

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER NO. 99-045

**ADOPTION OF REVISED SITE CLEANUP REQUIREMENTS AND RESCISSION OF
ORDER NOS. 95-136, 95-018, 94-044, 92-152, and 92-140 FOR:**

**THE CITY AND COUNTY OF SAN FRANCISCO,
THE UNITED STATES COAST GUARD,**

and

SAN FRANCISCO INTERNATIONAL AIRPORT TENANTS/OPERATORS:

AIRLINE TENANTS:

American Airlines
Delta Air Lines
Federal Express
Japan Airlines
Northwest Airlines
Qantas Airways
Trans World Airlines
United Airlines
U.S. Airways

AVIATION SUPPORT TENANTS:

Chevron U.S.A. Products Company
Ogden Allied Ground Services
PS Trading, Inc.
Aircraft Service International Group
Santa Fe Pacific Pipeline Partners, L.P.
Shell Oil Company
Signature Flight Support - San
Francisco, Inc.
Texaco Refining and Marketing Inc.
Unocal Corporation

GOVERNMENTAL AGENCY:

Federal Aviation Administration

**FOR THE PROPERTY AT: SAN FRANCISCO INTERNATIONAL AIRPORT,
SAN MATEO COUNTY**

FINDINGS:

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter called the Regional Board), finds that:

1. SITE DESCRIPTION

- a. Site Ownership / Location The four-and-a-half-square-mile San Francisco International Airport site is, with the exception of the U.S. Coast Guard parcel, owned and operated by the City and County of San Francisco. The site location, however, is within San Mateo County and is bounded by the cities of South San Francisco, San Bruno, Millbrae, and Burlingame (see Figure 1).
- b. Airport Operations The Airport Commission is the governing body in charge of overseeing all activities on the portion of the Site owned by the City and County of

San Francisco. In order to facilitate airport operations, the Airport Commission leases out and issues permits for the use of parcels, known as plots, within the airport boundaries to various airlines, aviation support companies, and concessionaires, such as ground transportation companies, who operate within their leasehold agreement areas. In addition, the Airport Commission leases out or issues permits for other areas to agencies such as the federal government. The areas and agreements change depending upon the needs of both the Airport Commission and tenant operations. The U. S. Coast Guard is in charge of activities on the portion of the Site owned by the United States.

- c. Adjacent Properties Land uses in the area are a mixture of commercial, industrial and residential. The San Francisco Airport is bounded on the north by San Bruno Channel. Directly across the channel is a commercial/industrial area which includes the Shell bulk terminal, the San Bruno sewage treatment plant and a shopping center. The San Francisco Bay lies to the east of the airport and the runways actually extend into the Bay itself. To the south is a park where jogging trails and a wetland area are surrounded mainly by hotels servicing airport travelers. To the west, a small wetland area exists on the westerly side of the Bayshore freeway (Highway 101) which provides habitat for the red-legged frog, a candidate for threatened species list. Beyond this wetland to the west are residential neighborhoods.

2. **SITE HISTORY AND PRESENT AND FUTURE USAGE**

- a. The San Francisco International Airport has been in existence since the 1920s when it began as a small airfield. Through reclamation of baylands, filling of the Bay, and acquisition of adjacent property, it has expanded to its current size.
- b. Historical and current property uses include passenger transport via both air and ground support vehicles, cargo transport and associated facilities operations, maintenance operations for both airplanes and ground support, a U.S. Coast Guard facility, a fuel distribution depot, a pressurized aircraft fueling network, a materials testing laboratory, storm water holding basins, a domestic wastewater treatment plant, and an industrial wastewater treatment plant. In addition, the Airport was also used as a military airfield, including barracks, during World War II. Certain of these facilities have been regulated under other Board orders. As this Order adopts Airport-wide site cleanup requirements, the three previously-adopted Site Cleanup Requirements for individual sites (i.e., Order No. 92-140 for the Terminal Tank Farm; Order No. 94-044 for the Taxiway C Project; and Order No. 92-152 for the Shell Oil Company's Satellite II Plant) are superseded and rescinded by this Order.
- c. The airport is undergoing a major Master Plan expansion project which will result in an approximately 35% increase in total building square footage and a significant increase in passenger handling capacity. As part of this \$2.4 billion expansion project, the airport has been systematically evaluating (i.e. plot by plot) the environmental conditions of the airport properties. To date, numerous investigations have been

performed under the direction of both the Airport Commission staff and the tenants. As a result, many areas have been found to contain pollution within the subsurface soils and groundwater.

3. CONTAMINANTS OF CONCERN

Investigations by the Airport and its tenants have found that both soil and groundwater at the Site have been polluted primarily by fuel products, including total petroleum hydrocarbons (as gasoline, TPH-g; jet fuel, TPH-j; or diesel, TPH-d), and fuel constituents such as benzene (B), toluene (T), ethyl-benzene (E) and xylene (X). Other significant potential chemicals of concerns (COCs) identified to date include benzo(a)pyrene, chloroform, 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethene (1,2-DCE), methylene chloride, methyl tertiary butyl ether (MTBE), naphthalene, oil and grease, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), tetrachloroethylene (PCE), 1,1,2-trichloroethane (1,1,2-TCA), trichloroethylene (TCE), and vinyl chloride.

For other chemicals that have been detected but are not considered as a significant COC, there may be a need for monitoring to ensure that water quality objectives are not exceeded.

4. AREAS OF CONTAMINATION

Many investigations have been performed to date at the site by the Airport Commission and by many of the tenants as well in order to identify polluted areas within the airport. The following table (Table 1: Summary of Contaminated Sites) summarizes the areas that have been investigated, the plot number, the Primary Discharger(s), the probable major source(s) of the pollution, and the significant pollutants that have been detected either in the subsurface soil or groundwater. [Note: Table 1 only lists Primary Discharger(s). As described in Finding No. 5 below, except for Site No. XVII, in addition to the named Discharger(s), the City and County of San Francisco is also considered as a Secondary Discharger by virtue of the fact that they owned the property at the time of the release.]

Table 1 is compiled based on currently available information, but is not intended to be a conclusive table. The complexity of the fate of numerous possible contamination sources present at the site and the great number of potentially responsible parties involved in the Airport's long history of operation have subjected Table 1 to the need of continual refinements. Additional sites or dischargers may be added to Table 1 as new investigation results become available. Similarly, Dischargers who have undertaken necessary remedial actions to achieve Tier-0 (see Finding No. 11 below) cleanup standards, or have proved their innocence, may be removed from the table. (See Figure 2 for site locations as indicated by their corresponding site number.)

Table 1: SUMMARY OF CONTAMINATED SITES

SITE NO.	AREA NAME	PLOT NO.	PRIMARY DISCHARGER	POLLUTION SOURCE	POLLUTANT
I	Former Pan Am Facility	1	United Airlines, Ogden Allied Ground Services	USTs, Fuel Hydrant System, Operations, Spills	TPH-g, TPH-d, TPH-j, PAHs, BTEX, VOCs, PCBs, Metals
II	Trans World Airlines Cargo/Freight	3	Trans World Airlines	USTs, Fuel Hydrant System	TPH-g, TPH-j, Oil & Grease, BTEX
III*	Former National Car Rental Facility	Old Road 16	*(See note below)	USTs	N/A. (Previously, TPH-g & BTEX)
IV*	Former Hertz Car Rental Facility	Old Road 16	*(See note below)	USTs	N/A. (Previously, TPH-g & BTEX)
V*	Former Avis Car Rental Facility	Old Road 16	*(See note below)	USTs	N/A. (Previously, TPH-g & BTEX)
VI	Chevron Station	Road 20	Chevron U.S.A. Products Company	USTs	TPH-g, BTEX, Oil & Grease
VII	United Air Lines Service Center	Plots 4, 5, 6	United Airlines	USTs, Fuel Hydrant System, Maintenance Operations	TPH-d, TPH-j, Motor Oil, VOCs, Semi-VOCs, Metals
VIII	South Terminals	Boarding Area "A"	United Airlines, Chevron U.S.A. Products Company, Shell Oil Company, PS Trading, Inc., Texaco Refining and Marketing Inc.	Fuel Hydrant System, Spill	TPH-j, TPH-d, Motor Oil
		Boarding Area "B"	Trans World Airlines, Delta Air Lines	Fuel Hydrant System, Spill	TPH-j, TPH-d, Motor Oil
		Boarding Area "C"	Delta Air Lines, Northwest Airlines, PS Trading, Inc.	Fuel Hydrant System, Spill	TPH-j
		Boarding Area "D" (International Terminal)	Aircraft Service International Group	Fuel Hydrant System, Spill	TPH-j, TPH-d, Motor Oil

SITE NO.	AREA NAME	PLOT NO.	PRIMARY DISCHARGER	POLLUTION SOURCE	POLLUTANT
IX	North Terminals	Boarding Area "E"	American Airlines, Delta Air Lines, Chevron U.S.A. Products Company	Fuel Hydrant System, Spill	TPH-j, TPH-d, Motor Oil
		Boarding Area "F"	United Airlines	Fuel Hydrant System, Spill	TPH-j, TPH-d, Motor Oil
		Gate 75	United Airlines, Chevron U.S.A. Products Company, Shell Oil Company	USTs, Fuel Hydrant System, Spill	TPH-g, TPH-j, Motor Oil
X	United Parking Area	Lot DD	Santa Fe Pacific Pipeline Partners	Fuel Hydrant System	TPH-j
XI	American Airlines/ Northwest Airlines Cargo Facility	Plot 9	American Airlines, Northwest Airlines, Chevron U.S.A. Products Company	Fuel Hydrant System	TPH-j
XII	Eastern Airlines Facility	Plots 7, 8, 10	Qantas Airways, Signature Flight Support, Chevron U.S.A. Products Company	USTs, Maintenance Operations, Fuel Hydrant System	TPH-g, TPH-d, TPH-j, Oil & Grease, BTEX, VOCs, Metals
XIII	Superbay Hangar	Plot 40	American Airlines, U.S. Airways	Maintenance Operations	TPH-d
XIV	ASI Building/ FAA Hangar	Plots 41/42	City & County of San Francisco	Maintenance Operations	Metals, Chromium, TPH
XV	Former Wastewater Treatment Plant	Plot 52	City & County of San Francisco	Treatment Plant Operations, Misc.	TPH-g, TPH-d, Oil & Grease, Metals
XVI	United Airlines Maintenance Operations Center	MOC	United Airlines	USTs, Maintenance Operations	TPH-g, TPH-d, TPH-j, VOCs, Metals, Waste Oils, Stoddard solvents

SITE NO.	AREA NAME	PLOT NO.	PRIMARY DISCHARGER	POLLUTION SOURCE	POLLUTANT
XVII	U.S. Coast Guard	U.S. Coast Guard	U.S. Coast Guard	Fuel Hydrant System	TPH-j
	Taxi-C	Taxi-C	Chevron U.S.A. Products Company, Shell Oil Company, PS Trading, Inc., Federal Express, U.S. Coast Guard	USTs, Fuel Pipelines	TPH-j, TPH-g
XVIII	North Field Cargo Area	Plot 50	City & County of San Francisco, Federal Express, Chevron U.S.A. Products Inc., Shell Oil Company, PS Trading, Inc., Japan Airlines	USTs, Fuel Hydrant System, Former Laboratory	TPH-g, BTEX, TPH-j, VOCs, vinyl Chloride
XIX	Bulk Tank Farm Area	North Tank Farm (Plots 22, 23, 24)	Shell Oil Company, PS Trading, Inc., Chevron U.S.A. Products Company	Bulk Storage Above Ground Tanks and Related Fuel Hydrant System Piping	TPH-j
XX	FAA Spill Area	Runway 28R	Federal Aviation Administration	2,000 gallon diesel spill	TPH-d
XXI	North Stormwater Retention Pond	North Pond	City & County of San Francisco	Industrial Wastewater, Spills, Misc.	TPH-g, TPH-d, TPH-j, PAHs?, PCBs?, BTEX, VOCs, Metals, Cyanide?, Oil
XXII	South Stormwater Holding & Oxidation Pond	South Pond	City & County of San Francisco	Industrial Wastewater, Spills, Misc.	TPH-g, TPH-d, TPH-j, PAHs ?, PCBs ?, BTEX, VOCs, Metals, Cyanide?, Oil
XXIII	Satellite II Facility	South Tank Farm (Plots 3A - 3E)	Unocal Corporation, Shell Oil Company, Texaco Refining and Marketing Inc., PS Trading, Inc.	Bulk Storage Above Ground Tanks and Related Fuel Hydrant System Piping	TPH-j

(* Note: Sites III, IV and V have achieved Tier-0 cleanup standards and have received closure status. Previous dischargers at these sites are no longer listed as responsible parties of this Order.)

- **Groundwater Pollution** The first ground water bearing zone has been polluted with various chemical constituents dependent upon the area (see Table 1 for potential COCs in the groundwater on a plot-by-plot basis). Free product has been documented in various locations and mainly consists of jet fuel from the fuel hydrant system and from leaking underground storage tanks.

- **Airport Fuel Hydrant System** This system distributes aircraft fuel from the bulk storage above ground tank farm, located at the northern section of the airport, to the terminals where the airplanes are fueled. The fuel hydrant system was found to contribute significant soil and groundwater pollution in the vicinity of the hydrants. At Boarding Areas A and B, thousands of gallons of free product have been recovered due to a leak in one of the subsurface valves. Many of the fueling pits and elbows have led to significant product loss due to the high pressure (approximately 160 to 180 psi) within the fuel lines. In addition to the currently operational systems at the Airport, there were also former pipelines and hydrant systems in many areas, some of which were removed and some of which were abandoned in place. These former hydrant systems are also a suspected source of releases to soil and groundwater. The references in Table 1 to "fuel hydrant system" are intended to refer generally to both current and former systems.

5. DESIGNATION OF DISCHARGERS

a. City and County of San Francisco

Many of the Airport facilities that have contributed to pollution at the Airport are operated primarily through permits, leases and other agreements for use of the premises by tenants, permittees, and owners. The City and County of San Francisco is considered a discharger because it owns the entire airport, with the exception of the U.S. Coast Guard plot, and has operated various facilities, such as a laboratory and a combined industrial and storm water system, that have caused or contributed to soil and/or groundwater pollution at the site.

b. U.S. Coast Guard

In addition to their operations, the U.S. Coast Guard is considered a Discharger because they own as well as operate a facility which has led to soil and groundwater contamination.

c. Airport Tenants/Operators: Airline Tenants, Aviation Support Tenants, Concessionaires, and Governmental Agencies: (See listing at the beginning of the Order)

The Airline Tenants, Aviation Support Tenants, Concessionaires, and Governmental Agencies are considered dischargers because their operations have caused or contributed to, or threaten to cause or contribute to, soil and/or ground water pollution at one or more of the plots at the site.

- d. The City and County of San Francisco, the U.S. Coast Guard and the Airport Tenants/Operators are hereinafter collectively referred to as the "Dischargers".
- e. The "Primary Discharger(s)" designated for any known contaminated sites are summarized in Table 1 above. For sites where the City and County of San Francisco has caused or contributed to, or threatens to cause or contribute to, soil and/or groundwater pollution, the City and County of San Francisco is designated as a Primary Discharger, as shown in Table 1 above. The City and County of San Francisco is also designated as a "Secondary Discharger" for all other contaminated sites that it owned at the time of the release(s). As a Secondary Discharger, the City and County of San Francisco will be responsible for compliance only if the Board or Executive Officer finds that the Primary Discharger(s) have failed to comply with the requirements of this Order and notifies the City and County of San Francisco in writing that it is responsible for compliance and provides the City and County of San Francisco a reasonable opportunity to comply.
- f. The designation of Discharger(s) at a given site on the Airport may change when new investigation results become available. In light of the ongoing airport expansion project and contamination cleanup, discharger(s) may be added or removed from this Order over time for any given site. As this order involves a significant number of sites and dischargers, it is impractical for the Board to amend the Order to change discharger status whenever a change occurs. The Executive Officer may amend the Order to change dischargers if, after a 30-day notice and opportunity for comment by the Airport and any other potentially affected parties, no objection is expressed by any potentially affected party that is not resolved by the Executive Officer.

In pursuing enforcement actions, the Regional Board may take actions collectively against all listed Primary Dischargers or selectively against individual Primary Discharger(s) who failed, individually or as a member of the named dischargers, to meet the requirements of this Order applicable to such Primary Discharger(s), including non-participant of a group task or report. The Regional Board will not pursue enforcement action against a discharger with respect to any failure to meet a requirement of this Order with respect to which that discharger is designated only as a Secondary Discharger unless the Regional Board has notified the discharger in writing of the Primary Discharger's failure to comply and provided the Secondary Discharger reasonable opportunity to comply.

6. SITE HYDROGEOLOGY

Many of the areas of concern within the airport are covered by asphalt or concrete which varies from one half to four feet in thickness. The asphalt or concrete is underlain by a fill material which varies in thickness (from a few to 35 feet) and composition dependent upon the time of fill and areal location. The fill varies in composition from sand to a fine grained silt or clay and has a permeability which varies depending on the composition of fill material. Within the fill material, there are buried stream channels that consist of sands and

gravels and manmade permeable channels due to various utility and storm drain lines. These channels, both as manmade and original stream bed deposits, are believed to be a major mechanism for ground water and pollutant transport. The fill material is underlain by young Bay mud which begins from a few feet below ground surface (bgs) to about 40 feet bgs dependent upon the location and thickness of the fill material. The young Bay mud ranges in thickness from approximately a few feet to over 60 feet. Based upon subsurface investigations performed to date it appears that the young Bay mud is contiguous across the site, with the exception of the northwest end of the Airport. In general, the young Bay mud thickens from west to east beneath the site.

The first water bearing zone, known as the A-fill zone, occurs at approximately 4 to over 16 feet bgs at the intersection of the fill material and the young Bay mud interface. It varies in occurrence, depth and thickness depending upon the thickness and type of fill material in the upper zone and the depth of the original Bay mud prior to fill activities.

The second zone, or A-sand zone occurs below the young Bay mud layer. It consists of poorly sorted sands containing some discontinuous layers of silts and clays. The A-sand zone beneath the Airport site has a thickness that ranges from about 5 to 40 feet. The old Bay mud is encountered beneath the A-sand zone and is generally described as a dark greenish-gray, silty clay, with varying amount of sand and gravel. Beneath the Airport site, the old Bay mud layer ranges from 5 to 60 feet in thickness.

