RISK-BASED CORRECTIVE ACTION
TIER II ANALYSIS

1620 South Delaware Street
San Mateo, California

Project No. 236

December 28, 2006

Brunsing Associates, Inc.

RISK-BASED CORRECTIVE ACTION
Tier II Analysis

1620 South Delaware Street
San Mateo, California

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1.0 INTRODUCTION

This report presents the findings of a Risk-Based Corrective Action (RBCA) conducted on the property located at 1620 South Delaware Street, San Mateo, California (Plate 1). The site is currently an operating convenience car wash.

The purpose of this RBCA assessment is to evaluate the potential risk to human health and the environment from exposure to soil and groundwater containing petroleum hydrocarbon constituents reported at the subject site. This RBCA analysis was completed using the American Society for Testing and Materials (ASTM) E 1739-95-(reapproved 2002), "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites" and was facilitated by the use of the computer software package "RBCA Tool Kit for Chemical Releases, Version 1.3b", Groundwater Services, Inc., 2003.

2.0 OVERVIEW OF ASTM RBCA PROCESS

Traditionally, the RBCA process is implemented in a three-tiered approach involving increasingly sophisticated levels of data collection and analysis. The assumptions of earlier tiers are replaced with site-specific data and information as the analysis progresses through the different tiers. Upon evaluation of each tier, the user reviews the results and decides whether more site-specific analysis is warranted (i.e., moving from a lower to a higher tier).

A Tier I evaluation is a risk-based analysis to develop non-site specific values for direct and indirect exposure pathways using conservative exposure factors and fate and transport for potential pathways and various property use categories (ASTM E 1739-95 – reapproved 2002). The result of conducting a Tier I analysis is typically the development of risk-based screening level(s) (RBSLs). The RBSLs are conservative risk-based site-specific corrective action target levels for specific chemical(s) of concern (COC). The developed RBSLs are then compared with media-specific chemical concentrations reported in samples collected at the site.

A Tier II evaluation is a risk-based analysis applying the direct exposure values, established under a Tier I evaluation, at the point(s) of exposure developed for a specific site. A Tier II evaluation is also used to develop values for potential indirect exposure pathways at the point(s) of exposure based on site-specific conditions (ASTM E 1739-95 – reapproved 2002). The result of conducting a Tier II analysis is typically the development of site-specific target level(s) (SSTLs). The SSTLs are risk-based remedial action target levels for chemical(s) of concern for a particular site. As part of conducting a Tier II analysis, simple fate and transport equations and/or simple accepted models may be used in the development of SSTLs.

A Tier III evaluation is a risk-based analysis to develop values for potential direct and indirect exposure pathways at the point(s) of exposure based on site-specific conditions (ASTM E 1739-95 – reapproved 2002). Typically for a Tier III evaluation, complex fate and transport models and/or statistical simulations are used.

3.0 SITE HISTORY

According to the Dames & Moore, Inc. (DMI) report "Report of Geohydrological Consultation," dated November 20, 1984, one 4,000-gallon and two 3,000-gallon gasoline underground storage tanks (USTs) were installed at the site in the 1950s, and one 10,000-gallon gasoline UST was installed in the 1970s. Water was reported in the three smaller tanks, and as a result, the 4,000-gallon tank was taken out of service before 1984. A 200-gallon gasoline spill occurred in 1983 when new pumps were being installed.

DMI installed monitoring wells B-1 through B-4 in October 1984 prior to the removal of the on site USTs. After installation of well B-2, approximately 18 inches of floating product was measured in the well.

In April 1985, the four gasoline tanks were emptied of their contents and tank tightness tests were performed on the USTs. Two additional monitoring wells (B-5 and B-6) were also installed in 1985. Monitoring well B-7 was installed up gradient of the USTs on February 6, 1986 by DMI.

In October 1984, 1.5 feet of free product was observed in well B-2, however no free product was observed in wells B-1, B-3, and B-4. In May of 1985, free product was observed in wells B-2, B-3, and B-4 at thicknesses of 0.58 feet, 0.33 feet, and 0.41 feet, respectively. In February 1986, free product continued to be observed in wells B-2 and B-4, according to DMI's report "Observation Well Installation, Service Station Property" dated March 5, 1986.

According to DMI's "Project Report Construction Management for Remedial Action Work (Phase V)", dated March 3, 1987, all four gasoline USTs and a waste oil UST (Plate 2) were removed from the site in April and May 1986. Prior to backfilling with pea gravel, floating product was skimmed from the surface of the water contained in the excavation to a thickness of 0.25 inches, and a geotextile liner was placed above the gravel. Two sloped collector trenches were excavated to drain groundwater back to the UST excavation.

Five standpipes (SPA, SPB, SPC, SPD, and SPG) were also installed in the trenches during backfilling activities. Additionally, recovery well RW-1 (now replaced by well EW-1) was installed near the center of the UST excavation.

In April 1989, DMI supervised the drilling and sampling of nine borings (HP-1, HP-2, HP-3, HP-6 through HP-9, HP-10A, and HP-11A) to characterize the off site groundwater contamination. The results of the investigation were presented in DMI's report dated May 5, 1989.

In January 1993, a groundwater remediation system designed by DMI was constructed by Brunsing Associates, Inc. (BAI). The remediation system consisted of groundwater extraction from well EW-1, with treatment by activated carbon.

A site investigation was conducted on December 13, 1996, and the investigation results were presented in BAI's "Soil and Groundwater Investigation Report," dated February 10, 1997. During that investigation, three off site soil borings (OSB-1, OSB-2, and OSB-4) and one on site soil boring (OSB-3) were drilled.

Further site work was conducted in November and December 1997, and presented in BAI's "Soil and Groundwater Investigation and Quarterly Groundwater Monitoring Report," dated March 20, 1998. As part of the investigation, six soil borings (OSB-5 through OSB-10) were advanced off site to define the lateral extent of contamination on adjacent properties. Furthermore, a groundwater monitoring well (MW-1) was installed in the down-gradient direction, in South Delaware Street.

In a San Mateo County Health Department (SMCHD) letter dated March 24, 1998, the agency requested submittal of a feasibility study (FS) to discuss remedial options and to make recommendations for site cleanup. A soil vapor extraction (SVE) pilot study was performed in April 1998, prior to the preparation of the FS.

BAI completed the FS dated July 1, 1998, with an addendum dated August 4, 1998. The estimated mass of contaminants remaining was approximately 1,000 pounds, with a significant portion of the contaminants being located below the water table. The FS included a domestic well survey, the results of the soil vapor extraction pilot test, and a recommendation for site cleanup using soil vapor and groundwater extraction combined with air sparging. The domestic well survey did not identify any domestic wells within a 600-foot radius, but did identify the adjacent surface water drainage ditch as a potential sensitive receptor.

In the SMCHD letter dated July 9, 1998, the agency concurred with the recommendations and requested submittal of a remedial action plan for this option. BAI completed the Remedial Action Workplan (RAP), dated November 9, 1998, which included design specifications and construction details for soil vapor and groundwater extraction combined with air sparging. The workplan was approved by the SMCHD in their correspondence dated November 19, 1998.

The construction phases of the RAP occurred concurrently with re-development of the site from a service station to a car wash. In October 1999, BAI installed five dual-phase soil vapor extraction/air sparge wells (DSP-1 through DSP-5); four sparge wells (SP-1 through SP-4), and replaced extraction well RW-1 with extraction well EW-1.

In 2000, the soil vapor and groundwater treatment system was installed, which included plumbing to the new extraction/sparge wells, a pneumatic pump in well EW-1, an air compressor, a regenerative blower, an air stripper, two liquid phase carbon vessels and a catalytic oxidizer. Operation of the treatment system commenced on October 22, 2000.

On September 4, 2001, monitoring well MW-2 was installed in a cross gradient direction in South Delaware Street, as proposed in the Remedial Action Plan. Installation of well MW-2 was documented in a report dated October 12, 2001.

In December 2002, the remedial system was shut down to perform modifications on the system. The modifications included increasing the capacity of the blower to a positive displacement blower from a regenerative blower in order to increase the vacuum supplied to the subsurface. The modification was due in part to problems associated with the highly brackish groundwater at the site. The modifications were completed and the system was restarted on September 17, 2003.

On February 20, 2003, BAI submitted a groundwater investigation workplan that proposed seven additional off site borings, a drainage ditch evaluation, and an updated sensitive receptor survey (SSR). The seven additional off site borings were proposed because the previous off site drilling was performed prior to the requirement to analyze samples for petroleum oxygenates and lead scavengers. The drainage ditch evaluation was proposed to determine if the adjacent drainage ditch was hydraulically connected to the site. The initial SSR was performed prior to the requirement to evaluate for conduits of water and vapor migration and surface waters, therefore the SSR was updated. Off site soil borings ASB-1 through ASB-6 were drilled on November 6, 2003 and April 19, 2004. The results are presented in BAI's report dated March 29, 2005.

The remediation system was operational until September 21, 2004 when the system was shut down while a site conceptual model for the site was prepared. In July and August 2004, BAI performed a series of minor system modifications to increase the influent vapor concentrations. These modifications included using dual-phase extraction to pull directly from wells B-3, B-4, and SPC. Extraction from wells B-3 and B-4 was relatively successful at increasing influent vapor concentrations.

BAI's "Site Conceptual Model" report, dated December 22, 2004, recommended several actions be performed prior to recommending any alterations to the current remediation system, including additional drilling to define the residual contamination, collection of data regarding the car wash inputs and outputs, collecting a sample of the car wash water to be analyzed for tert butyl alcohol (TBA) and general minerals, attempt to relocate monitoring well B-7, and evaluate if well B-1 extended into a deeper water bearing unit.

4.0 SITE ASSESSMENT

4.1 Site Location and Description

The site is located within a commercial/residential district in the City of San Mateo, California (Plate 1) at an approximate elevation of four feet above mean sea level. The site is a relatively flat, rectangular parcel, approximately 115 feet by 135 feet (Plate 2). It is bounded to the south by Garvey Way, to the east by South Delaware Street, to the west by the U.S. Post Office parking lot, and to the north by a drainage ditch. The site is presently occupied by a self-serve car wash facility. The site structure, which is located near the center of the property, contains four wash bays and a water recycling system. The floors of the wash bays are concrete slabs with a central sump connected to the recycling system. The remainder of the site is paved with asphalt, and slopes towards South Delaware Street. A soil and groundwater remediation treatment system compound is located in the western corner of the property. Groundwater elevations for August 2006 are shown on Plate 3.

Surrounding properties include an apartment complex to the west, a U.S. Post Office to the east, a Post Office parking lot to the south, and residential properties, across South Delaware Street to the north (Plate 2). The topography around the site gently slopes to the north. The nearest body of water is a drainage channel, located adjacent to the site on the north and west, in the general down gradient direction. A total of 20 monitoring, extraction, or sparge wells are currently installed on or near the site.

The site property surface is primarily paved asphalt and poured concrete. Near the perimeters of the property boundaries are landscaped planter box areas. The only enclosed structure on the site is storage room located near the center of the property.

4.2 Site Geologic and Hydrogeologic Conditions

Based on available boring logs, the lithology at the site and the nearby surrounding area consists primarily of interbedded, discontinuous layers of clay, silt, silty and gravelly sand, and gravel. The site is overlain generally by 1 to 2 feet of clay fill material. Below the fill material is 2 to 3 feet of brown to black clay (adobe). Below the clay, on the western side of the site is approximately 4 to 10 feet of sandy gravel and gravelly sand, which is underlain by sand and silty sandy clay. Gravel deposits have been reported in soil borings drilled to the north and northeast of the site, but not in the borings in South Delaware Street or on the eastern side of South Delaware Street. Boring logs were not available for most of the borings and wells drilled on the eastern portion of the site. Therefore, the lithologic deposits on the eastern side of the property are not well defined. Copies of boring logs for on-site borings are provided in Appendix F.

Based on the boring logs, the Conceptual Model Study concluded that the apparent spatial distribution of the gravel unit and the general lithology suggests a fluvial depositional environment, perhaps a meandering stream. The gravel lenses may be a point bar and the finer-grained deposits east of the site may represent overbank deposits or infilling of the stream channel after the channel was abandoned.

The former UST excavation and the western french drain appear to have intersected the gravel layer, whereas the eastern portion of the former UST excavation may intersect the finer-grained material.

4.3 Land and Water Use

It is our understanding that the site was a service station from approximately the 1950s until the USTs and dispensers were removed in 1986. The service station building operated as an automotive repair facility until the building was removed and replaced with the car wash facility in 1999.

There are no known groundwater supply wells on the site or in the vicinity (see Section 4.0). Water is supplied to the site by a municipal water supply system, and is discharged either through surface run-off or to the sanitary sewer. The adjacent drainage ditch flows easterly towards the San Francisco Bay.

5.0 RESULTS OF PREVIOUSLY CONDUCTED INVESTIGATIONS

5.1 Underground Storage Tanks Removal, Previous Soil Investigations

According to DMI's "Report of Geohydrological Consultation," dated November 20, 1984, one 4,000-gallon and two 3,000-gallon gasoline USTs were installed at the site in the 1950s, and one 10,000-gallon gasoline UST was installed in the 1970s. Water was reported in the three smaller tanks, and as a result, the 4,000-gallon tank was taken out of service before 1984. A 200-gallon gasoline spill occurred in 1983 when new pumps were being installed.

DMI installed monitoring wells B-1 through B-4 in October 1984 prior to the removal of the on site USTs. After installation of well B-2, approximately 18 inches of floating product was measured in the well.

In April 1985, the four gasoline tanks were emptied of their contents and tank tightness tests were performed on the USTs. Water and product levels were measured in the former gasoline tanks in February 1986 to determine whether seepage had occurred from the surrounding soil and groundwater. Two additional monitoring wells (B-5 and B-6) were also installed in 1985. Monitoring well B-7 was installed up gradient of the USTs on February 6, 1986 by DMI.

Based on BAI's file review of the DMI reports, no soil samples were collected during the drilling of wells B-1 through B-7 for laboratory chemical analyses; however, soil permeabilities and a sieve analyses were performed for samples from borings B-2 and B-7. In October 1984, 1.5 feet of free product was observed in well B-2; no free product was observed in wells B-1, B-3, and B-4. In May of 1985, free product was observed in wells B-2, B-3, and B-4 at thicknesses of 0.58 feet, 0.33 feet, and 0.41 feet, respectively. In February 1986, free product continued to be observed in wells B-2 and B-4, according to DMI's report "Observation Well Installation, Service Station Property" dated March 5, 1986.

According to DMI's "Project Report Construction Management for Remedial Action Work (Phase V)", dated March 3, 1987, all four gasoline USTs and a waste oil UST (Plate 2) were removed from the site in April and May 1986. The gasoline UST excavation was approximately 10 feet deep. Four to five feet of pea gravel was placed in the bottom of the excavation to facilitate backfill of the excavation below the water table.

Five standpipes (SPA, SPB, SPD, and SPG) were also installed by AMEC in the trenches during backfilling activities. Well B-2 was abandoned during the construction and replaced with standpipe SPC. SPF was installed with a drill rig after the excavation had been backfilled. Additionally, recovery well RW-1 (now replaced by well EW-1) was installed to a depth of 20 feet below ground surface (bgs) with a screened interval from 2 to 15 feet bgs near the center of the UST excavation. A pumping test on well EW-1 was also performed at this time. Pumping rates of 30 to 100 gallons per minute were observed to draw down water levels. Approximately 500 gallons of floating product and 2,000 gallons of water were removed during the excavation and pumping test activities.

In April 1989, DMI supervised the drilling and sampling of nine borings (HP-1, HP-2, HP-3, HP-4 through HP-6, HP-10A, and HP-11A) to characterize the off site groundwater contamination. The results of the investigation were presented in DMI's report dated May 5, 1989.

During a December 1996 investigation, three off site soil borings (OSB-1, OSB-2, and OSB-4) and one on site soil boring (OSB-3) were drilled. Groundwater samples were collected from each of the four soil borings, and soil samples were collected only from borings OSB-1, OSB-2, and OSB-3. No soil sample was collected from boring OSB-4 because the soil encountered in boring OSB-4 was saturated at approximately one foot bgs. Petroleum hydrocarbons were observed in the soil samples collected from borings OSB-2 from borings 4.5 feet bgs and OSB-3 at 4.5 feet bgs, but were not observed in the soil samples collected from OSB-1 at 8 feet bgs and OSB-2 at 10.5 feet bgs. Petroleum hydrocarbons were reported in all of the grab groundwater samples.

BAI conducted an investigation in November and December 1997, presented in BAI's "Soil and Groundwater Investigation and Quarterly Groundwater Monitoring Report," dated March 20, 1998. As part of the investigation, six soil borings (OSB-5 through OSB-10) were advanced off site to define the lateral extent of contamination on adjacent properties. Furthermore, a groundwater monitoring well (MW-1) was installed in the down-gradient direction, in South Delaware Street. The purpose of well MW-1 was to define the down-gradient extent of groundwater contamination.

BAI completed an FS dated July 1, 1998, with an addendum dated August 4, 1998. The estimated mass of contaminants remaining was approximately 1,000 pounds, with a significant portion of the contaminants being located below the water table. The FS included a domestic well survey, the results of the soil vapor extraction pilot test, and a recommendation for site cleanup using soil vapor and groundwater extraction combined with air sparging. The domestic well survey did not identify any domestic wells within a 600-foot radius, but did identify the adjacent ditch as a potential sensitive receptor.

On September 4, 2001, BAI installed monitoring well MW-2 in a cross gradient direction in South Delaware Street, as proposed in the remedial action plan. Installation of well MW-2 was documented in a report dated October 12, 2001. No soil samples were collected for analytical laboratory analyses due to the proximity of boring OSB-2.

On February 20, 2003, BAI submitted a groundwater investigation workplan that proposed seven additional off site borings, a drainage ditch evaluation, and an updated SSR. The seven additional off site borings were proposed because the previous off site drilling was performed prior to the requirement to analyze samples for petroleum oxygenates and lead scavengers. The drainage ditch evaluation was proposed to determine if the adjacent drainage ditch was hydraulically connected to the site. The initial SSR was performed prior to the requirement to evaluate for conduits of water and vapor migration and surface waters, therefore the SSR was updated. Off site soil borings ASB-1 through ASB-6 were drilled on November 6, 2003 and April 19, 2004.

5.2 Groundwater Monitoring

Groundwater monitoring has been performed at the site since June 1989. Due to the abundance of data, this section primarily focuses on total petroleum hydrocarbons (TPH) as gasoline, benzene, and methyl tert butyl ether (MTBE) concentrations. Historical groundwater analytical results for samples collected from monitoring wells and standpipes are included in Table 1. Groundwater elevation data is summarized in Table 2. Well construction details are included in Table 3. The locations of the wells are provided on Plate 2.

On October 9, 2006, groundwater samples were collected from wells MW-1, MW-2, B-5, and B-6, and standpipe SPC. In the sample collected from well B-5 on October 9, 2006, TPH as gasoline was reported at a concentration of 180 micrograms per liter (µg/l), benzene was reported at a concentration of 81.5 µg/l, and MTBE was reported at 10.4 µg/l. Historically, TPH as gasoline concentrations have decreased from 12,000 µg/l on June 20, 1989 to present concentrations. Benzene concentrations have decreased from 11,000 µg/l on June 20, 1989 to a low concentration of 13.8 µg/l on August 11, 2006. MTBE concentrations have generally decreased since the highest concentration of 80.5 was reported on March 14, 2002.

TPH as gasoline was reported in the sample collected on October 9, 2006 from well B-6 at a concentration of 530 µg/l, benzene was reported at a concentration of 347 µg/l, MTBE was reported at 12.5 µg/l. Historically, TPH as gasoline concentrations have ranged from 8,700 µg/l to 140 µg/l. Benzene concentrations have ranged from 8,500 µg/l on June 20, 1989 to 110 µg/l on April 30, 2003, and MTBE concentrations have ranged from 140 µg/l on March 20, 1996 to 11.3 µg/l on April 12, 2006.

In the sample collected on October 9, 2006 from standpipe SPC, TPH as gasoline was reported at a concentration of 620µg/l, benzene at 363 µg/l, ethylbenzene at 12.6 µg/l, and 1,2-DCA at 8.4 µg/l. TPH as gasoline concentrations have ranged from 12,000 µg/l on January 28, 2004 to 80 µg/l on January 29, 2003, benzene concentrations have ranged from 3,500 µg/l to 92.7 µg/l, and MTBE concentrations have ranged from 80 µg/l to <1 µg/l.

In the sample collected from monitoring well MW-2 on October 9, 2006, TPH as gasoline was reported at a concentration of 550 µg/l, benzene at 283 µg/l, MTBE at 12.1 µg/l. TPH as gasoline concentrations have ranged from 3,500 µg/l to 190 µg/l, benzene concentrations have ranged from 3,340 µg/l to 100 µg/l, and MTBE concentrations have ranged from 68 µg/l to 7.95 µg/l.

All analytes were reported as below reporting limits in the sample collected from well MW-1 on October 9, 2006. TPH as gasoline, benzene, and MTBE have not been reported in samples collected from well MW-1 since sampling commenced on January 4, 1998.

5.3 Remediation History and Performance

Prior to backfilling with pea gravel, floating product was skimmed from the surface of the water contained in the excavation to a thickness of 0.25 inches, and a geotextile liner was placed above the gravel. Two sloped collector trenches were excavated to drain groundwater back to the UST excavation. The trenches were excavated to approximately 8 to 10 feet bgs, in segments to prevent caving of the sides. To prevent infiltration of the fines, a geotextile filter fabric was used to line the trenches. The trenches were partially backfilled with 5 to 6.5 feet of washed river gravel, and the filter fabric was folded over the top of the gravel. Both the UST excavation and the trenches were backfilled and compacted to the surface with native soil that had been aerated to remove petroleum hydrocarbon contamination, and compacted. DMI's boring locations and as-built drawings for the excavation and trench areas (referred to herein as french drain) are included as Appendix A.

In January 1993, a groundwater remediation system designed by DMI was constructed by BAI. The remediation system consisted of groundwater extraction from well EW-1, with treatment by activated carbon. The water was to be discharged to the drainage ditch north of the site under a National Pollutant Discharge Elimination System (NPDES) permit. The system was started in October 1993 but failed to meet the NPDES discharge requirements for organics. After replacing the activated carbon units, the system was started in January 1994. At this time, the effluent sample failed the 96-hour fish bioassay (toxicity) and the treatment system was shut down.

BAI completed the "Remedial Action Workplan", dated November 9, 1998, which included air sparging. The workplan was approved by the SMCHSA in their correspondence dated November 19, 1998.

The construction phases of the remedial action plan occurred concurrently with re-development of the site, from a service station to a car wash. In October 1999, BAI installed five dual-phase soil vapor extraction/air sparge wells (DSP-1 through DSP-5); four sparge wells (SP-1 through SP-4), and replaced extraction well RW-1 with extraction well EW-1.

In 2000, the soil vapor and groundwater treatment system was installed, which included plumbing to the new extraction/sparge wells, a pneumatic pump in well EW-1, an air compressor, a regenerative blower, an air stripper, two liquid phase carbon vessels and a catalytic oxidizer. Operation of the treatment system commenced on October 22, 2000. Remediation reports have been submitted which provide the operational details of the remediation system design specifications and construction details for soil vapor and groundwater extraction.

In December 2002, the remedial system was shut down to perform modifications on the system. The modifications included increasing the capacity of the blower to a positive displacement blower from a regenerative blower in order to increase the vacuum supplied to the subsurface. The modification was due in part to problems associated with the highly brackish groundwater at the site. The modifications were completed and the system was restarted on September 17, 2003.

The remediation system was operational until September 21, 2004 when the system was shut down while a site conceptual model for the site was prepared. During the operational period, groundwater drawdown of approximately 1 to 2 feet in the vicinity of well EW-1 was generally observed. Vapor samples from the remedial system extracting from wells DSP-1 through DSP-5, and EW-1 did not show significant petroleum hydrocarbon recovery, and sparge wells were not used because of the concern for potential movement of hydrocarbon vapors in the subsurface along utility lines. In July and August 2004, BAI performed a series of minor system modifications to increase the influent vapor concentrations. These modifications included using dual-phase extraction to pull directly from wells B-3, B-4, and SPC. Extraction from wells B-3 and B-4 was relatively successful at increasing influent vapor concentrations. Only limited extraction was performed in well SPC because the system is not plumbed directly to the well, there were unusually high groundwater flow rates, and the chemistry of the extracted water was brackish. Analytical laboratory data from January and July 2004 data indicated that foaming and unexplainable elevated concentrations of TBA were occurring in several of the groundwater samples. As discussed in BAI's November 2, 2004 remediation report, a sample was collected from well SPC and the car wash water discharge to evaluate both samples for general minerals and the foaming agent methyl blue active substances (MBAS) on August 12, 2004. The results indicated that MBAS was observed in both the groundwater and car wash water at the site.

6.0 RBCA TIER II EXPOSURE ASSESSMENT

As site information is gathered and evaluated, ASTM RBCA guidance recommends classifying the site based on the urgency for response. The four possible site categories include: immediate, short-term, long-term, or no demonstrable threat to human health, safety, or sensitive environmental receptors. Once a site is classified, ASTM RBCA recommends appropriate initial response actions corresponding to each classification category. References are provided in Appendix G.

As described in previous sections, initial response at the site included removal and replacement of the former USTs and product piping, and excavation of impacted soils in the areas of the former USTs and product piping in an effort to remove soils containing petroleum constituents. The current site conditions indicate that the site does not pose an immediate or short-term threat to receptors. Based on available data, it appears that operating water supply wells are not present within a 500-foot radius of the site. However, since groundwater beneath the site has been impacted, the site would be classified under the ASTM RBCA scheme as potentially presenting a long-term threat. Therefore, the potential for a long-term threat from the site is evaluated in this tiered approach.

6.1 Potentially Exposed Populations

The site is located in a well-developed area of San Mateo and is surrounded by commercial and residential properties, including an apartment complex, a post office, single family dwellings, and a prominent roadway (Plate 3). A discussion of the land use is included in Section 4.1.

The site is currently used for commercial purposes, as an operating self-serve car wash. Potentially exposed populations at the site under current conditions are car wash workers who spend most of their time outdoors. There are no full time employees at the site. Customers are not included in this assessment due to their sporadic, short-term exposure and because their potential exposure would be less than that estimated for the car wash personnel.

There are no known construction or excavation activities ongoing at the site, although these activities could occur in the future. Future activities, such as construction of building(s) or underground utilities work, could feasibly bring a construction worker into contact with hydrocarbon-impacted soils at the site. Although exposure to construction workers would be of a short-term duration, hypothetical future construction workers are included in this evaluation.

Future land use of the property and surrounding area is not expected to change due to the current development in the area and the property's current commercial zoning; therefore, future receptors at the site are not expected to change. Since the zoning of the property is not expected to change from commercial to residential, a future resident on the site is not included in this evaluation.

The nearest off site building is an apartment complex located approximately 100 feet to the northwest. This property is expected to remain residentially zoned. The general direction of groundwater flow has historically ranged from northwest to northeast. The occupants of the apartment complex building are considered as the potentially, maximally exposed, off site population. The maximally potentially exposed population in the future for this off site property would continue to be an occupant of an apartment complex.

Other buildings are located further from the source than the buildings identified above. Because exposure concentrations decrease rapidly with distance, the risk to occupants in a building located further away from the site will be lower than the risk to occupants in the buildings identified above. Therefore, exposure and risk were not determined for occupants of buildings located at greater distances.

