronic and acute hazard indices. Further, the proposed project would reduce emissions of some toxic air contaminants, e.g. benzene, thus reducing the overall health risks associated with exposure to Refinery emissions. Therefore, adverse cumulative impacts associated with toxic air contaminants are not expected from the Paramount Clean Fuels Project.



### **TAC Impacts from Other Cumulative Projects**

Based on the available data, the cumulative impacts associated with other proposed Clean Fuels projects (Project Nos. 1 through 7) are not expected to result in significant TAC impacts since the projects are disbursed throughout the southern California area so TAC emissions would not be expected to overlap. The other cumulative projects (Project Nos. 8 through 17) are not expected to generate significant quantities of toxic air contaminants.

### **MITIGATION MEASURES**

Mitigation measures for construction activities have been imposed on the various individual projects. There are no additional feasible mitigation measures to further control construction emissions.

The mitigation measures to minimize emissions associated with operation of the related projects include the use of BACT for all new emission sources and modifications to existing sources. The use of BACT would control localized emissions. A BACT review will be completed during the SCAQMD permit approval process for all new/modified sources. In addition, the related refinery projects would provide regional emission benefits by reducing emissions from mobile sources that use the reformulated fuels.

### **LEVEL OF SIGNIFICANCE AFTER MITIGATION**

The cumulative air quality impacts due to construction and operation of the RFG Phase 3 projects exceed the SCAQMD significance thresholds in spite of implementing all feasible mitigation measures. The cumulative impacts of TACs for cancer risk at the MEIR as less than significant. The cumulative impacts associated with the post-project scenario would be below the significance criteria for cancer risk at the MEIW, MEIR, and for the chronic and acute hazard index.

### **E. HAZARDS AND HAZARDOUS MATERIALS**

#### **PROJECT IMPACTS**

The cumulative impacts from and between the onsite operation of the refineries' RFG Phase 3 projects (Project Nos. 1-7) are not expected to be significant because of the distance between Paramount and the other facilities. The closest refinery with a clean fuels project to the Paramount Refinery is the BP ARCO Refinery located about 11 miles south of the Paramount Refinery. The impacts associated with the Paramount Refinery proposed project are expected to travel less than 1,000 feet, which would not reach the other local refineries or any of the other cumulative projects. Projects Nos. 8 through 17 are not expected to involve hazardous materials or generate significant hazard impacts. Therefore, no significant cumulative hazard impacts are expected with the other related projects.

### MITIGATION MEASURES

The proposed project impacts on hazards are considered significant. However, these impacts will not combine with the impacts of related projects due to the distance between the facilities. A number of existing rules and regulations apply to the Paramount Refinery and other proposed projects. Compliance with these rules and regulations is expected to minimize refinery-related hazards. Compliance with these rules and regulations should also minimize the hazards at other refineries.

### LEVEL OF SIGNIFICANCE AFTER MITIGATION

The impacts of the various projects on hazards are not expected to be cumulatively considerable as hazards at or within one project area are not expected to impact or lead to hazards at other facilities or to combine in the same location.

#### F. TRANSPORTATION/TRAFFIC

For the proposed project, the project's contribution to cumulative transportation/traffic impacts is not significant because the traffic conditions would essentially be the same whether or not the proposed project is implemented, because the proposed project has such minimal effects on traffic conditions as explained below.

Cumulative traffic impacts have been analyzed using the traffic counts taken in 2003 and assuming general growth in the area. Table 5-8 shows the baseline and the cumulative LOS analysis and volume to capacity ratios due to general growth in the area. These ratios were calculated assuming a projected traffic growth of one percent per year and no changes in existing intersection geometrics. Cumulative impacts are not expected to result in significant changes in LOS.

The cumulative traffic analysis for the morning peak hour indicates that there would be no change in the LOS for all but one intersection in the Paramount area. The Lakewood Blvd/Somerset Blvd. intersection is expected to change from LOS A to B, which is not considered significant since traffic flow would not be significantly adversely impacted. Therefore, cumulative impacts on traffic during the morning are less than significant.

The cumulative traffic analysis for the evening peak hour indicates that there would be no change in the LOS for all but one intersection in the Paramount area. The Downey Avenue/Alondra Boulevard intersection is expected to change from LOS C to D. LOS D typically is the level for which a metropolitan area street system is designed. The growth in traffic is less than two percent of the overall traffic at the intersection and is considered less than significant. Therefore, cumulative impacts on traffic during the p.m. operations are less than significant.