The B-sand zone occurs beneath the old Bay mud and appears to thicken where the depth to bedrock increases. Near shallower bedrock areas, the B-sand zone can be absent. Depth to bedrock at the Airport site ranges from zero feet (near the north end) to almost 200 feet. The B-sand zone may be an extension of the upper aquifer (Colma or Colma-age deposits) in a two-aquifer system which comprises the Westside Basin beneath San Bruno.

7. REGULATORY STATUS

Current site Cleanup Requirements for the site, Board Order No. 95-136, were adopted on June 21, 1995, and were a revision to Order No. 95-018. Order No. 95-136 established various Remediation Management Zones (RMZs) at the site for distinguishing different soil and groundwater cleanup standards appropriate to the risk to water quality, public health, and the environment within each zone.

The Dischargers were required to perform various tasks under Order Nos. 95-018 and 95-136, including:

Tasks	Descriptions	Status
• Task 1A:	Compile and evaluate all geological data pertaining to the thickness and integrity of the Bay Mud for a given location of which each individual is named as a Discharger;	- Completed

Tasks	Descriptions	Status
• Task 1B:	Evaluate the risk to the Westside Basin across the entire airport area utilizing the Bay mud as a barrier;	- Completed
• Task 1C:	Use the results of Task 1B to evaluate the risk to the Westside Basin and propose any necessary modifications to the Westside Basin Protection Areas and standards;	- Completed
• Task 2A:	Identify discharger responsibility and location of leaks within the fuel hydrant system, delineate the extent of pollution, and prepare a remediation plan;	- This task is retained in this Order. Majority of the dischargers have completed the task.
• Task 2B:	Submit a report presenting the results of Task 2A;	- See status for Task 2A above.
• Task 3A:	Recommend appropriate and applicable cleanup objectives and an implementation schedule for all constituents for soil and groundwater within each Remediation Management Zone;	- Completed
• Task 3B:	Evaluate the effects of Total Petroleum Hydrocarbons on aquatic organisms.	- Completed
• Task 3C:	Perform a fate and transport study to evaluate the movement of contamination at the site;	- Completed
• Task 3D:	As a two-year review process, propose modifications to the RMZs boundary and cleanup standards, considering the results of Tasks 1B, 2, 3B, and 3C;	- Completed
• Task 3E:	Describe sensitive ecological habitat areas within the airport property based on existing studies;	- Completed
• Task 4:	Propose interim time frame prior to the adoption of final RMZ cleanup objectives for remediation of the ground transportation center area and the new international terminal area;	- Completed
• Task 5:	Submit a Feasibility Study/Remedial Action Plan outlining proposed remedial actions to be performed at individual discharger sites to comply with the RMZ Standards; and	- This task is ongoing and is retained in this Order.
• Task 6:	a) Submit an Airport-wide compliance groundwater monitoring plan, and	- Completed, but a more comprehensive plan is required under Task 7 of this Order to augment groundwater monitoring efforts, especially in the A-sand zone.
	b) Submit a compliance groundwater monitoring plan for individual discharger sites.	- This part of the task is ongoing and is combined with Task 5 in this Order.

The revisions proposed in this Order is partly based on the results and recommendations presented in the approved Task 3D report.

8. AIRPORT-WIDE CLEANUP AND MANAGEMENT STRATEGY

Due to the airport expansion project and other construction, operation and maintenance activities, many of the lease agreements and permits are changing to accommodate the new airport facilities. Many tenants changed locations to meet the needs of the new airport layout. In order to ensure a consistent and adequate cleanup, especially soil and groundwater cleanup under newly proposed facilities, an airport-wide cleanup and management strategy is appropriate. An airport-wide strategy also streamlines regulatory oversight and allows cleanup decisions to be made consistently for similar sites with similar water quality, public health, and environmental threats. This Order provides the framework to implement an airport-wide cleanup and management strategy.

The airport-wide strategy, as employed in Order No. 95-136, is based on potential risks considering the protection of human health, the environment, water quality in the surrounding San Francisco Bay, and the useable groundwater of the lower aquifer (the Westside Basin).

As the Airport encompasses a total area of four-and-a-half square miles, it is imperative that the airport-wide cleanup and management strategy allows cleanup decisions based on location-specific risks to probable ecological and human receptors, rather than having the same cleanup standards for the entire Airport site. Based on current knowledge of the site, this Order establishes, as described below, four revised Remediation Management Zones (RMZs). For each RMZ, the Order also establishes risk-based Tier-1 cleanup standards based on conservative assumptions. In addition to Tier-1, the dischargers may either (a) achieve a more stringent set of cleanup standards (Tier-0) in order to avoid tasks under the Order related to managing residual contamination or (b) comply, or be required to comply, with a more site-specific set of cleanup standards (Tier-2) that more accurately represent unique local conditions.

The methodology and rationale for defining the RMZ boundaries and developing the Tier-0 and Tier-1 standards are discussed in the following sections. A methodology is also provided in Attachment 2 for the development and approval of Tier-2 cleanup standards.

9. REMEDIATION MANAGEMENT ZONES (RMZs)

This Order establishes four Remediation Management Zones (RMZs) (see Figure 3) for distinguishing different soil and groundwater cleanup standards appropriate to the risk to water quality, public health, and the environment within each zone: 1) Saltwater Ecological Protection Zone, 2) Horizontal Migration Management Zone, 3) Human Health Protection Zone, and 4) Special Vertical Migration Management Zone. A brief description of each zone is presented below. Additionally, procedures shall be established as part of this Order to protect the Westside Basin aquifer by limiting vertical migration of residual

contamination in areas where construction activities may require penetration or significant excavation of the Bay mud layer.

RMZs Descriptions and Boundary Definitions:

(1) Saltwater Ecological Protection Zone (SEPZ)

This zone is established for the protection of saltwater flora and fauna inhabiting the Bay adjacent to the Airport as well as recreational users and fisherpersons using the Bay. This zone is defined as the area on the eastern side of the Airport adjacent to San Francisco Bay that extends from the mean high tide line inland to a distance of 300 feet. (See Figure 3)

(2) Horizontal Migration Management Zone (HMMZ)

This zone is defined as the entire Airport site, excluding the SEPZ. (See Figure 3)

(3) Human Health Protection Zone (HHPZ)

This zone is defined as all areas that are currently occupied or may be occupied as part of the Airport's Master Plan and other planned construction and is generally defined as all non-aircraft movement areas. (See Figure 3)

(4) Special Vertical Migration Management Zone (SVMMZ)

This area is located at the northwest end of the Airport site (see Figure 3) where the young Bay mud is absent due to the presence of a bedrock outcrop. The lack of young Bay mud in the area to serve as a barrier to vertical migration has resulted in contaminants detected in the underlying A-sand zone.

Westside Basin Protection Areas

These areas are defined as any area where piles are to be installed through the Bay mud, new construction will require significant excavation within the Bay mud, or any activity will lessen the capability of the Bay mud to perform as a protective aquitard. Since not all of the areas where these types of construction activities will occur have been identified, only a narrative description can be provided for these areas at this time. These areas will be identified on a site-specific basis jointly by Airport and Board staff.

10. STATE BOARD RESOLUTION NO. 92-49

On June 18, 1992, the State Water Resources Control Board adopted in its Resolution No. 92-49 the "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304". Resolution No. 92-49, which was later amended on April 21, 1994 and again on October 2, 1996, applies to this discharge. As

stated in Resolution No. 92-49, it is not the intent of the State or Regional Boards to allow dischargers to avoid responsibilities for cleanup. However, in some cases, attainment of background levels of water quality for groundwater cannot reasonably be achieved. In approving any alternative cleanup levels less stringent than background, any such alternative cleanup level must be consistent with maximum benefit to the people of the State; not unreasonably affect present and anticipated beneficial use of such water; and not result in water quality less than that prescribed in the Water Quality Control Plan and Policies adopted by the State and Regional Water Board. This Order and its requirements are consistent with the provisions of Resolution No. 92-49, as amended.

Resolution No. 92-49 provides an acceptable cleanup management option for polluted sites with limited risk. This is based on past experiences that cleanup to background is often impracticable; that most pollution of soil and ground water is limited in extent; that dissolved phase groundwater cleanup to low levels is costly compared to the benefits; that some pollutants (especially TPHs) will naturally degrade given time; and that polluted sites in limited risk areas can be managed to prevent significant risk to water quality, public health and the environment without cleanup to background. In addition to adequate pollutant source removal and cleanup, a residual contamination risk management plan is necessary to contain and manage the existing and/or remaining polluted soil and groundwater. To document compliance, the Board is requiring, as a condition of this Order, a long-term groundwater monitoring program to confirm that the pollutant plume(s) is stable and is not exceeding the water quality objectives at the designated compliance monitoring points.

11. CLEANUP STANDARDS

Investigation and cleanup of petroleum discharges to soil and groundwater normally require that:

- The primary source(s) of the discharge be removed, closed or repaired;
- Free product and soil saturated with petroleum in the immediate vicinity of the source be removed where practicable;
- A risk assessment and necessary cleanup or abatement be conducted if ecological and/or human receptors and probable beneficial uses of water are affected by the discharge; and
- Groundwater be monitored, if necessary, to determine plume stability and the effectiveness of the remedial strategy.

To determine appropriate cleanup standards, this Order establishes risk-based Tier-1 cleanup standards for soil and groundwater within each of the four RMZs. For dischargers who wish to avoid tasks associated with managing residual contamination under this Order and elect to voluntarily cleanup to a more stringent level, this Order also establishes Tier-0 cleanup standards. Additionally, the dischargers may perform, or be required to perform, a Tier-2 evaluation as specified in the Tier-2 Risk Assessment Methodology (See Attachment 2) for consideration and approval by the Executive Officer. Election to perform a Tier-2 evaluation must take into account the Master Plan and other construction, maintenance, and

operation schedule requirements. The rationale and methodology used in deriving the cleanup standards are presented below:

Tier-0 Cleanup Standards

The Tier-0 cleanup standards are for those dischargers who wish not to be burdened by any subsequent risk management and monitoring requirements under this Order. If the Executive Officer concludes that the Tier-0 standards have been achieved for the area for which a discharger is responsible under the Order, the Executive Officer may remove the discharger from the Order, if, after a 30-day notice and opportunity for comment by the Airport and any other potentially affected parties, no objection is expressed by any potentially affected party that the Executive Officer does not resolve.

The following Tier-0 cleanup standards are for contamination resulted from discharge of petroleum hydrocarbons only (i.e., TPH-gasoline, TPH-jet fuel, TPH-diesel, and BTEX - Benzene, Toluene, Ethylbenzene, and Xylene). These levels are technology-based, derived from the typically achievable level of TPH in soils treated by thermal desorption technology - a common and effective soil treatment method used at the Airport. These levels are applicable to the A-fill zone of the entire site, except for the SVMZ where a Tier-2 analysis is required. In such case, site-specific decisions will be made by the Executive Officer.

	<u>in Soil (mg/kg)</u>	<u>in Groundwater (mg/l)</u>
TPH-g	100	0.6
TPH-j, -d	200	0.2
BTEX (total)	5	0.1
Benzene	0.5	0.02

Tier-1 Cleanup Standards

The methodology used to derive the Tier-1 cleanup standards for each RMZ is presented below. The cleanup standards are prescribed in Specification B.2. and Attachment 1 of this Order.

1. Saltwater Ecological Protection Zone

Due to the close proximity of the Airport to San Francisco Bay, and the likelihood of polluted groundwater discharging into the bay, protection of the beneficial uses of the adjacent surface water receptor is the objective of the Saltwater Ecological Protection Zone. The cleanup objectives for the soil and groundwater are such that groundwater

within the zone is protective of the beneficial uses and does not pose a significant risk to either the aquatic species or the people using the Bay. No groundwater dilution or attenuation is assumed within the zone (i.e., dilution and attenuation factor is 1). Upon examining the possible exposure risk scenarios, two major objectives were identified: 1) the protection of the aquatic and other species such that there is no acute or significant chronic toxicity affecting the species inhabiting the bay and 2) the protection of humans who may come in contact with or eat the organisms exposed to the contaminated water.

To evaluate the level protective of saltwater aquatic species, the following applicable criteria documents were reviewed: U.S. EPA National Ambient Water Quality Criteria, the former California Enclosed Bays & Estuaries Plan, and the Regional Board Basin Plan's Shallow Water Effluent Limitations for marine water. The values from each of the documents were compared and the lowest value was selected for each of the COCs. The most current information available was used when comparing values. In those instances where no chronic criteria were available, 10% of the acute value was used for non-petroleum contaminants and 20% for petroleum contaminants. These values are considered to be protective of the aquatic species.

Since adopted aquatic standards do not currently exist for total petroleum hydrocarbons (TPH), site-specific studies of TPH's toxicity on aquatic organisms are used to establish ecologically-based cleanup standards. As required under Task 3B of Order 95-136, the Airport's tenant group performed additional biological toxicity testing and an extensive literature review to evaluate TPH's effect on aquatic organisms. The sea urchin fertilization test was used to evaluate TPH-g and Stoddard solvent. For TPH-j, the sea urchin fertilization, bivalve larval development, and mysid shrimp growth tests were used. The results of the extensive toxicity testing were reported in the tenant group's Task 3B report and supplement. These results, in particular the EC/IC₂₅ point estimates where 25% of the organisms are affected, with applied uncertainty factors, form the basis for Tier-1 cleanup standards for TPH in groundwater in the Saltwater Ecological Protection Zone. Through application of dilution/attenuation factors and partitioning coefficients, the SEPZ groundwater standards are used to calculate ecologically protective cleanup standards for TPH throughout the Airport.

Several possible human receptors were identified who may come into contact with the contaminants in groundwater which reaches surface water. They include recreational users (i.e. windsurfers, swimmers, etc.), recreational fishermen, and subsistence fishermen. A risk evaluation was performed for each category of human receptors and the subsistence fisherman was assessed as potentially the most sensitive to contaminants reaching shallow surface water. Therefore, available criteria values based on consumption of aquatic organisms were tentatively selected.

Finally, the human health levels were compared to the aquatic species levels and the limiting or lowest value was chosen for each COC. These Tier-1 groundwater

cleanup standards are listed in Attachment 1, Table 2, for the Saltwater Ecological Protection Zone.

2. Horizontal Migration Management Zone (HMMZ)

Excluding the SEPZ, the entire Airport site falls into the horizontal migration management zone. Although this zone is not contiguous to any surface water receptor (the minimum distance to San Francisco Bay is 300 feet), the potential for contaminants in soil to leach into groundwater and migrate to the Bay via a preferential pathway (i.e. utility or storm drain backfill) is still likely. Therefore, it is imperative to ensure that any residual contamination left within the zone would be protective of the water quality objectives once it reached the Bay.

In order to evaluate the level of pollution that could be managed in place, a fate and transport model was used to calculate the Dilution Attenuation Factor (DAF) a contaminant source would receive as it migrates via a preferential pathway to the Bay. Since DAF is contingent upon the distance that the chemical must travel prior to reaching the Bay, the Tier-1 cleanup standards are, therefore, location-specific. Sites with shorter distance to the Bay will be assigned a lower DAF value and be required to achieve more stringent cleanup standards. Based on the fate and transport modeling at the Airport site, the DAF ranges from 3 at the SEPZ boundary to over 50 at locations farthest from the Bay. Using the model assumptions, the relation between a contaminant source's distance to the Bay and the allowable DAF can be approximated by the following simplified equation: $DAF = (\text{Distance in feet}) \div 100$.

The DAF value was then used to calculate the maximum groundwater concentrations, or cleanup standards, at the source area that will not exceed the objectives once it reached the Bay. The groundwater concentrations were then used to calculate the soil cleanup objectives based upon the equilibrium partitioning of the chemicals between soil and groundwater. The U.S. EPA Organic Leaching Model (OLM) (Federal Register 1986) was used to calculate the Tier-1 soil standards, using chemical specific solubility concentrations. Since there are no partitioning values available for various TPH mixtures, a series of leachate analyses using U.S. EPA's synthetic precipitation leaching procedure (SPLP, EPA Method 1312) were performed to develop a site-specific partitioning coefficient, K_d . The K_d values used for TPH-g, TPH-d and TPH-j were 170, 810 and 1,000 L/kg, respectively.

The HMMZ Tier-1 cleanup standards for soil and groundwater are displayed in Attachment 1, Table 3.

3. Human Health Protection Zone (HHPZ)

The objective for the Human Health Protection Zone is to identify areas within the Airport that are occupied by Airport personnel and others and to establish cleanup objectives protective of the human groups present. (See Finding No. 9 for zone

descriptions.) A variety of human receptors were screened who may come in contact with the residual contaminated soil or groundwater. Similar receptors that were previously evaluated individually are grouped together if deemed appropriate. As a result, the following primary groups were identified: Airport indoor workers, outdoor/maintenance workers and construction workers.

A risk assessment of possible exposure pathways (inhalation, ingestion, and dermal contact) was performed for each primary human group to determine the protective Tier-1 cleanup standards. The Tier-1 soil and groundwater cleanup standards are listed in Attachment 1, Table 4, Human Health Protection Zone Standards for each of the three scenarios. The derivation of Tier-1 standards are based on the most critical scenario(s) assessed.

4. Special Vertical Migration Management Zone (SVMMZ)

As young Bay mud is not present in this area below the A-fill zone to serve as a barrier to vertical migration, groundwater contamination has been detected in the underlying A-sand zone. The objective of this Special Vertical Migration Management Zone is, therefore, to assure that residual soil and/or groundwater contamination is protective of existing and probable beneficial uses of underlying aquifers, especially the Merced Formation which underlies the Colma Formation north and west of the Airport and is used for drinking water supply. Dischargers located within the SVMMZ must perform a Tier-2 evaluation to determine site-specific soil and groundwater cleanup standards through the application of a Tier-2 risk assessment methodology (See "Tier-2 Cleanup Standards" below).

5. Westside Basin Protection Areas

In addition to removal of floating petroleum product, chlorinated hydrocarbons that exist in Dense Non-Aqueous Phase Liquid (DNAPL) form are required to be remediated in the Westside Basin Protection Areas in order to minimize the likelihood of vertical migration through the young Bay mud layer. Moreover, where construction activities could render the young Bay mud layer unprotective of underlying aquifers, the discharger will be required to either (a) conduct a Tier-2 analysis to determine appropriate cleanup levels under such circumstances and remediate contamination to such levels or (b) provide an equivalent level of protection by implementing engineered or other measures. Pile penetration or other similar subsurface activities (such as well installation/decommission) through the young Bay mud in these areas must follow established technical procedures/guidelines approved by the Executive Officer to minimize deterioration of the integrity of the young Bay mud as a vertical barrier.