6.2 Potential Exposure Pathways

An exposure pathway is the course that a chemical takes from the hydrocarbon source to the exposed individual. An exposure pathway consists of the following elements:

- A source of chemical release to the environment (such as impacted soil or groundwater)
- An environmental transport medium (soil, groundwater, or air)
- A point of potential human contact with the hydrocarbon-impacted medium
- An exposure route (ingestion, inhalation, or dermal contact)

Each exposure pathway describes a unique mechanism by which a population may be exposed to the hydrocarbons at the site. For an exposure pathway to be complete, all four elements listed above must be present. Pathways that are incomplete, such as when a hydrocarbon compound is released but there is no potential contact with a receptor, are excluded from this evaluation.

Drinking water for the site and local area is supplied by the City of San Mateo. Although groundwater is impacted, there are no drinking water wells on site or within 500 feet of the site. All hydrocarbon-impacted soils and groundwater are located beneath the surface. Because of the asphalt and concrete surface coverings, current direct human exposure such as through ingestion or dermal contact to hydrocarbon-containing media is not likely. Although no future construction activities are planned for the property, should future construction or excavation take place, direct exposure to hydrocarbon-impacted soil and groundwater may occur.

Although vapors have never been reported in the interior of the on site building, the RBCA approach assumes vapors from hydrocarbon-impacted soil and groundwater beneath the site may migrate through the soils to the surface or into buildings. The potential receptor point on the site is inside the storage room, as this is the only enclosed structure at the site. Therefore, indoor air inhalation is not included in this evaluation. The potential exposure to surface vapors at the source by outdoor air inhalation would be greater than indoor air inhalation.

In summary, based on current site conditions and anticipated future conditions as described above, potentially completed exposure pathways evaluated include:

- Vapor transport from hydrocarbon-impacted soil and groundwater through the soil to the surface at the site (commercial exposure – outdoor air inhalation)
- Direct exposure by ingestion, inhalation, and dermal contact as a result of future on site excavation into hydrocarbon-impacted soil or groundwater (commercial exposure)
- Direct exposure by ingestion, inhalation, and dermal contact of soil, groundwater, and vapors by future off site receptors (residential exposure)

7.0 RBCA TIER II EVALUATION

A Tier II evaluation is a risk-based analysis applying the direct exposure values, established under a Tier I evaluation at the point(s) of exposure developed for a specific site. A Tier II evaluation is also used to develop values for potential indirect exposure pathways at the point(s) of exposure based on site specific conditions (ASTM E 1739-95 – reapproved 2002). The result of conducting a Tier II analysis is typically the development of SSTLs. The SSTLs are risk-based remedial action target levels for chemical(s) of concern for a particular site. As part of conducting a Tire II analysis, simple fate and transport equations and/or simple accepted models may be used in the development of SSTLs.

Predictive models are used to account for chemical attenuation with time and distance from the source and are usually characterized by the following:

- The models are relatively simple and are often algebraic or semi-analytical expressions
- Input to the model is limited to practical, attainable, site-specific data, or easily estimated quantities, such as soil bulk density and total porosity
- The models are based on descriptions of relevant physical and/or chemical interactions. These simple models may neglect certain mechanisms; however, this generally results in lower, more conservative SSTLs (i.e. assuming constant concentrations in the source area)
- The models involve some degree of uncertainty, but are based on assumptions that tend to over-estimate the predicted exposure risk and, therefore, are conservative and protective of human health and the environment

The approach taken and the specific equations applied in this Tier II evaluation are described in ASTM E 1739-95 – reapproved 2002. The attenuation factors calculated for vapor and groundwater transport by the model equations are applied in the SSTL calculations to account for dispersion, adsorption, and natural attenuation.

7.1 Exposure Equations and Assumptions

The equations and fate and transport modeling methods used to develop RBCA Tier II SSTLs for those pathways identified as potentially complete are included in Appendix B.

Workers at the site are assumed to be adults and weigh an average of 70 kilograms (kg). The workers at the site are assumed to work 8 hours each day for 250 days each year (USEPA, 1991a).

Both adults and children are considered residential receptors. The average adult's weight is assumed to be 70 Kg and a child's weight an average of 15 Kg until the age of 6 years, during which is the period of time he/she is most sensitive to exposure (USEPA, 1991a). Both adult and child receptors are assumed to breath 20 cubic meters a day (m^3/day) outdoors.

Averaging time (AT) is the time period over which the dose is averaged. For carcinogens, the biological response is described in terms of lifetime probabilities, and the average time is a 70-year lifetime (LT) (USEPA, 1991a). For chronic exposure to non-carcinogens, the AT is the time period over which the exposure occurs (equivalent to the exposure duration).

For the purpose of vapor transport modeling, the soil vapor concentration at the source is assumed to be in equilibrium with impacted soils. Values used for site-specific soil properties and chemical-specific properties are a combination of values determined by sampling and testing of samples collected from the site and assumed values. Based on the lithologic data for borings included in the source area, a silty clay soil type is used for characterization of impacted soils. For the water bearing unit, a hydraulic conductivity of 1 foot per day (ft/day) is assumed. The hydraulic gradient of 0.004 feet per foot used in this evaluation is based on the calculated groundwater gradient for data collected as part of groundwater monitoring at the site on April 12, 2006. The April 2006 groundwater flow map is included in BAI's "April 2006 Groundwater Monitoring Report and April through June 2006 Remediation Status Report", dated July 18, 2006.

Chemical specific information for benzene, toluene, ethylbenzene, and xylenes (BTEX), such as toxicity values, site specific concentrations used for this evaluation, and accepted risk levels are included in Appendix C. Since it is not practical to evaluate every compound present in a petroleum product to assess risk from a release, indicator chemicals are typically selected to characterize risk. Selection of indicator chemicals is dependent on consideration of exposure routes, concentrations, mobility, and known toxicological properties. BTEX constituents were selected for this Tier II analysis based on their mobility, volatility, and known toxicity characteristics.

Based on historical soil and groundwater data of samples collected from the site (Tables 4 through 7), the source area of contamination used for modeling purposes is the subsurface at the eastern edge of the property, adjacent to Garvey Way. For the purposes of this evaluation, the source area is designated as the subsurface soils from approximately 3 to 8 feet bgs, with the depth to the water-bearing unit and groundwater depth at approximately 8 feet bgs, and the lateral extent of impacted soils and groundwater (the source) extending approximately 150 feet in all directions, centered at a point between well EW-1, in the former UST excavation, and well B-5, in the location of the former pump islands. This source area designation was selected because the highest concentrations of hydrocarbon-impacted soil and groundwater samples were collected from this area, therefore, a conservative risk analysis would be produced based on the greatest impacted media at the site. Available data indicates that petroleum hydrocarbon concentrations outside of this area are significantly less.

The representative concentrations of BTEX constituents used in this Tier II analysis was determined by calculating the mean of BTEX concentrations reported in groundwater samples collected from on site monitoring wells MW-1, MW-2, B-5, and B-6, and standpipe SPC during the most recent sampling event (October 2006; Table 1). The time difference between the November 2005 shut-down and the October 2006 sampling event is assumed to be sufficient to evaluate the impact to groundwater contaminant concentrations when groundwater from the surrounding area (including possible off site sources) is not being drawn toward the extraction wells. The representative concentrations of BTEX constituents for hydrocarbon-impacted soils was determined by calculating the mean of BTEX concentrations reported in all soil samples collected from all borings.

8.0 RBCA TIER II SSTLs AND SCREENING RESULTS

The calculation tables and modeling summary tables used to calculate the RBCA Tier II SSTLs for air, soil, and groundwater are included in Appendix D. The calculated RBCA Tier II SSTLs for air, soil, and groundwater are included in Appendix E. As indicated on the SSTLs summary tables, most of the individual SSTL values calculated exceed their respective constituent residual saturation limits in soil or are greater than the water solubility of the pure substance in groundwater. This indicates that the COCs which fall into this category would not pose a risk at any concentrations under these exposure conditions.

The calculated SSTL for benzene in outdoor air as a result of volatilization from subsurface soil is greater than 1,400 milligrams per kilograms (mg/kg) at the source area based on the commercial use of the property (Appendix E). For residential receptors located approximately 100 feet away from the source, the benzene SSTL is 31 mg/kg. Based on reported historical soil analytical data for soil samples collected from within the source area, the maximum concentration of benzene reported in soil samples was 22 mg/kg (sample OSB-2 at 4.5 feet; Table 4). Therefore, the calculated SSTLs for benzene in outdoor air as a result of volatilization from subsurface soil are greater than the maximum concentration of benzene reported in the source soil and indicates that volatilization from subsurface soil does not pose a significant risk. Because the majority of the property surface is either asphalt or concrete, and the majority of soil contamination appears to be at depths greater than 15 feet bgs, surface soil inhalation, ingestion, and dermal contact does not pose a significant risk.

As with soil and vapor pathways discussed in this section, the SSTLs summary tables included in Appendix D indicate that most of the individual SSTL values calculated are greater than the water solubility of the pure substance in groundwater (Appendix E). This indicates that the COCs would not pose a risk at any concentrations under these exposure conditions.

The calculated benzene SSTL for ingestion of groundwater from the source area is 0.0029 milligrams per liter (mg/l), based on commercial use of the property, and for residential receptors located approximately 100 feet away from the source, the benzene SSTL is 3.0 mg/l (Appendix E). The analytical results of groundwater samples collected within the source area indicate the highest concentration of benzene reported in the groundwater samples collected in October 2006 was 0.363 mg/l (SPC sample; Table 1). Compared with the calculated SSTLs, the maximum concentration of benzene reported in groundwater collected from the source area is greater than the SSTL for groundwater ingestion at the source but less than the calculated SSTL for groundwater ingestion for residential receptors located approximately 100 feet away from the source. This indicates that the groundwater at the source area does pose a risk to receptors if ingested at the source area but does not pose a significant risk to receptors off site. Because no drinking water wells are located within at least 500 feet of the site, and all potable water to the area is supplied by the City of San Mateo, ingestion of groundwater from the source area is not likely.

The calculated SSTL for exposure to benzene in outdoor air as a result of volatilization from subsurface groundwater is 87 mg/l for receptors at the source area (Appendix E). For residential receptors located approximately 140 feet away from the source, the SSTL for exposure to benzene in outdoor air as a result of volatilization from subsurface groundwater is greater than 1,800 mg/l. Compared to the reported concentrations of benzene in groundwater samples collected within the source area, the calculated groundwater SSTLs for exposure due to benzene in outdoor air as a result of volatilization from subsurface groundwater are greater than the highest concentration of benzene reported in the source groundwater (o.363mg/l in SPC; Table 1) and, therefore, indicates that volatilization from subsurface groundwater does not pose a significant risk.

9.0 DISCUSSION

Based on the potential risk to human health and the environment from exposure to soil and groundwater containing petroleum hydrocarbon constituents, the RBCA Tier II evaluation indicates that the only pathway that poses a potential risk is exposure to benzene by direct ingestion of groundwater from the source area. Furthermore, the analysis indicates that potential health risks from the other petroleum hydrocarbon constituents (toluene, ethylbenzene, and xylenes) are not significant for the maximally exposed population on site and adjacent to the site. The potential risk through exposure at more distant locations or for less mobile petroleum hydrocarbon constituents are, therefore, also insignificant.

Compared to the groundwater analytical results for July 2005, prior to shutdown of the remediation system, the concentrations of TPH as gasoline, BTEX, and MTBE in well MW-1, MW-2, B-5, and B-6, and standpipe SPC in October 2006 have decreased or remained relatively stable.

Because of the residual concentrations of benzene in shallow groundwater, use of shallow groundwater at the site should be restricted to non-potable applications. Since a city water supply is available for consumptive use, this restriction should not pose a negative impact to current or future site use. Based on the results of this Risk Assessment there are no other significant risks of exposure due to residual soil or groundwater contamination beneath this site.

10.0 DISTRIBUTION

This document is being distributed to the parties listed below:

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TABLES

TABLE 1.
Groundwater Analytical Results
1620 South Delaware Street, San Mateo, California

Well/ Standpipe Number	Date Sampled	TPH as gasoline (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethylbenzene (µg/l)	Xylenes (µg/l)	MTBE* (µg/l)	1,2-di-chloroethane (µg/l)	tert-butyl alcohol (µg/l)
B-1	6/20/1989	<50	<0.5	<0.5	<0.5	<0.5	—	—	—
B-1	9/22/1989	<100	<0.3	<0.3	<0.3	<0.3	—	—	—
B-1	12/18/1989	<100	<0.3	<0.3	<0.3	<0.3	—	—	—
B-1	3/20/1996	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	6/21/1996	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	9/24/1996	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	12/12/1996	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	4/21/1997	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	7/11/1997	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	10/30/1997	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	5/5/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	8/4/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	12/11/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	7/29/1999	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	3/9/2000	**78**	**52**	<0.5	<0.5	<0.5	<5.0	—	—
B-1	6/22/2000	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	9/20/2000	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-1	12/21/2000	<50	<0.5	<0.5	<0.5	**1.0**	<5.0	—	—
B-1	4/4/2001	<50	<0.5	<0.5	<0.5	<0.5	<5.0	<0.5	<10
B-1	4/22/2005	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
B-1	Abandoned March 8, 2006								
B-3	6/20/1989	**112,000**	**23,000**	**700**	**3,600**	**11,000**	—	—	—
B-3	9/22/1989	**14,000**	**1,800**	**100**	**1,300**	**710**	—	—	—
B-3	12/18/1989	**53,000**	**2,900**	**80**	**1,400**	**620**	—	—	—
B-3	3/20/1996	**11,000**	**2,700**	**120**	**830**	**700**	**25**	—	—
B-3	6/21/1996	**30,000**	**1,300**	**210**	**1,200**	**1,100**	<125	—	—
B-3	9/24/1996	**27,000**	**570**	**210**	**750**	**590**	<100	—	—

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Well/ Standpipe Number	Date Sampled	TPH as gasoline (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethylbenzene (µg/l)	Xylenes (µg/l)	MTBE* (µg/l)	1,2-di-chloroethane (µg/l)	tert-butyl alcohol (µg/l)
B-3	12/12/1996	**20,000**	**260**	**230**	**480**	**410**	<125	—	—
B-3	4/21/1997	**16,000**	**1,100**	**89**	**630**	**540**	<50	—	—
B-3	7/11/1997	**8,000**	**300**	**66**	<10	**160**	<100	—	—
B-3	10/30/1997	**10,000**	**270**	**62**	**260**	**85**	<250	—	—
B-3	5/5/1998	**19,000**	**750**	**48**	**160**	**260**	**100**	—	—
B-3	8/4/1998	**6,300**	**320**	**34**	**110**	**46**	**110**	—	—
B-3	12/11/1998	**4,400**	**73**	**88**	**63**	**37**	**97**	—	—
B-3	7/29/1999	**8,900**	**110**	**60**	**41**	**46**	**190**	—	—
B-3	3/9/2000	**28,000**	**93**	**190**	<25	**120**	<250	—	—
B-3	12/5/2001	**2,500**	**2.93**	**1.02**	**432**	**2.26**	<1.0	<0.50	<10
B-3	3/14/2002	**13,000**	**11.3**	**8.75**	**737**	**9.45**	<5.0	<2.5	<50
B-3	6/26/2002	**3,800**	**6.59**	<2.5	**245**	<2.5	<5.0	<2.5	<50
B-3	9/4/2002	**8,300**	**4.59**	<2.5	**11.9**	<2.5	<5.0	<2.5	<50
B-3	1/29/2003	**12,000**	**17.3**	**0.620**	**98.0**	**2.91**	<1.0	<0.5	<10
B-3	4/30/2003	**2,600**	**25.3**	<2.5	**39.0**	<2.5	<5.0	<2.5	<50
B-3	7/29/2003	**4,800**	**44.9**	**2.50**	**24.3**	**4.03**	<5.0	<2.5	<50
B-3	10/16/2003	**2,500**	**1.69**	<0.50	<0.50	<0.50	**1.95**	**1.67**	<10
B-3	1/28/2004	**5,500**	**0.32**	<0.30	**5.1**	<0.50	<0.50	<0.50	<10
B-3	4/21/2004	**830**	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
B-3	7/14/2004	**770**	**5.78**	<0.50	<0.50	<0.50	<1.0	<0.50	<10
B-3	10/27/2004	**60**	**1.45**	<0.50	<0.50	<0.50	**3.46**	<0.50	<10
B-3	1/19/2005	**170**	**12.4**	<0.50	**3.38**	**1.92**	<1.0	<0.50	<10
B-3	4/26/2005	**290**	**106**	<0.50	**7.90**	<0.50	**9.47**	**3.30**	<10
B-3	7/27/2005	<50	**1.97**	<0.50	<0.50	<0.50	**5.35**	**1.57**	<10
B-3	10/24/2005	<50	<0.50	<0.50	<0.50	<0.50	**1.05**	**1.07**	<10
B-3	1/24/2006	<50	<0.50	<0.50	<0.50	<0.50	<1.0	**3.82**	<10
B-3	4/12/2006	<50	**2.01**	<0.50	<0.50	<0.50	**1.72**	**1.23**	<10
B-3	8/11/2006	<50	<0.50	<0.50	<0.50	<0.50	**4.40**	**4.40**	**24.4**

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B-4	6/20/1989	**23,300**	**21,000**	<50	<50	<50	—	—	—
B-4	9/22/1989	**1,000**	**9,300**	**10**	**22**	<3	—	—	—
B-4	12/18/1989	**12,000**	**8,900**	**6**	**31**	**1**	—	—	—
B-4	3/20/1996	**2,400**	**1,900**	**16**	**3.3**	**6.2**	**150**	—	—
B-4	6/21/1996	**1,900**	**1,400**	**8.3**	**3.1**	**5.1**	**110**	—	—
B-4	9/24/1996	**490**	**320**	**11**	**4.6**	**20**	**18**	—	—
B-4	12/12/1996	**1,600**	**840**	**10**	**2.4**	**4.8**	**90**	—	—
B-4	4/21/1997	**2,600**	**700**	**8.2**	**2.2**	**4.6**	**110**	—	—
B-4	7/11/1997	**1,100**	**890**	**10**	**4.8**	**14**	**50**	—	—
B-4	10/30/1997	**1,300**	**460**	**8.3**	**4.6**	**12**	**35**	—	—
B-4	5/5/1998	**1,700**	**830**	**7.5**	**1.6**	**3.2**	**100**	—	—
B-4	8/4/1998	**1,500**	**810**	**8.6**	<5.0	<5.0	**90**	—	—
B-4	12/11/1998	**1,300**	**700**	**8.3**	**2.0**	**3.7**	**95**	—	—
B-4	7/29/1999	**1,900**	**830**	**7.8**	**3.2**	**2.8**	**110**	—	—
B-4	3/9/2000	**1,000**	**400**	**8.4**	**1.3**	**2.7**	**82**	—	—
B-4	6/22/2000	**1,100**	**410**	**6.3**	**2.1**	**1.5**	**70**	—	—
B-4	9/20/2000	**850**	**270**	**13**	**5.0**	**17**	**41**	—	—
B-4	12/21/2000	**450**	**440**	**10**	<5.0	<5.0	77	—	—
B-4	4/4/2001	**656**	**184**	**0.912**	**1.02**	**2.73**	**55.1**	**25.5**	<100
B-4	12/5/2001	**940**	**363**	<2.5	<2.5	<2.5	**37.2**	**30.0**	<50
B-4	12/5/2001	**280**	**276**	<2.5	**10.3**	<2.5	**19.8**	**55.7**	**370**
B-4	3/14/2002	**2,300**	**1,250**	**9.30**	**12.9**	**11.9**	**32.3**	**46.2**	<50
B-4	6/26/2002	**1,000**	**372**	<5.0	<5.0	<5.0	**29.1**	**22.1**	<100
B-4	9/4/2002	**430**	**128**	<5.0	<5.0	<5.0	**33.5**	**23.9**	<100
B-4	1/29/2003	**620**	**68.3**	<2.5	<2.5	**2.80**	**31.4**	**18.3**	<50
B-4	4/30/2003	**680**	**111**	<2.5	<2.5	<2.5	**28.0**	**16.8**	<50
B-4	7/29/2003	**520**	**132**	<2.5	<2.5	<2.5	**31.2**	**24.8**	<50
B-4	10/16/2003	**2,500**	**1,380**	<2.5	**2.81**	<2.5	**37.6**	**51.3**	<50

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B-4	1/28/2004	**3,300** [A]	**790**	<15	<25	<25	**110** [B]	<25	<500
B-4	4/21/2004	**2,600**	**1,710**	<5.0	<5.0	<5.0	**56.4**	**53.6**	**1,100**
B-4	7/14/2004	**1,800**	**1,750**	**5.35**	<5.0	**7.03**	**36.4**	**47.6**	**1,770**
B-4	10/27/2004	**810**	**372**	<5.0	<5.0	<5.0	<10	**16.9**	<100
B-4	1/19/2005	**1,400**	**666**	**2.17**	<2.5	**3.26**	**25.0**	**31.8**	**165**
B-4	4/22/2005	**1,000**	**348**	<2.5	**9.33**	<2.5	**24.8**	**31.6**	**243**
B-4	7/27/2005	**1,000**	**482**	<2.5	**8.06**	<2.5	**23.0**	**31.2**	**177**
B-5	6/20/1989	**12,000**	**11,000**	<50	<50	<50	—	—	—
B-5	9/22/1989	**400**	**7,900**	**9**	**5**	**7**	—	—	—
B-5	12/18/1989	**6,000**	**4,700**	**3**	**13**	**2**	—	—	—
B-5	3/20/1996	**910**	**780**	**5.3**	<0.5	**1.6**	**65**	—	—
B-5	6/21/1996	**920**	**840**	**1.9**	**1.2**	**0.8**	**39**	—	—
B-5	9/24/1996	**670**	**640**	**0.6**	**0.8**	**1.0**	**22**	—	—
B-5	12/12/1996	**890**	**580**	**5.6**	<1.0	**1.5**	**46**	—	—
B-5	4/21/1997	**790**	**460**	**3.8**	**1.5**	**1.0**	**50**	—	—
B-5	7/11/1997	**420**	**220**	**2.5**	**1.2**	**0.7**	**24**	—	—
B-5	10/30/1997	**580**	**280**	**1.2**	**1.0**	**1.3**	**14**	—	—
B-5	5/5/1998	**1,500**	**1,500**	**5.8**	**1.3**	**1.1**	**67**	—	—
B-5	8/4/1998	**770**	**360**	**2.4**	**1.3**	**1.0**	**60**	—	—
B-5	12/11/1998	**670**	**570**	**1.0**	**0.92**	**0.90**	**30**	—	—
B-5	7/29/1999	**520**	**460**	**2.5**	**1.2**	**0.90**	**62**	—	—
B-5	3/9/2000	**870**	**430**	**3.5**	**1.6**	**1.5**	**57**	—	—
B-5	6/22/2000	**110**	**430**	**2.5**	<1.0	<1.0	**39**	—	—
B-5	9/20/2000	**600**	**330**	**3.0**	**1.9**	**6.6**	**38**	—	—
B-5	12/21/2000	**520**	**260**	**2.3**	<0.5	<0.5	**31**	—	—
B-5	4/4/2001	**320**	**112**	<0.5	<0.5	<0.5	<50.0	**73.6**	<100

TABLE 1.
Groundwater Analytical Results
1620 South Delaware Street, San Mateo, California

Well/ Standpipe Number	Date Sampled	TPH as gasoline (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethylbenzene (µg/l)	Xylenes (µg/l)	MTBE* (µg/l)	1,2-di-chloroethane (µg/l)	tert-butyl alcohol (µg/l)
B-5	12/5/2001	**520**	**397**	<13	<13	<13	**37.0**	**50.5**	**1,800**
B-5	3/14/2002	**320**	**330**	**43.5**	<25	**53.0**	**80.5**	**160**	<500
B-5	6/26/2002	**450**	**224**	<10	<10	<10	**32.5**	**40.2**	<200
B-5	9/4/2002	**600**	**559**	<10	<10	<10	**27.6**	**51.2**	<200
B-5	1/29/2003	**350**	**295**	<2.5	<2.5	<2.5	**19.7**	**25.5**	<50
B-5	4/30/2003	**130**	**56.4**	<2.5	<2.5	<2.5	**28.1**	**33.8**	<50
B-5	7/29/2003	**280**	**182**	<2.5	<2.5	<2.5	**30.3**	**50.6**	<50
B-5	10/16/2003	**180**	**61.3**	<2.5	<2.5	<2.5	**31.1**	**58.6**	<50
B-5	1/28/2004	**720**	**220**	<6.0	<10	<10	<10	**14**	<200
B-5	4/21/2004	**300**	**168**	<0.50	<0.50	<0.50	**3.25**	**7.04**	**282**
B-5	7/14/2004	**260**	**172**	<0.50	<0.50	<0.50	**9.01**	**21.2**	**205**
B-5	10/27/2004	**330**	**317**	<1.0	<1.0	<1.0	**9.90**	**17.7**	**179**
B-5	1/19/2005	**420**	**198**	<2.5	<2.5	<2.5	**8.12**	**18.7**	**67.5**
B-5	4/25/2005	**460**	**216**	<2.5	<2.5	<2.5	**13.5**	**21.0**	**133**
B-5	7/27/2005	**420**	**259**	<2.5	<2.5	<2.5	**10.8**	**18.9**	**93.2**
B-5	10/24/2005	<250	**18.8**	<1.0	<1.0	<1.0	**3.96**	**13.6**	<20
B-5	1/24/2006	**320**	**105**	<2.5	<2.5	<2.5	**14.5**	**33.8**	**106**
B-5	4/12/2006	**380**	**149**	<2.5	<2.5	<2.5	**7.04**	**15.7**	**64.0**
B-5	8/11/2006	<50	**13.8**	<1.0	<1.0	<1.0	**4.25**	**10.3**	<20
B-5	10/9/2006	**180**	**81.5**	<1.0	<1.0	<1.0	**10.4**	**26.8**	**46.9**
B-6	6/20/1989	**8,700**	**8,500**	<50	<50	<50	—	—	—
B-6	9/22/1989	**300**	**1,400**	**20**	**24**	**10**	—	—	—
B-6	12/18/1989	**3,000**	**2,100**	**11**	**21**	**10**	—	—	—
B-6	3/20/1996	**460**	**380**	**0.8**	<0.5	**0.6**	**140**	—	—
B-6	6/21/1996	**1,100**	**750**	**0.70**	**4.9**	**1.7**	**80**	—	—
B-6	9/24/1996	**1,200**	**1,100**	**0.8**	**5.8**	**2.4**	**49**	—	—

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B-6	12/12/1996	1,100	980	2.3	7.8	3.2	42	—	—
B-6	4/21/1997	760	660	<0.5	3.2	0.9	50	—	—
B-6	7/11/1997	<50	<0.5	<0.5	<0.5	<0.5	56	—	—
B-6	10/30/1997	560	290	<0.5	2.0	1.0	20	—	—
B-6	5/5/1998	1,900	1,100	2.6	6.3	2.2	130	—	—
B-6	8/4/1998	1,500	1,000	1.1	6.9	1.8	50	—	—
B-6	12/11/1998	710	520	<0.5	1.9	<0.5	22	—	—
B-6	7/29/1999	1,000	870	0.50	4.3	1.2	44	—	—
B-6	3/9/2000	2,000	1,000	1.7	3.1	1.2	38	—	—
B-6	6/22/2000	2,100	1,500	1.9	3.4	1.7	36	—	—
B-6	9/20/2000	2,200	1,600	3.0	3.5	6.3	35	—	—
B-6	12/21/2000	1,600	910	<3.0	5.7	<3.0	34	—	—
B-6	4/4/2001	1,800	870	<50.0	<50.0	<50.0	<500	<50.0	<1,000
B-6	12/5/2001	940	873	52.5	<25	105	125	90.5	<500
B-6	3/14/2002	3,000	3,000	<25	<25	<25	60.0	200	<500
B-6	6/26/2002	1,400	924	<10	<10	<10	39.9	73.2	<200
B-6	9/4/2002	950	1,080	<10	<10	<10	23.8	66.7	<200
B-6	1/29/2003	350	302	<2.5	<2.5	<2.5	19.0	29.7	<50
B-6	4/30/2003	140	110	<2.5	<2.5		15.9	22.3	<50
B-6	7/29/2003	750	618	2.56	<2.5	2.91	24.2	49.7	<50
B-6	10/16/2003	1,000	618	<2.5	<2.5	<2.5	14.4	38.7	<50
B-6	1/28/2004	1,900	490	<30	<50	<50	<50	<50	<1,000
B-6	4/21/2004	810	603	<2.5	<2.5	<2.5	17.8	38.5	366
B-6	7/14/2004	540	476	<2.5	<2.5	<2.5	17.5	26.1	360
B-6	10/27/2004	440	391	<2.5	<2.5	<2.5	15.4	27.8	165
B-6	1/19/2005	1,100	572	<2.5	2.11	<2.5	15.1	30.6	117