**On-and-Off Ramp Freeway Traffic During Operations**

Two freeways bordering the proposed project were analyzed for traffic impacts during operations. The Century Freeway (I-105) is located approximately six miles north of the proposed project and the Artesia Freeway (SR-91) is approximately 14 miles south. The cumulative traffic analysis included the intersections of Downey Avenue and SR-91, Lakewood Boulevard and SR-91, both of which are south of the Paramount Refinery, and the intersection of Lakewood Boulevard and the I-105, which is north of the Refinery. The analysis indicates that the LOS at these intersections is not expected to change. Therefore, the cumulative impacts at these intersections are expected to be less than significant.

**TABLE 5-8**

**CUMULATIVE TRAFFIC IMPACTS  
LEVEL OF SERVICE ANALYSIS AND VOLUME-TO-CAPACITY RATIOS  
OPERATIONAL**

INTERSECTION	BASELINE				CUMULATIVE IMPACTS					
	AM PEAK		PM PEAK		AM PEAK			PM PEAK		
	LOS	Volume to Capacity Ratio	LOS	Volume to Capacity Ratio	LOS	Volume to Capacity Ratio	Volume to Capacity Ratio Increase	LOS	Volume to Capacity Ratio	Volume to Capacity Ratio Increase
Downey Ave. & Rosecrans Ave.	B	0.662	C	0.761	B	0.674	0.000	C	0.777	0.003
Downey Ave. & Somerset Blvd.	D	0.854	B	0.687	D	0.871	0.001	B	0.701	0.001
Downey Ave. & Alondra Blvd.	B	0.637	C	0.793	B	0.649	0.000	D	0.808	0.000
Downey Ave. & SR91 WB offramp/ SR91 WB on & EB offramps.	C	0.780	B	0.625	C	0.795	0.000	B	0.637	0.000
Downey Ave. & SR91 EB onramp/ SR91 EB offramp.	B	0.661	B	0.622	B	0.673	0.000	B	0.633	0.000
Lakewood Blvd. & I105 EB offramp/ I105 WB offramp.	A	0.560	C	0.749	A	0.573	0.000	C	0.766	0.001
Lakewood Blvd. & Rosecrans Ave.	A	0.562	C	0.745	A	0.577	0.000	C	0.764	0.000
Lakewood Blvd. & Somerset Blvd.	A	0.598	B	0.671	B	0.621	0.000	B	0.685	0.000
Lakewood Blvd. & Alondra Blvd.	A	0.540	C	0.750	A	0.551	0.000	C	0.765	0.000
Lakewood Blvd. & SR91 WB on/off ramps SR91 WB onramp	A	0.418	A	0.586	A	0.427	0.000	A	0.598	0.000
Lakewood Blvd. & SR91 EB onramp SR91 EB on/off ramps.	A	0.520	B	0.691	A	0.529	0.000	B	0.704	0.000

## CHAPTER 5: CUMULATIVE IMPACTS

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### LEVEL OF SIGNIFICANCE

All intersections near the Paramount Refinery are considered to have less than significant cumulative impacts, since free-flowing traffic would continue and is not expected to change. Therefore, the cumulative impacts on traffic during the a.m and p.m. would be considered less than significant.

### MITIGATION MEASURES

No significant cumulative impacts have been identified so no mitigation measures are required.

### LEVEL OF SIGNIFICANCE AFTER MITIGATION

The traffic impacts associated with the proposed project and other related projects are not expected to be significant or result in adverse traffic impacts that would contribute to the cumulative traffic impacts.

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July 2003

# ToxFAQs™ for Trichloroethylene (TCE) (*Tricloroetileno*)

CAS# 79-01-6

This fact sheet answers the most frequently asked health questions about trichloroethylene. For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

**HIGHLIGHTS:** Trichloroethylene is a colorless liquid which is used as a solvent for cleaning metal parts. Drinking or breathing high levels of trichloroethylene may cause nervous system effects, liver and lung damage, abnormal heartbeat, coma, and possibly death. Trichloroethylene has been found in at least 852 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

## What is trichloroethylene?

Trichloroethylene (TCE) is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers.