Tier-2 Cleanup Standards

In the event that the Tier-1 cleanup standards are not applicable to a given site, the discharger may request, or be required by the Executive Officer, to determine site-specific cleanup standards through the application of a Tier-2 risk assessment methodology. Reasons for deeming Tier-1 standards as inapplicable may include site-specific conditions such as: unique conditions relating to contaminant types, levels and/or extent; unique conditions relating to human or ecological receptors; subsurface conditions unique to the site such as absence or insufficient thickness of the Bay mud; and changes in current or future land-use scenarios that necessitate application of alternate standards; etc. The Discharger shall prepare for review and approval by the Executive Officer a risk evaluation workplan describing the methods by which Tier-2 cleanup standards will be determined. A copy of the proposed workplan shall also be sent to the Airport's staff and the adjacent tenants or potentially affected parties. Dischargers who wish to comment on the proposed Tier-2 workplan must submit comments to the Executive Officer within 30 days. The resulting Tier-2 evaluation and cleanup standards must be approved by the Executive Officer prior to implementation. Attachment 2 outlines the general procedures to be employed for the Tier-2 analysis.

12. APPLICATION OF STANDARDS AND RESIDUAL RISK MANAGEMENT

When more than one cleanup standard is applicable for a particular constituent or contamination due to multiple receptor scenarios, the Discharger will be required to satisfy the most stringent standard. The Discharger will also be required to prepare and comply with a plan for source removal and a residual risk management plan for containment, management, and monitoring of existing and/or remaining polluted soil and groundwater that is consistent with current and projected land and water uses.

The residual contamination risk management plan must include an assessment of the residual risks to human health, water quality and the environment; measures to manage the risks (e.g., site operation, maintenance, construction and health and safety plans, worker notices, etc.); an agreement with the Airport and, as necessary, other affected parties needed to implement the plans; monitoring requirements; and contingency options if the monitoring standards are not met. The receptor scenarios and the remedial and residual risk management plans must be approved by the Executive Officer. Prior to approval by the Executive Officer, the receptor scenarios and the remediation and residual risk management plans must be submitted to the Airport for review and comment.

In order to ensure consistency and reduce duplication of effort, the Dischargers are required to develop a model residual risk management plan (see Task 10 of Provision C.1. of this Order) that addresses commonly-encountered scenarios at the Airport. Discharger(s) of individual sites may make reference to the risk management measures established in the model plan, when appropriate, or propose a

site-specific residual risk management plan, taking into consideration special site conditions.

Dischargers complying with Tier-1 or Tier-2 cleanup standards will remain responsible for any future source removal, cleanup, containment, management and/or monitoring of existing and/or remaining polluted soil and groundwater that may be required as a result of changes in land use, applicable requirements or available information. If the proposed land use changes, the Discharger will be required to compare the use with the receptor scenarios and risks addressed in the Discharger's approved remediation and residual risk management plans. If the proposed land use involves receptor scenarios that result in application of a more stringent cleanup level or risks not adequately addressed in the approved plans, the Discharger shall prepare a remediation and/or residual risk management plan, as necessary, for the proposed use. The revised remediation and residual risk management plans must be approved by the Executive Officer. Prior to approval by the Executive Officer, the Airport and other affected parties must be provided with a copy and be allowed a minimum of 30 days for review and comment.

In addition, continued long-term airport-wide monitoring program (for surface and ground water, and sediment) may be required as part of this Order to determine compliance with water quality objectives. A comprehensive airport-wide groundwater monitoring program is required under Task 7 (Provision C. 1.) of this Order.

13. BASIN PLAN

The Board adopted a revised Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) on June 21, 1995. This updated and consolidated plan represents the Board's master water quality control planning document. The revised Basin Plan was approved by the State Water Resources Control Board and the Office of Administrative Law on July 20, 1995, and November 13, 1995, respectively. A summary of regulatory provisions is contained in Title 23, California Code of Regulations, Section 3912. The Basin Plan defines beneficial uses and water quality objectives for waters of the State, including surface waters and groundwaters.

14. DESIGNATION OF GROUNDWATER BENEFICIAL USES

The Basin Plan designates the following present and/or potential beneficial uses for groundwater within the Region.

- a. Municipal and domestic water supply (with limited exceptions for areas of high total dissolved solids (TDS), low yield, or naturally-high contaminant levels)
- b. Industrial process water supply
- c. Industrial service water supply

- d. Agricultural water supply
- e. Fresh water replenishment to surface water

The shallow and A-sand groundwater zones underlying the site are not currently being used.

The deeper aquifer underlying and/or adjacent to the shallow and A-sand zone is identified as the Westside Basin. The Merced formation aquifer within this Basin is currently used as a drinking water supply. It is also currently being considered for additional municipal supply and is considered by several water agencies, including the City of San Bruno, to be a high priority aquifer for future municipal water supply development.

15. DESIGNATION OF SURFACE WATER BENEFICIAL USES

The largest surface water body adjacent to the Site is the Lower San Francisco Bay. The existing and/or potential beneficial uses of the Lower San Francisco Bay as identified in the Basin Plan include:

- a. Water Contact Recreation
- b. Non-Contact Water Recreation
- c. Preservation of Rare and Endangered Species
- d. Estuarine Habitat
- e. Wildlife Habitat
- f. Industrial Service Supply
- g. Navigation
- h. Ocean Commercial and Sport Fishing
- i. Fish Migration
- j. Shellfish Harvesting

16. STATE BOARD RESOLUTION NO. 68-16

On October 28, 1968, the State Board adopted Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality Waters in California". This policy applies to this discharge and requires attainment of background levels of water quality, or the highest level of water quality which is reasonable if background levels of water quality cannot be restored. Cleanup levels other than background must be consistent with the maximum benefit to the people of the State, not unreasonably affect present and anticipated beneficial uses of such water, and not result in exceedance of applicable water quality objectives. This Order and its requirements are consistent with Resolution No. 68-16.

17. REUSE OR DISPOSAL OF EXTRACTED GROUNDWATER:

Board Resolution No. 88-160 allows discharges of extracted, treated groundwater from site cleanups to surface waters only if (a) it has been demonstrated that neither reclamation nor discharge to the sanitary sewer is technically and economically feasible and (b) beneficial uses of the receiving water are not adversely affected. Furthermore, the Board recognizes the resource value of the extracted and treated groundwater and urges its utilization for the highest beneficial use for which applicable water quality standards can be achieved.

- 18. BASIS FOR 13304 ORDER** The Dischargers have caused or permitted waste to be discharged or deposited where it is, or probably will be, discharged into waters of the State and creates, or threatens to create, a condition of pollution or nuisance.
- 19. COST RECOVERY** Pursuant to California Water Code Section 13304, the Dischargers are hereby notified that the Regional Board is entitled to, and may seek reimbursement for, all reasonable costs actually incurred by the Board to investigate unauthorized discharges of waste and to oversee cleanup of such waste, abatement of the effects thereof, or other remedial action, required by this Order.
- 20. CEQA EXEMPTION** This action is an order to enforce the laws and regulations administered by the Board. As such, this action is categorically exempt from the provisions of the California Environmental Quality Act (CEQA) pursuant to Section 15321 of the Resources Agency Guidelines.
- 21. NOTIFICATION** The Board has notified the Dischargers, responsible parties and interested agencies and persons of its intent under California Water Code Section 13304 to prescribe site cleanup requirements for the discharge and provided them with the opportunity for a public workshop and an opportunity to submit their written comments.

IT IS HEREBY ORDERED, pursuant to Section 13304 of the California Water Code, that the Dischargers (or its agents, successors, or assigns) shall cleanup and abate the effects described in the above findings as follows:

A. PROHIBITIONS

1. The discharge of wastes or hazardous substances in a manner which will degrade water quality or adversely affect the beneficial uses of the waters of the State is prohibited.
2. Further significant migration of pollutants through subsurface transport to waters of the State is prohibited.

3. Activities associated with subsurface investigation, cleanup or construction which will cause significant adverse migration, either horizontally or vertically, of wastes or hazardous substances are prohibited.
4. The storage, handling, treatment or disposal of contaminated soil or groundwater creating a nuisance as defined in Section 13050(m) of the California Water Code is prohibited.

B. SPECIFICATIONS

1. Investigation, Remediation, Management, and Monitoring Activities:

The Dischargers shall, in a timely manner, conduct site investigation, remediation, management and monitoring activities to adequately define the current hydrogeologic conditions, define the lateral and vertical extent of soil pollution, define the lateral and vertical extent of groundwater pollution on or emanating from their individual sites, eliminate the primary cause for the discharge on or emanating from their individual site(s), remove where practicable any free product or soil saturated with contaminant, remediate as may be required any soil pollution on or emanating from their individual site(s), remediate as may be required any groundwater pollution on or emanating from their site(s), and monitor and/or manage any remaining polluted soil and groundwater and any associated water quality, human health, or environmental risk.

In addition to a remediation plan, the Dischargers shall prepare a residual contamination risk management plan, as needed, to include:

- an assessment of residual risks;
- measures to manage risks (e.g., health and safety plans, worker notices, etc.);
- monitoring plans;
- necessary agreements with the Airport and other affected parties for plan implementation;
- contingency plans if water quality standards are exceeded or changes in land use, regulatory requirements or new information indicate increased residual risks; and
- a commitment to mitigation measures such as participation in an Airport-wide groundwater monitoring and/or protection program.

2. Soil and Groundwater Cleanup Levels within designated Remediation Management Zones (RMZs):

RMZs descriptions and boundary definitions are discussed in Finding No. 9 of this Order and shown in Figure 3. For those dischargers who do not wish to be burdened with subsequent monitoring and risk management requirements, cleanup to Tier-0 standards is an option as described in Finding No. 11 of this Order. Otherwise, Tier-1 cleanup standards for soil and groundwater are listed in Attachment 1 for the Saltwater Ecological Protection Zone (Table 2), the Horizontal Migration

Management Zone (Table 3) and the Human Health Protection Zone (Table 4). For the Special Vertical Migration Management Zone (SVMMZ), a Tier-2 evaluation is required (see Provision C.1, Task 9 below), as outlined in Attachment 2.

As described in Finding No. 11, the Tier-1 cleanup standards for the Horizontal Migration Management Zone (Table 3) are dependent upon the Dilution and Attenuation Factor (DAF) which is directly related to an individual site's distance to the San Francisco Bay. To facilitate determination of appropriate cleanup standards, Table 3 depicts the relationship between DAF and soil and groundwater cleanup standards in a graphical format for each individual chemical of concern. Once a DAF is determined (based on the shortest distance from the perimeter of an individual contaminated area to the San Francisco Bay), corresponding soil and groundwater cleanup standards can be determined by referring to the graphs in Table 3.

Except in the SVMMZ and Westside Basin Protection Areas where a Tier-2 evaluation is required and the Tier-2 level is more stringent than the applicable Tier-1 standards, the Dischargers must remediate the contaminants within their designated areas to the applicable Tier-1 standards, unless a Tier-2 evaluation is performed. Before any alternative Tier-2 cleanup standard may be used, it must be approved by the Executive Officer.

If a Tier-2 evaluation is elected or required, the Dischargers shall prepare for review and approval by the Executive Officer a workplan describing the methods by which Tier-2 cleanup standards will be determined. Prior to Executive Officer's approval, a copy of the workplan shall also be sent to the Airport's staff and the adjacent tenants or potentially affected parties for review. Comments on the proposed Tier-2 risk evaluation workplan shall be submitted to the Executive Officer within 30 days. The resulting Tier-2 evaluation and cleanup standards must be approved by the Executive Officer prior to implementation. Attachment 2 outlines the general procedures to be employed for the Tier-2 analysis. An accelerated review may be given to those Dischargers within the Master Plan or other construction areas. Election to perform a Tier-2 evaluation must take into account the Master Plan and other construction, maintenance, and operation schedule requirements.

In the event the soil and/or groundwater pollution is located within more than one zone, the Dischargers must comply with the applicable standards for all zones in which the pollution is located. The Dischargers shall compare the standards for each zone for each COC and apply the most stringent value as the cleanup standard.

For the Human Health Protection Zone, the three possible exposure scenarios must be considered. The Dischargers must identify the applicable receptor scenario for their designated area, including possible offsite receptors who may be affected, and remediate to the standard listed for that particular scenario. If more than one scenario is applicable based on the Dischargers' use of the site, the Discharges shall compare the standards for all applicable exposure scenarios and apply the most stringent

standard as the cleanup standard. The receptor scenario(s) selected by the Dischargers must be approved by the Executive Officer after the Airports Commission and other possible affected parties has had a reasonable opportunity to comment on the proposed scenario.

3. Westside Basin Protection:

Where construction activities could reduce the ability of the young Bay mud to act as a protective barrier (e.g., via significant reduction of Bay mud thickness or pile driving activities) such that otherwise applicable cleanup standards would not be protective of underlying aquifers, the Dischargers will be required to (a) conduct a Tier-2 analysis to determine appropriate cleanup levels under such circumstances and remediate contamination to such levels, or (b) provide an equivalent level of protection by implementing engineered or other measures, as needed. Such measures shall be sufficient to hydraulically isolate the A-fill zone groundwater from the Westside Basin aquifer to prevent cross contamination between the two water bearing formations. For this purpose, the Dischargers are required to propose (see Provision C.1., Task 8 below) (a) certain good engineering practices intended to minimize cross contamination and (b) the minimum thickness of the Bay mud to maintain its functionality as an impermeable barrier such that Dischargers need not propose Tier-2 standards or alternative engineering measures.

Prior to the above-described construction activities, the Dischargers shall either perform a Tier-2 analysis for the protection of the Westside Basin or submit a technical report describing the construction techniques, the potential risks associated with such activities, and proposed engineering practices/solutions to be utilized. Site remediation and residual contamination risk management plans must take into consideration the applicable cleanup standards, the proposed construction techniques, and any additional engineered control measures implemented. If a site remediation plan allows residual contamination, the Discharger's residual contamination risk management plan shall assess the risk of cross contamination between the A-fill zone and the Westside Basin aquifer and include measures as needed to prevent such cross contamination (e.g., management and/or construction plans, or any agreements with the Airport or other affected parties necessary to implement the plans, etc.).

If proposed construction activities take place in areas where chlorinated hydrocarbons are present, the Dischargers must demonstrate that there is no threat of vertical migration of dense phase non-aqueous phase chlorinated hydrocarbons (DNAPL) from the A-Fill groundwater to the underlying water-bearing formation. Such demonstration must be completed and approved prior to the proposed construction activities.

4. Reclamation: If groundwater extraction and treatment is considered as a remediation method, the feasibility of water reclamation and discharge to the sanitary sewer must be evaluated prior to approval of discharging to surface waters. Based on Regional

Board Resolution 88-160, the Dischargers shall optimize, with a goal of 100%, the reclamation or reuse of groundwater extracted as a result of cleanup activities for the highest possible beneficial uses. The Dischargers shall not be found in violation of this Order if documented factors beyond the Dischargers' control prevent the Dischargers from attaining this goal, provided the Dischargers have made a good faith effort to attain this goal. If discharge to waters of the State is part of a proposed alternative, an application for an NPDES permit must be completed and submitted, and must include an evaluation of the feasibility of water reclamation and disposal to the sanitary sewer.

5. Soil Reuse: A soil reuse/treatment plan shall be submitted, when applicable, as part of the remedial action plan and/or residual contamination risk management plan. In order to ensure consistency and reduce duplication of effort, the Dischargers are encouraged to establish, and comply with, acceptable Airport-wide soil management procedures. Any previously-established procedures must be updated to be consistent with the specifications of this Order. Unless the environmental setting and exposure scenarios are compatible, proposals to reuse untreated soils at another location must be reviewed and approved by the Executive Officer on a case-by-case basis.

C. PROVISIONS

1. The Dischargers shall comply with the Prohibitions and Specifications above, in accordance with the following time schedule and tasks. Tasks required under previous site cleanup requirements are described in Finding No. 7 of this Order. To ensure continuity and clarification of subsequent related tasks, the numbering sequence from previous site cleanup requirements is continued in this Order. Certain tasks from previous site cleanup requirements (e.g., Tasks 2A, 2B and 5) are retained in this Order. For those Dischargers named within the previous Orders and have not participated in the completion of the required tasks, this does not relieve them of their responsibilities and they are considered in violation of this Order.

Tasks required below may not be necessarily listed in a chronological order. For those tasks for which more than one discharger is responsible, either because the task applies to all Dischargers or because the task involves contamination at or from an individual site for which more than one Discharger is designated, the responsible Dischargers should coordinate among themselves and complete all such task(s), either individually or as a member of a group. An individual discharger responsible for such a task who fails to complete the task, either individually or as a member of a group, may be subject to enforcement actions by the Board. The Regional Board will not pursue enforcement action against a discharger with respect to any failure to complete a task with respect to which that discharger is only a Secondary Discharger unless the Regional Board has notified the discharger in writing of the failure by Primary Discharger(s) to comply and provided the Secondary Discharger reasonable opportunity to comply.

TASK 2A (modified): Submit a technical report satisfactory to the Executive Officer to identify discharger responsibility and to propose a plan to (a) identify locations of leaks within the fuel hydrant system and (b) delineate the extent of pollution. [Note: This task is retained from Order Nos. 95-018 and 95-136 and is intended only for the portion of the fuel hydrant system for which a Task 2A report has not previously been completed.]

DUE DATE: **Forthwith** (For dischargers named in Order Nos. 95-018 and 95-136)

October 31, 1999 (For dischargers not named in Order Nos. 95-018 and 95-136 but are currently responsible for a portion of the fuel hydrant system for which a Task 2A report has not been completed.)

Description: For the sections of the fuel hydrant system for which a Task 2A report has not previously been completed, the technical report(s) shall determine the current ownership/responsible parties of the fuel hydrant system. Based upon this determination, the responsible Discharger or group of Dischargers will be responsible for submitting a workplan to determine the integrity of the section of pipeline that they own/operate and the extent of the pollution, if any, emanating from the leaking pipeline and hydrant system. The workplan should include investigation at hydrant pits, elbows, fittings, abandoned lines, and any other area that may be potential source for leaking (or determined to be leaking as a result of a line integrity test) hydrocarbons into the surrounding soils and groundwater. A joint workplan by all or a group of responsible dischargers is strongly encouraged. An implementation schedule must be included.