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B-6	4/25/2005	**1,300**	**604**	<2.5	<2.5	<2.5	**19.7**	**37.7**	**218**
B-6	7/27/2005	**750**	**475**	<5.0	<5.0	<5.0	**20.0**	**33.9**	<100
B-6	10/24/2005	<500	**344**	<5.0	<5.0	<5.0	**15.6**	**30.1**	<10
B-6	1/24/2006	**720**	**364**	<5.0	<5.0	<5.0	<10	**21.3**	<100
B-6	4/12/2006	<500	**124**	<5.0	<5.0	<5.0	**11.3**	**17.5**	<100
B-6	8/11/2006	**300**	**167**	<5.0	<5.0	<5.0	**16.7**	**23.3**	<100
B-6	10/9/2006	**530**	**347**	<2.5	<2.5	<2.5	**12.5**	**27.2**	**100**
B-7	6/20/1989	**9,500**	**8,600**	<50	<50	**350**	—	—	—
B-7	9/22/1989	<100	<0.3	<0.3	<0.3	<0.3	—	—	—
B-7	12/18/1989	<100	**1**	<0.3	<0.3	<0.3	—	—	—
B-7	3/20/1996	<50	**5.0**	**0.7**	<0.5	**0.7**	<5.0	—	—
B-7	6/21/1996	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-7	9/24/1996	<50	**4.5**	<0.5	<0.5	<0.5	<5.0	—	—
B-7	12/12/1996	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-7	4/21/1997	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-7	7/11/1997	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-7	10/30/1997	<50	**19**	<0.5	<0.5	<0.5	<5.0	—	—
B-7	5/5/1998	<50	**17**	<0.5	<0.5	<0.5	<5.0	—	—
B-7	8/4/1998	**110**	**5.1**	<0.5	<0.5	**1.8**	<5.0	—	—
B-7	12/11/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
B-7	7/29/1999	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
MW-1	1/4/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
MW-1	5/5/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
MW-1	8/4/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
MW-1	12/11/1998	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
MW-1	7/29/1999	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—

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MW-1	3/9/2000	<50	<0.5	<0.5	<0.5	<0.5	<5.0	—	—
MW-1	12/5/2001	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	3/14/2002	<50	<0.50	**1.60**	<0.50	**2.48**	<1.0	<0.50	<10
MW-1	6/26/2002	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	9/4/2002	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	1/29/2003	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	4/30/2003	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	7/29/2003	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	10/16/2003	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	1/28/2004	<50	<30	<30	<50	<50	<1.0	<50	<1,000
MW-1	4/21/2004	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1 [D]	7/14/2004	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	10/27/2004	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	4/12/2006	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	8/11/2006	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-1	10/9/2006	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
MW-2	12/5/2001	**3,500**	**3,340**	**17.8**	**40.8**	**50.7**	**68.0**	**123**	<300
MW-2	4/2/2002	**3,000**	**1,660**	<5.0	<5.0	**14.8**	**29.4**	**69.6**	<100
MW-2	6/26/2002	**2,000**	**1,150**	<2.5	<2.5	**5.00**	**23.9**	**53.5**	<50
MW-2	9/4/2002	**2,000**	**1,350**	<5.0	**9.10**	**11.2**	**11.3**	**55.1**	<100
MW-2	1/29/2003	**1,700**	**905**	<2.5	**5.46**	**11.6**	**17.3**	**36.8**	<50
MW-2	4/30/2003	**1,400**	**1,020**	<2.5	**2.85**	**6.00**	**23.9**	**43.9**	<50
MW-2	7/29/2003	**1,500**	**1,180**	**3.07**	**4.93**	**12.2**	**19.5**	**57.7**	<50
MW-2	10/16/2003	**1,100**	**713**	<5.0	<5.0	<5.0	**33.8**	**50.9**	<100
MW-2	1/28/2004	**3,100** [C]	**640**	<15	<25	<25	<25	**34**	<500

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MW-2	4/21/2004	**1,200**	**852**	<5.0	**5.66**	**11.1**	<10	**38.8**	**1,060**
MW-2 [D]	7/14/2004	**870**	**896**	<5.0	**7.35**	**14.4**	<10	**33.8**	**1,130**
MW-2	10/27/2004	**840**	**716**	<5.0	**4.07**	**5.34**	**7.95**	**34.9**	**576**
MW-2	4/12/2006	**640**	**516**	<2.5	**3.64**	**7.00**	**8.15**	**27.4**	**372**
MW-2	8/11/2006	**190**	**100**	<2.5	<2.5	<2.5	**11.9**	**18.0**	**45.5**
MW-2	10/9/2006	**550**	**283**	<2.5	<2.5	<2.5	**12.1**	**26.7**	**124**
SPB	6/22/2000	**450**	**4.5**	**6.0**	**0.85**	<0.5	<5.0	—	—
SPB	9/20/2000	**610**	**11**	**14**	<2.5	<2.5	<25.0	—	—
SPB	12/21/2000	**820**	**1.0**	**6.9**	<0.5	<0.5	<5.0	—	—
SPB	12/5/2001	**130**	**10.9**	<0.50	<0.50	**1.22**	<1.0	<0.50	<10
SPB	3/14/2002	**100**	**4.40**	**2.20**	<0.50	**1.35**	**8.05**	<0.50	<10
SPB	6/26/2002	**590**	**189**	<5.0	**32.7**	<5.0	**19.3**	**21.9**	<100
SPB	1/29/2003	**260**	**226**	**2.57**	**24.2**	**4.13**	<5.0	<2.5	<50
SPB	4/30/2003	**360**	**154**	<2.5	**17.4**	**4.15**	<5.0	<2.5	<50
SPB	7/29/2003	**370**	**30.0**	**3.02**	**4.49**	**6.95**	**10.6**	**10.5**	<50
SPB	10/16/2003	**180**	**3.98**	<2.5	<2.5	<2.5	**9.98**	**12.9**	<50
SPB	4/21/2004	**150**	<2.5	<2.5	<2.5	<2.5	**64.9**	**13.5**	<50
SPB	4/22/2005	**440**	**103**	<2.5	**13.0**	<2.5	**27.5**	**12.5**	<50
SPC (B-2)	3/20/1996	**4,900**	**770**	**30**	**360**	**420**	**18**	—	—
SPC	6/21/1996	**4,000**	**500**	**21**	**230**	**190**	**19**	—	—
SPC	9/24/1996	**4,900**	**2,100**	**22**	**160**	**46**	**50**	—	—
SPC	12/12/1996	**2,600**	**1,400**	**25**	**40**	**12**	**80**	—	—
SPC	4/21/1997	**2,300**	**430**	**26**	**88**	**25**	<50	—	—
SPC	7/11/1997	**2,900**	**1,100**	**22**	<5.0	**8.8**	<50	—	—
SPC	10/30/1997	**1,700**	**560**	**8.3**	**18**	**4.8**	**35**	—	—
SPC	5/5/1998	**1,000**	**43**	**15**	**15**	**2.8**	**23**	—	—

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SPC	8/4/1998	**8,000**	**3,500**	**51**	**91**	**45**	**75**	—	—
SPC	12/11/1998	**3,000**	**1,400**	**19**	**2.9**	**8.3**	**60**	—	—
SPC	7/29/1999	**4,500**	**2,400**	**21**	**58**	**28**	**76**	—	—
SPC	3/9/2000	**1,700**	**3.3**	**3.9**	<0.5	**2.1**	**8.7**	—	—
SPC	6/22/2000	**1,500**	**620**	**8.9**	**18**	<2.5	**45**	—	—
SPC	9/20/2000	**5,200**	**2,600**	**8.1**	**30**	<2.5	**80**	—	—
SPC	12/21/2000	**1,500**	**500**	**21**	**58**	**11**	<50.0	—	—
SPC	12/5/2001	**110**	**94.9**	<0.50	**10.3**	**2.05**	<1.0	<0.50	**80.5**
SPC	3/14/2002	**410**	**115**	**3.02**	**1.69**	**2.00**	**14.6**	**20.5**	<10
SPC	6/26/2002	**3,400**	**2,470**	**12.6**	**49.3**	<10	**24.0**	**48.6**	<200
SPC	1/29/2003	**80**	**78.5**	<2.5	**6.23**	**3.15**	<5.0	<2.5	<50
SPC	4/30/2003	**1,900**	**142**	<2.5	<2.5	<2.5	<5.0	<2.5	<50
SPC	7/29/2003	**180**	**108**	**5.16**	**6.91**	**13.0**	**13.0**	**14.1**	<50
SPC	10/16/2003	**4,100**	**3,380**	<10	**20.7**	<10	**46.5**	**80.3**	<200
SPC	1/28/2004	**12,000**	**2,500**	**33**	**410**	<50	<50	<50	<1,000
SPC	7/14/2004	**420**	**401**	<10	<10	<10	**39.2**	<10	<200
SPC	10/27/2004	**490**	**209**	<10	<10	<10	<20	<10	<200
SPC	1/19/2005	**640**	**108**	**4.87**	**2.71**	**2.64**	**18.0**	<2.5	<50
SPC	4/22/2005	**2,800**	**1,380**	**56.0**	**81.8**	**16.3**	**30.1**	**40.4**	<200
SPC	7/27/2005	**10,000**	**4,360**	**35.3**	**292**	**29.8**	**54.3**	**111**	**450**
SPC	10/24/2005	**2,700**	**1,850**	<10	**61.7**	<10	**31.2**	**51.8**	<200
SPC	1/26/2006	**4,400**	**1,780**	**176**	**72.6**	**39.7**	**34.6**	**46.8**	<200
SPC	4/12/2006	<250	**92.7**	**17.6**	**8.68**	**4.65**	**5.57**	**7.00**	<50
SPC	8/11/2006	**1,500**	**832**	<5.0	**51.5**	<5.0	**13.8**	**19.6**	<100
SPC	10/9/2006	**620**	**363**	<5.0	**12.6**	<5.0	<10	**8.40**	<10

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SPF	3/20/1996	**4,000**	**880**	**39**	**240**	**43**	**21**	—	—
SPF	6/21/1996	**2,800**	**710**	**29**	**130**	**27**	**19**	—	—
SPF	9/24/1996	**4,700**	**310**	**73**	**56**	**27**	**17**	—	—
SPF	12/12/1996	**3,400**	**520**	**40**	**180**	**33**	<50	—	—
SPF	4/21/1997	**3,500**	**540**	**40**	**220**	**22**	<50	—	—
SPF	7/11/1997	**460**	**78**	**13**	<0.5	**3.1**	<5.0	—	—
SPF	10/30/1997	**3,200**	**550**	**22**	**17**	**16**	**52**	—	—
SPF	5/5/1998	**1,600**	**120**	**20**	**53**	**4.2**	**31**	—	—
SPF	8/4/1998	**1,800**	**98**	**28**	**6.8**	**3.4**	**15**	—	—
SPF	12/11/1998	**230**	**2.3**	**15**	<0.5	**1.9**	**6.2**	—	—
SPF	7/29/1999	**1,100**	**83**	**24**	4.4	**4.0**	**14**	—	—
SPF	10/16/2003	**1,500**	**965**	<10	**10.3**	<10	**80.9**	<10	<200
SPF	4/22/2005	**3,100**	**1,310**	<25	**37.9**	<25	<50	<25	<500
SPG	6/22/2000	**110**	<0.5	**6.1**	<0.5	<0.5	<5.0	—	—
SPG	9/20/2000	**2,400**	**3.8**	**62**	**6.2**	**17**	<25	—	—
SPG	12/21/2000	**120**	**120**	**4.3**	<0.5	<0.5	**17**	—	—
SPG	4/25/2005	**55**	**10.0**	<0.50	<0.50	<0.50	**11.1**	**21.0**	**78.7**
SP-1	4/4/2001	<50	**1.95**	<0.5	<0.5	<0.5	<5.0	**4.67**	<10
SP-2	4/26/2005	**870**	**510**	<2.5	<2.5	<2.5	**26.8**	**86.1**	**545**
SP-4	4/25/2005	**2,700**	**1,480**	<5.0	**12.9**	<5.0	**57.1**	**43.0**	**722**
DSP-2 (SVE)	10/16/2003	<50	<0.50	<0.50	<0.50	<0.50	**1.56**	<0.50	<10
DSP-2 (SVE)	4/26/2005	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
DSP-2 (sparge)	4/4/2001	**848**	**377**	<5.0	<5.0	<5.0	<50.0	<5.0	<100
DSP-2 (sparge)	4/26/2005	**1,200**	**498**	<2.5	<2.5	<2.5	**16.4**	**26.8**	**525**

TABLE 1.
Groundwater Analytical Results
1620 South Delaware Street, San Mateo, California

Well/ Standpipe Number	Date Sampled	TPH as gasoline (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethylbenzene (µg/l)	Xylenes (µg/l)	MTBE* (µg/l)	1,2-di-chloroethane (µg/l)	tert-butyl alcohol (µg/l)
DSP-3 (SVE)	4/25/2005	<100	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<20
DSP-4 (SVE)	4/25/2005	**2,500**	**907**	<25	**312**	<25	<50	<25	<500
DSP-4 (sparge)	4/25/2005	<2,500	**1,880**	<25	<25	<25	<50	**66.3**	<500
DSP-5 (SVE)	10/16/2003	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<0.50	<10
DSP-5 (SVE)	4/22/2005	<250	<2.5	<2.5	<2.5	<2.5	<5.0	<25	<50
DSP-5 (sparge)	4/22/2005	**2,700**	**1,150**	**1.17**	**3.96**	**5.03**	**35.3**	**57.8**	**623**

Groundwater samples for March, June, and December 1989 collected and reported by Dames & Moore. Data included in Dames & Moore monitoring reports, dated May 5, 1988, August 2, 1989, and January 3, 1989

DSP (SVE) wells are screened from 2 to 5 feet bgs, and DSP (sparge) wells are screened from 11 to 12 feet bgs.

Laboratory dilution factor may increase reporting limit, see original data reports for dilution factors

Less than symbol indicates not detected at specified laboratory reporting limit

µg/l = micrograms per liter

MTBE = methyl tert butyl ether

TPH = total petroleum hydrocarbons

— = not analyzed

* after 2000, analyzed using EPA Test Method 8260 for petroleum oxygenates and lead scavengers, only those detected are listed

[A] result does not include MTBE component

[B] analytical report states "The reporting limits for this analysis are elevated due to sample foaming

[C] analytical report states "Results in the gasoline organics range are primarily due to a single unknown peak"

[D] based on analytical data it appears that samples MW-1 and MW-2 were mislabeled in the field. Data has been input as it appears appropriate

Di-isopropyl ether (DIPE) reported at 1.27 µg/l.

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	6/20/1989	101.14	3.57	97.57	North
B-3	6/20/1989	102.15	5.52	96.63	
B-4	6/20/1989	100.9	4.39	96.51	
B-5	6/20/1989	100.65	4.12	96.53	
B-6	6/20/1989	101.29	4.67	96.62	
B-7	6/20/1989	101.0	4.21	96.79	
B-1	9/22/1989	101.14	4.70	96.44	North-Northwest
B-3	9/22/1989	102.15	6.51	95.64	
B-4	9/22/1989	100.9	5.27	95.63	
B-5	9/22/1989	100.65	5.00	95.65	
B-6	9/22/1989	101.29	5.99	95.30	
B-1	12/18/1989	101.14	4.48	96.66	North-Northeast
B-3	12/18/1989	102.15	6.75	95.40	
B-4	12/18/1989	100.9	5.55	95.35	
B-5	12/18/1989	100.65	5.27	95.38	
B-6	12/18/1989	101.29	5.77	95.52	
B-7	12/18/1989	101.0	5.10	95.90	
B-2/SPC	3/20/1996	101.25	3.53	97.72	North
B-3	3/20/1996	102.15	4.53	97.62	
B-4	3/20/1996	100.9	3.22	97.68	
B-5	3/20/1996	100.65	2.82	97.83	
B-6	3/20/1996	101.29	3.57	97.72	
B-7	3/20/1996	101.0	2.81	98.19	
SPF	3/20/1996	100.43	2.72	97.71	
SPC	6/21/1996	101.25	4.81	96.44	North-Northeast
B-3	6/21/1996	102.15	5.79	96.36	
B-4	6/21/1996	100.9	4.50	96.40	
B-5	6/21/1996	100.65	4.23	96.42	
B-6	6/21/1996	101.29	4.92	96.37	
B-7	6/21/1996	101.0	4.26	96.74	
SPF	6/21/1996	100.43	3.98	96.45	
B-1	9/24/1996	101.14	4.83	96.31	North
SPC	9/24/1996	101.25	5.55	95.70	
B-3	9/24/1996	102.15	6.57	95.58	
B-4	9/24/1996	100.9	5.33	95.57	
B-5	9/24/1996	100.65	5.13	95.52	
B-6	9/24/1996	101.29	5.71	95.58	
B-7	9/24/1996	101.0	5.47	95.53	
SPF	9/24/1996	100.43	4.73	95.70	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
SPC	12/12/1996	101.25	4.96	96.29	North-Northwest
B-3	12/12/1996	102.15	5.86	96.29	
B-4	12/12/1996	100.9	4.65	96.25	
B-5	12/12/1996	100.65	4.38	96.27	
B-6	12/12/1996	101.29	5.10	96.19	
B-7	12/12/1996	101.0	4.26	96.74	
SPF	12/12/1996	100.43	4.13	96.30	
SPC	4/21/1997	101.25	5.00	96.25	North
B-3	4/21/1997	102.15	6.16	95.99	
B-4	4/21/1997	100.9	4.66	96.24	
B-5	4/21/1997	100.65	4.39	96.26	
B-6	4/21/1997	101.29	5.09	96.20	
B-7	4/21/1997	101.0	4.61	96.39	
SPF	4/21/1997	100.43	4.18	96.25	
SPC	7/11/1997	101.25	5.49	95.76	North-Northeast
B-3	7/11/1997	102.15	6.74	95.41	
B-4	7/11/1997	100.9	5.18	95.72	
B-5	7/11/1997	100.65	4.91	95.74	
B-6	7/11/1997	101.29	5.60	95.69	
B-7	7/11/1997	101.0	5.24	95.76	
SPF	7/11/1997	100.43	4.67	95.76	
B-1	10/30/1997	101.14	5.32	95.82	North
SPC	10/30/1997	101.25	6.14	95.11	
B-3	10/30/1997	102.15	7.32	94.83	
B-4	10/30/1997	100.9	5.90	95.00	
B-5	10/30/1997	100.65	5.70	94.95	
B-6	10/30/1997	101.29	6.31	94.98	
B-7	10/30/1997	101.0	5.88	95.12	
SPF	10/30/1997	100.43	5.35	95.08	
SPC	5/5/1998	101.25	3.99	97.26	North-Northwest
B-3	5/5/1998	102.15	5.01	97.14	
B-4	5/5/1998	100.9	3.56	97.34	
B-5	5/5/1998	100.65	3.25	97.40	
B-6	5/5/1998	101.29	4.07	97.22	
B-7	5/5/1998	101.0	3.33	97.67	
SPF	5/5/1998	100.43	3.17	97.26	
MW-1	5/5/1998	100.43	4.16	96.27	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
SPC	9/9/1998	101.25	5.37	95.88	North
B-3	9/9/1998	102.15	6.62	95.53	
B-4	9/9/1998	100.9	5.08	95.82	
B-5	9/9/1998	100.65	4.81	95.84	
B-6	9/9/1998	101.29	5.51	95.78	
B-7	9/9/1998	101.0	5.19	95.81	
SPF	9/9/1998	100.43	4.55	95.88	
MW-1	9/9/1998	100.43	5.69	94.74	
SPC	12/11/1998	101.25	5.45	95.80	North-Northwest
B-3	12/11/1998	102.15	6.50	95.65	
B-4	12/11/1998	100.9	5.05	95.85	
B-5	12/11/1998	100.65	4.77	95.88	
B-6	12/11/1998	101.29	5.51	95.78	
B-7	12/11/1998	101.0	4.51	96.49	
SPF	12/11/1998	100.43	4.61	95.82	
MW-1	12/11/1998	100.43	4.80	95.63	
B-1	7/29/1999	101.14	4.16	96.98	North
SPC	7/29/1999	101.25	5.23	96.02	
B-3	7/29/1999	102.15	6.39	95.76	
B-4	7/29/1999	100.9	4.91	95.99	
B-5	7/29/1999	100.65	4.64	96.01	
B-6	7/29/1999	101.29	5.34	95.95	
B-7	7/29/1999	101.0	5.22	95.78	
SPF	7/29/1999	100.43	4.40	96.03	
MW-1	7/29/1999	100.43	5.35	95.08	
B-3	3/9/2000	4.51	4.59	-0.08	Not Calculated
B-4	3/9/2000	3.54	3.27	0.27	
B-5	3/9/2000	2.97	2.77	0.20	
B-6	3/9/2000	3.61	3.43	0.18	
SPC	3/9/2000	3.60	nm		
MW-1	3/9/2000	3.00	3.30	-0.30	
B-1	6/22/2000	3.00	2.40	0.60	Not Calculated
B-3	6/22/2000	4.51	nm		
B-4	6/22/2000	3.54	4.65	-1.11	
B-5	6/22/2000	2.97	8.50	-5.53	
B-6	6/22/2000	3.61	4.70	-1.09	
SPB	6/22/2000	4.03	5.12	-1.09	
SPC	6/22/2000	3.60	4.68	-1.08	
SPG	6/22/2000	3.93	5.40	-1.47	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	9/20/2000	3.00	3.86	-0.86	Not Calculated
B-3	9/20/2000	4.51	nm		
B-4	9/20/2000	3.54	5.16	-1.62	
B-5	9/20/2000	2.97	4.63	-1.66	
B-6	9/20/2000	3.61	5.23	-1.62	
SPB	9/20/2000	4.03	5.65	-1.62	
SPC	9/20/2000	3.60	5.23	-1.63	
SPG	9/20/2000	3.93	5.90	-1.97	
B-1	12/21/2000	3.00	4.02	-1.02	North-Northwest to North-Northeast
B-3	12/21/2000	4.51	nm		
B-4	12/21/2000	3.54	6.11	-2.57	
B-5	12/21/2000	2.97	5.53	-2.56	
B-6	12/21/2000	3.61	6.20	-2.59	
SPB	12/21/2000	4.03	6.48	-2.45	
SPC	12/21/2000	3.60	6.04	-2.44	
SPG	12/21/2000	3.93	7.03	-3.10	
B-1	4/4/2001	3.00	2.53	0.47	Northwest to Northeast
B-3	4/4/2001	4.51	nm		
B-4	4/4/2001	3.54	4.43	-0.89	
B-5	4/4/2001	2.97	3.74	-0.77	
B-6	4/4/2001	3.61	4.46	-0.85	
SPB	4/4/2001	4.03	nm		
SPC	4/4/2001	3.60	nm		
SP-1	4/4/2001	3.37	4.53	-1.16	
DSP-2	4/4/2001	3.93	4.65	-0.72	
B-1	12/5/2001	3.00	2.87	0.13	Northwest to Northeast
B-3	12/5/2001	4.51	4.93	-0.42	
B-4	12/5/2001	3.54	4.14	-0.60	
B-5	12/5/2001	2.97	3.59	-0.62	
B-6	12/5/2001	3.61	4.14	-0.53	
SPB	12/5/2001	4.03	4.98	-0.95	
SPC	12/5/2001	3.60	3.95	-0.35	
SP-1	12/5/2001	3.37	nm		
SPF	12/5/2001	2.78	3.23	-0.45	
SPG	12/5/2001	4.32	4.76	-0.44	
DSP-2	12/5/2001	3.93	nm		
MW-1	12/5/2001	3.29	4.40	-1.11	
MW-2	12/5/2001	2.57	3.58	-1.01	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	3/14/2002	3.00	2.46	0.54	
B-3	3/14/2002	4.51	5.76	-1.25	
B-4	3/14/2002	3.54	4.57	-1.03	
B-5	3/14/2002	2.97	4.03	-1.06	
B-6	3/14/2002	3.61	4.79	-1.18	
SPB	3/14/2002	4.03	5.22	-1.19	Northeast
SPC	3/14/2002	3.60	4.79	-1.19	to
SP-1	3/14/2002	3.37	nm		Southwest
SPF	3/14/2002	2.78	3.96	-1.18	
SPG	3/14/2002	4.32	5.48	-1.16	
DSP-2	3/14/2002	3.93	nm		
EW-1	3/14/2002	4.56	5.72	-1.16	
SVE-1	3/14/2002	4.55	5.75	-1.20	
MW-1	3/14/2002	3.29	4.42	-1.13	
MW-2	4/2/2002	2.57	3.32	-0.75	
B-1	6/26/2002	3.00	3.41	-0.41	
B-3	6/26/2002	4.51	7.08	-2.57	
B-4	6/26/2002	3.54	5.64	-2.10	
B-5	6/26/2002	2.97	5.03	-2.06	
B-6	6/26/2002	3.61	5.66	-2.05	
SPB	6/26/2002	4.03	6.22	-2.19	Northeast
SPC	6/26/2002	3.60	5.83	-2.23	to
SP-1	6/26/2002	3.37	nm		Southwest
SPF	6/26/2002	2.78	5.03	-2.25	(inward)
SPG	6/26/2002	4.32	6.50	-2.18	
DSP-2	6/26/2002	3.93	nm		
EW-1	6/26/2002	4.56	6.82	-2.26	
SVE-1	6/26/2002	4.55	6.77	-2.22	
MW-1	6/26/2002	3.29	4.69	-1.40	
MW-2	6/26/2002	2.57	4.64	-2.07	
B-1	9/4/2002	3.00	4.11	-1.11	
B-3	9/4/2002	4.51	7.70	-3.19	
B-4	9/4/2002	3.54	7.15	-3.61	
B-5	9/4/2002	2.97	6.56	-3.59	
B-6	9/4/2002	3.61	7.24	-3.63	
SPB	9/4/2002	4.03	7.10	-3.07	North
SPC	9/4/2002	3.60	6.65	-3.05	to
SP-1	9/4/2002	3.37	nm		South
SPF	9/4/2002	2.78	6.89	-4.11	(inward)
SPG	9/4/2002	4.32	8.05	-3.73	
DSP-2	9/4/2002	3.93	nm		
EW-1	9/4/2002	4.56	9.51	-4.95	
SVE-1	9/4/2002	4.55	7.35	-2.80	
MW-1	9/4/2002	3.29	5.95	-2.66	
MW-2	9/4/2002	2.57	6.04	-3.47	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	1/29/2003	3.00	2.29	0.71	North to Northwest (outward)
B-3	1/29/2003	4.51	5.86	-1.35	
B-4	1/29/2003	3.54	4.69	-1.15	
B-5	1/29/2003	2.97	4.18	-1.21	
B-6	1/29/2003	3.61	4.75	-1.14	
SPB	1/29/2003	4.03	5.28	-1.25	
SPC	1/29/2003	3.60	4.77	-1.17	
SPF	1/29/2003	2.78	4.01	-1.23	
SPG	1/29/2003	4.32	5.46	-1.14	
EW-1	1/29/2003	4.56	5.82	-1.26	
SVE-1	1/29/2003	4.55	6.21	-1.66	
MW-1	1/29/2003	3.29	4.58	-1.29	
MW-2	1/29/2003	2.57	3.79	-1.22	
B-1	4/30/2003	3.00	1.88	1.12	Northeast to Northwest
B-3	4/30/2003	4.51	4.94	-0.43	
B-4	4/30/2003	3.54	3.81	-0.27	
B-5	4/30/2003	2.97	3.28	-0.31	
B-6	4/30/2003	3.61	3.93	-0.32	
SPB	4/30/2003	4.03	4.34	-0.31	
SPC	4/30/2003	3.60	3.96	-0.36	
SPF	4/30/2003	2.78	3.16	-0.38	
SPG	4/30/2003	4.32	4.65	-0.33	
EW-1	4/30/2003	4.56	4.95	-0.39	
SVE-1	4/30/2003	4.55	5.32	-0.77	
MW-1	4/30/2003	3.29	3.92	-0.63	
MW-2	4/30/2003	2.57	2.94	-0.37	
B-1	7/29/2003	3.00	3.31	-0.31	Northeast to Northwest
B-3	7/29/2003	4.51	5.91	-1.40	
B-4	7/29/2003	3.54	4.82	-1.28	
B-5	7/29/2003	2.97	4.31	-1.34	
B-6	7/29/2003	3.61	4.90	-1.29	
SPB	7/29/2003	4.03	5.34	-1.31	
SPC	7/29/2003	3.60	4.93	-1.33	
SPF	7/29/2003	2.78	4.18	-1.40	
SPG	7/29/2003	4.32	5.69	-1.37	
EW-1	7/29/2003	4.56	5.96	-1.40	
SVE-1	7/29/2003	4.55	6.33	-1.78	
MW-1	7/29/2003	3.29	4.79	-1.50	
MW-2	7/29/2003	2.57	3.93	-1.36	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	10/16/2003	3.00	3.54	-0.54	Towards Well EW-1
B-3	10/16/2003	4.51	7.34	-2.83	
B-4	10/16/2003	3.54	6.93	-3.39	
B-5	10/16/2003	2.97	6.29	-3.32	
B-6	10/16/2003	3.61	6.88	-3.27	
SPB	10/16/2003	4.03	6.83	-2.80	
SPC	10/16/2003	3.60	6.35	-2.75	
SPF	10/16/2003	2.78	6.65	-3.87	
SPG	10/16/2003	4.32	7.88	-3.56	
EW-1 (1)	10/16/2003	4.56	10.00	-5.44	
SVE-1	10/16/2003	4.55	7.60	-3.05	
MW-1	10/16/2003	3.29	5.75	-2.46	
MW-2	10/16/2003	2.57	5.79	-3.22	
B-1	1/28/2004	3.00	2.65	0.35	Towards Well EW-1
B-3	1/28/2004	4.51	6.92	-2.41	
B-4	1/28/2004	3.54	6.76	-3.22	
B-5	1/28/2004	2.97	6.20	-3.23	
B-6	1/28/2004	3.61	6.85	-3.24	
SPB	1/28/2004	4.03	6.51	-2.48	
SPC	1/28/2004	3.60	6.09	-2.49	
SPF	1/28/2004	2.78	6.60	-3.82	
SPG	1/28/2004	4.32	7.80	-3.48	
EW-1(1)	1/28/2004	4.56	10.00	-5.44	
SVE-1	1/28/2004	4.55	7.61	-3.06	
MW-1	1/28/2004	3.29	4.41	-1.12	
MW-2	1/28/2004	2.57	5.38	-2.81	
B-1	4/21/2004	3.00	2.69	0.31	Towards Well EW-1
B-3	4/21/2004	4.51	6.36	-1.85	
B-4	4/21/2004	3.54	6.59	-3.05	
B-5	4/21/2004	2.97	5.91	-2.94	
B-6	4/21/2004	3.61	6.67	-3.06	
SPB	4/21/2004	4.03	6.39	-2.36	
SPC	4/21/2004	3.60	5.92	-2.32	
SPF	4/21/2004	2.78	6.40	-3.62	
SPG	4/21/2004	4.32	7.59	-3.27	
EW-1(1)	4/21/2004	4.56	10.00	-5.44	
SVE-1	4/21/2004	4.55	7.38	-2.83	
MW-1	4/21/2004	3.29	4.62	-1.33	
MW-2	4/21/2004	2.57	nm		