Trichloroethylene is not thought to occur naturally in the environment. However, it has been found in underground water sources and many surface waters as a result of the manufacture, use, and disposal of the chemical.

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## What happens to trichloroethylene when it enters the environment?

- Trichloroethylene dissolves a little in water, but it can remain in ground water for a long time.
- Trichloroethylene quickly evaporates from surface water, so it is commonly found as a vapor in the air.
- Trichloroethylene evaporates less easily from the soil than

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from surface water. It may stick to particles and remain for a long time.

- Trichloroethylene may stick to particles in water, which will cause it to eventually settle to the bottom sediment.
- Trichloroethylene does not build up significantly in plants and animals.

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### **How might I be exposed to trichloroethylene?**

- Breathing air in and around the home which has been contaminated with trichloroethylene vapors from shower water or household products such as spot removers and typewriter correction fluid.
- Drinking, swimming, or showering in water that has been contaminated with trichloroethylene.
- Contact with soil contaminated with trichloroethylene, such as near a hazardous waste site.
- Contact with the skin or breathing contaminated air while manufacturing trichloroethylene or using it at work to wash paint or grease from skin or equipment.

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### **How can trichloroethylene affect my health?**

Breathing small amounts may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating.

Breathing large amounts of trichloroethylene may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage.

Drinking large amounts of trichloroethylene may cause nausea, liver damage, unconsciousness, impaired heart function, or death.

Drinking small amounts of trichloroethylene for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear.

Skin contact with trichloroethylene for short periods may cause skin rashes.

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### **How likely is trichloroethylene to cause cancer?**

Some studies with mice and rats have suggested that high levels of trichloroethylene may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of trichloroethylene in drinking water or in workplace air have found evidence of increased cancer. Although, there are some concerns about the studies of people who were exposed to trichloroethylene, some of the effects found in people were similar to effects in animals.

In its 9th Report on Carcinogens, the National Toxicology Program (NTP) determined that trichloroethylene is “reasonably anticipated to be a human carcinogen.” The International Agency for Research on Cancer (IARC) has determined that trichloroethylene is “probably carcinogenic to humans.”

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### **Is there a medical test to show whether I've been exposed to trichloroethylene?**

If you have recently been exposed to trichloroethylene, it can be detected in your breath, blood, or urine. The breath test, if it is performed soon after exposure, can tell if you have been exposed to even a small amount of trichloroethylene.

Exposure to larger amounts is assessed by blood and urine tests, which can detect trichloroethylene and many of its breakdown products for up to a week after exposure. However, exposure to other similar chemicals can produce the same breakdown products, so their detection is not absolute proof of exposure to trichloroethylene. This test isn't available at most doctors' offices, but can be done at special laboratories that have the right equipment.

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### **Has the federal government made recommendations to protect human health?**

The EPA has set a maximum contaminant level for trichloroethylene in drinking water at 0.005 milligrams per liter (0.005 mg/L) or 5 parts of TCE per billion parts water.

The EPA has also developed regulations for the handling and disposal of trichloroethylene.

The Occupational Safety and Health Administration (OSHA) has set an exposure limit of 100 parts of trichloroethylene per million parts of air (100 ppm) for an 8-hour workday, 40-hour workweek.

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### **Glossary**

**Carcinogenicity:** The ability of a substance to cause cancer.

**CAS:** Chemical Abstracts Service.

**Evaporate:** To change into a vapor or gas.

**Milligram (mg):** One thousandth of a gram.

**Nonflammable:** Will not burn.

**ppm:** Parts per million.

Sediment: Mud and debris that have settled to the bottom of a body of water.

Solvent: A chemical that dissolves other substances.

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### References

Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Managing Hazardous Materials Incidents. Volume III – Medical Management Guidelines for Acute Chemical Exposures: Trichloroethylene (TCE). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological Profile for trichloroethylene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

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### Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

### For more information, contact:

Agency for Toxic Substances and Disease Registry  
Division of Toxicology  
1600 Clifton Road NE, Mailstop F-32  
Atlanta, GA 30333  
Phone: 1-888-42-ATSDR (1-888-422-8737)  
FAX: (770)-488-4178  
Email: [ATSDRIC@cdc.gov](mailto:ATSDRIC@cdc.gov)

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This page was updated on November 22, 2004

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