TASK 2B (modified): Submit a technical report acceptable to the Executive Officer presenting the results of the Tasks 2A fuel hydrant system evaluation as required above. [Note: This task is retained from Order No. 95-136 and is intended only for the portion of the fuel hydrant system for which a Task 2B report has not previously been completed.]

DUE DATE: **Within 90 days of the approval of the Task 2A workplan**

Description: The report must include the results of the field investigation for the delineation of contamination originating from the fuel hydrant system. It must include all sample locations and sample results including any previous sample data. Each Discharger is responsible for the segment of pipeline as designated within the Task 2A Workplan. However, a joint report for all or a group of responsible dischargers is

strongly encouraged. Recommendation for any additional characterization must be included. Once the site characterization is deemed complete, the responsible dischargers must comply with Task 5 (as described below) within 90 days.

TASK 5: Submit a Feasibility Study/Remedial Action Plan acceptable to the Executive Officer outlining proposed remedial actions to be performed to comply with the RMZ Cleanup Standards.

DUE DATE: Within 90 days of the approval of site characterization report and at least 30 days prior to the proposed remedial actions

Description: Once a contaminated site is adequately characterized, a Feasibility Study shall be submitted outlining the various actions that can be performed to meet the cleanup standard(s) for the zone(s) in which it is located. As a result of the Feasibility Study, the Discharger(s) shall select a remedial action alternative and prepare a Remedial Action Plan (RAP) for the selected alternative. On a case-by-case basis, the Discharger(s) may proceed with the preparation of a RAP without a Feasibility Study when, based on past experience and knowledge at other individual sites, that the remedial action is considered routine and that there is remedial alternative known to be effective under the circumstances. The RAP must identify the applicable standards or, alternatively, include a workplan with a time schedule to conduct a Tier-2 analysis pursuant to Attachment 2. A confirmation sampling plan documenting compliance with the RMZ objectives is required. A residual contamination risk management plan and a compliance groundwater monitoring plan will be required, as described in the findings and specifications, if residual levels of pollution exceed Tier-0 cleanup standards. The residual contamination risk management plan must be submitted for approval with any RAP or RAP amendment that proposes residual levels above Tier-0 cleanup standards. An implementation schedule must be included in the RAP. Any discharger(s) designated for sites within an area affected by the Airport Master Plan expansion construction or related operation or maintenance activities shall take into consideration the schedule of expansion construction and plan their investigative and remedial actions accordingly.

TASK 7: Submit a report acceptable to the Executive Officer for an Airport-wide compliance groundwater monitoring plan.

DUE DATE: October 31, 1999

Description: A workplan acceptable to the Executive Officer establishing a comprehensive Airport-wide groundwater monitoring program is required to document compliance with the provisions of this Order. Detailed plan of sampling methods, sampling locations, analytical parameters, quality control procedures, sampling frequency, and implementation schedule shall be established for review and approval.

The groundwater monitoring program shall evaluate existing monitoring wells network at the Airport and determine the adequacy of existing wells and propose additional wells if necessary. The evaluation shall include the location and purpose of the wells, the monitoring results to-date, the adequacy of monitored parameters and sampling frequencies, and shall take into consideration the locations and monitoring results of major source areas at the Airport.

In addition to the existing monitoring points along the Airport perimeter, monitoring wells shall be placed in the A-sand zone within the interior of the Airport. Those wells are to detect any vertical migration of contamination through the young Bay mud layer and shall be strategically placed downgradient of areas of significant contamination (e.g., extensive free product or DNAPL) or areas of significant impairment to the integrity of the Bay mud layer due to construction activities. (Installation of such wells must follow proper procedures to prevent cross contamination between A-fill and A-sand zones.) Individual Dischargers may be required to perform plume or site-specific monitoring as part of Task 5 above to augment the monitoring effort.

The monitoring program shall also address areas already identified to be of concern by the monitoring effort to-date (e.g., certain A-fill wells and utility backfill wells along the Bayshore) and propose additional monitoring effort, if necessary, to identify the cause of impact. A remedial action plan (see Task 5 above) may be required when a source has been properly identified and characterized.

TASK 8: Submit a technical report acceptable to the Executive Officer establishing procedures necessary to minimize vertical migration through the Bay mud layer.

DUE DATE: November 30, 1999

Descriptions: A technical report shall be submitted which establishes the proposed good engineering practices intended to minimize cross contamination between the A-fill zone and underlying water bearing formations in connection with construction and decommission of all types of wells, driving piles into and through the young Bay mud and other similar type of construction activities. The technical report must also identify the minimum thickness of the Bay mud sufficient to maintain its functionality as an impermeable barrier such that Dischargers need not propose Tier-2 standards or alternative engineering measures.

TASK 9: Submit a workplan acceptable to the Executive Officer for establishing Tier-2 cleanup standards for the Special Vertical Migration Management Zone.

DUE DATE: October 31, 1999

Descriptions: The Discharger(s) in the Special Vertical Migration Management Zone, located at the northwest end of the Airport (see Figure 3), is required to submit a technical report that includes a risk assessment workplan to establish site-specific Tier-2 soil and groundwater cleanup standards. The lack of sufficient young Bay mud in this area to serve as a barrier to vertical migration has resulted in contaminants detected in the underlying A-sand zone. Attachment 2 outlines the general procedures to be employed for the Tier-2 risk assessment. Prior to the workplan, a conceptual site model must be proposed and approved. A copy of the proposed conceptual site model and workplan shall be sent to the Airport's staff and the adjacent tenants or potentially affected parties for review. Comments from affected parties on the proposed Tier-2 risk evaluation workplan shall be submitted to the Executive Officer within 30 days of submittal. The resulting Tier-2 evaluation and cleanup standards must be approved by the Executive Officer prior to implementation.

TASK 10: Submit a report acceptable to the Executive Officer establishing a model residual risk management plan.

DUE DATE: November 30, 1999

Descriptions: To ensure consistency and reduce duplication of effort, a model residual risk management plan shall be developed to establish acceptable residual risk management methodology that addresses commonly-encountered scenarios at the Airport. Individual Discharger sites can fulfill the requirements of residual risk management by complying with the applicable procedures outlined in the model plan. The model plan shall address all aspects of residual risk management, including the containment, management, and monitoring of existing and/or remaining polluted soil and groundwater that is consistent with current and projected land and water uses. The plan shall summarize commonly-encountered scenarios at the Airport and include an assessment of the residual risks to human health, water quality and the environment and necessary measures to manage the risks (e.g., site operation, maintenance, construction and health and safety plans, worker notices, institutional notices, and other necessary agreements with the Airport or other affected parties needed to implement the plan, etc.). In addition to monitoring requirements, the plan shall also include contingency options if the monitoring standards are not met or changes in land use, regulatory requirements or new information indicate increased residual risks. The receptor scenarios and residual risk management plans must be approved by the Executive Officer.

2. The Dischargers shall submit to the Regional Board the following reports acceptable to the Executive Officer on compliance with the requirements of this Order and monitoring reports that contain descriptions and results of work and analysis performed. These reports are to be submitted according to a program outlined below.
 - a. **ON A QUARTERLY BASIS**, the Dischargers shall submit status reports, which may be prepared in a business letter format, documenting compliance with this Order commencing on **October 15, 1999**. Thereafter, reports shall be due **quarterly** on the 15th of each ensuing January, April, July and October. Each quarterly report shall cover the previous calendar quarter and include at least the following information:
 - (1) Summary of the work completed since submittal of the previous report, and work projected to be completed before the submittal of the next report.
 - (2) Identification of any obstacles which may threaten compliance with the schedule set forth by this Order, and what actions are being taken to overcome these obstacles.

This report may be combined with the quarterly monitoring report as outlined below. The Board strongly encourages consolidated reports among multiple Dischargers, especially for matters that are common. With appropriate justification and written request from the dischargers, the Executive Officer may agree to waive this report, or to amend the reporting requirements for content and frequency, when all or the majority of the required tasks are completed satisfactorily.

- b. **ON A QUARTERLY BASIS**, technical reports documenting quarterly ground water monitoring (on-going, might be revised as a result of Task 7 of this Order) shall be submitted by the Dischargers to the Regional Board commencing on October 15, 1999. Thereafter, reports shall be due **quarterly** on the 15th of each ensuing January, April, July and October. In order to generate comparable Airport-wide data, it is strongly encouraged that water level measurements and samples of all monitoring wells be collected at the same time to the extent possible. Each quarterly monitoring report shall include, but not be limited to, the following information:
 - (1) Cumulative tabulated results of free product measurements for total petroleum hydrocarbons and water quality sampling analyses for all monitoring wells both on and related off-Site. This data shall be accompanied by pollutant isoconcentration plume maps for each chemical

constituent of concern for the first water bearing formations based upon the results of the recent sampling event.

- (2) A cumulative tabulation of all well construction details including screen intervals, screen lengths, well installation dates, quarterly water level measurements, and cumulative chemical concentrations for each well.
- (3) Quarterly updated water table and piezometric surface maps, based upon the most recent water level measurements for all affected water bearing zones for all on-Site and related off-Site wells.
- (4) A cumulative tabulation of volume of extracted ground water, quarterly chemical analyses results for all extraction wells, and a report indicating the pounds of pollutants removed during the quarter and total pounds of pollutants removed to date.
- (5) Reference diagrams and maps including the hydrogeologic conditions of the Site, and appropriately scaled and detailed base maps showing the location of all monitoring wells and extraction wells, and identifying facilities and structures.

With appropriate justification and written request from the dischargers, the Executive Officer may amend the reporting requirements for content and frequency in accordance with the report to be submitted under Task 7 of this Order. The Executive Officer may also consider accepting reports in electronic format.

- c. **ON AN ANNUAL BASIS**, technical reports summarizing the progress of compliance with all requirements of this Order and any proposed modifications which could increase the effectiveness of final cleanup actions shall be submitted to the Regional Board by the Dischargers. The annual compliance report is due every year on **January 15** and shall cover the previous calendar year's activities. Annual reports may combine with quarterly reports that are due concurrently. The annual progress reports shall include, but not necessarily be limited to, progress on compliance with the tasks required under this Order, progress on site investigation and remediation activities, operation and implementation of interim and final remediation systems, effectiveness of remediation actions and systems, and an evaluation of the feasibility of meeting the ground water and soil cleanup standards established by this Order. Additionally, the annual report shall include an updated dischargers list to reflect proposed addition or removal of responsible parties from individual Dischargers sites.

3. The dischargers may, by written request, seek modifications or revisions, or termination of this Order or any program, plan, or schedule submitted pursuant to this

Order at any time. This Order and any applicable program, plan, or schedule may be modified, terminated, or revised by the Regional Board or the Executive Officer.

4. If the Dischargers are delayed, interrupted or prevented from meeting one or more of the completion dates specified in this Order, the Dischargers shall promptly notify the Executive Officer. If, for any reason, the Dischargers are unable to perform any activity or submit any document within the time required under this Order, the Dischargers may make a written request for a specified extension of time. The extension request shall include justification for the delay, and shall be submitted to the Regional Board in advance of the date on which the activity is to be performed or the document is due. The Regional Board staff may propose an amendment to the Order and bring the matter to the Board for consideration.
5. All hydrogeological plans, specifications, technical reports and documents shall be signed by or stamped with the seal of a State registered geologist, registered civil engineer, registered hydrogeologist, or certified engineering geologist.
6. All samples shall be analyzed by a State certified laboratory or laboratory accepted by the Regional Board using approved EPA methods for the type of analysis to be performed. All laboratories or the consultant shall be required to maintain quality assurance/quality control records for Regional Board review.
7. The Dischargers shall maintain in good working order, and operate in the normal standard of care, any facility or control system installed to achieve compliance with the requirements of this Order.
8. Copies of all correspondence, reports, and documents pertaining to compliance with the Prohibitions, Specifications, and Provisions of this Order shall also be provided to the following agencies:
 - a. San Mateo County Environmental Health Division
 - b. San Francisco International Airports Commission
9. The Dischargers shall permit, within the scope of each of their authorities, the Regional Board or its authorized representative, in accordance with Section 13267 (c) of the California Water Code:
 - a. Entry upon Dischargers' premises in which any pollution sources exist, or are suspected to exist, or inspection of any required records, which are relevant to this Order.
 - b. Access to copy any records required to be kept under the terms or conditions of this Order.

- c. Inspection of any monitoring equipment or methodology implemented in response to this Order.
 - d. Sampling of any groundwater or soil which is accessible, or may become accessible, as part of any investigation or remedial action program undertaken by the Dischargers.
10. To the extent a Discharger has any ownership or present possessory interest in or to the Site, such Discharger shall file a report in a timely manner on any changes in Site occupancy and ownership associated with the facility/property described in this Order.
11. If in performing any work pursuant to this Order, any hazardous substance is discharged in or on any waters of the State, or discharged and deposited where it is, or probably will be discharged in or on any waters of the State, the Dischargers shall report such a discharge to this Board, at (510) 622-2300 on weekdays during office hours from 8:00 a.m. to 5:00 p.m., and the Office of Emergency Services at (800) 852-7550 during non-office hours. A written report shall be filed with the Board within five (5) working days and shall contain information relative to: the nature of the waste or pollutant, quantity involved, duration of incident, cause of spill, Spill Prevention, Control and Countermeasure Plan in effect, if any, estimated size of affected area, nature of effects, corrective measures that have been taken or planned, and a schedule of these activities, and persons notified.
12. This Order is intended to be the primary regulating document by which Site cleanup shall proceed for the Dischargers and properties identified herein, with the Regional Board as the lead agency. This Order supersedes and rescinds Order Nos. 95-136, 95-018, 94-044, 92-152, and 92-140. The Dischargers shall establish a primary contact representing the named Discharger(s) and submit the name of that representative to the Regional Board.
13. If the Executive Officer finds that the Discharger(s) have failed to comply with the Provisions of this Order, he/she is authorized to issue a complaint for Board consideration of Administrative Civil Liabilities, or after approval of the Board Chairperson, to request the Attorney General to take appropriate action against the Discharger(s), including injunctive and civil remedies, if appropriate.
14. The Dischargers shall be liable, pursuant to Section 13304 of the California Water Code, to the Board for all reasonable costs actually incurred by the Board to investigate unauthorized discharges of waste and to oversee cleanup of such waste, abatement of the effects thereof, or other remedial actions, required by this Order. All sites regulated under the Regional Board's Above-Ground Petroleum Storage Tank (AGT) program will continue to reimburse pursuant to the AGT program. If the Dischargers addressed by this Order are enrolled in a State Board-managed reimbursement program, reimbursement shall be made pursuant to this Order and according to procedures established in that program. Any disputes raised by

discharger(s) over the reimbursement amounts or methods used in that program shall be consistent with the dispute resolution procedures of that program.

15. The Regional Board will review this Order periodically and may revise the requirements when necessary. The Executive Officer may amend the Order to change dischargers if, after a 30-day notice and opportunity for comment by the Airport and any other potentially affected parties, no objection is expressed by any potentially affected party that is not resolved by the Executive Officer.

June 16, 1999
Date

Loretta K. Barsamian
Loretta K. Barsamian
Executive Officer

FIGURES:

- Figure-1: Site Location Map
- Figure-2: Site/Plot Identification Map
- Figure-3: Remediation Management Zone Map

ATTACHMENTS:

- Attachment 1: Remediation Management Zone Tier-1 Cleanup Standards
(Including, Table-2: Ecological Protection Zone Tier-1 Standards;
Table-3: Horizontal Migration Management Zone Tier-1
Standards; &
Table-4: Human Health Protection Zone Tier-1 Standards.)
- Attachment 2: Tier-2 Risk Assessment Methodology