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	7/14/2004	3.00	3.72	-0.72	Towards Well EW-1
B-3	7/14/2004	4.51	6.83	-2.32	
B-4	7/14/2004	3.54	nm		
B-5	7/14/2004	2.97	6.41	-3.44	
B-6	7/14/2004	3.61	6.82	-3.21	
SPB	7/14/2004	4.03	6.46	-2.43	
SPC	7/14/2004	3.60	6.02	-2.42	
SPF	7/14/2004	2.78	6.24	-3.46	
SPG	7/14/2004	4.32	7.68	-3.36	
EW-1(1)	7/14/2004	4.56	10.00	-5.44	
SVE-1	7/14/2004	4.55	7.49	-2.94	
MW-1(2)	7/14/2004	3.29	5.84	-2.55	
MW-2(2)	7/14/2004	2.57	5.33	-2.76	
B-1	10/27/2004	3.00	3.47	-0.47	Transitional Flow Regime -- Mounding in the Vicinity of Wells B-1, EW-1, and B-5
B-3	10/27/2004	4.51	6.19	-1.68	
B-4	10/27/2004	3.54	5.15	-1.61	
B-5	10/27/2004	2.97	4.15	-1.18	
B-6	10/27/2004	3.61	5.27	-1.66	
SPB	10/27/2004	4.03	5.52	-1.49	
SPC	10/27/2004	3.60	5.10	-1.50	
SPF	10/27/2004	2.78	4.34	-1.56	
SPG	10/27/2004	4.32	5.81	-1.49	
EW-1(1)	10/27/2004	4.56	5.43	-0.87	
SVE-1	10/27/2004	4.55	6.05	-1.50	
MW-1	10/27/2004	3.29	4.58	-1.29	
MW-2	10/27/2004	2.57	4.29	-1.72	
B-1	1/19/2005	3.00	1.74	1.26	Mounding in the Vicinity of Wells EW-1 and B-4
B-3	1/19/2005	4.51	5.94	-1.43	
B-4	1/19/2005	3.54	3.71	-0.17	
B-5	1/19/2005	2.97	3.90	-0.93	
B-6	1/19/2005	3.61	4.63	-1.02	
SPB	1/19/2005	4.03	5.21	-1.18	
SPC	1/19/2005	3.60	4.76	-1.16	
SPF	1/19/2005	2.78	3.97	-1.19	
SPG	1/19/2005	4.32	5.42	-1.10	
EW-1(1)	1/19/2005	4.56	5.13	-0.57	
SVE-1	1/19/2005	4.55	5.69	-1.14	
MW-1	1/19/2005	3.29	nm	nm	
MW-2	1/19/2005	2.57	nm	nm	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	4/21/2005	3.00	1.75	1.25	Northerly
B-3	4/21/2005	4.51	7.55	-3.04	
B-4	4/21/2005	3.54	5.53	-1.99	
B-5	4/21/2005	2.97	5.52	-2.55	
B-6	4/21/2005	3.61	5.90	-2.29	
SPB	4/21/2005	4.03	6.24	-2.21	
SPC	4/21/2005	3.60	5.83	-2.23	
SPF	4/21/2005	2.78	4.97	-2.19	
SPG	4/21/2005	4.32	6.58	-2.26	
EW-1[1]	4/21/2005	4.56	6.21	-1.65	
SVE-1	4/21/2005	4.55	6.76	-2.21	
MW-1	4/21/2005	3.29	nm	nm	
MW-2	4/21/2005	2.57	nm	nm	
DSP-2 SVE[3]	4/21/2005	3.93	2.20	1.73	
DSP-2 sparge[3]	4/21/2005	3.93	5.85	-1.92	
DSP-3 SVE[3]	4/21/2005	2.99	3.11	-0.12	
DSP-3 sparge[3]	4/21/2005	2.99	nm	nm	
DSP-4 SVE[3]	4/21/2005	2.64	1.96	0.68	
DSP-4 sparge[3]	4/21/2005	2.64	5.12	-2.48	
DSP-5 SVE[3]	4/21/2005	3.53	3.44	0.09	
DSP-5 sparge[3]	4/21/2005	3.53	6.00	-2.47	
SP-2	4/21/2005	2.99	5.24	-2.25	
SP-4	4/21/2005	2.36	4.99	-2.63	
B-1	7/27/2005	3.00	3.23	-0.23	Northerly
B-3	7/27/2005	4.51	6.56	-2.05	
B-4	7/27/2005	3.54	5.34	-1.80	
B-5	7/27/2005	2.97	4.88	-1.91	
B-6	7/27/2005	3.61	5.52	-1.91	
SPB	7/27/2005	4.03	6.16	-2.13	
SPC	7/27/2005	3.60	5.71	-2.11	
SPF	7/27/2005	2.78	4.94	-2.16	
SPG	7/27/2005	4.32	6.41	-2.09	
EW-1[1]	7/27/2005	4.56	6.07	-1.51	
SVE-1	7/27/2005	4.55	6.67	-2.12	
MW-1	7/27/2005	3.29	nm	nm	
MW-2	7/27/2005	2.57	nm	nm	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-1	10/24/2005	3.00	4.08	-1.08	Not Calculated
B-3	10/24/2005	4.51	6.88	-2.37	
B-4	10/24/2005	3.54	nm	nm	
B-5	10/24/2005	2.97	5.21	-2.24	
B-6	10/24/2005	3.61	5.78	-2.17	
SPB	10/24/2005	4.03	6.38	-2.35	
SPC	10/24/2005	3.60	5.95	-2.35	
SPF	10/24/2005	2.78	5.10	-2.32	
SPG	10/24/2005	4.32	6.63	-2.31	
EW-1[1]	10/24/2005	4.56	6.29	-1.73	
SVE-1	10/24/2005	4.55	6.90	-2.35	
MW-1	10/24/2005	3.29	nm	nm	
MW-2	10/24/2005	2.57	nm	nm	
B-1	1/24/2006	3.00	0.94	2.06	Not Calculated
B-3	1/24/2006	4.51	6.07	-1.56	
B-4	1/24/2006	3.54	nm	nm	
B-5	1/24/2006	2.97	3.94	-0.97	
B-6	1/24/2006	3.61	4.71	-1.10	
SPB	1/24/2006	4.03	5.37	-1.34	
SPC	1/24/2006	3.60	4.95	-1.35	
SPF	1/24/2006	2.78	5.66	-2.88	
SPG	1/24/2006	4.32	4.16	0.16	
EW-1[1]	1/24/2006	4.56	5.26	-0.70	
SVE-1	1/24/2006	4.55	5.89	-1.34	
MW-1	1/24/2006	3.29	nm	nm	
MW-2	1/24/2006	2.57	nm	nm	
B-3	4/12/2006	4.51	5.45	-0.94	South[5] 0.004 ft/ft
B-4	4/12/2006	3.54	nm	nm	
B-5	4/12/2006	2.97	3.44	-0.47	
B-6	4/12/2006	3.61	4.21	-0.60	
SPB	4/12/2006	4.03	4.88	-0.85	
SPC	4/12/2006	3.60	4.49	-0.89	
SPF	4/12/2006	2.78	4.69	-1.91	
SPG	4/12/2006	4.32	5.19	-0.87	
EW-1[1]	4/12/2006	4.56	4.84	-0.28	
SVE-1	4/12/2006	4.55	5.40	-0.85	
MW-1[4]	4/12/2006	3.45	3.84	-0.39	
MW-2[4]	4/12/2006	2.46	2.91	-0.45	

TABLE 2.
Groundwater Elevation Data
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Measured	Top of Casing Elevation	Depth to Groundwater (feet)	Groundwater Elevation	Predominant Flow Direction
B-3	8/11/2006	4.51	6.92	-2.41	North(5) 0.001 ft/ft
B-4	8/11/2006	3.54	nm	nm	
B-5	8/11/2006	2.97	5.00	-2.03	
B-6	8/11/2006	3.61	5.67	-2.06	
SPB	8/11/2006	4.03	6.23	-2.20	
SPC	8/11/2006	3.60	5.81	-2.21	
SPF	8/11/2006	2.78	5.00	-2.22	
SPG	8/11/2006	4.32	6.51	-2.19	
EW-1(1)	8/11/2006	4.56	6.25	-1.69	
SVE-1	8/11/2006	4.55	6.72	-2.17	
MW-1(4)	8/11/2006	3.45	5.55	-2.10	
MW-2(4)	8/11/2006	2.46	4.51	-2.05	
B-3	10/9/2006	4.51	nm	nm	North(5) 0.001 ft/ft
B-4	10/9/2006	3.54	nm	nm	
B-5	10/9/2006	2.97	4.49	-1.52	
B-6	10/9/2006	3.61	6.00	-2.39	
SPB	10/9/2006	4.03	5.56	-1.53	
SPC	10/9/2006	3.60	6.20	-2.60	
SPF	10/9/2006	2.78	4.37	-1.59	
SPG	10/9/2006	4.32	6.21	-1.89	
EW-1(1)	10/9/2006	4.56	5.62	-1.06	
SVE-1	10/9/2006	4.55	nm	nm	
MW-1	10/9/2006	3.45	4.90	-1.45	
MW-2	10/9/2006	2.46	4.50	-2.04	

Groundwater elevation data for March, June, and December 1989, collected and reported by Dames & Moore in their quarterly monitoring reports, dated May 5, 1988, August 2, 1989, and January 3, 1989

Groundwater elevations prior to 2000 were relative to an arbitrary benchmark of 100.0 feet. Wells were resurveyed to mean sea level on May 7, 2001 by R.W. Davis and Associates, Land Surveyors. Wells B-5 and SPF resurveyed by BAI to MSL on May 30, 2001 due to omission on May 7, 2001. Wells MW-1 and MW-2 surveyed on April 2, 2002 by R.W. Davis and Associates to MSL. Elevations beginning in March 2000 calculated using the 2001 and 2002 survey data

nm = not measured

MSL = mean sea level

(1) EW-1 is an operational groundwater extraction well within granular backfill placed in the overexcavation of the former tanks and french drain. The depth to groundwater reported for this well is assumed to be the depth to the top of the submersible pump at approximately 10 feet below the top of the well casing.

(2) Measurements for well MW-1 and MW-2 appear to have been mis-recorded in the field. Data has been input as it appears appropriate.

(3) DSP SVE wells are screened from 2 to 5 feet bgs and DSP sparge wells are screened from 11 to 12 feet bgs.

(4) Wells MW-1 and MW-2 were repaired on March 8, 2006, and re-surveyed by Bohley Consulting, Inc. on March 21, 2006

(5) Groundwater gradient and flow direction calculated from data from wells MW-1, MW-2, and B-6

TABLE 3.
Well Construction Details
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Installed	Installed by	Borehole Diameter (inches)	Total Borehole Depth (feet)	Screened Interval (feet)	Total Well Depth (feet)	Casing Diameter (inches)	Screen Slot Size (inches)	Casing Elevation (ft, MSL)	Existing or Abandoned
B-1*	Oct-84	Dames and Moore	-	-	-	-	-	-	3.00	Existing
B-2*	Oct-84	Dames and Moore	-	-	-	-	-	-	-	Abandoned
B-3*	Oct-84	Dames and Moore	-	-	-	15	2	-	4.51	Existing
B-4*	Oct-84	Dames and Moore	-	-	-	12	2	-	3.54	Existing
B-5*	1985	Dames and Moore	-	-	-	13	2	-	2.97	Existing
B-6*	1985	Dames and Moore	-	-	-	13	2	-	3.61	Existing
B-7*	2/6/1986	Dames and Moore	8	15	3.4 to 13	14	2	0.020	-	Can't Locate
SPA (SVE-1)**	Jul-86	AEMC	na	na	between 2.5 to 10 and 4 to 8	8 to 10	4	0.020	4.55	Existing
SPB**	Jul-86	AEMC	na	na	between 2.5 to 10 and 4 to 8	8 to 10	4	0.020	4.03	Existing
SPC**	Jul-86	AEMC	na	na	between 2.5 to 10 and 4 to 8	8 to 10	4	0.020	3.60	Existing
SPD**	Jul-86	AEMC	na	na	between 2.5 to 10 and 4 to 8	8 to 10	4	0.020	-	Abandoned
SPF**	Jul-86	AEMC	na	na	between 2.5 to 10 and 4 to 8	8 to 10	4	0.020	2.78	Existing
SPG**	Jul-86	AEMC	na	na	between 2.5 to 10 and 4 to 8	8 to 10	4	0.020	4.32	Existing
RW-1 (EW-1)	Jul-86	AEMC	14?	20	2 to 15	20	10	0.020	-	Abandoned
SP-1***	Oct-99	BAI	8	12	11 to 12	12	1	0.020	3.37	Existing
SP-2***	Oct-99	BAI	8	12	11 to 12	12	1	0.020	2.99	Existing
SP-3***	Oct-99	BAI	8	12	11 to 12	12	1	0.020	3.57	Existing
SP-4***	Oct-99	BAI	8	12	11 to 12	12	1	0.020	2.36	Existing

TABLE 3.
Well Construction Details
1620 South Delaware Street
San Mateo, California

Well/ Standpipe Number	Date Installed	Installed by	Borehole Diameter (inches)	Total Borehole Depth (feet)	Screened Interval (feet)	Total Well Depth (feet)	Casing Diameter (inches)	Screen Slot Size (inches)	Casing Elevation (ft, MSL)	Existing or Abandoned
DSP-1****	Oct-99	BAI	10	12	2 to 5 (4") and 11 to 12 (1")	12	4 and 1	0.020	4.35	Existing
DSP-2****	Oct-99	BAI	10	12	2 to 5 (4") and 11 to 12 (1")	12	4 and 1	0.020	3.93	Existing
DSP-3****	Oct-99	BAI	10	12	2 to 5 (4") and 11 to 12 (1")	12	4 and 1	0.020	2.99	Existing
DSP-4****	Oct-99	BAI	10	12	2 to 5 (4") and 11 to 12 (1")	12	4 and 1	0.020	2.64	Existing
DSP-5****	Oct-99	BAI	10	12	2 to 5 (4") and 11 to 12 (1")	12	4 and 1	0.020	3.53	Existing
EW-1	Oct-99	BAI	10	16	6 to 16	16	4	0.020	4.56	Existing
MW-1*	12/11/1997	BAI	8	16	5 to 15	15	2	0.020	3.29	Existing
MW-2*	9/4/2001	BAI	8	16	5 to 15	15	2	0.020	2.57	Existing

Wells were resurveyed on May 7, 2001 by R.W. Davis and Associates, Land Surveyors to MSL; Wells B-5 and SPF surveyed by BAI to MSL on May 30, 2001 due to omission on May 7, 2001. Well B-7 has not been found since site re-development

MSL = mean sea level

na = not applicable

* Monitoring well

** Standpipe in french drain

*** Sparge point

**** Dual sparge/SVE

TABLE 4. ANALYTICAL RESULTS FOR SOIL SAMPLES COLLECTED FROM BORINGS

1620 South Delaware Street
San Mateo, California

Boring Number	Sample Depth (feet bgs)	Date Sampled	TPH as gasoline (mg/kg)	Benzene (µg/kg)	Toluene (µg/kg)	Ethyl-benzene (µg/kg)	Xylenes (µg/kg)	MTBE (µg/kg)
OSB-1	8.0	12/13/1996	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
OSB-2	4.5	12/13/1996	**3,100**	**22,000**	**38,000**	**69,000**	**210,000**	<2,500
OSB-2	10.5	12/13/1996	< 1.0	**33**	<5.0	<5.0	<5.0	<50
OSB-3	4.5	12/13/1996	**420**	**630**	**2,600**	**13,000**	**48,000**	<1,500
OSB-5	8.5	11/19/1997	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
OSB-6	8.5	11/19/1997	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
OSB-7	8.5	11/19/1997	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
OSB-8	8.5	11/19/1997	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
OSB-9	8.5	1/22/2001	**170**	<50	**220**	**200**	**750**	<500
OSB-10	8.5	11/19/1997	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
MW-2	6.0	9/4/2001	< 1.0	<5.0	<5.0	<5.0	<5.0	na
MW-2	11.0	9/4/2001	< 3.0	**100**	<15	<15	<15	na
ASB-1	5.0	11/6/2003	< 1.0	<5.0	<5.0	<5.0	<5.0	**480**
ASB-1	10.0	11/6/2003	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
ASB-2	5.0	11/6/2003	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
ASB-2	10.0	11/6/2003	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
ASB-3	5.0	11/6/2003	< 1.0	<5.0	<5.0	<5.0	<5.0	<50
ASB-4	5.0	4/19/2004	**280**	<2,500	**11,600**	**6,020**	**34,600**	<2,500
ASB-4	10.0	4/19/2004	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0
ASB-5	5.0	4/19/2004	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0
ASB-6	5.0	4/19/2004	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0
ASB-7	5.0	12/7/2005	<1.0	**20.1**	<5.0	<5.0	<5.0	<5.0
ASB-7(A)	10.0	12/7/2005	<1.0	**82.1**	<5.0	<5.0	<5.0	<5.0
ASB-8	5.0	12/7/2005	<1.0	**18.2**	<5.0	<5.0	<5.0	<5.0
ASB-8 (B)	10.0	12/7/2005	<1.0	**172**	<5.0	<5.0	<5.0	**6.45**
ASB-9	5.0	12/7/2005	<1.0	**7.92**	<5.0	<5.0	<5.0	<5.0
ASB-9(C)	10.0	12/7/2005	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0
ASB-10	5.0	12/7/2005	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0
ASB-10	10.0	12/7/2005	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0
ASB-11	5.0	12/8/2005	**730**	<2,500	<2,500	**7,950**	**2,920**	<2,500
ASB-11	10.0	12/8/2005	< 1.0	**13.6**	<5.0	<5.0	<5.0	<5.0
ASB-12	5.0	12/7/2005	**210**	**2,360**	<1,000	**9,820**	<1,000	<1,000
ASB-12	10.0	12/7/2005	< 1.0	**84.4**	**6.22**	**30.0**	<5.0	<5.0
ASB-13	5.0	12/6/2005	<200	**2,150**	**5,490**	**1,570**	**7,960**	<1,000
ASB-13	10.0	12/6/2005	< 1.0	**5.60**	**6.39**	<5.0	**7.82**	<5.0
ASB-13	15.0	12/6/2005	< 1.0	**9.53**	**15.8**	<5.0	**12.7**	<5.0
ASB-14	5.0	12/6/2005	<130	**1,200**	**1,060**	**1,630**	**5,100**	<670
ASB-14	10.0	12/6/2005	< 1.0	**42.3**	<5.0	<5.0	<5.0	<5.0

TABLE 4. ANALYTICAL RESULTS FOR SOIL SAMPLES COLLECTED FROM BORINGS

1620 South Delaware Street
San Mateo, California

Boring Number	Sample Depth (feet bgs)	Date Sampled	TPH as gasoline (mg/kg)	Benzene (μg/kg)	Toluene (μg/kg)	Ethyl-benzene (μg/kg)	Xylenes (μg/kg)	MTBE (μg/kg)
ASB-15	5.0	12/6/2005	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0
ASB-15	10.0	12/6/2005	< 1.0	**56.8**	**44.2**	<5.0	<5.0	<5.0
ASB-16	5.0	12/6/2005	**570**	<2,500	<2,500	**14,600**	<2,500	<2,500
ASB-16	10.0	12/6/2005	< 1.0	<5.0	<5.0	<5.0	<5.0	<5.0

μg/kg = micrograms per kilogram
ND = not detected
bgs = below ground surface
na = not analyzed
< = not detected at given laboratory reporing limit
(A) = 1,2-dichloroethane reported at 11.0 μg/kg, tert-Butyl alcohol at 54.0 μg/kg
(B) = 1,2-dichloroethane reported at 7.56 μg/kg, tert-Butyl alcohol at 76.2 μg/kg
(C) = 1,2-dichloroethane reported at 6.89 μg/kg

TABLE 5.
ANALYTICAL RESULTS FOR GRAB GROUNDWATER SAMPLES COLLECTED FROM BORINGS AND DITCH
1620 South Delaware Street
San Mateo, California

Sample Number	Date Sampled	TPH as gasoline (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethyl-benzene (µg/l)	Xylenes (µg/l)	Methyl tert butyl ether [A] (µg/l)
Borings							
HP-1	4/17/1989	<50	**12**	**4.7**	**3.2**	**0.6**	na
HP-2	4/17/1989	<50	<0.5	**1**	**3**	<0.5	na
HP-3	4/18/1989	<50	<0.5	<0.5	<0.5	<0.5	na
HP-6	4/18/1989	<50	<0.5	<0.5	<0.5	<0.5	na
HP-7	4/18/1989	<50	<0.5	<0.5	<0.5	<0.5	na
HP-8	4/18/1989	**170,000**	**7,100**	**5,700**	**5,200**	**17,000**	na
HP-9	4/19/1989	<50	<0.5	<0.5	<0.5	<0.5	na
HP-10A	4/19/1989	**120**	**17**	<0.5	<0.5	**4.6**	na
HP-11A	4/20/1989	**50**	<0.5	**3**	**1**	**1**	na
OSB-1	12/13/1996	<50	<0.5	**1.4**	<0.5	<0.5	<5.0
OSB-2	12/13/1996	**14,000**	**3,100**	**190**	**340**	**1,100**	**66**
OSB-3	12/13/1996	**15,000**	**700**	**940**	**820**	**3,700**	<100
OSB-4	11/19/1997	**210**	**0.7**	**19**	**0.9**	**2.2**	<5.0
OSB-6	11/19/1997	<50	<0.5	<0.5	<0.5	<0.5	<5.0
OSB-8	11/19/1997	<50	<0.5	<0.5	<0.5	<0.5	<5.0
OSB-9	1/22/2001	**290**	<0.5	**1.4**	**19**	**1.3**	<5.0
ASB1-W	11/6/2003	<50	<6.0	<6.0	<10	<10	**570**
ASB2-W	11/6/2003	<50	< 0.30	< 0.30	<0.50	<0.50	<0.50
ASB3-W	11/6/2003	<50	**4.1**	< 0.30	<0.50	<0.50	**2.1** [B]
ASB4-W	4/19/2004	**21,000**	**1,290**	**1,910**	**187**	**849**	<50
ASB5-W	4/19/2004	<50	<0.50	<0.50	<0.50	<0.50	<1.0
ASB6-W	4/19/2004	<50	<0.50	<0.50	<0.50	<0.50	<1.0
ASB-7-W	12/7/2005	<50	**2.67**	<0.50	<0.50	<0.50	<1.0 [C]
ASB-11-W	12/8/2005	**2,400**	**87.4**	**9.65**	**113**	**112**	**42.5** [D]
ASB-12-W	12/7/2005	**4,300**	**370**	**6.51**	**114**	**6.76**	**8.11** [E]
ASB-13-W	12/6/2005	**27,000**	**2,680**	**4,570**	**543**	**2,530**	<50
ASB-14-W	12/6/2005	**20,000**	**7,820**	**315**	**341**	**403**	**26.0** [F]
ASB-15-W	12/6/2005	**450**	**123**	**81.1**	<0.50	**8.13**	<1.0
ASB-16-W	12/6/2005	**5,100**	**387**	**2.58**	**443**	**4.81**	<5.0

TABLE 5.
ANALYTICAL RESULTS FOR GRAB GROUNDWATER SAMPLES COLLECTED FROM BORINGS AND DITCH
1620 South Delaware Street
San Mateo, California

Sample Number	Date Sampled	TPH as gasoline (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethyl-benzene (µg/l)	Xylenes (µg/l)	Methyl tert butyl ether [A] (µg/l)
Drainage Ditch							
C1-U	11/6/2003	<50	< 0.30	< 0.30	<0.50	<0.50	<0.50
C1-D	11/6/2003	<50	< 0.30	< 0.30	<0.50	<0.50	<0.50

Data for HP borings collected by Dames and Moore
µg/l = micrograms per liter
bgs = below ground surface
na = not analyzed
< = not detected at given laboratory reporing limit
[A] Analyzed for petroleum oxygenates and lead scavengers; only those detected are listed
[B] 1,2-dicholorethane also reported at 2.5 µg/l
[C] 1,2-dicholorethane also reported at 3.68 µg/l
[D] 1,2-dicholorethane also reported at 20.6 µg/l
[E] 1,2-dicholorethane also reported at 8.28 µg/l
[F] 1,2-dicholorethane also reported at 82.1 µg/l

TABLE 6.

Metals and Anions Analytical Results for Drainage Ditch and Well Samples

1620 South Delaware Street
San Mateo, California

Sample Location	Date Sampled	Calcium (mg/l)	Iron (mg/l)	Potassium (mg/l)	Magnesium (mg/l)	Manganese (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Nitrate-Nitrogen (mg/l)	Sulfate as SO_4 (mg/l)
Wells										
DSP-2	10/16/2003	**400**	**5.3**	**370**	**990**	**13**	**4,300**	**12,000**	**270**	**2,000**
DSP-5	10/16/2003	**42**	**14**	**190**	**140**	**0.70**	**1,600**	**2,600**	**52**	**450**
Drainage Ditch										
C1-U	11/6/2003	**40**	**4.0**	**4.8**	**12**	**0.12**	**53**	**94**	**5.0**	**24**
C1-D	11/6/2003	**32**	**0.61**	**2.2**	**24**	**0.057**	**88**	**100**	**5.0**	**42**

mg/l = milligrams per liter
< = less than symbol indicates not detected at specified reporting limit

TABLE 7.

General Mineral Analytical Results for Drainage Ditch and Well Samples

1620 South Delaware Street

San Mateo, California

Sample Location	Date Sampled	Total Alkalinity (mg/l)	Carbonate Alkalinity (mg/l)	Bicarbonate Alkalinity (mg/l)	Hydroxide Alkalinity (mg/l)	Specific Conductivity µmhos/cm	Total Hardness (mg/l)	pH pH Units	TDS (mg/l)
Wells									
DSP-2	10/16/2003	**470**	<1.0	**470**	<1.0	**33,000**	**5,090**	**6.7**	**18,000**
DSP-5	10/16/2003	**750**	<1.0	**750**	<1.0	**9,600**	**700**	**7.7**	**4,900**
Drainage Ditch									
C1-U [A]	11/6/2003	**180**	<1.0	**180**	<1.0	**630**	**150**	**7.8**	**340**
C1-D [A]	11/6/2003	**220**	<1.0	**220**	<1.0	**820**	**180**	**6.9**	**440**

mg/l = milligrams per liter

TDS = total dissolved solids

µmhos/cm = micromhos per centimeter

< = less than symbol indicates not detected at specified reporting limit

[A] Also analyzed for TPH as gasoline, BTEX, petroleum oxygenates and lead scavengers; none reported

PLATES

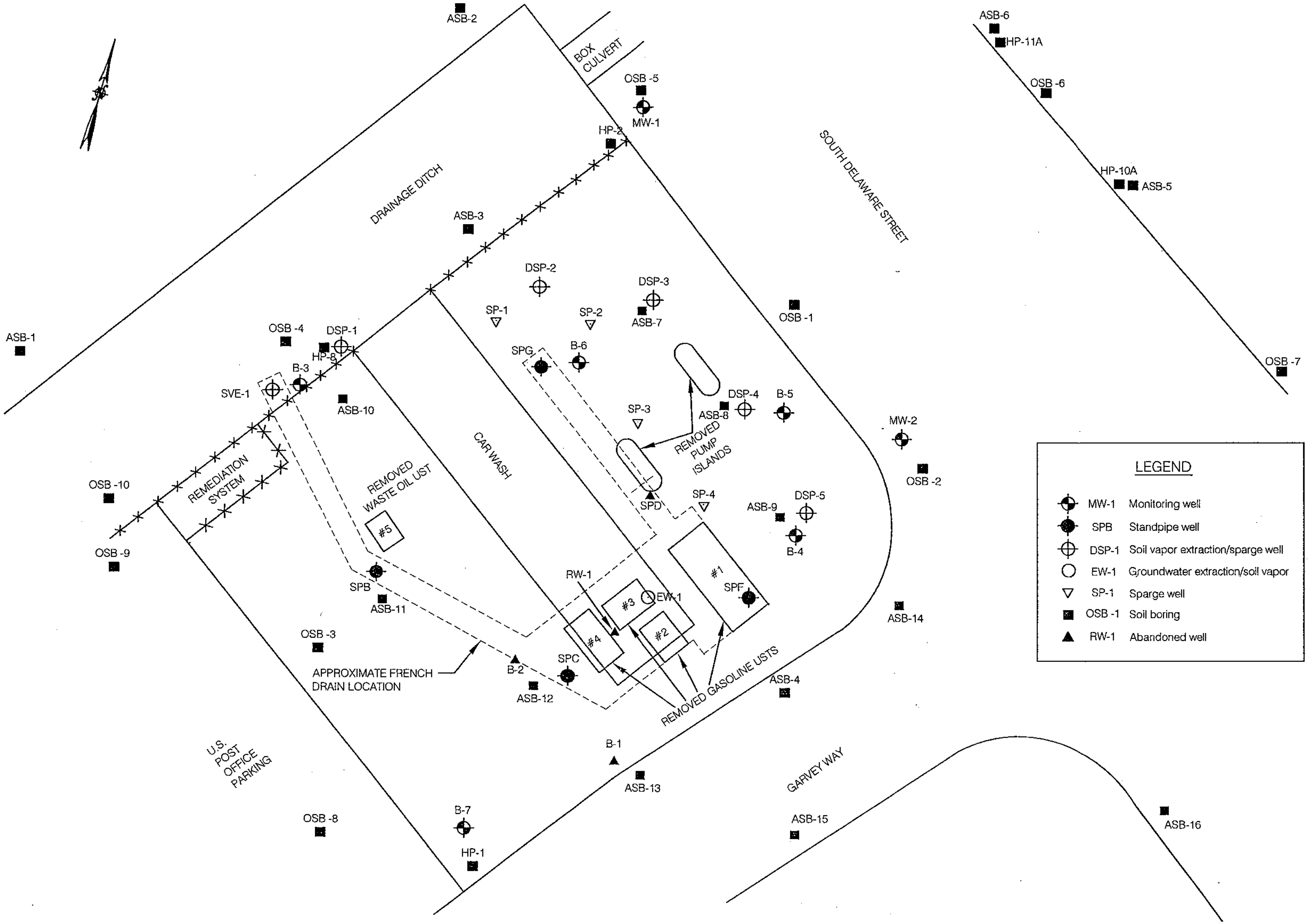
Mag 15.00
Wed Mar 24 16:27 2004

Scale 1:12,500 (at center)
1000 Feet
200 Meters

Secondary SR/Road/Hwy Ramp
State Route

NORTH

PROJECT NO.: 236			Brunsing Associates, Inc. P.O. Box 588 Windsor, California 95492	**PLATE 1** **Site Vicinity Map** 1620 South Delaware Street San Mateo, California
DRAWN BY:	SMS	3/24/04		
CHECKED BY:				
APPROVED BY:	[signature]	10/5/06		
REVISED:				



APPROXIMATE SCALE
(FEET)

0 12.5 25 50

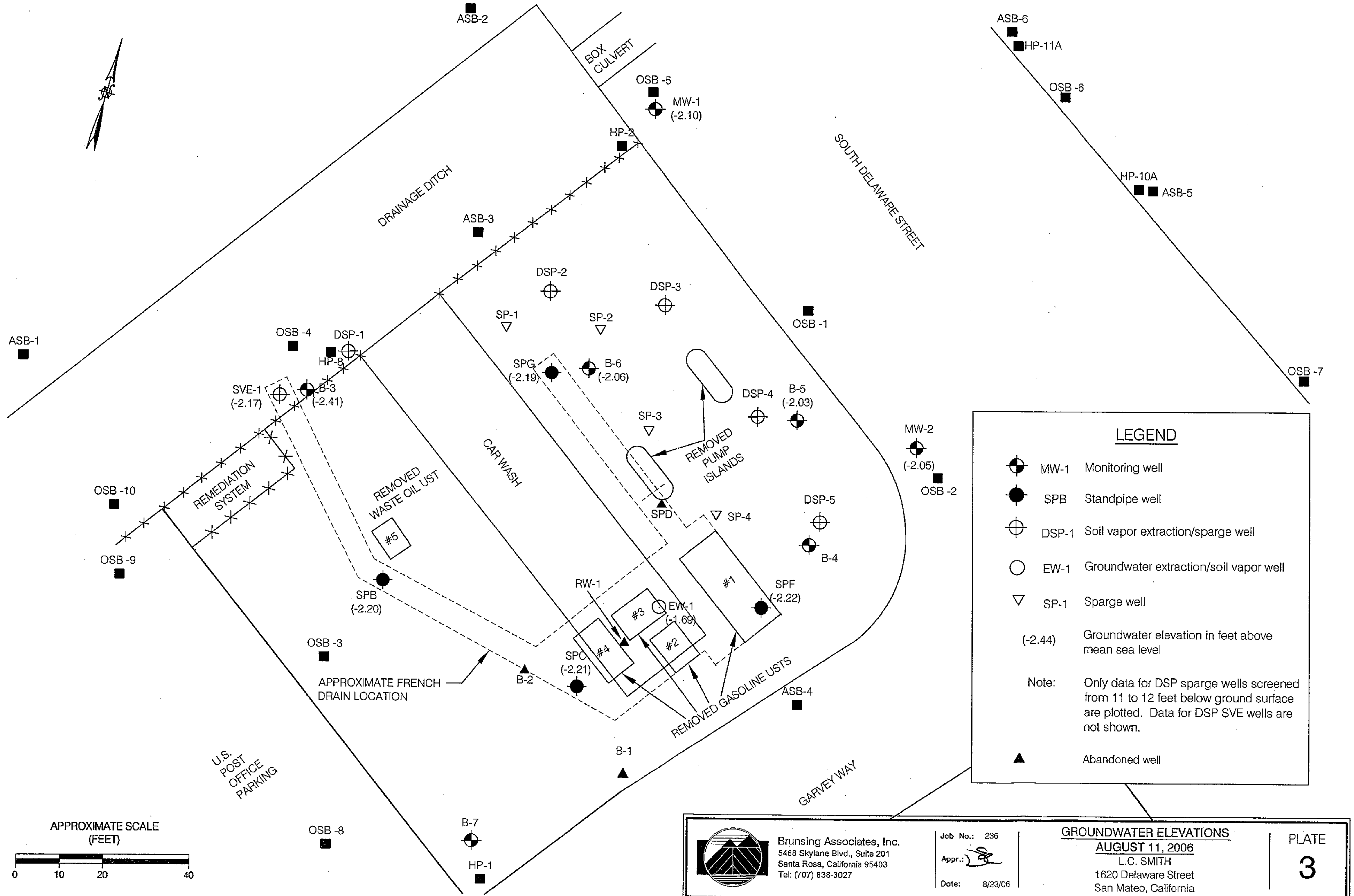
Reference: Well locations surveyed by R.W. Davis & Associates, 2001

Brunsing Associates, Inc.
5468 Skylane Blvd., Suite 201
Santa Rosa, California 95403
Tel: (707) 838-3027

Job No.: 236
Appr.: [signature]
Date: 2/16/06

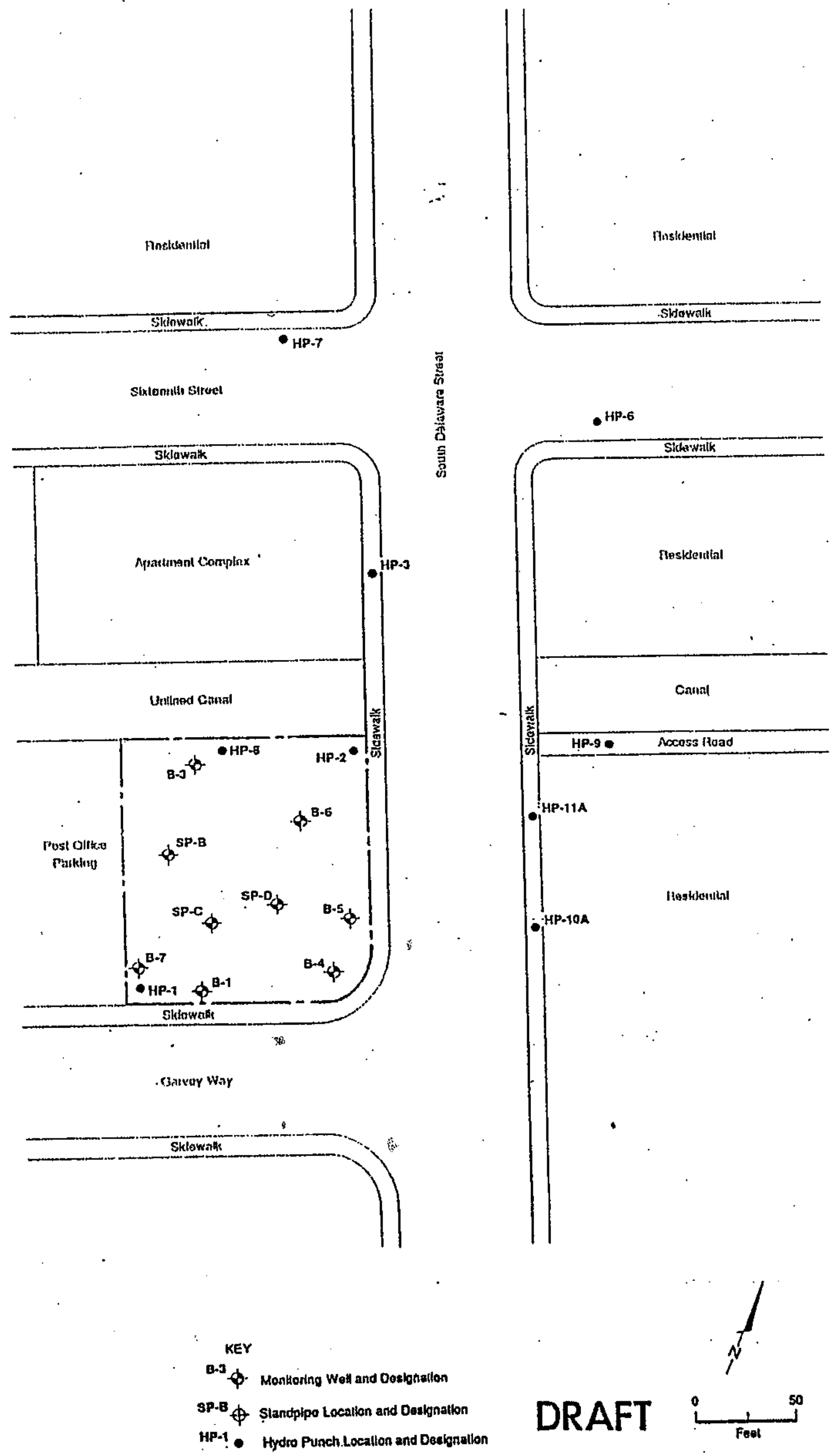
SITE MAP
L.C. SMITH
1620 South Delaware Street
San Mateo, California

PLATE
2


ASB-2
BOX CULVERT
OSB -5
MW-1 (-2.10)
HP-2
SOUTH DELAWARE STREET
ASB-6
HP-11A
OSB -6
HP-10A
ASB-5
OSB -7
DRAINAGE DITCH
ASB-3
DSP-2
DSP-3
SP-1
SP-2
OSB -1
ASB-1
OSB -4
DSP-1
HP-8
SPG (-2.19)
B-6 (-2.06)
SVE-1 (-2.17)
B-3 (-2.41)
DSP-4
B-5 (-2.03)
SP-3
REMOVED PUMP ISLANDS
MW-2 (-2.05)
OSB -2
CAR WASH
REMOVED WASTE OIL UST
#5
REMEDIATION SYSTEM
OSB -10
SPD
SP-4
DSP-5
B-4
OSB -9
SPB (-2.20)
RW-1
#3
EW-1 (-1.69)
#1
SPF (-2.22)
#4
#2
OSB -3
SPC (-2.21)
B-2
APPROXIMATE FRENCH DRAIN LOCATION
REMOVED GASOLINE USTS
ASB-4
B-1
U.S. POST OFFICE PARKING
GARVEY WAY
B-7
HP-1
OSB -8
APPROXIMATE SCALE (FEET)
0 10 20 40
LEGEND
MW-1 Monitoring well
SPB Standpipe well
DSP-1 Soil vapor extraction/sparge well
EW-1 Groundwater extraction/soil vapor well
SP-1 Sparge well
(-2.44) Groundwater elevation in feet above mean sea level
Note: Only data for DSP sparge wells screened from 11 to 12 feet below ground surface are plotted. Data for DSP SVE wells are not shown.
Abandoned well
Brunsing Associates, Inc.
5468 Skylane Blvd., Suite 201
Santa Rosa, California 95403
Tel: (707) 838-3027
Job No.: 236
Appr.:
Date: 8/23/06
GROUNDWATER ELEVATIONS
AUGUST 11, 2006
L.C. SMITH
1620 Delaware Street
San Mateo, California
PLATE
3

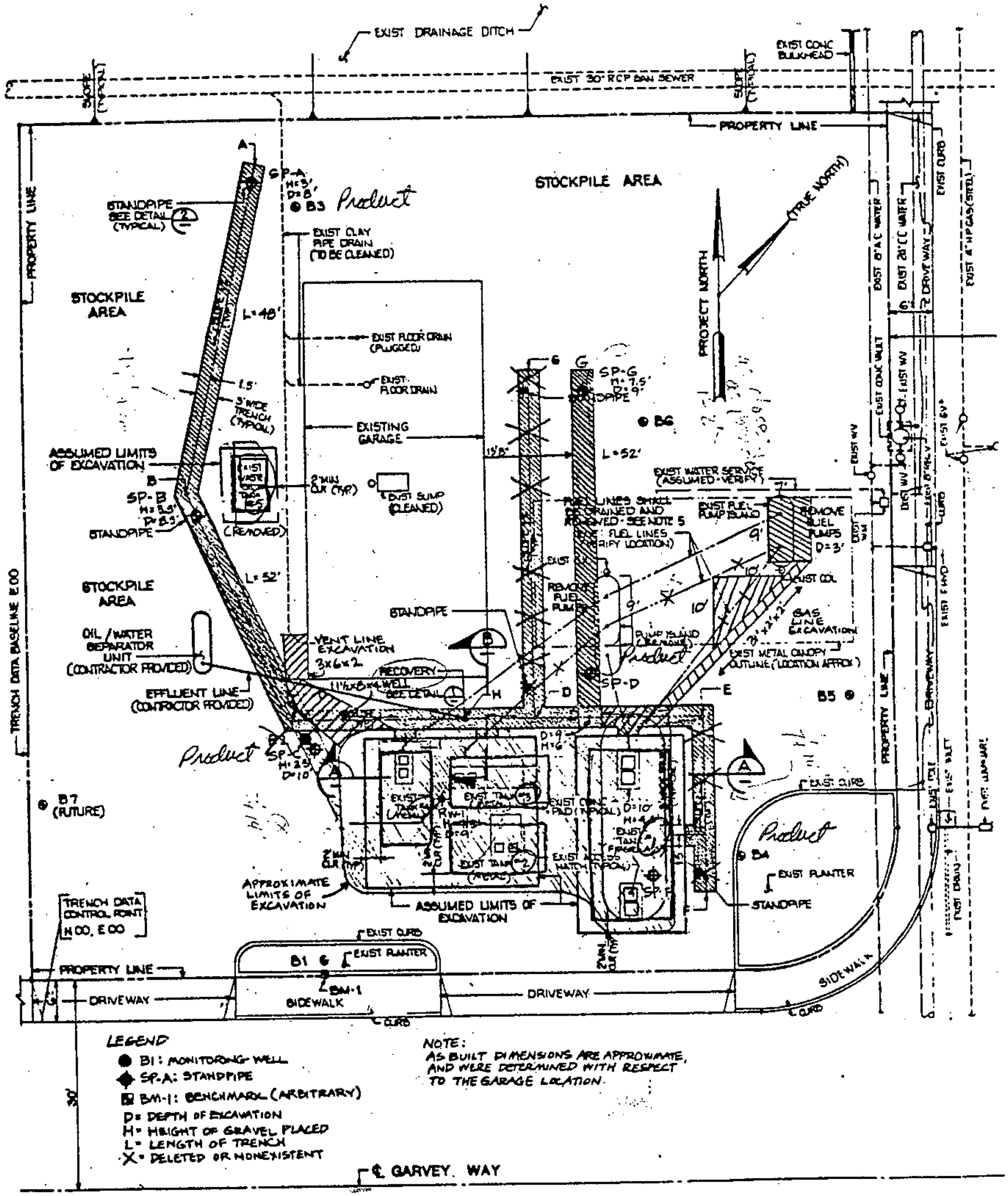
APPENDIX A

DMI Boring Locations



2626-027-043	Bank of California	GROUNDWATER SAMPLING LOCATIONS
Dames & Moore	1620 SOUTH DELAWARE STREET San Mateo, California	

PLATE 3



Source: "Bank of California, Gasoline Recovery System, Site at Garvey Way and South Delaware Street, San Mateo, California" Dames & Moore dwg. no. 02826-018--C-01, Issued for Bids 1/15/86.

apparent leak areas (from photos)

GASOLINE RECOVERY SYSTEM (AS-BUILT)

Dames & Moore

PLATE 3

APPENDIX B

RBCA Equations and Fate and Transport Modeling Methods

APPENDIX A: RISK-BASED SITE EVALUATION PROCESS

Overview of Risk Management Steps

Effective risk management at chemical release sites involves: i) identification of applicable risk factors on a site-specific basis; and ii) development and implementation of appropriate protective measures in the timeframe necessary to prevent unsafe conditions. Key elements of the risk-based site evaluation process include:

- ***Exposure Pathway Screening*:** Identify potential mechanisms for exposure of human or ecological receptors on a site-specific basis.
- ***Risk-Based Cleanup Objectives*:** For each complete exposure pathway, evaluate potential for exposure in excess of safe limits based on tiered evaluation of soil and groundwater cleanup limits.
- ***Remedy Selection*:** Develop risk-based exposure control strategy based on the nature and timing of the potential impact.
- ***Compliance Monitoring*:** If needed, conduct final compliance monitoring to confirm satisfactory remedy completion prior to formal case closure.

Further discussion of these process steps and relevant risk-based modeling tools is provided below.

Exposure Pathway Screening

The risk-based evaluation addresses the potential for constituent transport from the affected media source zone to a point of contact with a human or ecological receptor via various *exposure pathways.* For most remediation sites, the primary exposure pathways of human health concern are i) groundwater ingestion, ii) soil-to-groundwater release, and iii) soil ingestion, vapor inhalation, and dermal contact. Additional exposure pathways may apply based on site conditions and land use (e.g., surface water impacts, ecological exposures). To pose a risk, three components of each exposure pathway must be present: an affected source medium, a mechanism for constituent transport, and a receptor. In practical terms, exposure pathways may therefore be screened from further consideration based on the presence and mobility of the constituents of concern and the proximity of receptors to the source zone. For example, for an affected groundwater plume in a stable or diminishing condition, no potential exists for impacts on water supply wells located outside the current plume area.

Pathways determined to be potentially complete should be retained for site-specific evaluation. However, if the preliminary screening analysis shows no complete exposure pathways, no further evaluation is required.

- ***Applicable Data Evaluation Tools*:** The RBCA Tool Kit is organized to facilitate pathway screening via the "Exposure Pathway Identification" input screen. The user identifies affected source media and actual and/or potential receptors from among a matrix of possible options. Based on these selections, the complete exposure pathways may be viewed on the Exposure Flowchart output screen. In addition, ASTM standard E-1943, "Standard Guide for Remediation by Natural Attenuation (RNA)," outlines practical data evaluation methods for analysis of groundwater plume stability, including historical data plots, estimation of bulk attenuation rates, and modeling methods. The *GSI Natural Attenuation Tool Kit* developed for use with the ASTM RNA Standard, is also available from GSI (*http://www.gsi.net.com*).

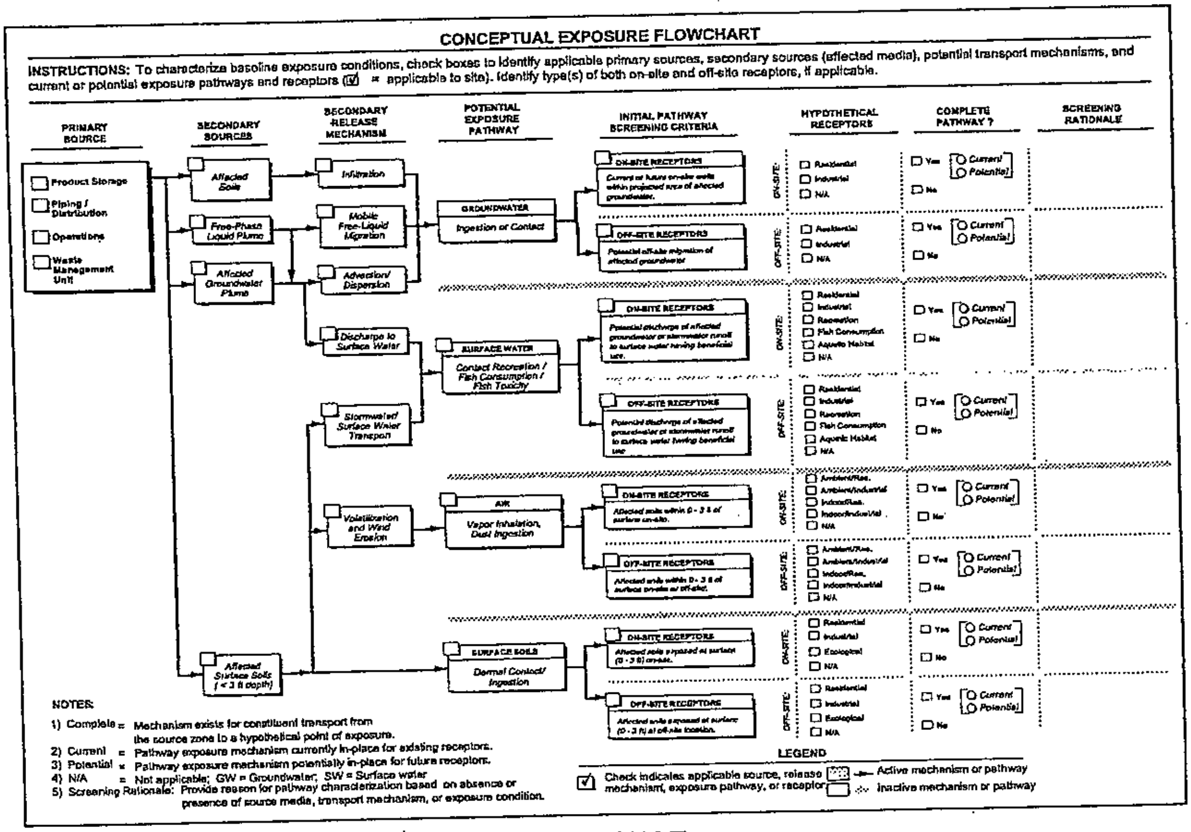


FIGURE A.1. CONCEPTUAL EXPOSURE FLOWCHART

Risk-Based Cleanup Objectives

The RBCA process employs a tiered approach to derivation of risk-based soil and groundwater cleanup goals, with each tier serving to refine the risk analysis based upon additional site data and more sophisticated fate and transport modeling methods. For example, Tiers 1 and 2 of the site evaluation process are amenable to use of simple analytical models to estimate risk-based concentration limits, while more complex and costly numerical modeling methods are reserved for Tier 3 evaluations. In each case, risk-based concentration limits are derived for relevant exposure pathways, receptors, and constituents of concern (COCs) and compared to measured source media concentrations. Source media exceeding these target levels will require either further investigation or remedial action in the timeframe necessary to control exposure. Summary information regarding principal calculation steps is provided below.

i) ***Media-Specific Cleanup Standards:*** For a given exposure pathway and COC, the risk-based standard represents a concentration in the affected source medium (soil or groundwater) that is protective of a human or ecological receptor located at a relevant point of exposure (POE). For example, for the human health soil-to-air exposure pathway, the cleanup standard is the mean concentration in the affected surface soil zone that will prevent unsafe human exposures via soil vapor or particulate release to air. The ASTM RBCA Standard and other regulatory programs distinguish between two types of risk-based cleanup standards: i) the Risk-Based Screening Level (RBSL), a *generic* target level utilized under Tier 1, and ii) a Site-Specific Target Level (SSTL), a *site-specific* target level utilized under Tier 2 or Tier 3. Under the RBCA process, Tier 1 RBSLs are based on an assumed exposure in immediate proximity to the source. If source media COC concentrations exceed Tier 1 RBSLs, the relevant exposure pathways and COCs may be further evaluated under Tier 2 or Tier 3 to calculate SSTLs, which would address actual site-specific exposure conditions , and where the POE may be located at some distance away from the source. For each complete exposure pathway, cleanup standards for the source medium can be back-calculated from safe exposure levels at the POE using the following general expressions:

Tier 1: $RBSL = RBEL \times NAF_{CM}$

Tier 2: $SSTL = RBSL \times NAF_{LT}$

where

RBEL = Risk-based *exposure* limit for direct intake of exposure medium (e.g. air concentration limit for inhalation).