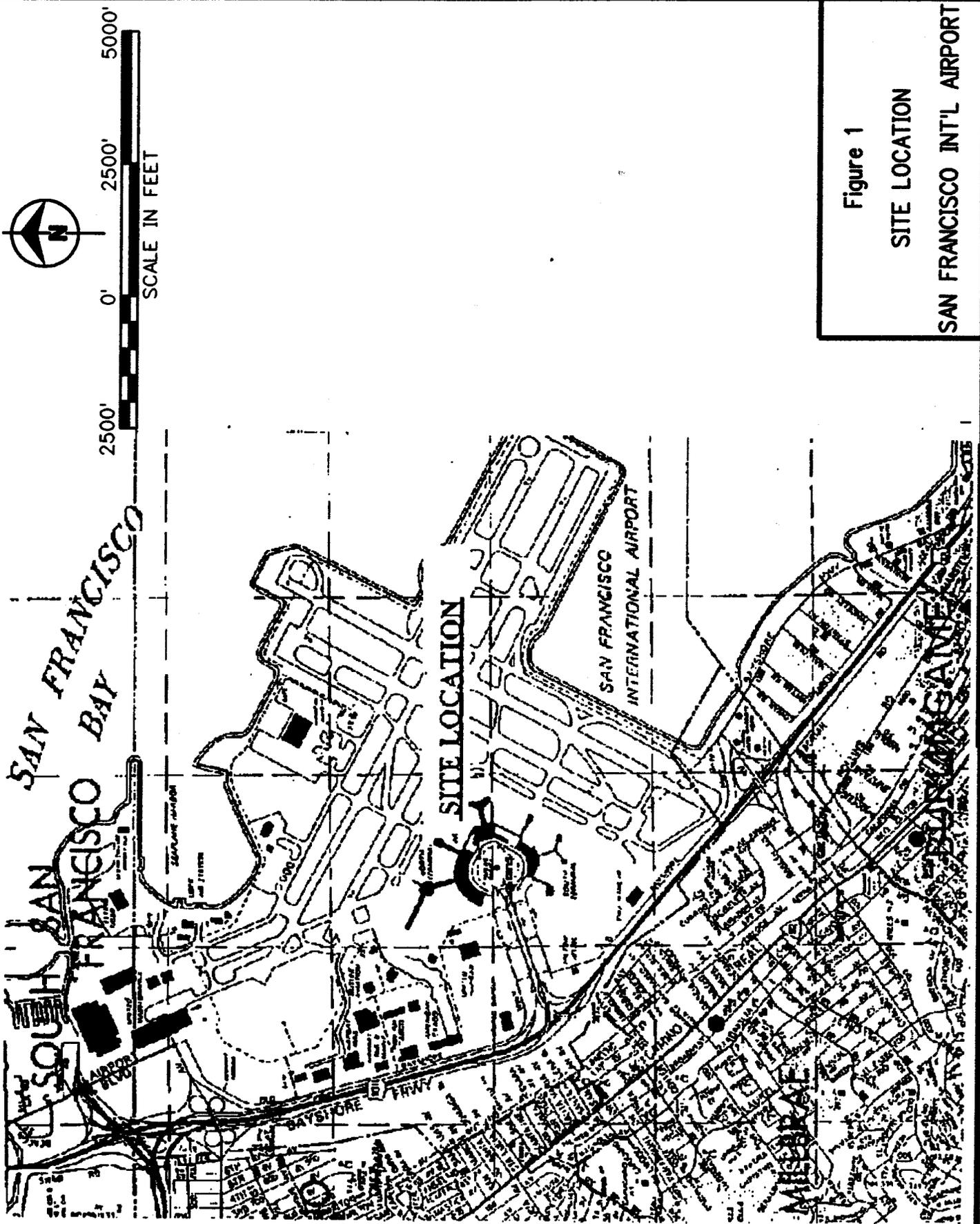
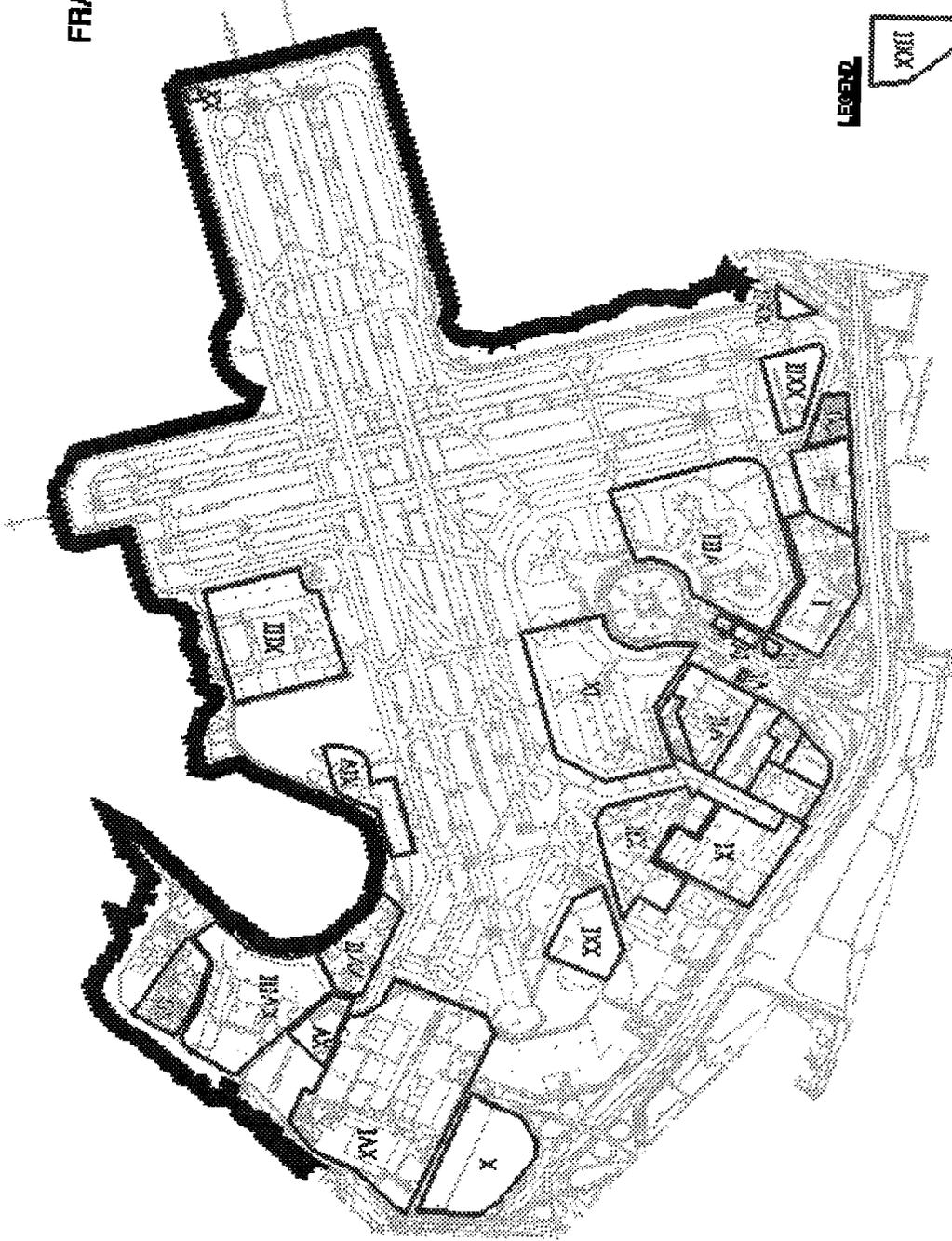


Figure 1

SITE LOCATION

SAN FRANCISCO INT'L AIRPORT

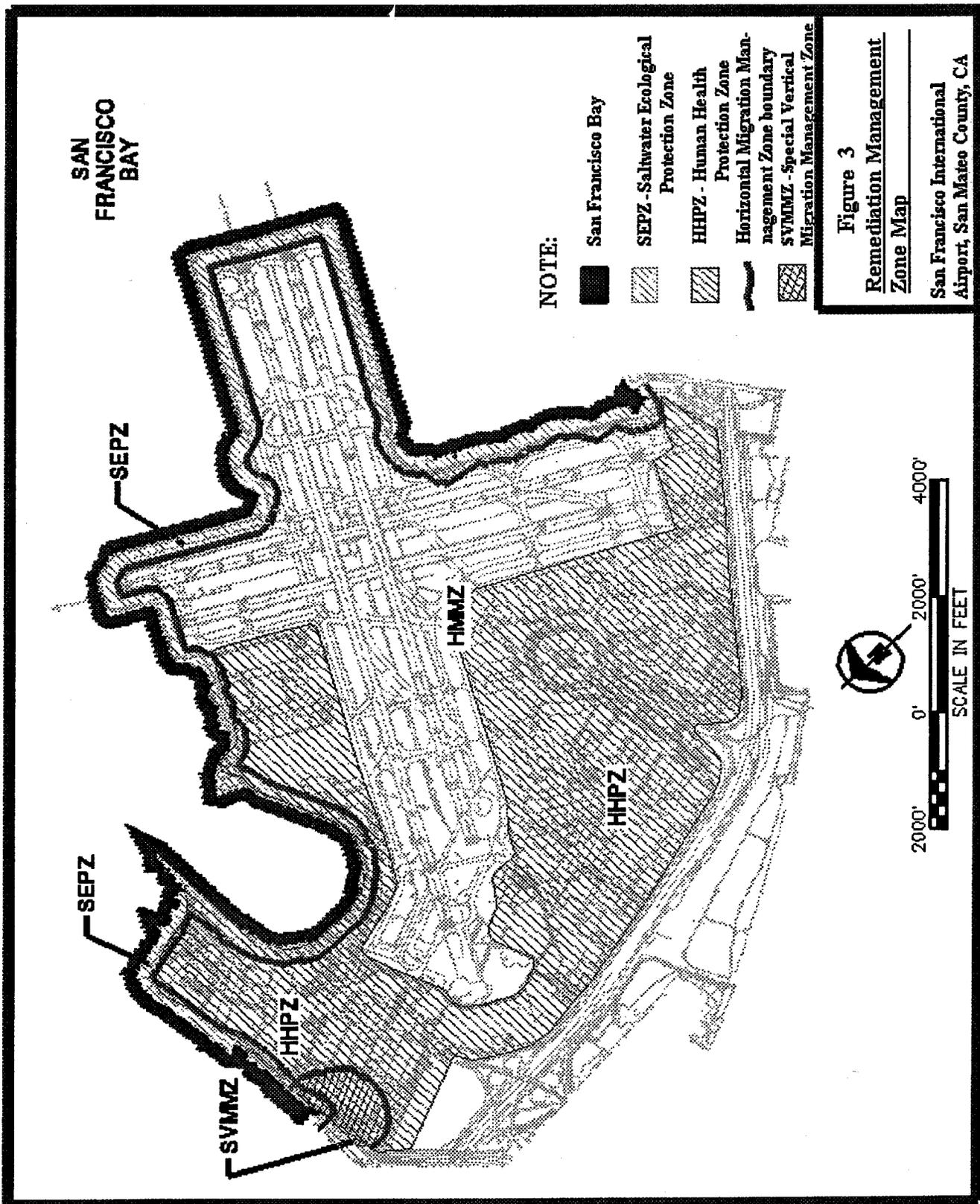
SAN FRANCISCO BAY



LEGEND
XXII DISCHARGER SITE



Figure 2
DISCHARGER SITES
SAN FRANCISCO INTL AIRPORT



Attachment 1

Remediation Management Zones
Tier-1 Cleanup Standards

Table 2: ECOLOGICAL PROTECTION ZONE TIER 1 STANDARDS

Chemical Constituent	Maximum Soil Concentration	Maximum Groundwater Concentration	Basis for Standard (Limiting Factor)
	mg/kg	µg/L	
1. Benzene (B)	2.73	71	Soil: OLM Water: USEPA WQC (USEPA, 1997)
2. Benzo(a)pyrene	0.064	0.031	Soil: OLM Water: USEPA WQC (USEPA, 1997)
3. Carbon Tetrachloride	0.057	3.8	Soil: OLM Water: CA WQO (SWRCB, 1993)
4. Chloroethane	2.3	99	Soil: OLM Water: 1,2 -DCA
5. Chloroform	19	470	Soil: OLM Water: USEPA WQC (USEPA, 1997)
6. 1,1-Dichloroethane (1,1-DCA)	2.5	99	Soil: OLM Water: 1,2 -DCA
7. 1,2-Dichloroethane (1,2-DCA)	1.9	99	Soil: OLM Water: USEPA WQC (USEPA, 1997)
8. 1,1-Dichloroethene (1,1-DCE)	2.5	3.2	Soil: OLM Water: CA WQO (SWRCB, 1993)
9. 1,2-Dichloroethene (1,2-DCE)	8,818	22,400	Soil: OLM Water: USEPA WQC (MC/10) (USEPA, 1997)
10. Ethylbenzene (E)	13	86	Soil: OLM Water: USEPA WQC (MC/5) (USEPA, 1997)
11. Methylene Chloride (MC)	89	1,600	Soil: OLM Water: USEPA WQC (USEPA, 1997)
12. 2-Methylnaphthalene	456	470	Soil: OLM Water: Naphthalene
13. Methyl Tertiary Butyl Ether (MTBE)	447	8,000	Soil: OLM Water: Tentative Criteria (RWQCB, 1998)
14. Naphthalene	402	470	Soil: OLM Water: USEPA WQC (MC/5) (USEPA, 1997)
15. Oil & Grease (TOG)	Site Specific	Site Specific	
16. Phenol	5.8	500	Soil: OLM Water: Basin Plan SWEL (RWQCB, 1995)

Table 2: ECOLOGICAL PROTECTION ZONE TIER 1 STANDARDS

Chemical Constituent	Maximum Soil Concentration	Maximum Groundwater Concentration	Basis for Standard (Limiting Factor)
	mg/kg	µg/L	
17. Polynuclear Aromatic Hydrocarbons (PAHs), Noncarcinogenic	19	15	Soil: OLM Water: Basin Plan SWEL (RWQCB, 1995)
18. Polychlorinated Biphenyls/Aroclor (Total PCBs)	0.0000014	0.0002*	Soil: OLM Water: USEPA WQC (USEPA, 1997) * recalculated (USEPA, 1996)
19. Stoddard Solvent	979	680	Soil: Kd = 1,400 Water: Stoddard Solvent Bioassay (BMWCI, 1997)
20. Tetrachloroethylene (PCE)	0.29	6.9	Soil: OLM Water: CA WQO (SWRCB, 1993)
21. Toluene (T)	930	5,000	Soil: OLM Water: USEPA WQC (USEPA, 1997)
22. Total Petroleum Hydrocarbons as Diesel (TPH-d)	518	640	Soil: Kd = 810 Water: Bioassay (Task 3B) Report (Addendum) (BMWCI, March 1999)
23. Total Petroleum Hydrocarbons as Gasoline (TPH-g)	629	3,700	Soil: Kd = 170 Water: Bioassay (Task 3B) Report (BMWCI, 1997) (RWQCB, 1998)
24. Total Petroleum Hydrocarbons as Jet Fuel (TPH-j)	640	640	Soil: Kd = 1,000 Water: Bioassay (Task 3B) Report (Addendum) (BMWCI, March 1999)
25. 1,1,1-Trichloroethane (1,1,1-TCA)	827	3,120	Soil: OLM Water: USEPA WQC (MC/10) (USEPA, 1997)
26. 1,1,2-Trichloroethane (1,1,2-TCA)	0.76	42	Soil: OLM Water: USEPA WQC (USEPA, 1997)
27. Trichloroethylene (TCE)	4.3	81	Soil: OLM Water: USEPA WQC (USEPA, 1997)
28. Vinyl Chloride (VC)	0.72	34	Soil: OLM Water: CA WQO (SWRCB, 1993)
29. Xylene (X)	358	2,200	Soil: OLM Water: PHYTOTOX database (USEPA, 1995)

Table 3 - HMMZ Standards

Derivation of Standards

The chemical standards for the Horizontal Migration Management Zone (HMMZ) are all derived from the groundwater standards applicable to the Saltwater Ecological Protection Zone (SEPZ). The SEPZ groundwater standards are aquatic toxicity values taken from various references (see Table 2). Groundwater standards for interior portions of the airport within the HMMZ are calculated as follows:

$$\text{SEPZ Groundwater Standard} \times \text{DAF} = \text{HMMZ Groundwater Standard}$$

The DAF (dilution-attenuation factor) is a value ranging from 3 at the inside edge of the SEPZ to greater than 50 at airport locations furthest from the Bay. The DAF is distance dependent and is set at a value of 1 per 100 feet from the Bay. A DAF of 1 is imposed throughout the SEPZ to protect the Bay.

SEPZ and HMMZ soil standards for a particular location are calculated from the groundwater standards for the location using either a chemical specific K_d value (as for TPH) or USEPA's Organic Leachate Model (OLM). The OLM equation is:

$$C_L = 0.00221 C_s^{0.678} S^{0.373}$$

Rearranging to solve for soil concentration yields:

$$C_s = [C_L / (0.00221 S^{0.373})]^{1.47}$$

Where:

C_L = Concentration in water (mg/L)

C_s = Concentration in soil (mg/kg)

S = Solubility of chemical in water (mg/L)

Use of Graphs

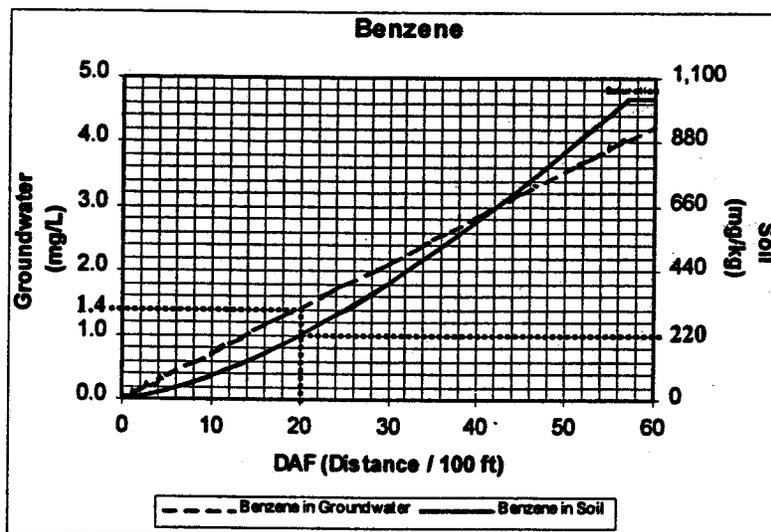
To determine the HMMZ soil and groundwater standards for a particular site, first the distance is measured from the edge of the site's contaminated area to the nearest point on the Bay (mean high tide line). This distance is divided by 100 to calculate the site-specific DAF. The DAF is