NAF_{CM} = Natural attenuation factor defining natural reduction in constituent concentrations during cross-media (CM) transport (e.g., soil to air volatilization).

NAF_{LT} = Natural attenuation factor defining natural reduction in constituent concentrations during lateral transport (LT) (e.g., via dispersion during lateral migration in air).

RBSL or SSTL values must be developed for each complete exposure pathway and COC. For exposure pathways with multiple POEs (e.g., ambient vapor inhalation by on-site worker and by off-site resident), separate SSTLs must be developed for each POE using the appropriate RBEL value. In general, the RBEL value does not vary among Tiers 1, 2, and 3. Rather, the cleanup standard value is refined at each successive tier by improving the NAF estimations, based upon more complete site information and more sophisticated data evaluation and/or modeling methods. Determination of applicable RBEL and NAF values is addressed below.

ii) ***Risk-Based Exposure Limits:*** The RBEL represents the constituent concentration exposed to the receptor that does not exceed target risk limits, based on applicable regulatory criteria. The RBEL applies at the POE, i.e., the likely point of constituent intake or contact by a human or ecological receptor. For each complete exposure pathway and COC, the applicable RBEL must be matched to each relevant POE based on the type of exposure medium (air, water, soil) and the type of receptor (resident, commercial/industrial worker, etc.). For certain exposure media, human health-based exposure limits are specified under applicable regulations, such as Maximum Contaminant Levels (MCLs) for drinking water ingestion or Permissible Exposure Limits (PELs) for industrial air exposure. In the absence of such standards, human health RBELs can be derived for each constituent and exposure medium (air, water, soil) using the following general expressions:

Carcinogens: $$RBEL = \frac{TR}{E \cdot SF}$$

Non-carcinogens: $$RBEL = \frac{THQ \cdot RfD}{E}$$

where

E = effective exposure rate for specified pathway, based on applicable exposure factors (e.g., daily intake rate in mg/day per kg body weight),

TR = target risk limit for carcinogenic effects of individual constituents (dimensionless),

SF = slope factor for carcinogenic effects of COC $(mg/kg\text{-}day)^{-1}$,

THQ = target hazard quotient for non-carcinogenic effects of individual constituents (dimensionless), and

RfD = reference dose for non-carcinogenic effect of COC (mg/kg-day).

Applicable target risk limits (TR, THQ) for health protection can be matched to levels specified by the environmental regulatory authority. Toxicological parameters for each COC can be determined from published references, such as the U.S. EPA Integrated Risk Information System (IRIS). Exposure rates correspond to the chronic rate of contact or intake of the affected exposure medium (air, water, soil) by the receptor under anticipated land use conditions. As a conservative measure, these rates can be estimated based on standard exposure factors published by the regulatory authority or other source (e.g., American Industrial Health Council) for the anticipated land use at the site (e.g., residential, commercial, etc.).

Quantitative measures for derivation of RBELs for ecological receptors are not well defined. However, if the pathway screening evaluation indicates a reasonable potential for ecological exposure (e.g., surface water/aquatic species), applicable RBELs may be based on published standards or ecological screening criteria (e.g., surface water quality standard for aquatic life protection, ecological screening limits for terrestrial species, etc.). The U.S. EPA and various state agencies maintain databases of ecological screening levels for various types of receptors. However, given the highly conservative nature of these concentration limits, use of these values as ecological RBELs is appropriate only for preliminary screening-level analyses.

iii) ***Applicable Exposure Factors:*** For each complete pathway, *exposure factors* must be defined characterizing the potential duration, frequency, and rate of contact of the receptor with affected media at the POE. Depending upon the degree of conservatism desired, exposure activities can be characterized on the basis of either i) *most likely exposure* (MLE) factors, representing average exposure rates, or ii) *reasonable maximum exposure* (RME) factors, corresponding to the highest rate of exposure that could reasonably be expected to occur (i.e., upper 95% value). Standard RME and MLE exposure factors for various exposure pathways, under both residential and non-residential land use scenarios, are listed on Table A.1.

To select appropriate exposure factors, the user must first define the type of receptor anticipated under current and future land use (i.e., residential vs. commercial/industrial) and then evaluate the applicability of the standard factors to site-specific conditions. The likelihood that such exposure will occur and the degree of conservatism desired should be considered in selecting among MLE and RME values. A Tier 2 evaluation may use both MLE and RME values, in order to estimate the potential range of risks associated with exposure to the site. Modification of these standard values may be justified under certain conditions (e.g., frequency of dermal contact with soils in cold weather climates). For detailed information regarding derivation and application of these exposure factors, see U.S. EPA (1997; 1992a; 1991a) and American Industrial Health Council (1994).

iv) ***Natural Attenuation Factor:*** For each complete exposure pathway, the NAF represents the cumulative effect of various partitioning, dilution, and attenuation factors acting to reduce constituent concentrations during transport from source to receptor (see Figure A.2). These NAF components may involve both cross-media transfer factors (NAF_{CM}, such as soil-to-air volatilization or soil-to-groundwater leaching) and lateral transport factors (NAF_{LT}, such as air dispersion or groundwater advection-dispersion; see Appendix B). For exposure pathways with multiple POEs, separate NAF_{LT} values must be derived for each POE location (e.g., ambient vapor inhalation by on-site worker and off-site resident; or groundwater ingestion at both hypothetical and actual wells). For a given site and exposure pathway, the NAF value may vary among evaluation of Tiers 1, 2, and 3, based on use of improved site data and evaluation methods.

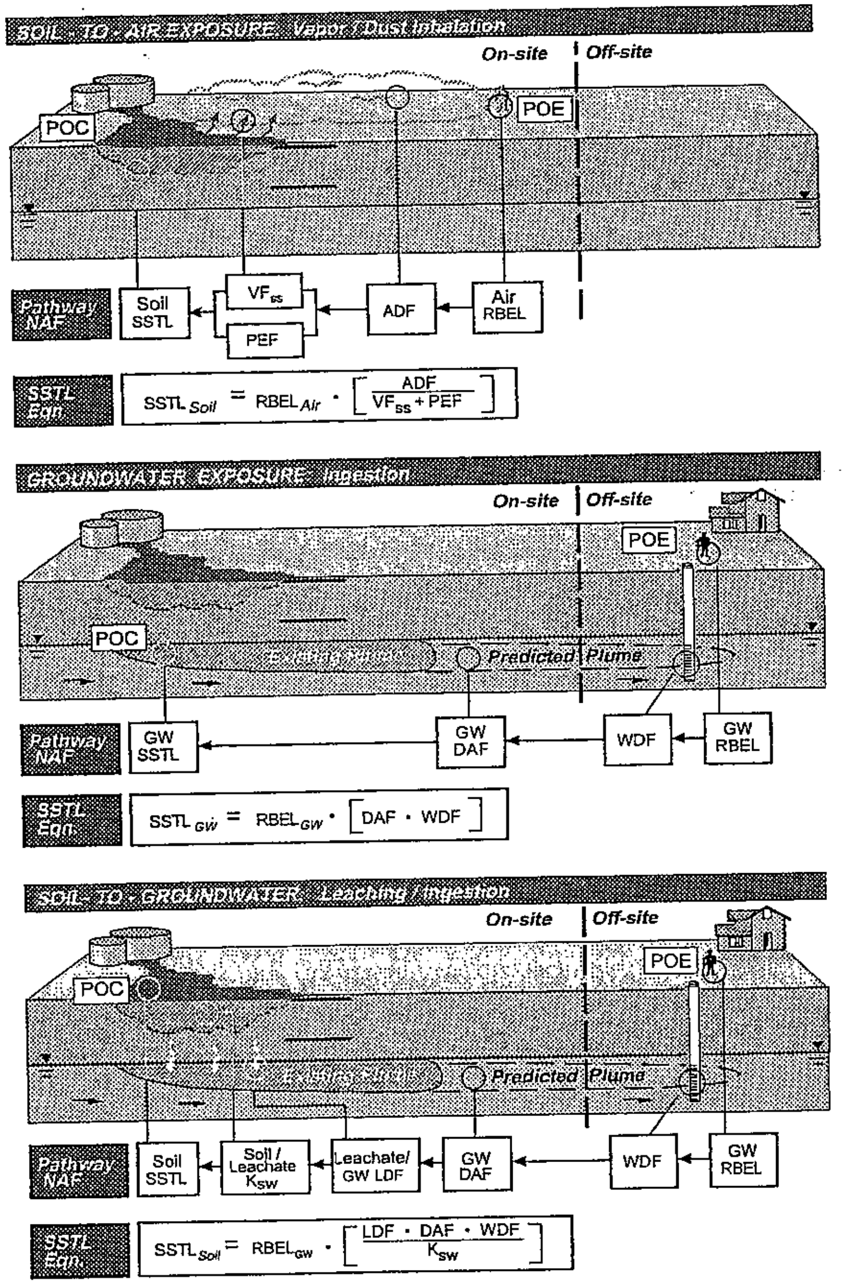
For each complete exposure pathway and COC, the applicable NAF values can be derived based on either: i) the actual measured concentration ratio between the source medium and the POE or

TABLE A.1 STANDARD EXPOSURE FACTORS FOR TIER 1 AND TIER 2 EVALUATIONS

EXPOSURE PATHWAY		Contact Rate (CR)	Exposure Frequency (EF)	Exposure Duration (ED)	Body Weight (BW)	Surface Contact Area (SA)	Soil Adherence Factor (AF)	Dermal Adsorption Factor (DA)	EXPOSURE RATE (E) Equation	Value for Carcinogens	Value for Non-carcinogens
RESIDENTIAL LAND USE											
Ingestion of potable water	MLE	1.4 L/day	350 days/yr	8 years	70 kg	—	—	—	$\frac{CR \cdot EF \cdot ED}{BW \cdot AT}$	0.0022 L/kg-day	0.019 L/kg-day
	RME	2 L/day	350 days/yr	30 years	70 kg	—	—	—		0.0012 L/kg-day	0.027 L/kg-day
Ingestion of soil and dust	MLE	25 mg/day	350 days/yr	8 years	70 kg	—	—	—	$\frac{CR \cdot EF \cdot ED}{BW \cdot AT}$	0.039 mg/kg-day	0.34 mg/kg-day
	RME	100 mg/day	350 days/yr	30 years	70 kg	—	—	—		0.59 mg/kg-day	1.4 mg/kg-day
Inhalation of volatiles	MLE	—	350 days/yr	8 years	—	—	—	—	$\frac{EF \cdot ED}{BW \cdot AT}$	40 days/yr	350 days/yr
	RME	—	350 days/yr	30 years	—	—	—	—		150 days/yr	350 days/yr
Dermal contact with soils	MLE	—	40 days/yr	9 years	70 kg	5000 cm^2	0.2 mg/cm^2-day	Organics: 0.04* Metals: 0.001*	$\frac{EF \cdot ED \cdot SA \cdot AF \cdot DA}{BW \cdot AT}$	0.008 mg/kg-day**	0.063 mg/kg-day**
	RME	—	350 days/yr	30 years	70 kg	5800 cm^2	1.0 mg/cm^2-day	Organics: 0.04* Metals: 0.001*		1.4 mg/kg-day**	3.2 mg/kg-day**
COMMERCIAL / INDUSTRIAL LAND USE											
Ingestion of potable water	MLE	1 L/day	250 days/yr	4 years	70 kg	—	—	—	$\frac{CR \cdot EF \cdot ED}{BW \cdot AT}$	0.00056 L/kg-day	0.0098 L/kg-day
	RME	1 L/day	250 days/yr	25 years	70 kg	—	—	—		0.0035 L/kg-day	0.0098 L/kg-day
Ingestion of soil and dust	MLE	50 mg/day	250 days/yr	4 years	70 kg	—	—	—	$\frac{CR \cdot EF \cdot ED}{BW \cdot AT}$	0.028 mg/kg-day	0.49 mg/kg-day
	RME	50 mg/day	250 days/yr	25 years	70 kg	—	—	—		0.17 mg/kg-day	0.49 mg/kg-day
Inhalation of volatiles	MLE	—	250 days/yr	4 years	—	—	—	—	$\frac{EF \cdot ED}{AT}$	14 days/yr	250 days/yr
	RME	—	250 days/yr	25 years	—	—	—	—		89 days/yr	250 days/yr
Dermal contact with soils	MLE	—	40 days/yr	4 years	70 kg	5000 cm^2	0.2 mg/cm^2-day	Organics: 0.04* Metals: 0.001*	$\frac{EF \cdot ED \cdot SA \cdot AF \cdot DA}{BW \cdot AT}$	0.0036 mg/kg-day**	0.063 mg/kg-day**
	RME	—	250 days/yr	25 years	70 kg	5800 cm^2	1.0 mg/cm^2-day	Organics: 0.04* Metals: 0.001*		1.4 mg/kg-day**	2.3 mg/kg-day**

NOTES:
1) Exposure factors shown above are matched to published U.S. EPA guidelines, when available (U.S. EPA, 1997, 1992a, 1991a). If no EPA value available, other peer-reviewed reference applied (American Industrial Health Council, 1994).
2) MLE = Most Likely Exposure; corresponding to mean exposure rate for exposed population (American Industrial Health Council, 1994; U.S. EPA, 1992a).
3) RME = Reasonable Maximum Exposure; corresponding to upper 95% exposure rate for exposed population (American Industrial Health Council, 1994; U.S. EPA, 1997, 1992a, 1991a).
4) AT = Averaging Time. For carcinogens, AT = 70 yrs x 365 days/yr. For non-carcinogens, AT = ED x 365 days/yr.
5) * = Default value. Use chemical-specific data if available. Values shown represent mid- to upper-range values per U.S. EPA, 1992b; Howard et al., 1991.
6) ** = Calculations of dermal contact with soils or sediments are based on organic default values. Contact rates for soil ingestion and dermal contact shown above are based upon adult receptor.

ii) fate-and-transport modeling analyses predicting this concentration ratio. For purpose of simplicity and accuracy, direct field measurements represent the preferred method of NAF estimation, whenever feasible. However, due to temporal variability and sampling difficulties, some of these factors can prove difficult to quantify via direct field measurements (e.g., soil volatilization or leaching factors). In this case, modeling analyses, based on appropriate site-specific data and conservative assumptions, provide a convenient method of estimation. NAF_{LT} for groundwater may be referred to as a groundwater dilution attenuation factor (DAF). DAFs are amenable to direct measurement via wells spaced along the centerline of the plume. In all cases, time-series groundwater monitoring data should be evaluated to establish the stability condition of the affected groundwater plume. Stable or diminishing plumes pose no risk to downgradient receptors located outside the plume area (i.e., DAF = infinite). Consequently, groundwater modeling analyses are necessary only for plumes for which available data either are insufficient to establish the stability condition or indicate an expanding plume.



NOTES:

SSTL = Site-Specific Target Level; i.e., allowable COC concentration in source medium.
RBEL = Risk-Based Exposure Limit, i.e., allowable COC concentration in exposure medium at point of exposure.

COC = Constituent of Concern
GW = Groundwater
POC = Point of Compliance
POE = Point of Exposure

Natural Attenuation Factors:

NAF = Natural Attenuation Factor.
VF_{ss} = Volatilization Factor for surface soils (mg/m^3 - air) / (mg/kg-soil).
PEF = Particulate Emission Factor for surface soils (g/cm^2 - s).
ADF = Air Dispersion Factor (mg/m^3 - air at POC) / (mg/m^3 - air at POE).
DAF = Groundwater Dilution-Attenuation Factor (mg/L - GW at POC) / (mg/L - GW at POE).
WDF = Well Dilution Factor (mg/L - well discharge) / (mg/L - plume edge).
LDF = Leachate - Groundwater Dilution Factor (cm^3/yr - GW) / (cm^3/yr - Leachate).
K_{sw} = Soil - Water Partition Factor (mg/L-water) / (mg/kg-soil).

FIGURE A.2. BACK-CALCULATION OF SSTL VALUES FOR SOIL AND GROUNDWATER

Various models are available to derive site-specific NAF values, ranging from simple analytical equations with limited data requirements (e.g., Tier 1 and Tier 2 evaluation) to complex numerical models requiring three-dimensional data resolution (e.g., Tier 3 evaluation). The appropriate evaluation tier and modeling tool will depend on the adequacy of the available data, the relative complexity of the site, the acceptable degree of conservatism, and the anticipated cost of the remedial action.

v) ***Actual vs. Potential POEs:*** In development of SSTL values, careful distinction should be made between *actual* POEs, that correspond to existing conditions (e.g., current site users, existing water supply well), and *potential* POEs that represent possible future conditions (e.g., future users, hypothetical water supply well). Engineered remedies may be needed for protection of actual receptors, whereas, for potential receptors, sufficient time may be available for use of natural attenuation remedies. To accommodate this remedy selection strategy, each SSTL should be characterized as to the potential vs. actual nature of the exposure condition. For example, for surface soil exposure pathways, unpaved affected soil may pose a current exposure to on-site workers or residents, whereas soils beneath existing pavement represent a potential future exposure in the event the pavement were removed.

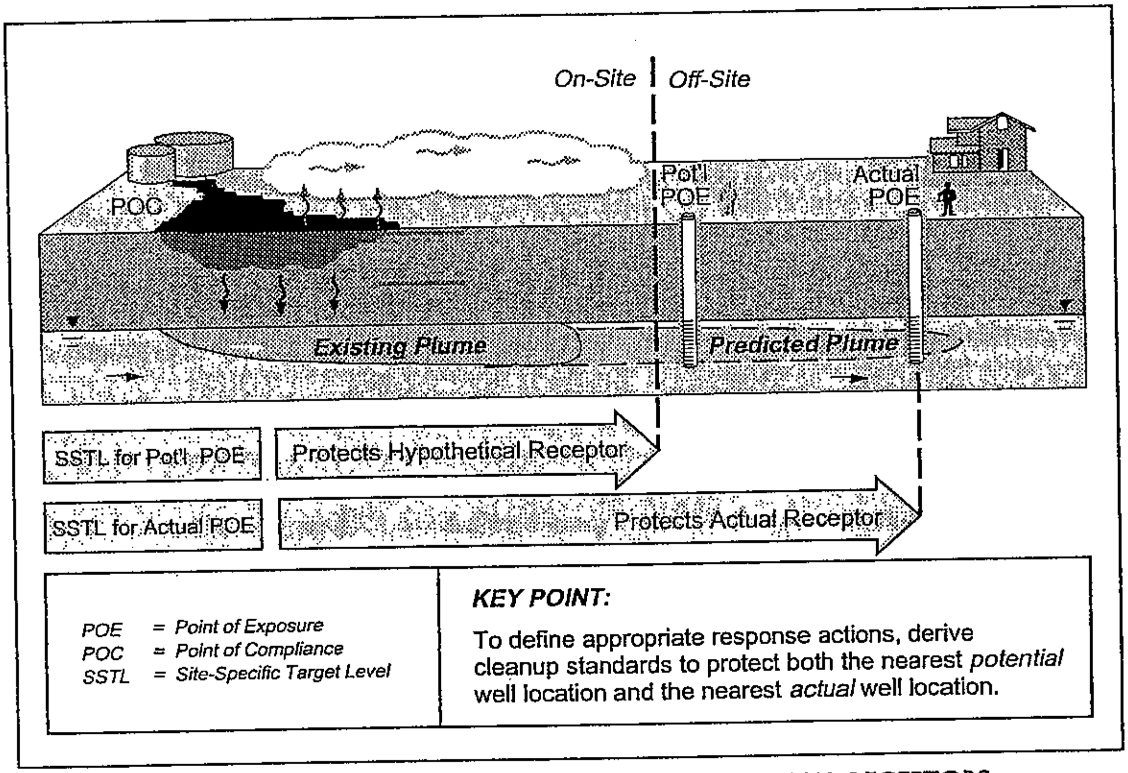


FIGURE A.3. SSTL ANALYSES FOR BOTH POTENTIAL AND ACTUAL RECEPTORS

For the groundwater ingestion pathway, it is advisable to derive separate SSTL values both for a potential POE and an actual POE location as shown on Figure A.3. For some programs, the location of the hypothetical groundwater ingestion POE may be specified under applicable regulations (e.g., nearest downgradient off-site property line). However, to support appropriate remedy selection, a second SSTL can be derived based on the nearest actual downgradient water supply well location. Note, however, that such modeling analyses of POEs located outside the current plume area are appropriate only for plumes for which available data indicate an expanding plume or are insufficient to establish the stability condition.

vi) ***Risk Reduction Requirements:*** The SSTL represents an action level for affected media in the source zone. Source media containing COC concentrations in excess of applicable SSTLs will require further assessment or remediation to control exposure via the relevant exposure pathway(s). If the SSTLs were estimated on the basis of limited site-specific data or highly conservative assumptions, the appropriate response may be further site assessment and re-evaluation of appropriate target levels. For those pathways for which the results of the site-specific evaluation are reliable, appropriate remedies and exposure control measures must be selected and implemented, as discussed in Remedy Selection below.

- ***Applicable Data Evaluation Tools:*** Derivation of SSTL values involves calculation of NAF values for each complete exposure pathway and relevant constituents of concern. Analytical models which can be used for estimation of steady-state NAF values for various air, soil, and groundwater exposure pathways under Tiers 1 and 2 are incorporated in the RBCA Tool Kit. As noted above, it is advisable to evaluate SSTLs for both *actual* and *potential* POE locations in order to support remedy selection. In addition to steady-state models, the Transient Domenico Worksheet can be used to provide important information regarding the timing and duration of potential groundwater impacts.

Remedy Selection

For each exposure pathway determined to pose a health/environmental concern, a cost-effective remedy must be selected and implemented to achieve necessary risk reduction in the appropriate timeframe. This step of the site evaluation process involves development of an overall *exposure control strategy* and selection of optimal remediation technologies to implement this strategy.

The goal of risk-based site management is to minimize risk by preventing exposure to harmful levels of site constituents. Risk reduction can be achieved by addressing any component of the exposure pathway: i) removing or treating the source, ii) interrupting contaminant transport mechanisms, or iii) controlling activities at the point of exposure. The remedial action plan may consist of one or more exposure control strategies, including:

i) ***Removal/Treatment Action:*** Removal or treatment of affected source media (i.e., affected soils, groundwater, etc.) to reduce COC concentrations to levels less than or equal to applicable SSTLs (e.g., via excavation, soil venting, pump-and-treat, etc.).

ii) ***Containment Measures:*** Long-term engineering controls to prevent migration of harmful concentrations of COCs from the source to the POE (e.g., surface cover/capping, barrier walls, soil stabilization, hydraulic containment, etc.).

iii) ***Natural Attenuation Monitoring:*** Periodic sampling and analysis to confirm stabilization or reduction of affected media concentrations via natural attenuation processes.

iv) ***Institutional Controls:*** Legal or administrative measures to control the nature and frequency of human activity at the POE (e.g., deed notice, alternative water supply, etc.).

The appropriate exposure control strategy for a given site will depend on the nature of the risk reduction requirements. For example, as shown on Figure A.4, engineered remedies (such as removal/ treatment or containment strategies) are appropriate for response to current or anticipated impacts on actual receptors. If risk reduction is required only for protection of potential future receptors (e.g., hypothetical water well users), groundwater remediation by natural attenuation may be employed to confirm plume stabilization or reduction. No response action is required if constituent concentrations do not exceed SSTL values for either actual or potential receptors. The estimated *time to impact* determined in the risk-based site evaluation is also a key consideration in the remedy selection process. For example, if source media concentrations presently exceed an applicable SSTL value but the corresponding RBEL is not likely to be exceeded at the POE for an extended time period, additional time may be available for re-evaluation of potential exposure conditions based on site-specific monitoring program.

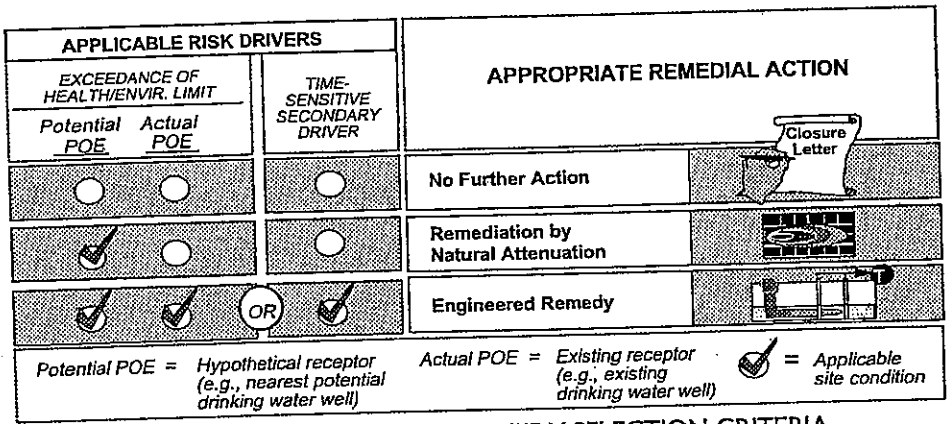


FIGURE A.4. POTENTIAL RISK-BASED REMEDY SELECTION CRITERIA

Compliance Monitoring Program Design

Under many regulatory programs, a final compliance monitoring period is required to confirm satisfactory completion of the remedy. Compliance monitoring (or *verification sampling*) typically involves sampling of one or more locations on an established schedule to identify either i) an exceedance of an applicable concentration limit or ii) a change of condition (e.g., change of land use, failure of engineering control) that might invalidate the basis for the remedy selection. If, upon completion of the monitoring period, compliance with applicable concentration limits is demonstrated, no further action is required.