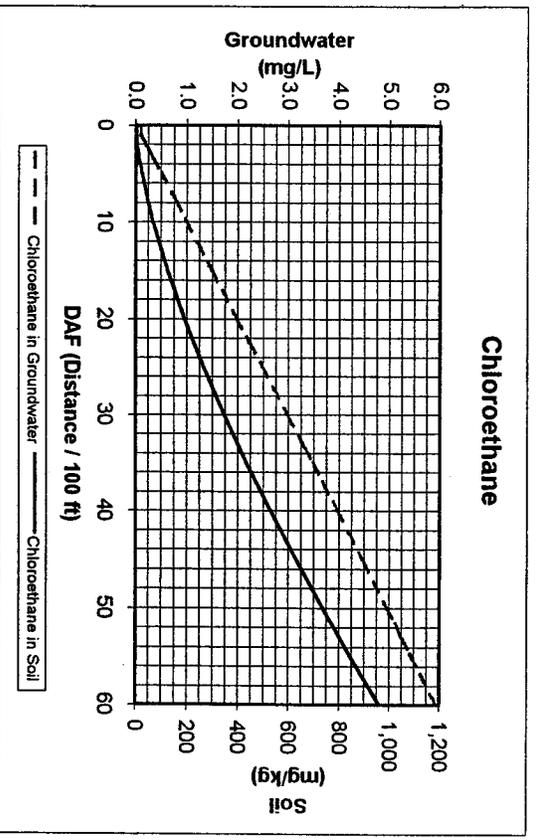
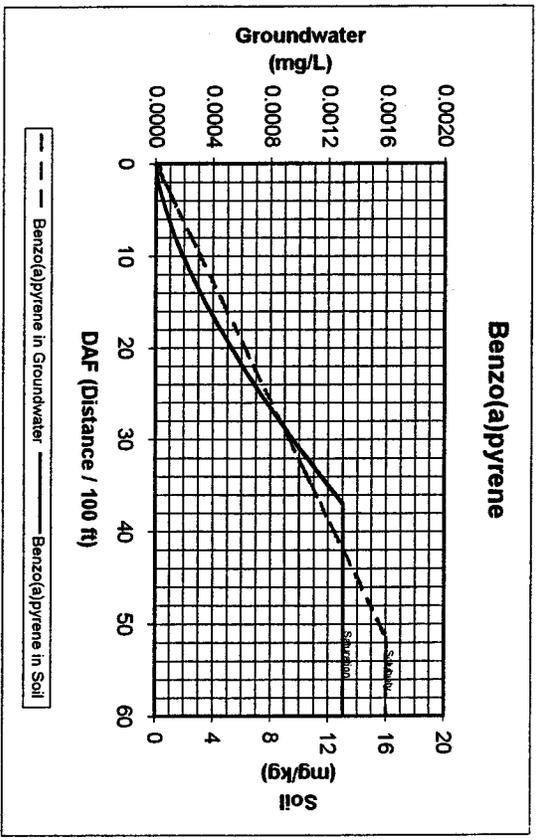
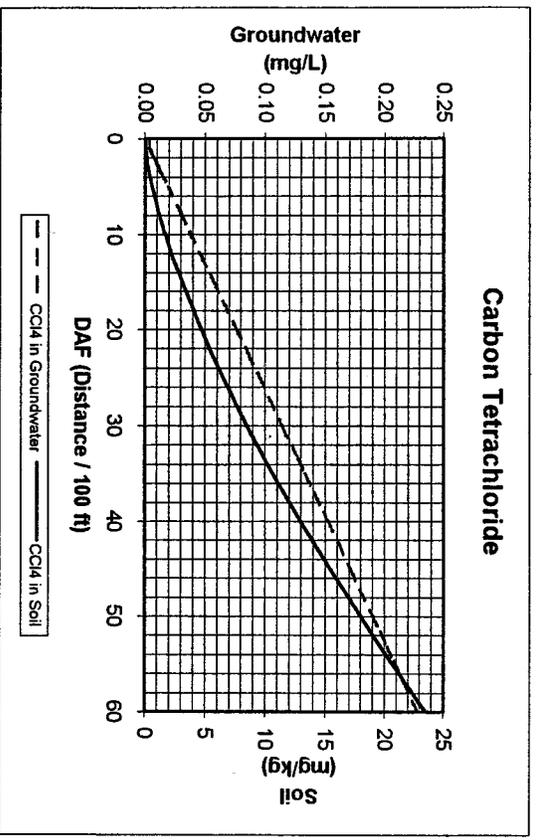
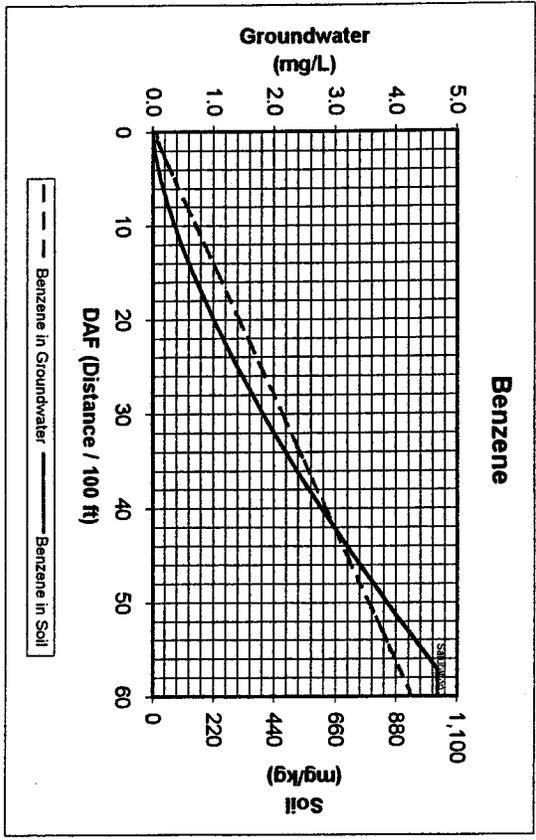
used as the entering argument on the graph of each chemical of concern. The DAFs are along the bottom of the graphs, soil concentrations are on the right side, and groundwater concentrations are on the left side. Where the vertical DAF line intersects the soil line (a solid, usually curved line) is the allowable soil concentration, which is read from the intersection point horizontally to the soil concentrations on the right side. The point where the vertical DAF line intersects the groundwater line (dashed) is the allowable groundwater concentration, which is read from the intersection point horizontally to the groundwater concentrations on the left.

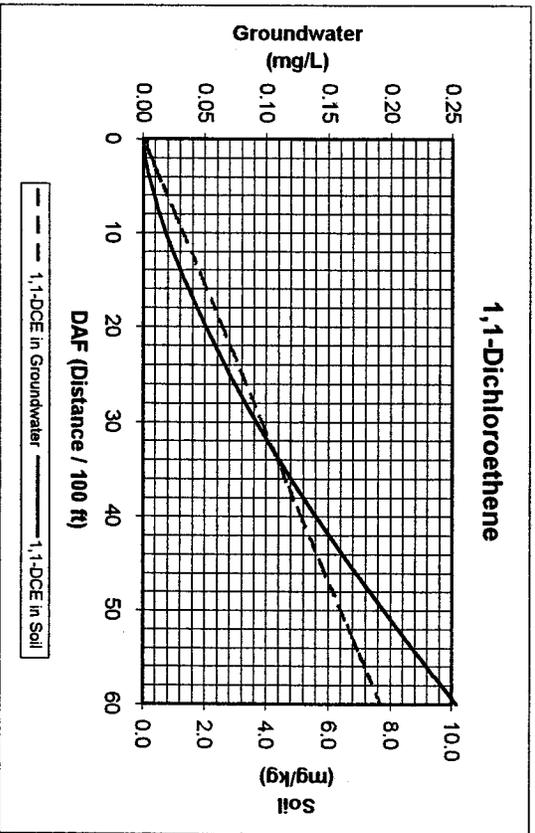
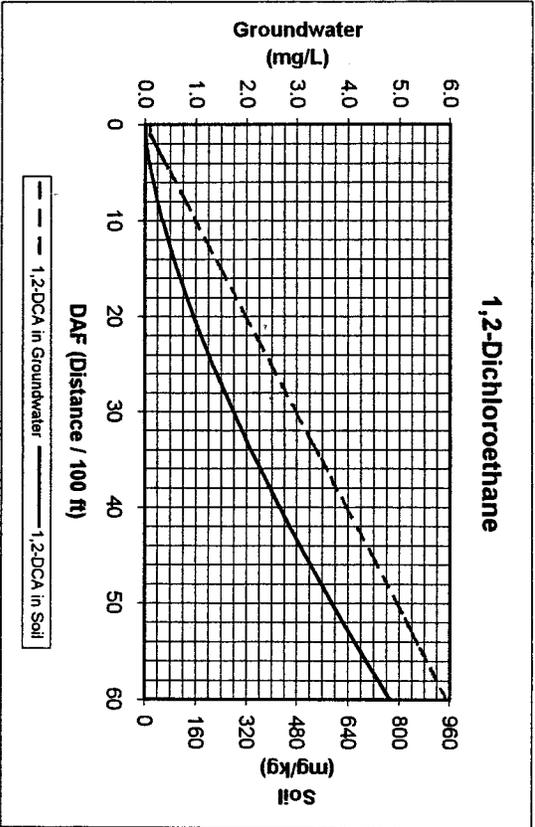
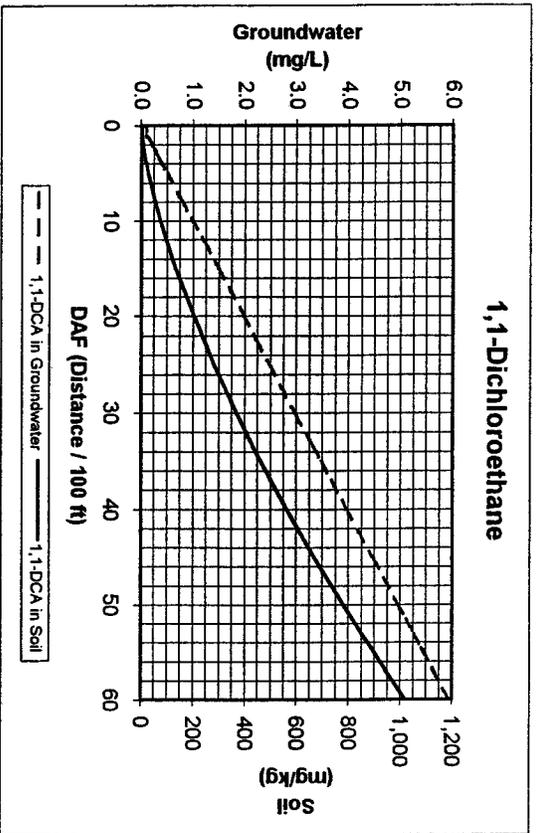
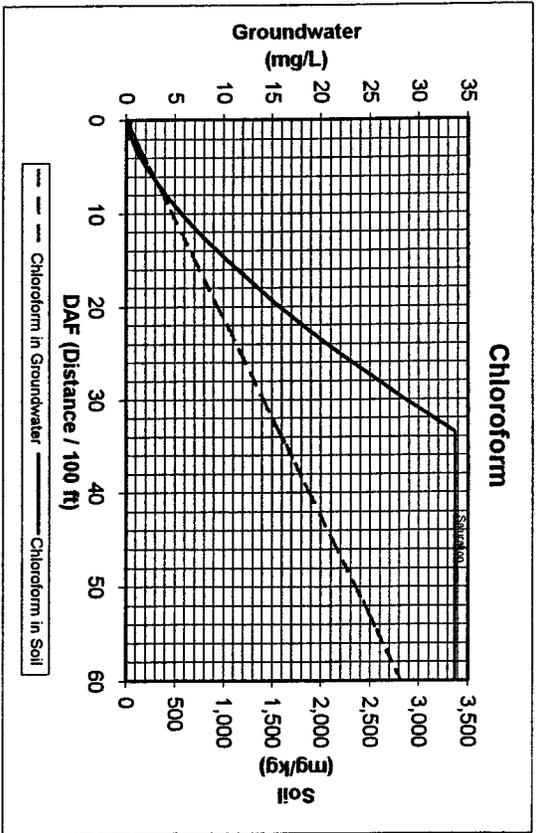
As an example with benzene as the chemical of concern:

Site to Bay Distance = 2000'

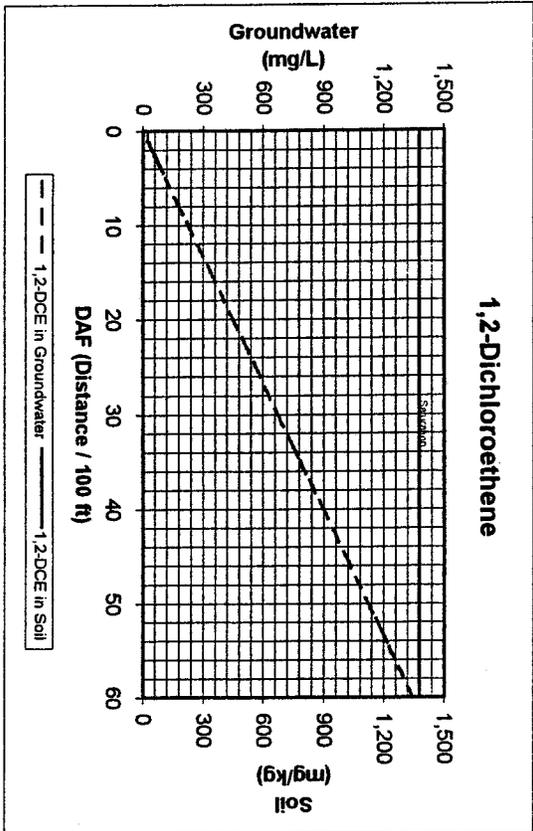
$$\text{DAF} = 2000' / 100 = 20$$



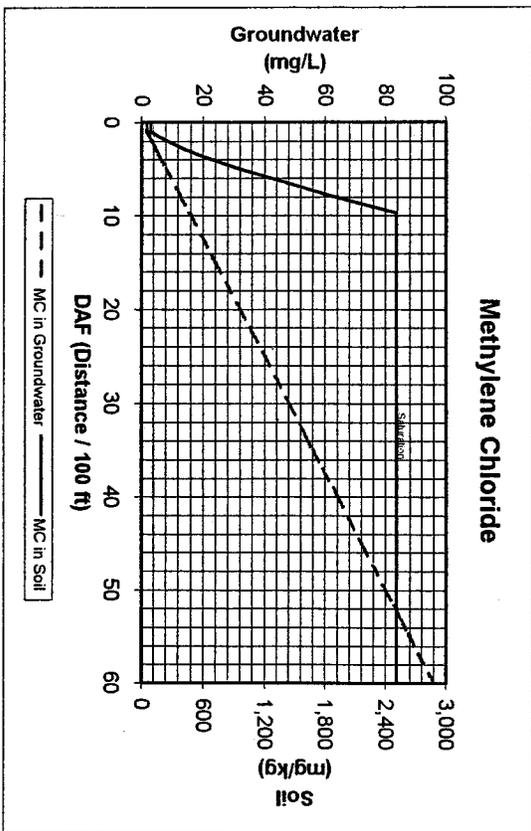




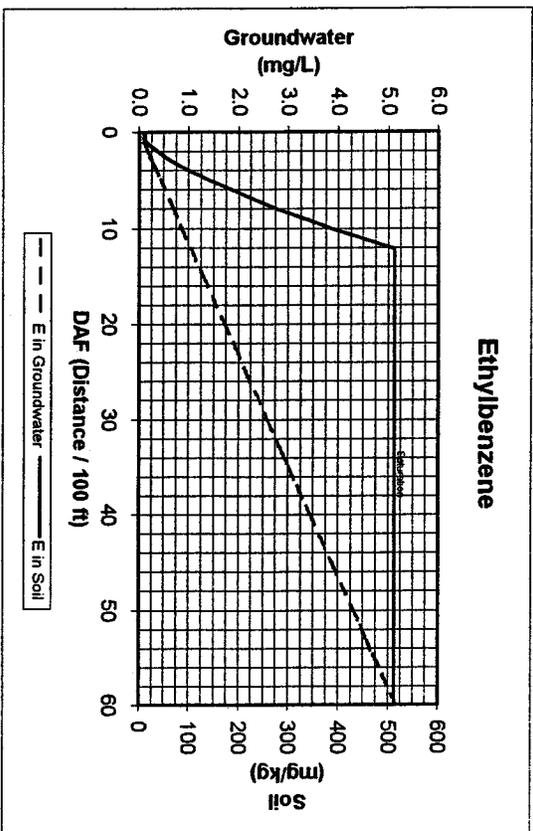
1,2-Dichloroethene



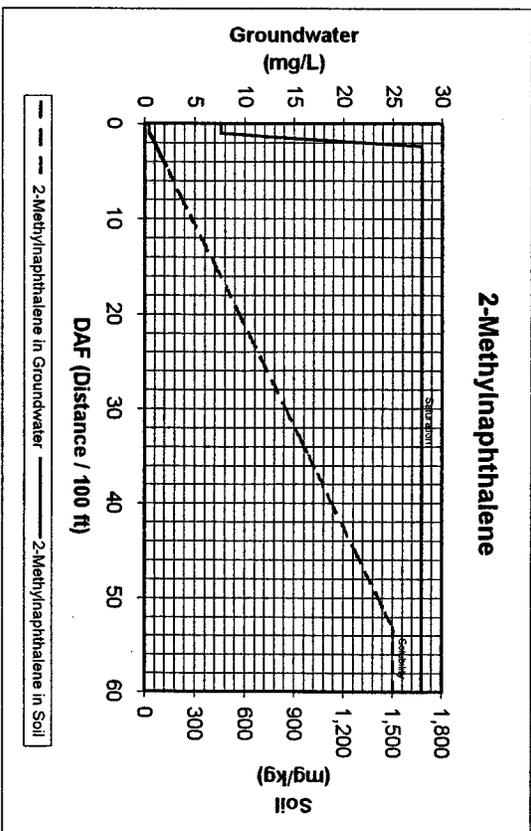
Methylene Chloride

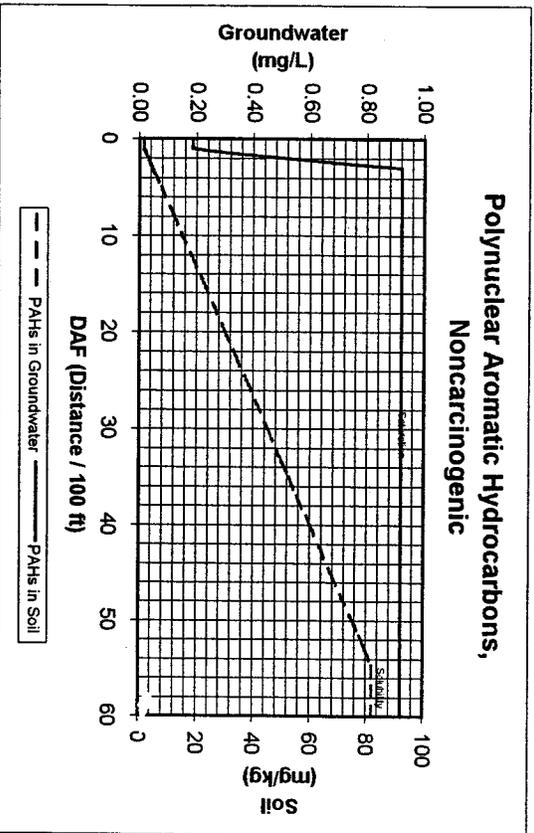
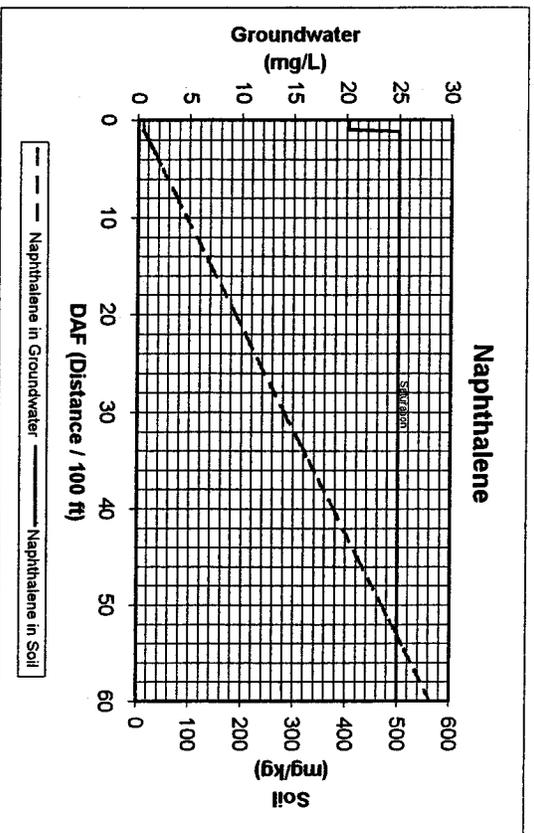
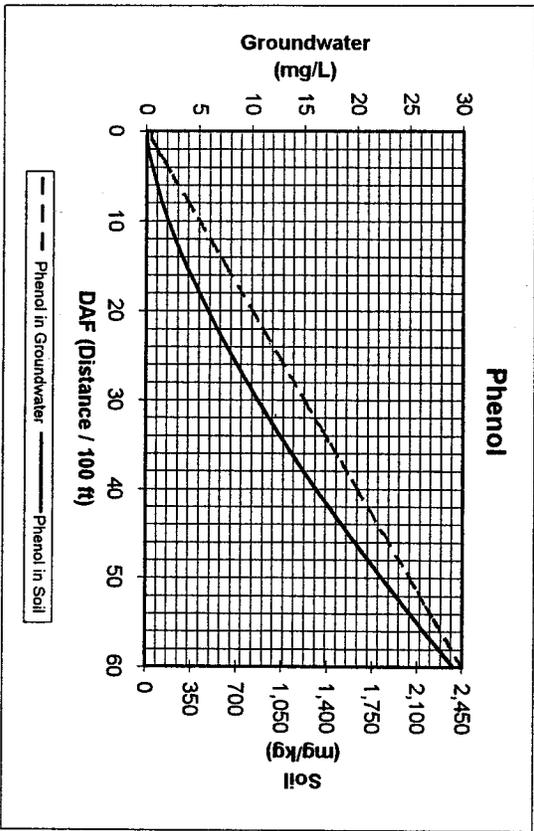
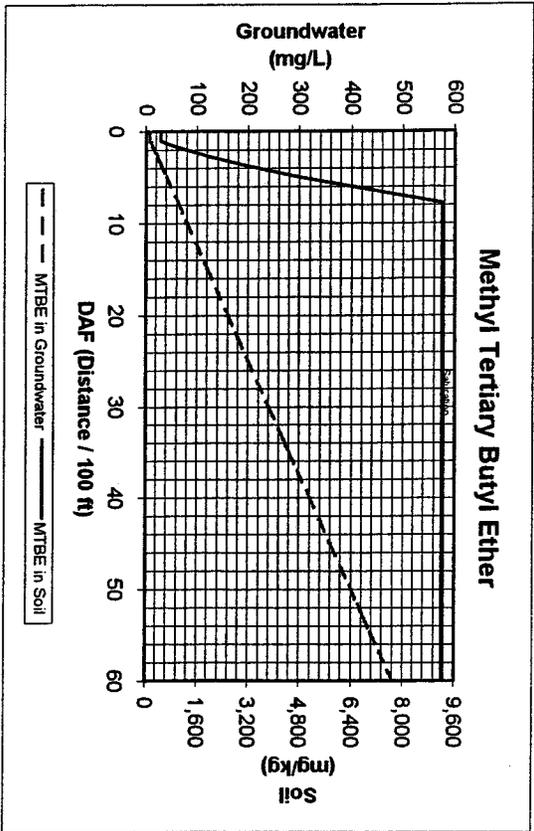


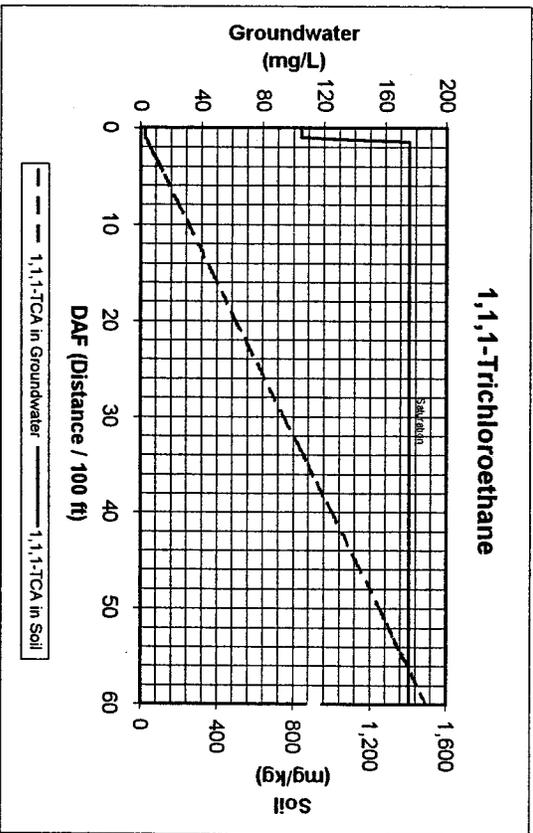
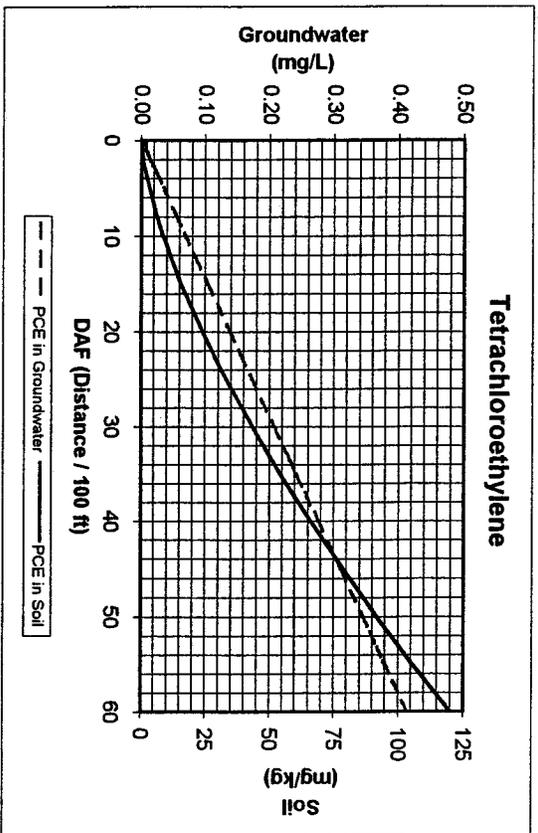
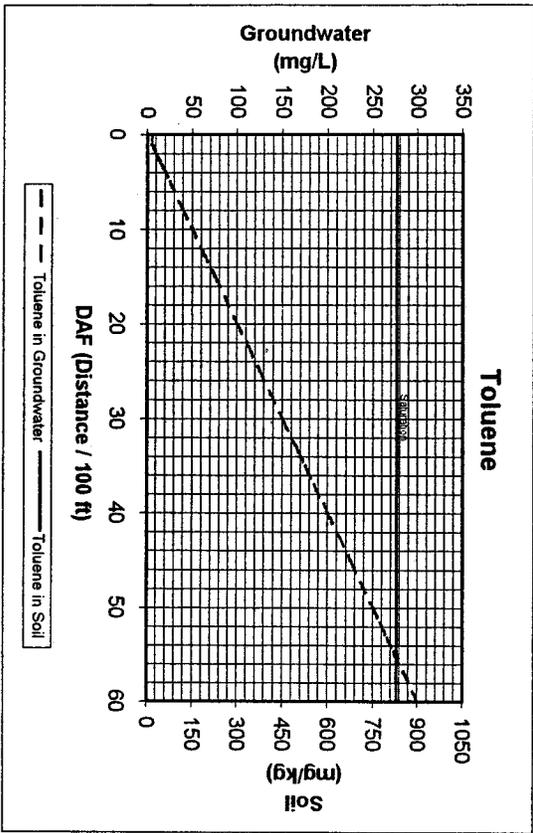
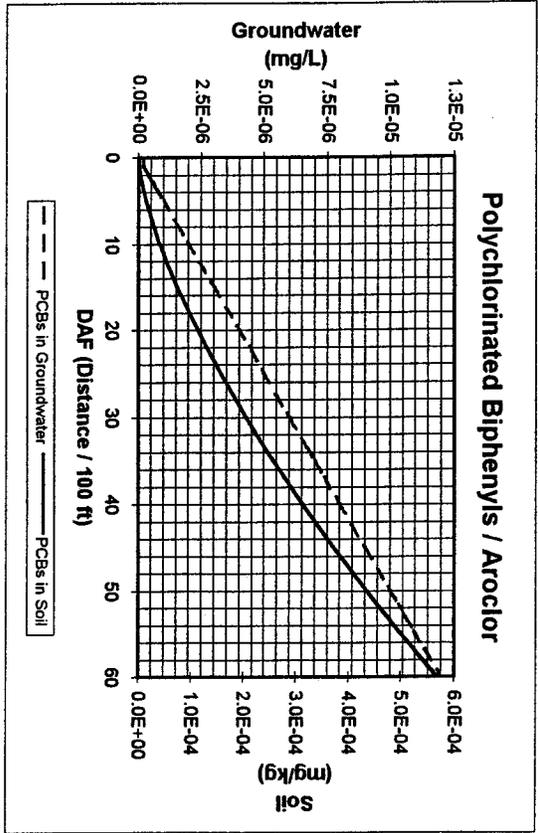
Ethylbenzene

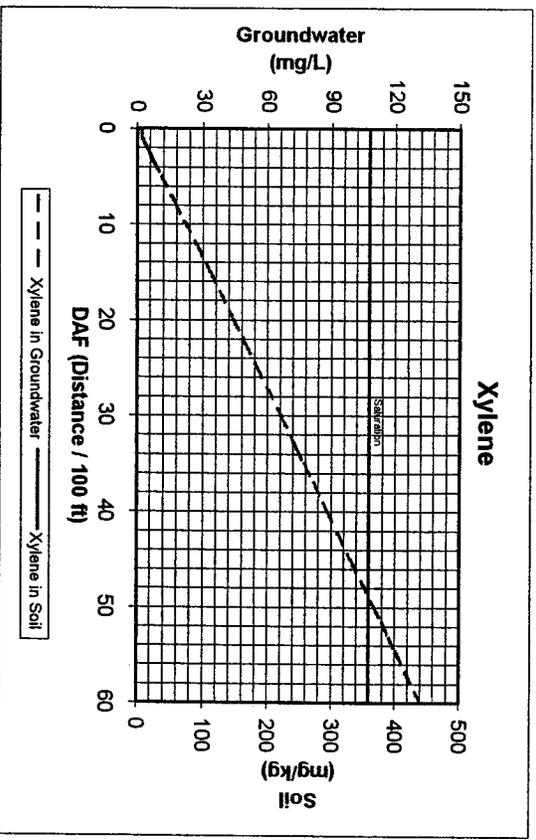
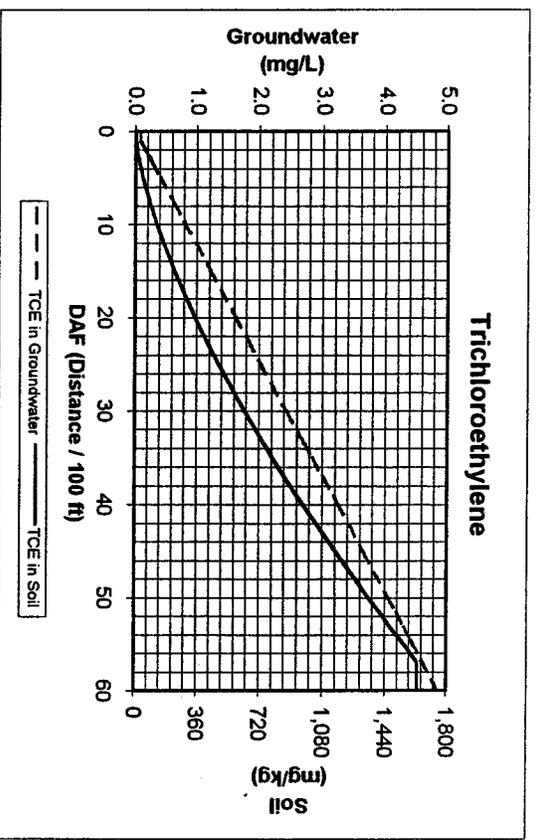
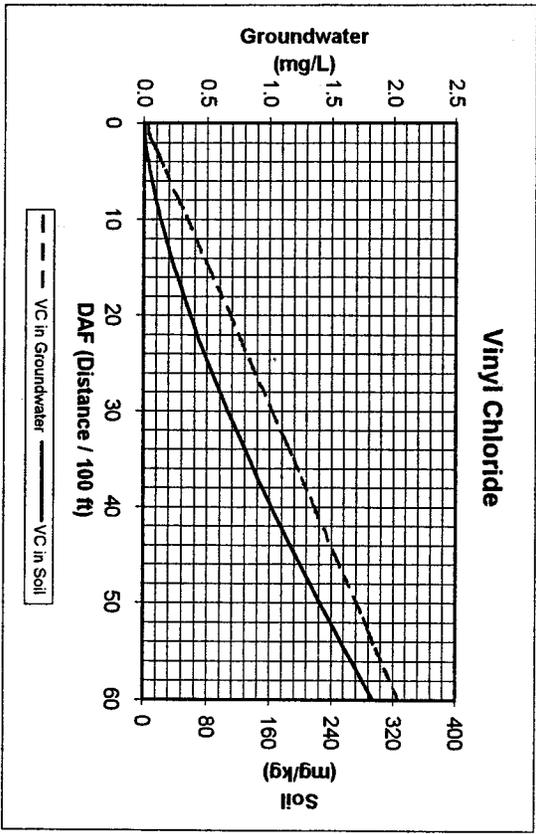
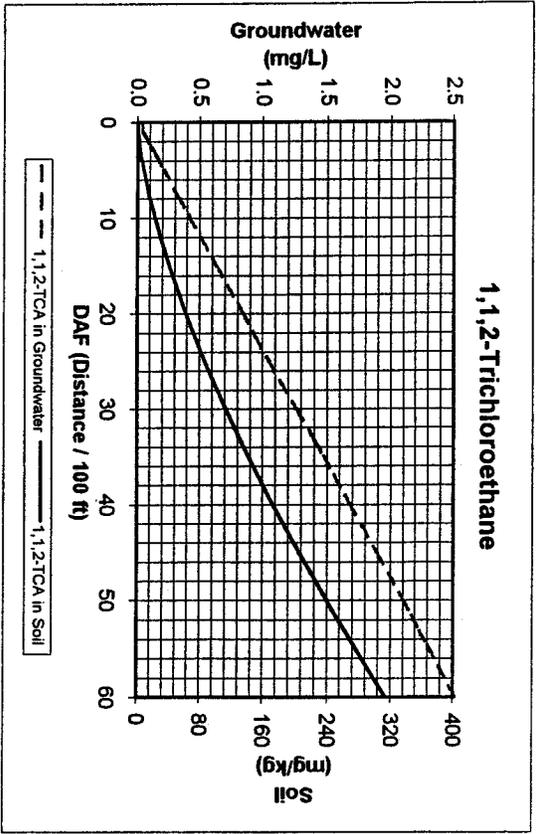