- ***Applicable Data Evaluation Tools***: To confirm compliance with applicable cleanup standards, compliance monitoring *action levels* for the groundwater exposure pathway can be derived using the same models used for SSTL calculation. Under this approach, groundwater compliance monitoring locations are selected between the source location (point of compliance) and the point of exposure (POE). By adjusting the distance variable on Transient Domenico Worksheet in the RBCA Tool Kit, the NAF value can be calculated for constituent transport from each monitoring point to the POE. The action level can be calculated as the arithmetic product of the NAF times the applicable RBEL for each constituent. If action levels are exceeded during the compliance monitoring period, further evaluation may be required to ensure adequate protection of downgradient receptors.

Model Selection Guidelines

Under the risk-based site evaluation process outlined above, fate-and-transport models are used to derive SSTL values based on estimation of the pathway-specific natural attenuation factor (NAF). Whenever feasible, direct field measurements represent the preferred method of NAF estimation. However, if the exposure pathway is not amenable to direct NAF measurement (e.g., volatilization factors, leachate factors, etc.) or if time-series analyses show the contaminant zone to be expanding over time, modeling analyses, based on appropriate site-specific data and conservative assumptions, can provide a convenient method of estimating future exposure levels.

The "best" model for a given site will be the simplest model providing a reliable and reasonably conservative prediction of potential exposure. Under the ASTM RBCA process, relatively simple analytical modeling tools are applied under Tiers 1 and 2, followed by more sophisticated modeling methods, if warranted, under Tier 3. The choice between simple and complex modeling methods should be dictated by the adequacy of the site database and the relative degree of error likely to be introduced by the model itself. In addition, the cost of upgrading to a more complex Tier 3 site evaluation must be warranted by the potential reduction in site remediation costs or the complex nature of the anticipated exposure condition. General guidelines for application of various types of fate-and-transport models under Tiers 1,2, and 3 are summarized below.

Model Dimensions: For each of the exposure pathways addressed in the RBCA standard, fate-and-transport models are available to estimate NAF values based on either a one-, two-, or three-dimensional analysis of contaminant transport. In reality, all contaminant transport occurs in three dimensions; however, one-dimensional (1-D) or two-dimensional (2-D) modeling tools may be employed for purpose of conservatism and simplicity. One-dimensional models, which ignore lateral and vertical dispersion effects, may significantly overestimate exposure levels and underestimate the pathway NAF. For this purpose, 2-D fate-and-transport models are commonly employed for Tier 1 and Tier 2 analyses, as presented in Appendix X3 of the ASTM RBCA Standard (PS 104, 1998) and included in the RBCA Tool Kit. Three-dimensional transport models may provide a more accurate and less conservative NAF estimate under a Tier 3 evaluation, but must be supported by three-dimensional characterization of key transport parameters (e.g., hydraulic conductivity, etc.). While three-dimensional models are not included in the RBCA Tool Kit, NAF values calculated by these models may be entered directly into the software in order to calculate baseline risks and cleanup standards.

Steady-State vs. Transient Analyses: Steady-state fate-and-transport models, which assume a constant source concentration and constant flow conditions over time, provide a conservative (lowerbound) NAF estimate corresponding to maximum chronic exposure conditions. In reality, following termination of the release, source concentrations in soil and groundwater are likely to diminish over time, resulting in time-variable exposure concentrations at the POE. For purpose of simplicity and conservatism, steady-state, constant-source models, providing a lowerbound NAF value, are commonly employed under Tiers 1 and 2. However, to support risk management decisions, these constant-source models can be run in a transient mode to predict the *time to impact*, i.e., the time required for the exposure concentration to exceed the RBEL at the POE. Under Tier 3, fully transient models, simulating both time-variable source concentrations and transport phenomena, can be used to characterize both the timing and *duration* of the RBEL exceedance. Again, these more sophisticated Tier 3 analyses should be based on sufficient site-specific data to support reliable modeling results.

Probabilistic vs. Deterministic Models: Under Tiers 1 and 2, exposure concentrations and NAF values are characterized on the basis of *deterministic* models which provide a unique output value for each unique set of input values. Uncertainty in the modeling analysis is addressed by means of a *sensitivity study*, i.e., by varying key input values to evaluate their potential impact on the model output. Under Tier 3, *probabilistic* modeling may be employed as a more sophisticated approach to management of model uncertainty. In probabilistic modeling, for each key input parameter, the user provides a probability distribution corresponding to the range and type of distribution observed for the parameter at the site. The model then completes the fate-and-transport calculation for the full range of these input values, effectively conducting multiple random model sensitivity studies. The model result is not a unique value but a probability distribution defining the possible range of results (e.g., exposure concentration, NAF value) for the specified site conditions. The probabilistic analysis provides the user with relatively sophisticated information regarding possible exposure conditions (e.g., for a given SSTL value, what is the probability that the RBEL will be exceeded at any future time?) However, to support reliable results, this Tier 3 modeling method will typically require significant additional site characterization data relative to Tier 1 or Tier 2 deterministic analyses.

RBCA Tool Kit for Chemical Releases

The RBCA Tool Kit has been developed expressly for use with the Tier 1 and Tier 2 site evaluation procedures outlined in the ASTM RBCA Standard (PS 104, 1998). Based upon site-specific data supplied by the user, the RBCA Tool Kit combines fate-and-transport modeling and risk characterization functions to compute: exposure concentrations, average daily intake, baseline risk levels, and risk-based media cleanup standards

Key features of the RBCA Tool Kit relevant to SSTL calculations and risk-based remedy selection are outlined below.

MODEL CALCULATION FUNCTIONS

Using a system of ten analytical models linked to internal libraries of standard exposure factors and chemical/toxicological data for over 90 compounds, the RBCA Tool Kit can calculate either baseline risk levels or cleanup standards for each complete exposure pathway identified by the user. Key calculation steps are as follows:

Exposure Concentrations: Based on representative concentrations of constituents of concern (COCs) present in the affected source media, maximum steady-state concentrations likely to occur at the point of exposure (POE) are calculated using the steady-state analytical fate-and-transport models identified in Appendix X3 of ASTM PS 104. To perform these calculations, the system evaluates cross-media partitioning (e.g., volatilization from soil to air) and lateral transport from the source to the POE (e.g., contaminant transport via air or groundwater flow). The source media and optional exposure pathways included in the software are as follows:

SOURCE MEDIA	EXPOSURE PATHWAYS
Surface Soils	Inhalation of Vapor and Particulates Dermal Contact with Soil Ingestion of Soil and Dust Leaching to Groundwater
Subsurface Soils	Inhalation of Vapor Leaching to Groundwater
Groundwater	Ingestion of Potable Water Inhalation of Vapor Discharge to Surface Water - Ingestion/Dermal Contact via Swimming - Ingestion via Fish Consumption - Aquatic Life Protection

Average Daily Intake: Based upon the exposure factors selected by the user, the average daily chemical intake for each receptor along each selected pathway is calculated in accordance with EPA guidelines (see Connor et al., 1998). These values are used in baseline risk calculations for each complete pathway.

Baseline Risk Characterization: Human health risks associated with exposure to COCs are calculated by the software on the basis of average daily intake rates and the corresponding toxicological parameters for carcinogenic and non-carcinogenic effects. For each complete pathway, the system output provides both individual and additive constituent results for carcinogens and non-carcinogens.

Media Cleanup Values: The RBCA Tool Kit has the ability to i) compare the site data to Tier 1 Risk-Based Screening Levels (RBSLs), computed using the default parameter values as listed in ASTM PS 104, or ii) calculate Tier 2 Site-Specific Target Levels (SSTLs) based on user-supplied site information. For each source medium (i.e., affected soil and groundwater), the software reports target concentrations for all complete pathways and identifies the applicable (i.e., minimum) value for source remediation. The equations used by the RBCA Tool Kit to calculate RBSLs and SSTLs are presented in Table A.2.

TABLE A.2 RBSL AND SSTL EQUATIONS USED IN THE RBCA TOOL KIT

GROUNDWATER EXPOSURE PATHWAY	
Groundwater Ingestion	
Carcinogens: $RBSL_{GW} = \frac{TR \cdot BW \cdot AT_C}{SFo \cdot EF \cdot ED \cdot IR_w}$ Non-Carcinogens: $RBSL_{GW} = \frac{THQ \cdot RfDo \cdot BW \cdot AT_n}{EF \cdot ED \cdot IR_w}$	$SSTL_{GW} = RBSL_{GW} \cdot DAF$
Soil Leaching to Groundwater → Groundwater Ingestion	
Carcinogens: $RBSL_S = \frac{TR \cdot BW \cdot AT_C}{SFo \cdot EF \cdot ED \cdot IR_w \cdot LF}$ Non-Carc.: $RBSL_S = \frac{THQ \cdot RfDo \cdot BW \cdot AT_n}{EF \cdot ED \cdot IR_w \cdot LF}$	$SSTL_s = RBSL_s \cdot DAF$
SOIL EXPOSURE PATHWAY	
Surface Soil Ingestion, Inhalation, and Dermal Contact	
Carcinogens: $RBSL_{SS} = \frac{TR \cdot BW \cdot AT_C}{EF \cdot ED \cdot \left[(SFo \cdot IR_s) + \left(URF \cdot 1000 \cdot BW \cdot (VF_{ss} + VF_p)\right) + (SFd \cdot SA \cdot M \cdot RAF_d)\right]}$ Non-Carc.: $RBSL_{SS} = \frac{THQ \cdot BW \cdot AT_n}{EF \cdot ED \cdot \left[\left(\frac{IR_s}{RfDo}\right) + \left(\frac{BW \cdot (VF_{ss} + VF_p)}{RfC}\right) + \left(\frac{SA \cdot M \cdot RAF_d}{RfDd}\right)\right]}$	$SSTL_{ss} = RBSL_{ss}$ *(No lateral transport; receptor at source.)*
OUTDOOR AIR EXPOSURE PATHWAY	
Subsurface Soil Volatilization to Ambient Air	
Carcinogens: $RBSL_S = \frac{TR \cdot AT_C}{EF \cdot ED \cdot URF \cdot 1000 \cdot VF_{samb}}$ Non-Carcinogens: $RBSL_S = \frac{THQ \cdot RfC \cdot AT_n}{EF \cdot ED \cdot VF_{samb}}$	$SSTL_s = RBSL_s \cdot ADF$
Groundwater Volatilization to Ambient Air	
Carcinogens: $RBSL_{GW} = \frac{TR \cdot AT_C}{EF \cdot ED \cdot URF \cdot 1000 \cdot VF_{wamb}}$ Non-Carcinogens: $RBSL_{GW} = \frac{THQ \cdot RfC \cdot AT_n}{EF \cdot ED \cdot VF_{wamb}}$	$SSTL_{GW} = RBSL_{GW} \cdot ADF$

Continued

TABLE A.2 RBSL AND SSTL EQUATIONS USED IN THE RBCA TOOL KIT *Continued*

INDOOR AIR EXPOSURE PATHWAY

Subsurface Soil Volatilization to Enclosed Space

Carcinogens: $RBSL_S = \frac{TR \cdot AT_C}{EF \cdot ED \cdot URF \cdot 1000 \cdot VF_{sesp}}$ Non-Carcinogens: $RBSL_S = \frac{THQ \cdot RfC \cdot AT_n}{EF \cdot ED \cdot VF_{sesp}}$	$SSTL_{GW} = RBSL_{GW}$ *(No lateral transport; receptor at source.)*

Groundwater Volatilization to Enclosed Space

Carcinogens: $RBSL_{GW} = \frac{TR \cdot AT_C}{EF \cdot ED \cdot URF \cdot 1000 \cdot VF_{wesp}}$ Non-Carcinogens: $RBSL_{GW} = \frac{THQ \cdot RfC \cdot AT_n}{EF \cdot ED \cdot VF_{wesp}}$	$SSTL_{GW} = RBSL_{GW}$ *(No lateral transport; receptor at source.)*

SURFACE WATER EXPOSURE PATHWAY

Groundwater Discharge to Surface Water → Swimming and Fish Consumption

RBSL not applicable. *(Receptor located away from source.)*	Carcinogens: $SSTL_{GW} = \frac{TR \cdot BW \cdot AT_C \cdot DAF \cdot DF_{gw-sw}}{ED \cdot [(SFo \cdot EV \cdot ET \cdot IR_{sw}) + (SFd \cdot EV \cdot SA_{sw} \cdot Z) + (SFo \cdot IR_{fish} \cdot FI_{fish} \cdot BCF)]}$ Non-Carc.: $SSTL_{GW} = \frac{THQ \cdot BW \cdot AT_n \cdot DAF \cdot DF_{gw-sw}}{ED \cdot \left[\left(\frac{EV \cdot ET \cdot IR_{sw}}{RfDo}\right) + \left(\frac{EV \cdot SA_{sw} \cdot Z}{RfDd}\right) + \left(\frac{IR_{fish} \cdot FI_{fish} \cdot BCF}{RfDo}\right)\right]}$

Soil Leaching to Groundwater → Groundwater Discharge to Surface Water → Swimming and Fish Consumption

RBSL not applicable. *(Receptor located away from source.)*	Carcinogens: $SSTL_S = \frac{TR \cdot BW \cdot AT_C \cdot DAF \cdot DF_{gw-sw}}{ED \cdot [(SFo \cdot EV \cdot ET \cdot IR_{sw}) + (SFd \cdot EV \cdot SA_{sw} \cdot Z) + (SFo \cdot IR_{fish} \cdot FI_{fish} \cdot BCF)] \cdot LF}$ Non-Carc.: $SSTL_S = \frac{THQ \cdot BW \cdot AT_n \cdot DAF \cdot DF_{gw-sw}}{ED \cdot \left[\left(\frac{EV \cdot ET \cdot IR_{sw}}{RfDo}\right) + \left(\frac{EV \cdot SA_{sw} \cdot Z}{RfDd}\right) + \left(\frac{IR_{fish} \cdot FI_{fish} \cdot BCF}{RfDo}\right)\right] \cdot LF}$

Groundwater Discharge to Surface Water → Aquatic Life Protection

RBSL not applicable. *(Receptor located away from source.)*	Carcinogens: $SSTL_{GW} = AQL \cdot DAF \cdot DF_{gw-sw}$ Non-Carcinogens: $SSTL_{GW} = AQL \cdot DAF \cdot DF_{gw-sw}$

Soil Leaching to Groundwater → Groundwater Discharge to Surface Water → Aquatic Life Protection

RBSL not applicable. *(Receptor located away from source.)*	Carcinogens: $SSTL_S = \frac{AQL \cdot DAF \cdot DF_{gw-sw}}{LF}$ Non-Carcinogens: $SSTL_S = \frac{AQL \cdot DAF \cdot DF_{gw-sw}}{LF}$

Continued

TABLE A.2 RBSL AND SSTL EQUATIONS USED IN THE RBCA TOOL KIT *Continued*

PARAMETER DEFINITIONS			
ADF	Lateral air dispersion factor (unitless)	RfC	Reference concentration (mg/m^3)
AQL	Aquatic protection criteria (mg/L)	RfDd	Chronic dermal reference dose (mg/kg/d)
AT_c	Averaging time - carcinogens (yr)	RfDo	Chronic oral reference dose (mg/kg/d)
AT_n	Averaging time - non-carcinogens (yr)	SA	Skin surface area for soil dermal contact (cm^2)
BCF	Bioconcentration factor (mg/kg-fish)/(mg/L-wat)	SA_{sw}	Skin surface area for swimming dermal contact (cm^2)
BW	Body weight (kg)	SFd	Dermal slope factor (mg/kg/d)$^{-1}$
DAF	Lateral groundwater dilution-attenuation factor (unitless)	SFo	Oral slope factor (mg/kg/d)$^{-1}$
$DF_{gw\text{-}sw}$	Groundwater to surface water dilution factor (unitless)	$SSTL_{GW}$	Site-specific target level for groundwater (mg/L)
ED	Exposure duration (yr)	$SSTL_s$	Site-specific target level for soil (mg/kg)
EF	Exposure frequency (d/yr)	$SSTL_{ss}$	Site-specific target level for surface soil (mg/kg)
ET	Exposure time (hr/event)	THQ	Target hazard quotient
EV	Event frequency (events/yr)	TR	Target risk
FI_{fish}	Fraction of ingested fish from affected surface water (unitless)	URF	Unit risk factor (µg/m^3)$^{-1}$
IR_{fish}	Rate of fish consumption (kg/yr)	VF_p	Particulate emission factor (mg/m^3-air)/(mg/kg-soil)
IR_s	Soil ingestion rate (kg/d)	VF_{samb}	Subsurface soil to ambient air volatilization factor (mg/m^3-air)/(mg/kg-soil)
IR_{sw}	Water ingestion rate while swimming (L/hr)	VF_{sesp}	Subsurface soil to enclosed space volatilization factor (mg/m^3-air)/(mg/kg-soil)
IR_w	Water ingestion rate (L/d)	VF_{ss}	Surface soil to ambtnt air volatilization factor (mg/m^3-air)/(mg/kg-soil)
LF	Soil-to-GW leaching factor (mg/L-wat)/(mg/kg-soil)		
M	Soil-to-skin adherence factor (mg/cm^2/d)	VF_{wamb}	GW to ambient air volatilization factor (mg/m^3-air)/(mg/L-wat)
RAF_d	Relative absorption factor for soil dermal contact (unitless)		
$RBSL_{GW}$	Risk-based screening level for groundwater (mg/L)	VF_{wesp}	GW to enclosed space volatilization factor (mg/m^3-air)/(mg/L-wat)
$RBSL_S$	Risk-based screening level for soil (mg/kg)		
$RBSL_{SS}$	Risk-based screening level for surface soil (mg/kg)	Z	Water to skin dermal absorption factor (cm/event)

RISK-BASED DECISION SUPPORT FEATURES

The RBCA Tool Kit includes several features designed to support key steps of the risk-based site evaluation process, including the following:

Step-by-Step Evaluation Process: From the Main Screen of the graphical user interface, the user is guided through all the necessary steps for completing the Tier 1 or Tier 2 evaluation process. On subsequent screens the interface leads the user through exposure pathway identification, model selection, site-specific parameter input, and output review. All output screens may be printed in a report-quality format.

Analysis of Actual and Potential POEs: Multiple off-site exposure points are allowed for the groundwater and outdoor air pathways. This enables the user to evaluate risks at both actual (e.g. an actual nearby well) and potential (e.g., a hypothetical well at the property boundary) POEs. Whether site risks affect an actual or potential POE adds a qualitative dimension to the risk calculations which may be an important factor in remedy selection at some sites.

Transient Groundwater Modeling Analyses: An optional Transient Domenico Worksheet is provided to allow the user to estimate the time required for site constituents to impact off-site groundwater POEs. Groundwater risk levels and cleanup standards calculated by the software are based on steady-state concentrations. However, the time to reach steady-state concentrations at off-site POEs may be very long for some constituents. Thus, the time required to exceed a concentration limit at a POE may be an important factor in remedy selection as near-term impacts may require a significantly different response than longer-term impacts (e.g., an engineered response vs. natural attenuation).

Summary

The RBCA Tool Kit for Chemical Releases provides a system of simple analytical fate-and-transport models that can be used for comprehensive risk-based evaluation of potential soil, air, groundwater, and surface water exposure pathways. However, as with all predictive modeling efforts, reliable results require proper characterization of site-specific input parameters. In all cases, model predictions must be shown to be consistent with the actual constituent distributions observed at the site. Use of the Tier 1 and Tier 2 calculation methods outlined in the ASTM RBCA Standard (PS 104, 1998) and incorporated in the RBCA Tool Kit can significantly reduce the time and effort required for evaluation of risk reduction requirements and selection of appropriate exposure control methods. However, proper scientific and/or engineering expertise is required both for characterization of input parameters and assessment of model results.

APPENDIX B: FATE AND TRANSPORT MODELING METHODS

The RBCA Tool Kit contains a series of fate and transport models for predicting COC concentrations at points of exposure (POEs) located downwind or downgradient of source areas for air or groundwater exposure pathways, respectively. Under Tiers 1 and 2, relatively simple analytical models are to be employed for these calculations. The RBCA Tool Kit is consistent with Appendix X3 of ASTM PS-104, although selected algorithms and default parameters have been updated to reflect advances in evaluation methods.

The idealized schematic shown on Figure B.1 illustrates the steps included in the RBCA Tool Kit for predicting transport of contaminants from the source zone to the POE for air and groundwater exposure pathways. Each element in Figure B.1 represents a step-specific attenuation factor, corresponding to either a cross-media transfer factor (CM) or a lateral transport factor (LT). The effective NAF value for each COC on each pathway is then calculated as the arithmetic product of the various attenuation factors occurring along the flow path from source to receptor. These steady-state NAF values are then used for calculation of baseline risks and back-calculation of Site-Specific Target Levels (SSTLs). Please note that fate and transport modeling is *not* required for direct exposure pathways, such as soil ingestion or dermal contact, where the source and exposure concentrations are equal (i.e., NAF = 1). Analytical models used for conservative estimation of each transport factor are described below.

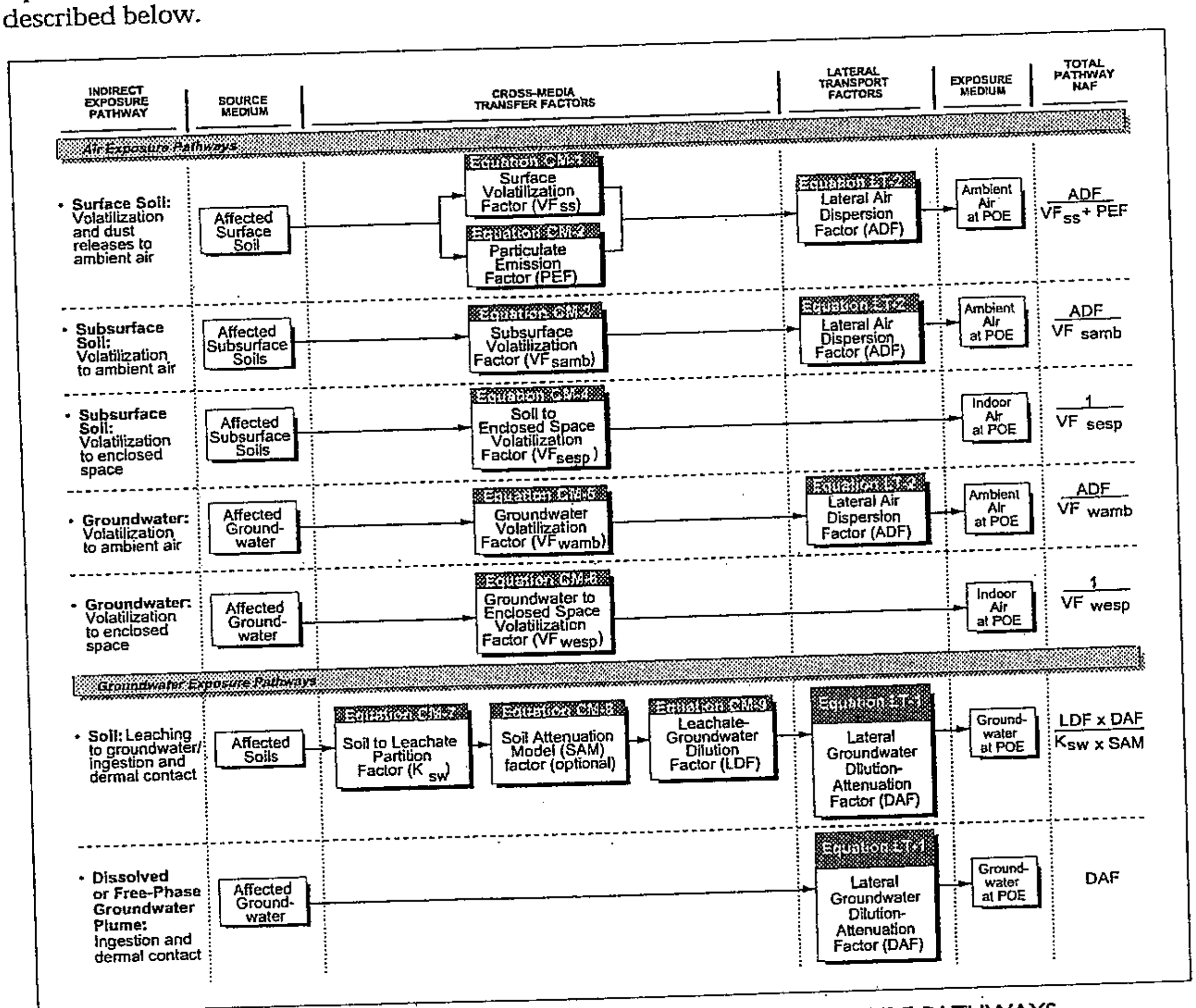


FIGURE B.1. NAF CALCULATION SCHEMATIC FOR INDIRECT EXPOSURE PATHWAYS

Cross-Media Transfer Factors

Exposure pathways involving transport of COCs from one medium to another (e.g., soil-to-air, soil-to-groundwater) require estimation of the corresponding cross-media transfer factor. Various analytical expressions are available for estimating soil-to-air *volatilization factors* as a function of site soil characteristics and the physical/chemical properties of volatile organic COCs. *Leaching factors* for organic and inorganic constituent releases from soil to groundwater can similarly be estimated as a function of COC characteristics, soil conditions, and annual rainfall infiltration. Cross-media transfer equations incorporated in the RBCA Tool Kit are presented in Figure B.2. Detailed discussion of each of these cross-media factors is provided below.

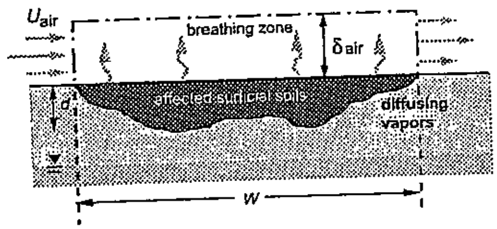
- ***VF_{ss}: Surface Soil Volatilization Factor (Equation CM-1)***
  The surface volatilization factor is the steady-state ratio of the predicted concentration of an organic constituent in the ambient air breathing zone to the source concentration in the surface soil. The surface volatilization factor incorporates two cross-media transfer elements: i) organic vapor flux from the surface soil mass to ground surface and ii) mixing of soil vapors in the ambient air breathing zone directly over the affected surface soil. For each site, the applicable VF_{SS} value corresponds to the lesser result of two calculation methods (termed CM-1a and CM-1b on Figure B.2). Equation CM-1a typically controls for low-volatility compounds, as it assumes there is an infinite source of chemical in the surface soils and uses a volatilization rate based primarily on chemical properties. Equation CM-1b, which typically controls for volatile organic compounds (VOCs), is based on a mass balance approach. In this equation, a finite amount of chemical is assumed to be present in the surface soil (based on the representative COC concentration), volatilizing at a constant rate over the duration of the exposure period (e.g., 25-30 years). Both expressions account for the dilution of chemicals in ambient air above the source zone due to mixing with ambient air moving across the site. A simple box model is used for this dilution calculation, based on the following adjustable default assumptions: 2-meter mixing zone height and 225 cm/sec (5 mph) lateral wind speed. The length of the mixing zone is set equal to the lateral dimension of the exposed affected surface soil area parallel to the assumed wind direction.