2-Methylnaphthalene









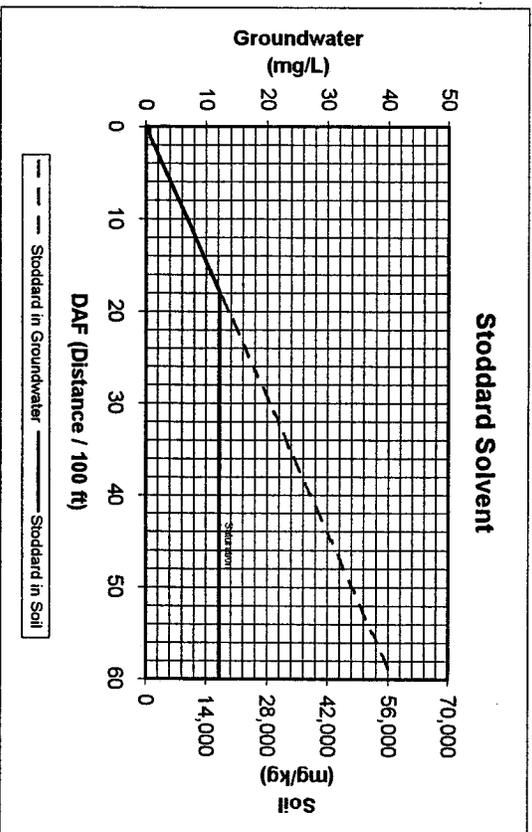
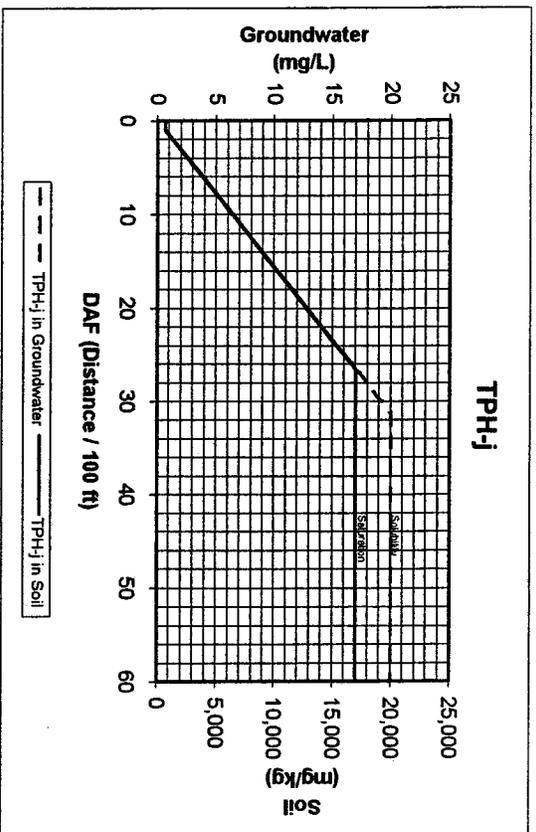
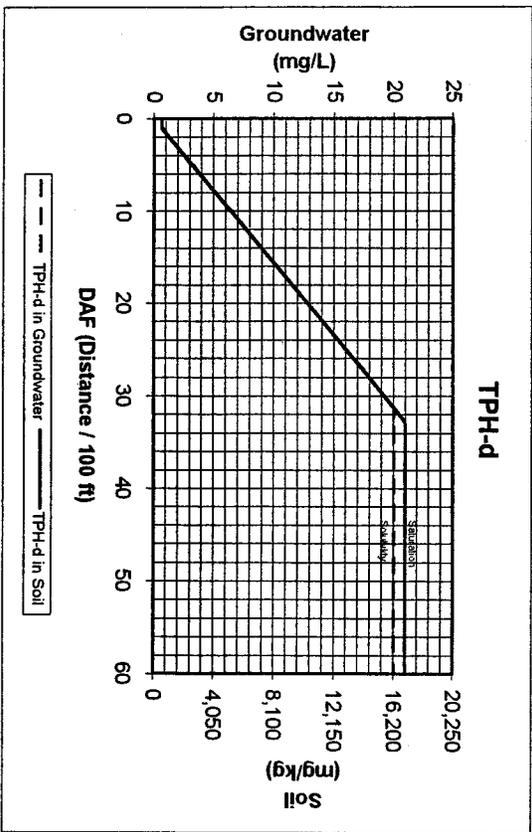
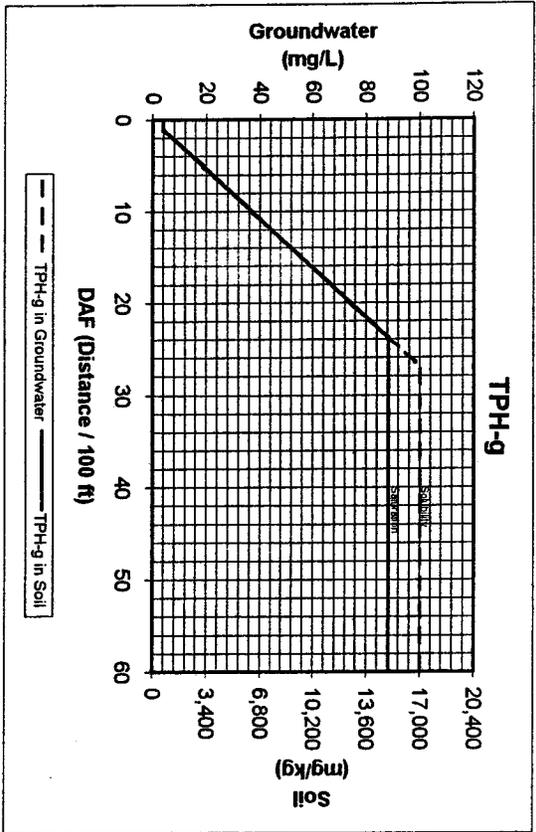


Table 4: HUMAN HEALTH PROTECTION ZONE TIER 1 STANDARDS

Chemical Constituent	Risk Scenario	Maximum Soil Concentration	Maximum Groundwater Concentration
		mg/kg	ug/L
1. Benzene	Indoor Worker	2.5	4,200
	Outdoor/Maintenance Worker	7.5	13,000
	Construction Worker	6.5	11,000
2. Benzo(a)pyrene	Indoor Worker	13	1.6
	Outdoor/Maintenance Worker	1.6	0.20
	Construction Worker	2.6	0.32
3. Carbon Tetrachloride	Indoor Worker	0.9	580
	Outdoor/Maintenance Worker	3.7	2,300
	Construction Worker	1.6	990
4. Chloroethane	Indoor Worker	2,300	5,700,000
	Outdoor/Maintenance Worker	2,300	5,700,000
	Construction Worker	2,300	5,700,000
5. Chloroform	Indoor Worker	2.9	6,700
	Outdoor/Maintenance Worker	9.2	22,000
	Construction Worker	8.1	19,000
6. 1,1-Dichloroethane (1,1-DCA)	Indoor Worker	32	87,000
	Outdoor/Maintenance Worker	110	300,000
	Construction Worker	99	270,000

Table 4: HUMAN HEALTH PROTECTION ZONE TIER 1 STANDARDS

Chemical Constituent	Risk Scenario	Maximum Soil Concentration	Maximum Groundwater Concentration
		mg/kg	ug/L
7. 1,2-Dichloroethane (1,2-DCA)	Indoor Worker	5.2	22,000
	Outdoor/Maintenance Worker	11	49,000
	Construction Worker	10	44,000
8. 1,1-Dichloroethene (1,1-DCE)	Indoor Worker	0.33	480
	Outdoor/Maintenance Worker	1.9	2,700
	Construction Worker	1.7	2,400
9. 1,2-Dichloroethene (1,2-DCE)	Indoor Worker	95	240,000
	Outdoor/Maintenance Worker	280	710,000
	Construction Worker	39	99,000
10. Ethylbenzene (E)	Indoor Worker	510	170,000
	Outdoor/Maintenance Worker	510	170,000
	Construction Worker	510	170,000
11. Methylene Chloride (MC)	Indoor Worker	51	270,000
	Outdoor/Maintenance Worker	170	880,000
	Construction Worker	150	780,000
12. 2-Methylnaphthalene	Indoor Worker	1,700	25,000
	Outdoor/Maintenance Worker	120	1,800
	Construction Worker	18	260

Table 4: HUMAN HEALTH PROTECTION ZONE TIER 1 STANDARDS

Chemical Constituent	Risk Scenario	Maximum Soil Concentration	Maximum Groundwater Concentration
		mg/kg	ug/L
13. Methyl Tertiary Butyl Ether (MTBE)	Indoor Worker	9,200	51,000,000
	Outdoor/Maintenance Worker	4,700	26,000,000
	Construction Worker	830	4,600,000
14. Naphthalene	Indoor Worker	410	25,000
	Outdoor/Maintenance Worker	61	3,800
	Construction Worker	8.6	530
15. Oil & Grease (TOG)	Indoor Worker	-- ¹	-- ¹
	Outdoor/Maintenance Worker	18,000	-- ¹
	Construction Worker	7,900	-- ¹
16. Phenol	Indoor Worker	26,000	83,000,000
	Outdoor/Maintenance Worker	26,000	83,000,000
	Construction Worker	26,000	83,000,000
17. Polycyclic Aromatic Hydrocarbons (PAHs), Noncarcinogenic	Indoor Worker	92	820
	Outdoor/Maintenance Worker	92	820
	Construction Worker	92	820
18. Polychlorinated Biphenyls / Aroclor (Total PCBs)	Indoor Worker	1,800	700
	Outdoor/Maintenance Worker	13	5.3
	Construction Worker	3.0	1.2

Table 4: HUMAN HEALTH PROTECTION ZONE TIER 1 STANDARDS

Chemical Constituent	Risk Scenario	Maximum Soil Concentration	Maximum Groundwater Concentration
		mg/kg	ug/L
19. Stoddard Solvent	Indoor Worker	-- ¹	-- ¹
	Outdoor/Maintenance Worker	17,000	-- ¹
	Construction Worker	11,000	-- ¹
20. Tetrachloroethylene (PCE)	Indoor Worker	110	77,000
	Outdoor/Maintenance Worker	220	150,000
	Construction Worker	210	150,000
21. Toluene (T)	Indoor Worker	830	530,000
	Outdoor/Maintenance Worker	830	530,000
	Construction Worker	670	420,000
22. Total Petroleum Hydrocarbons as Diesel (TPH-d) ²	Indoor Worker	-- ¹	-- ¹
	Outdoor/Maintenance Worker	17,000	-- ¹
	Construction Worker	7,900	-- ¹
23. Total Petroleum Hydrocarbons as Gasoline (TPH-g) ³	Indoor Worker	-- ¹	-- ¹
	Outdoor/Maintenance Worker	15,000	-- ¹
	Construction Worker	8,500	-- ¹

Table 4: HUMAN HEALTH PROTECTION ZONE TIER 1 STANDARDS

Chemical Constituent	Risk Scenario	Maximum Soil Concentration	Maximum Groundwater Concentration
		mg/kg	ug/L
24. Total Petroleum Hydrocarbons as Jet Fuel (TPH-j) ²	Indoor Worker	-- ¹	-- ¹
	Outdoor/Maintenance Worker	17,000	-- ¹
	Construction Worker	9,600	-- ¹
25. 1,1,1-Trichloroethane (1,1,1-TCA)	Indoor Worker	1,400	1,300,000
	Outdoor/Maintenance Worker	1,400	1,300,000
	Construction Worker	780	740,000
26. 1,1,2-Trichloroethane (1,1,2-TCA)	Indoor Worker	25	52,000
	Outdoor/Maintenance Worker	32	64,000
	Construction Worker	28	57,000
27. Trichloroethylene (TCE)	Indoor Worker	37	25,000
	Outdoor/Maintenance Worker	91	62,000
	Construction Worker	28	19,000
28. Vinyl Chloride (VC)	Indoor Worker	0.089	240
	Outdoor/Maintenance Worker	0.66	1,800
	Construction Worker	0.59	1,600
29. Xylene (X)	Indoor Worker	360	180,000
	Outdoor/Maintenance Worker	360	180,000
	Construction Worker	360	180,000

NOTES (for Table 4):

1. Dashes indicate that the vapor inhalation pathway, which is believed to be the main exposure pathway for the indoor worker scenario, was not evaluated for petroleum mixtures due to complex compositions. As a result, both soil and groundwater cleanup standards for petroleum mixtures cannot be determined for the indoor worker scenario. The vapor inhalation pathway was evaluated, however, for individual petroleum constituents of concern and these standards should be used concurrently as cleanup standards, when applicable. Direct contact with groundwater was considered to be an essentially incomplete pathway for all receptor groups.
2. Analyses for TPH-d/j alone are not sufficient for remedial action planning or confirmation, based on the discussion in note 1 above. The concentrations of relevant individual constituents must be adequately documented by analyzing at least 10% (more may be required on a site-specific basis) of samples for PAHs and naphthalenes. The samples selected for analysis of constituents must be representative of the full range of TPH concentrations present at the site.
3. Analyses for TPH-g alone are not sufficient for remedial action planning or confirmation, based on the discussion in note 1 above. BTEX concentrations must also be determined for all samples.

Attachment 2

Tier-2

Risk Assessment Methodology

ATTACHMENT 2

TIER-2 SITE-SPECIFIC RISK ASSESSMENT METHODOLOGY

The methodology outlined below describes the general procedures required for the completion of a site-specific risk assessment. As opposed to a Tier-1 risk assessment which derives acceptable target levels for standard exposure scenarios under general site conditions, a Tier-2 (or further) risk assessment utilizes site-specific data to address unique conditions in localized areas where a Tier-1 assessment may not be representative. Both Tier-1 and Tier-2 assessments are based on achieving similar levels of protection of human health and the environment. However, in Tier-2 the non-site-specific assumptions and point(s) of exposure used in Tier-1 are replaced with site-specific data and information. As a result, additional site assessment data may be needed. For example, the Tier-2 target levels can be derived from the same equations used to calculate the Tier-1 levels, except that site-specific parameters are used in the calculations. The additional site-specific data may also support alternate fate and transport analysis or point(s) of exposure.

To ensure protection for both ecological and human receptors and the Westside Basin, the gathering of adequate site-specific data and subsequent analysis is required. The Regional Board strongly encourages the dischargers to utilize the framework provided in the American Society for Testing and Materials (ASTM) E 1739-95 "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites" [RBCA] (September 10, 1995) or its successor when developing Tier-2 cleanup standards. The tiered approach, and the methodology to perform

the tiered analyses in the ASTM RBCA provides a consistent decision-making tool, especially where multiple parties are involved.

Details on site-specific risk assessments will be based on procedures outlined in Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities (California Department of Toxic Substances Control, DTSC, 1992), Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) (U.S. EPA 1989), Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities (DTSC 1994), and Guidance for Data Usability in Risk Assessment (U.S. EPA 1992).

Conceptual Site Model Prior to initiating Tier-2 risk assessments, a site-specific conceptual site model (CSM) that best describes the chemicals of concern, the release mechanisms, and the point of exposures must be constructed for both human and ecological receptors and be agreed upon by the Executive Officer and all potentially affected parties. At a minimum, the CSM will include: primary sources, primary release mechanisms, secondary sources, secondary release mechanisms, natural and man-made pathways, and current and potential future receptors. The CSM should also evaluate whether an exposure pathway is complete and, if so, significant or insignificant.

Risk Evaluation Workplan
Subsequent to an approved CSM, a workplan must be prepared for review and

approval that describes (a) the need of, and the ways to obtain, additional data in order to validate the assumptions made in the CSM and (b) the proposed procedures to be used to calculate the risks (e.g., assumptions, parameters or equations to be used, fate and transport analysis method, etc.).

As a first step, the risk assessment workplan should evaluate existing data and propose investigative and sampling plans to fill in the data gap (e.g., soil, groundwater, surface water, soil vapor and sediment data; geological and hydrogeological information; behavior of COCs in the environment; etc.). It is necessary to demonstrate that primary contaminant sources have been properly mitigated and that residual contaminant plume has been stabilized. If it is found that field investigation results could not validate the assumptions made in the CSM, the CSM must be revisited and revised, where appropriate.

Secondly, the workplan should define acceptable risk levels and describe the selected exposure pathways and the proposed toxicity evaluation methodology. The evaluation should include current and future potential impact on human health, ecology, environment, water quality and water resources, where appropriate. [The April 1998 Task 3D report submitted by the Airport's Consolidated Tenants Group, as well as the Regional Board staff's review comment, forms the framework used in deriving the Tier-1 cleanup standards contained in this Order. The same framework could be used for Tier-2 site-specific assessment, if deemed applicable.]

Samples from each applicable medium (e.g., soil, groundwater, surface water, sediment, soil vapor, etc.) should be

collected and analyzed for appropriate analysis as determined by historical contamination, using established sampling procedures. At a minimum, chemicals of concern (COCs) listed in this Order must be considered as chemicals of potential concern (COPCs) for the Tier-2 risk assessments, or an explanation must be provided for their exclusion. Statistical significance, data evaluation, detection limits, and COC selection will be determined as outlined in Guidance for Data Usability in Risk Assessment (U.S. EPA 1992).

The hierarchy of toxicity values to be used in the workplan should be as follows:

- 1) Cancer potency factors (slope factors, SFs) or chronic reference doses (RfDs) promulgated into California regulations.
- 2) SFs or chronic RfDs used to develop environmental criteria promulgated into California regulations.
- 3) U.S. EPA's Integrated Risk Information System (IRIS). Access to this database can be obtained through the National Library of Medicine's "TOXNET" system, (301) 496-6531; U.S. EPA's Risk Information Hotline, (513) 569-7254; or a variety of commercially available databases.
- 4) The most current edition of U.S. EPA's Health Effects Assessment Summary Tables (HEAST). Copies of this document may be ordered through National Technical Information Service in Springfield, Virginia, (800) 553-6847.

Acceptable risk and hazard will be determined based on the following criteria: the cumulative cancer risk for any exposed

population shall not exceed 1×10^{-4} , and the cumulative hazard from non-carcinogenic constituents shall not exceed a total hazard index of 1.0. U.S. EPA's OSWER Directive 9355.0-30 provides further clarification on what is acceptable risk in risk management decision. For sites where day care centers are proposed on the ground floor, the cumulative risk for all carcinogens for the exposed population shall not exceed 1×10^{-6} .

For ecological assessment, the workplan should include: habitat and species identification for both terrestrial and aquatic flora and fauna, with particular emphasis on rare, threatened, and endangered species within one mile of the site; pathway assessment for all applicable medium, including potential movement of contaminants to higher trophic levels; data evaluation, including COPC identification; and a toxicity evaluation. Both qualitative and quantitative information will be required. Examples of possible quantitative information include: chemical analysis of surface water and sediment of the near shore saltwater and fresh water of the adjacent estuarine and wetlands, species diversity, community structure and contaminant concentrations in the adjacent benthic populations, wetland delineation, and bioassay studies.

Tier-2 Risk Assessment Report Once the assumptions made in the CSM have been field validated and the risk evaluation workplan has been approved, a risk assessment should be conducted to assess the magnitude of risks associated with the pathways and receptors identified in the CSM. The results of the evaluation should be summarized in a risk assessment report for review and approval by the Executive Officer. The report should clearly

document and discuss the CSM, the risk assessment protocol, and the sources of information used. In addition, a qualitative uncertainty analysis should be performed on the assumptions, models, and variables used in quantifying risk and developing risk-based target levels.

Implementation Procedure At the same time a Discharger submit a Tier-2 risk evaluation **workplan** proposal to the Executive Officer, a copy of which shall also be sent to the Airport's staff and the adjacent tenants or potentially affected parties for review. Comments from affected parties on the proposed Tier-2 analysis shall be submitted to the Executive Officer within 30 days of the submittal. The resulting Tier-2 target levels will not become effective until the final Tier-2 risk assessment **report** is approved by the Executive Officer.

* * * * *

(Note: Certain chemical toxicity data can be obtained from various environmental regulatory agencies. A list of all Cal/EPA agencies/ departments and links to their web sites can be found at: <http://www.calepa.ca.gov/epaorgs>. The following is a list of web sites that may be useful.

Air Resources Board
<http://www.arb.ca.gov>
Department of Pesticide Regulation
<http://www.cdpr.ca.gov>
Department of Toxic Substances Control
<http://www.dtsc.ca.gov>
Integrated Waste Management Board
<http://www.ciwmb.ca.gov>
Office of Environmental Health Hazard Assessment
<http://www.oehha.ca.gov>
State Water Resources Control Board
<http://www.swrcb.ca.gov>

Other useful website addresses of environmental regulation agencies outside of Cal/EPA include:

Site Cleanup Requirements
San Francisco International Airport

California Resources Agency

<http://ceres.ca.gov/CRA/>

Department of Health Services

<http://www.dhs.ca.gov/>

Federal EPA

<http://www.epa.gov/iris>

Federal EPA, Region 9

[http://www.epa.gov/region09/waste/sfund/
prg/](http://www.epa.gov/region09/waste/sfund/prg/)

The above is not intended to be an exclusive list
and is provided for information only.)

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