  Key assumptions used in this model and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: VF_{SS}	EFFECT ON CLEANUP STANDARD
• **Uniform COC Concentrations:** Constituent levels uniformly distributed in soil and constant over exposure period.	-----
• **No COC Decay:** No biodegradation or other loss mechanism in soil or vapor phase.	⇩
• **Finite Source Term:** Source term mass adjusted for constant volatilization over exposure period.	-----

- ***PEF: Soil Particulate Emission Factor (Equation CM-2)***
  The Particulate Emission Factor (PEF) is the steady-state ratio of the predicted concentration of chemicals in particulates in the ambient air breathing zone to the source concentration of chemical in the surface soil. The factor incorporates two cross-media transfer elements: i) the release rate of soil particulates (dust) from ground surface and ii) mixing of these particulates in the ambient air breathing zone directly over the affected surface soil. The particulate release rate is commonly matched to a conservative default value of 6.9×10^{-14} g/cm^2-sec (approximately 0.2 lbs/acre-year), unless a more appropriate site-specific estimate is available. (If the site is paved, the particulate release rate and resultant PEF value for the covered soil area will be zero.) Particulates are assumed to be diluted by lateral air flow directly over the source zone. For this purpose, a simple box model is employed, based on the following adjustable default assumptions: 2-meter mixing zone height and 225 cm/sec (5 mph) lateral wind speed. The length of the mixing zone is matched to the lateral dimension of the exposed affected surface soil area parallel to the assumed wind direction.

Equation CM-1: Surface Soil Volatilization Factor (VFss)



CM-1a:

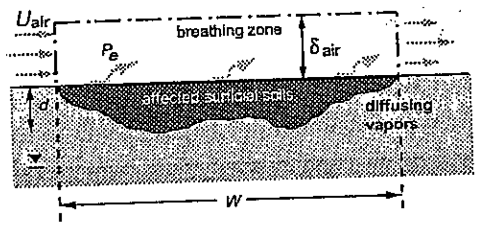
$$VF_{ss}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{2W\rho_s}{U_{air}\delta_{air}}\sqrt{\frac{D_s^{eff}H}{\pi\tau(\theta_{ws}+k_s\rho_s+H\theta_{as})}}\times10^3$$

or CM-1b:

$$VF_{ss}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{W\rho_s d}{U_{air}\delta_{air}\tau}\times10^3$$

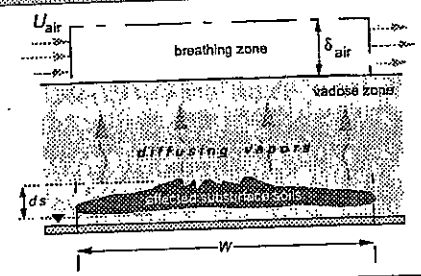
whichever is less

Equation CM-2: Soil Particulate Emission Factor (PEF)



$$PEF\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{P_e W}{U_{air}\delta_{air}}\times10^3$$

Equation CM-3: Subsurface Soil Volatilization Factor (VFsamb)



CM-3a:

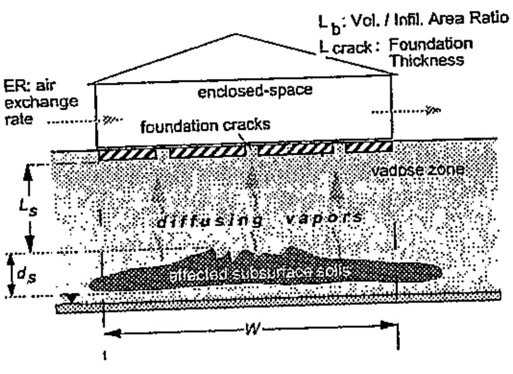
$$VF_{samb}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{H\rho_s}{[\theta_{ws}+k_s\rho_s+H\theta_{as}]\left[1+\frac{U_{air}\delta_{air}L_s}{D_s^{eff}W}\right]}\times10^3$$

or CM-3b:

$$VF_{samb}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{W\rho_s d_s}{U_{air}\delta_{air}\tau}\times10^3$$

whichever is less

Equation CM-4: Subsurface Soil to Enclosed Space Volatilization Factor (VFsesp)



CM-4a:

For $Q_s=0$:

$$VF_{sesp}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{\frac{H\rho_s}{[\theta_{ws}+k_s\rho_s+H\theta_{as}]}\left[\frac{D_s^{eff}/L_s}{ER\,L_B}\right]}{1+\left[\frac{D_s^{eff}/L_s}{ER\,L_B}\right]+\left[\frac{D_s^{eff}/L_s}{(D_{crack}^{eff}/L_{crack})\eta}\right]}\text{x}10^3$$

For $Q_s>0$:

$$VF_{sesp}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{\frac{H\rho_s}{[\theta_{ws}+k_s\rho_s+H\theta_{as}]}\left[\frac{D_s^{eff}/L_s}{ER\,L_B}\right]e^{\xi}}{e^{\xi}+\left[\frac{D_s^{eff}/L_s}{ER\,L_B}\right]+\left[\frac{D_s^{eff}/L_s}{(Q_s/A_b)}\right]\left[e^{\xi}-1\right]}\text{x}10^3$$

or CM-4b:

$$VF_{sesp}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{\rho_s d_s}{L_B ER\tau}\text{x}\times10^3$$

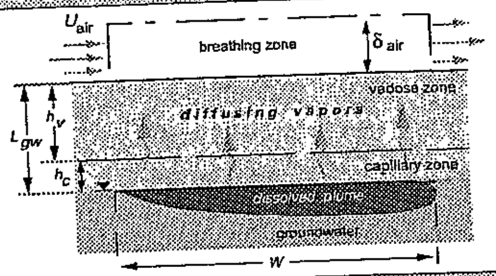
whichever is less

Continued

FIGURE B.2. CROSS-MEDIA TRANSFER FACTORS IN THE RBCA TOOL KIT

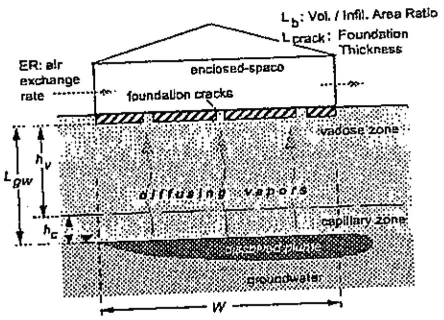
Continued

Equation CM-5: Groundwater Volatilization Factor (VFwamb)



$$VF_{wamb}\left[\frac{(mg\ /\ m^3-air)}{(mg/L\ -H_2O)}\right]=\frac{H}{1+\left[\frac{U_{air}\ \delta_{air}\ L_{GW}}{D_{ws}^{eff}\ W}\right]}\times 10^3$$

Equation CM-6: Groundwater to Enclosed Space Volatilization Factor (VFwesp)



For $Q_s=0$:

$$VF_{wesp}\left[\frac{(mg\ /\ m^3-air)}{(mg\ /\ L-H_2O)}\right]=\frac{H\left[\frac{D_{ws}^{eff}\ /\ L_{GW}}{ER\ L_B}\right]}{1+\left[\frac{D_{ws}^{eff}\ /\ L_{GW}}{ER\ L_B}\right]+\left[\frac{D_{ws}^{eff}\ /\ L_{GW}}{\left(D_{crack}^{eff}\ /\ L_{crack}\right)\cdot\eta}\right]}\times 10^3$$

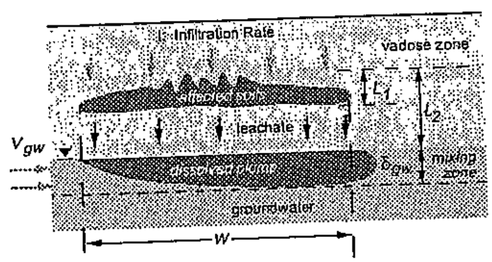
For $Q_s>0$:

$$VF_{sesp}\left[\frac{(mg\ /\ m^3-air)}{(mg\ /\ L-H_2O)}\right]=\frac{H\left[\frac{D_{ws}^{eff}\ /\ L_{GW}}{ER\ L_B}\right]e^{\xi}}{e^{\xi}+\left[\frac{D_{ws}^{eff}\ /\ L_{GW}}{ER\ L_B}\right]+\left[\frac{D_{ws}^{eff}\ /\ L_{GW}}{Q_s\ /\ A_b}\right]\left[e^{\xi}-1\right]}\times 10^3$$

Equation CM-7: Soil Leachate Partition Factor(Ksw)

Equation CM-8: Optional Soil Attenuation Model (SAM) Factor

Equation CM-9: Leachate-Groundwater Dilution Factor (LDF)



CM-7: $$K_{sw}\left[\frac{(mg/L-H_2O)}{(mg/kg-soil)}\right]=\frac{\rho_s}{\theta_{ws}+k_s\rho_s+H\theta_{as}}$$

CM-8: $$SAM[dimensionless]=\frac{L_1}{L_2}$$

CM-9: $$LDF[dimensionless]=1+\frac{V_{gw}\delta_{gw}}{I\cdot W}$$

Effective Diffusion Coefficients

Effective diffusivity in vadose zone soils:

$$D_s^{eff}\left[\frac{cm^2}{s}\right]=D^{air}\ \frac{\theta_{as}^{3.33}}{\theta_T^2}+\left[\frac{D^{wat}}{H}\right]\left[\frac{\theta_{ws}^{3.33}}{\theta_T^2}\right]$$

Effective diffusivity above the water table:

$$D_{ws}^{eff}\left[\frac{cm^2}{s}\right]=(h_c+h_v)\left[\frac{h_c}{D_{cap}^{eff}}+\frac{h_v}{D_s^{eff}}\right]^{-1}$$

Effective diffusivity through foundation cracks:

$$D_{crack}^{eff}\left[\frac{cm^2}{s}\right]=D^{air}\ \frac{\theta_{acrack}^{3.33}}{\theta_T^2}+\left[\frac{D^{wat}}{H}\right]\left[\frac{\theta_{wcrack}^{3.33}}{\theta_T^2}\right]$$

Effective diffusivity in the capillary zone:

$$D_{cap}^{eff}\left[\frac{cm^2}{s}\right]=D^{air}\ \frac{\theta_{acap}^{3.33}}{\theta_T^2}+\left[\frac{D^{wat}}{H}\right]\left[\frac{\theta_{wcap}^{3.33}}{\theta_T^2}\right]$$

Convective Air Flow Through Foundation Cracks

$$\xi=\frac{Q_s\ /\ A_b}{\left(D_{crack}^{eff}\ /\ L_{crack}\right)\cdot\eta}$$

$$Q_s=\frac{2\pi\ \Delta p\ k_v\ X_{crack}}{\mu_{air}\ \ln\left[\frac{2\ Z_{crack}\ X_{crack}}{A_b\ \eta}\right]}$$

FIGURE B.2. CROSS-MEDIA TRANSFER FACTORS IN THE RBCA TOOL KIT

Continued

Continued

Definitions for Cross-Media Transfer Equations

A_b	Area of building foundation (cm^2)
d	Lower depth of surficial soil zone (cm)
d_s	Thickness of affected subsurface soils
D^{air}	Diffusion coefficient in air (cm^2/s)
D^{wat}	Diffusion coefficient in water (cm^2/s)
ER	Enclosed-space air exchange rate (l/s)
f_{oc}	Fraction of organic carbon in soil (g-C/g-soil)
H	Henry's law constant (cm^3-H_2O)/(cm^3-air)
h_c	Thickness of capillary fringe (cm)
h_v	Thickness of vadose zone (cm)
I	Infiltration rate of water through soil (cm/year)
k_{oc}	Carbon-water sorption coefficient (g-H_2O/g-C)
k_s	Soil-water sorption coefficient = foc . koc (g-H_2O/g-soil)
L_B	Enclosed space volume/infiltration area ratio (cm)
L_{crack}	Enclosed space foundation or wall thickness (cm)
L_{GW}	Depth to groundwater = h_{cap} + h_v (cm)
L_s	Depth to subsurface soil sources (cm)
L_1	Thickness of affected soils (cm)
L_2	Distance from top of affected soils to top of water-bearing unit = L_{GW} - L_s (cm)
P_e	Particulate emission rate (g/cm^2-s)
U_{air}	Wind speed above ground surface in ambient mixing zone (cm/s)
V_{gw}	Groundwater Darcy velocity (cm/s)
W	Width of source area parallel to wind, or groundwater flow direction (cm)
X_{crack}	Enclosed space foundation perimeter (cm)
Z_{crack}	Depth to base of enclosed space foundation (cm)
δ_{air}	Ambient air mixing zone height (cm)
δ_{gw}	Groundwater mixing zone thickness (cm)
η	Areal fraction of cracks in foundations/walls (cm^2-cracks/cm^2-total area)
θ_{acap}	Volumetric air content in capillary fringe soils (cm^3-air/cm^3-soil)
θ_{acrack}	Volumetric air content in foundation/wall cracks (cm^3-air/cm^3 total volume)
θ_{as}	Volumetric air content in vadose zone soils (cm^3-air/cm^3-soil)
θ_T	Total soil porosity (cm^3-pore-space/ cm^3-soil)
θ_{wcap}	Volumetric water content in capillary fringe soils (cm^3-H_2O/cm^3-soil)
θ_{wcrack}	Volumetric water content in foundation/wall cracks (cm^3-H_2O)/cm^3 total volume)
θ_{ws}	Volumetric water content in vadose zone soils (cm^3-H_2O/cm^3-soil)
ρ_s	Soil bulk density (g-soil/cm^3-soil)
τ	Averaging time for vapor flux (s)

FIGURE B.2. CROSS-MEDIA TRANSFER FACTORS IN THE RBCA TOOL KIT

Key assumptions incorporated in this model and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: PEF	EFFECT ON CLEANUP STANDARD
• **Uniform COC Concentrations:** Constituent levels uniformly distributed in soil and constant over exposure period.	-----
• **No COC Decay:** No biodegradation or other loss mechanism in soil or vapor phase.	⇩
• **Default Emission Rate:** Conservative particulate emission rate.	⇩

- ***VF_{samb}: Subsurface Soil Volatilization Factor (Equation CM-3)***
The subsurface soil volatilization factor is comparable to the surface volatilization equation, except that the algorithm has been adjusted to account for vapor flux from greater soil depths. The volatilization factor accounts for two cross-media transfer elements: i) organic vapor flux from the subsurface affected soil mass to ground surface and ii) mixing of soil vapors in the ambient air breathing zone directly over the affected soil zone. As with the surface soil volatilization factor, VF_{SS}, the applicable subsurface soil volatilization factor, VFsamb, corresponds to the lesser result of two calculation methods (termed CM-3a and CM-3b on Figure B.2). Equation CM-3a, which corresponds to the expression given in Appendix X3 of ASTM PS-104, assumes a constant source mass in the subsurface and can severely overpredict the soil vapor flux rate. To correct for this problem, Equation CM-3b, which accounts for a mass balance of the volatilized source mass over the exposure period (similar to Equation CM-1b) has been incorporated in the RBCA Tool Kit. With either equation (CM-3a or CM 3-b), dilution of soil vapors in the ambient air breathing zone is estimated using the same box model described for Equation CM-1.

Key assumptions incorporated in this model and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: VF_{samb}	EFFECT ON CLEANUP STANDARD
• **Uniform COC Concentrations:** Constituent levels uniformly distributed in soil and constant over exposure period.	-----
• **No COC Decay:** No biodegradation or other loss mechanism in soil or vapor phase.	⇩
• **Finite Source Term:** Source term mass adjusted for constant volatilization over exposure period.	-----

- ***VF_{sesp}: Subsurface Soil-to-Enclosed-Space Volatilization Factor (Equation CM-4)***
  This factor is the steady-state ratio of the predicted concentration of a chemical constituent in indoor air to the concentration in underlying subsurface soils. Again, two expressions are evaluated: i) Equation CM-4a, which assumes an infinite source mass and is of the same form as Equation CM-3a with a term added to represent diffusion through cracks in the foundation of the building, and ii) Equation CM-4b which accounts for a finite source mass volatilizing at a constant rate over the exposure period. The applicable VFsesp value corresponds to the lesser of these two expressions. The soil-to-enclosed-space volatilization factor incorporates two cross-media transfer elements: i) organic vapor flux from the underlying soil mass through the building floor and ii) mixing of soil vapors with indoor air. Tier 1 default assumptions in the software include: i) a 1% open crack space in the foundation allowing vapors to diffuse into the building and ii) a building air exchange rate of 20 exchanges per day (commercial) or 12 exchanges per day (residential). When used with these default values, the expression yields very conservative results and can represent the controlling pathway for SSTL calculations for many sites. In such case, users are advised to conduct direct air or soil vapor measurements prior to proceeding with remedial measures for this pathway.

  Key assumptions used in this model and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: VF_{sesp}	EFFECT ON CLEANUP STANDARD
• **Uniform COC Concentrations:** Constituent levels uniformly distributed in soil and constant over exposure period.	-----
• **No COC Decay:** No biodegradation or other loss mechanism in soil or vapor phase.	⇩
• **Finite Source Term:** Source term mass adjusted for constant volatilization over exposure period.	-----
• **Default Building Parameters:** Conservative default values for foundation crack area and air exchange rate.	⇩

- ***VF_{wamb}: Groundwater Volatilization Factor (Equation CM-5)***
  The groundwater volatilization factor is the steady-state ratio of the predicted concentration of a chemical constituent in ambient air to the source concentration in underlying affected groundwater. Vapor flux rates from groundwater to soil vapor and thence from soil vapor to ground surface are generally lower than those associated with direct volatilization from affected soils. Consequently, this groundwater-to-ambient-air volatilization factor is typically not significant in comparison to soil volatilization factors (i.e., Equations CM-1 or CM-3). This factor accounts for i) steady-state partitioning of dissolved organic constituents from groundwater to the soil vapor phase, ii) soil vapor flux rates to ground surface, and iii) mixing of soil vapors in the ambient air breathing zone directly over the plume. Dilution of vapors in the breathing zone is estimated using a box model, as described for Equation CM-1 above.

Key assumptions incorporated in this model and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: VF_{wamb}	EFFECT ON CLEANUP STANDARD
• **Vapor Equilibrium:** Soil vapor concentrations reach immediate equilibrium with groundwater source.	⇩
• **No COC Decay:** No biodegradation or other loss mechanism in groundwater or vapor phase.	⇩
• **Infinite Source:** COC mass in source term constant over time.	⇩

- ***VF_{wesp}*: *Groundwater to Enclosed Space Volatilization Factor (Equation CM-6)***
  This factor is the steady-state ratio of the predicted concentration of a chemical constituent in indoor air to the source concentration in the underlying affected groundwater. The algorithm is equivalent to Equation CM-5, modified to address vapor diffusion through a building floor and enclosed space accumulation. Tier 1 default values are the same as those specified for Equation CM-4 and, as noted previously, can provide a relatively conservative (upper-range) estimate of indoor vapor concentrations. If this pathway produces the controlling (minimum) RBSL or SSTL value for a given site, the user is advised to conduct direct air or soil vapor measurements to evaluate the actual need for remedial measures.

  Key assumptions used in this model and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: VF_{wesp}	EFFECT ON CLEANUP STANDARD
• **Vapor Equilibrium:** Soil vapor concentrations reach immediate equilibrium with groundwater source.	⇩
• **No COC Decay:** No biodegradation or other loss mechanism in groundwater or vapor phase.	⇩
• **Infinite Source:** COC mass in source term constant over time.	⇩
• **Default Building Factors:** Conservative default values for foundation crack area and air exchange rate.	⇩

- ***K_{sw}*: *Soil Leachate Partition Factor (Equation CM-7)***
  The soil leachate partition factor is the steady-state ratio between the concentration of an organic constituent in soil pore water and the source concentration on the affected soil mass. This factor is used to represent the release of soil constituents to leachate percolating through the affected soil zone.

  Key assumptions used in this equation and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: K_{SW}	EFFECT ON CLEANUP STANDARD
• **Leachate Equilibrium:** Leachate concentrations reach immediate equilibrium with affected soil source.	⇩
• **No COC Decay:** No biodegradation or other loss mechanism in soil or leachate.	⇩
• **Infinite Source:** COC mass in soil constant over time.	⇩

- ***SAM: Optional Soil Attenuation Model (SAM) factor (Equation CM-8)***
  An optional factor based on the Soil Attenuation Model (see Connor *et al.*, 1997) may be applied to incorporate depth effects by accounting for the sorption of constituents from the leachate onto clean soils underlying the affected soil zone. The presence of clean intervening soils reduces constituent concentrations ultimately delivered to the underlying groundwater. In deeper groundwater systems, wherein a significant thickness of unaffected soils underlies the affected soil zone, neglecting the sorptive capacity of the intervening soils can prove overly conservative. Note that SAM corresponds to movement of *dissolved* constituents through porous media and does not apply to cases involving downward migration of mobile NAPL materials.

  Key assumptions used in this equation and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: SAM	EFFECT ON CLEANUP STANDARD
• **No COC Decay:** No biodegradation or other loss mechanism in soil or leachate.	⇩
• **Infinite Source:** COC mass in soil constant over time.	⇩

- ***LDF: Leachate-Groundwater Dilution Factor (Equation CM-9)***
  The LDF factor accounts for dilution of chemical constituents as leachate from the overlying affected soil zone mixes with groundwater in the underlying water-bearing unit. As indicated on Figure B.1, the leachate dilution factor (LDF) divided by the soil-leachate partition factor (K_{sw}) represents the steady-state ratio between the concentration of a constituent in the groundwater zone and the source concentration in the overlying affected soil. To estimate the leachate dilution factor, a simple box model is used to estimate dilution within a mixing zone in the water-bearing unit directly beneath the affected soil mass (see Equation CM-9, Figure B.2). The leachate volume entering the water-bearing unit is represented by the deep infiltration term, I, which typically falls in the range of 0.5% - 5% of annual site precipitation. For the Tier 1 RBSL calculation, a conservative default infiltration value of 30 cm/year is used, consistent with the example provided in ASTM PS-104, Appendix X3. For many sites, this default value (equivalent to an annual rainfall rate of over 200 in/year) may significantly overestimate actual leachate rates.

  Key assumptions used in this equation and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: LDF	EFFECT ON CLEANUP STANDARD
• **Rainfall Infiltration:** Deep percolation through affected soil assumed to reach water-bearing unit regardless of soil thickness or permeability.	⇩
• **No COC Decay:** No biodegradation or other loss in mechanism groundwater zone.	⇩
• **Default Dilution Parameters:** Conservative default value for infiltration rate.	⇩

Lateral Transport Factors

During lateral transport within air or groundwater, COC concentrations in the flow stream will be diminished due to mixing and attenuation effects (see Figure B.1). Site-specific attenuation factors characterizing COC mass dilution or loss during lateral transport can be estimated using the air dispersion and groundwater transport models provided in the RBCA Tool Kit. Equations for the steady-state analytical transport models incorporated in the RBCA Tool Kit are shown on Figure B.3. The user must provide information regarding COC properties and transport parameters (flow velocities, dispersion coefficients, retardation factors, decay factors, etc.), as required for the selected contaminant transport model. Calculation procedures for lateral air dispersion and groundwater dilution-attenuation factors are described below.

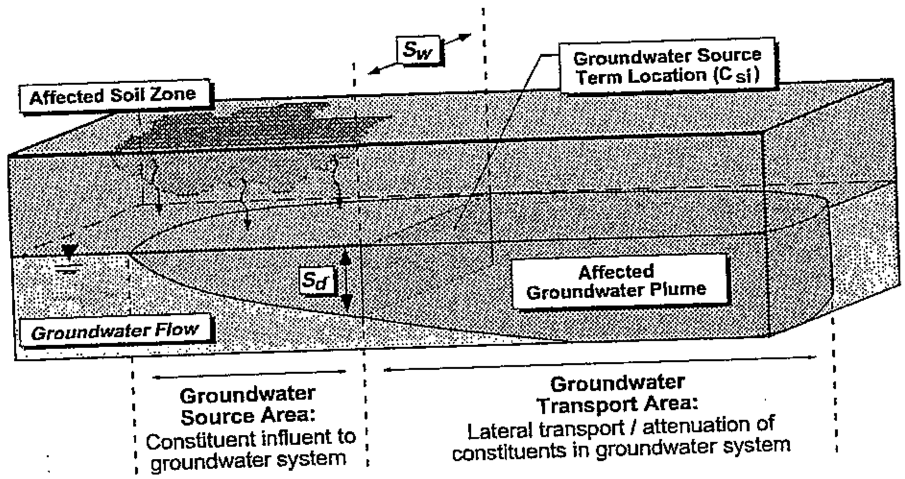
- ***DAF: Lateral Groundwater Dilution Attenuation Factor (Equation LT-1)*** To account for attenuation of affected groundwater concentrations between the source and POE, the Domenico analytical solute transport model has been incorporated into the RBCA Tool Kit. This model uses a partially or completely penetrating vertical plane source, perpendicular to groundwater flow, to simulate the release of constituents from the mixing zone to the migrating groundwater (see Figure B.3). Within the groundwater flow regime, the model accounts for the effects of advection, dispersion, sorption, and biodegradation. Given a representative source zone concentration for each COC, the model can predict steady-state plume concentrations at any point (x, y, z) in the downgradient flow system. In the RBCA Tool Kit, the model is set to predict centerline plume concentrations at any downgradient distance x, based on 1-D advective flow and 3-D dispersion. The receptor well is assumed to be located on the plume centerline, directly downgradient of the source zone at a location specified by the user. Source concentrations and critical flow parameters must be provided by the user. Guidelines for selection of key input parameters are outlined below.

  i) **Groundwater Source Term.** The Domenico model represents the groundwater source term as a vertical plane source, perpendicular to groundwater flow, releasing dissolved constituents into groundwater passing through the plane. In the RBCA Tool Kit, the source plane dimensions are matched to the source width and thickness specified by the user. The user should provide source dimensions equivalent to the measured thickness and transverse width of the groundwater plume at the source point (area of maximum plume concentration). The source is assumed to be constant, with source zone concentrations set equal to the representative COC concentrations supplied by the user. Representative source concentrations must be provided for each COC. These values should correspond to the maximum COC concentrations measured at the plume "core" unless sufficient data are available to describe a representative maximum based on statistical estimates. If non-aqueous phase liquids (NAPLs) are present, maximum COC solubility limits in groundwater can be corrected for mixture effects by using Raoult's Law. For this purpose, the user must provide data regarding the mole fractions of principal NAPL constituents.

  ii) **Flow and Mixing Parameters.** The degree of contaminant mixing predicted by the model will be a function of the dispersion coefficients, hydraulic conductivity, hydraulic flow gradient, and effective soil porosity specified by the user. Hydraulic conductivity and flow gradient should be matched directly to site measurements. In many cases, the effective soil porosity of the water-bearing unit can be reasonably estimated based on soil type using published references. Typical default values are provided in the software. Selection of dispersion coefficients can prove problematic, given the impracticability of direct site measurements. Two dispersivity relationships are incorporated in the RBCA Tool Kit: i) the method employed in ASTM E-1739 (1995) and ii) the Xu and Eckstien (1995) dispersivity model. These relationships allow the user to estimate dispersion coefficients based on the distance from the source to the receptor.

  iii) **Retardation Factors.** The rate of plume migration can be reduced due to constituent sorption to the solid matrix of the water-bearing unit. The user is referred to standard hydrogeologic texts regarding calculation of retardation factors for both inorganic and organic plume constituents. The RBCA Tool Kit calculates a retardation factor for each COC using information on the organic-carbon partition coefficient (k_{OC}) of the constituent and the fraction organic carbon (f_{OC}) of the soil matrix. Sorption can significantly affect the NAF calculation if first-order decay conditions are assumed to apply. However, the retardation factor will not affect model results under steady-state conditions.

  iv) **First-Order Decay Parameters.** Under steady-state conditions, hydrolysis and biodegradation represent the principal mechanisms of organic contaminant mass reduction during groundwater plume transport within the subsurface. Many groundwater transport models account for these attenuation phenomena by means of a first-order decay function within the advection-dispersion equation. In the RBCA Tool Kit, the user may elect to use a version of the Domenico solute transport model incorporating first-order decay (see Equation LT-1a on Figure B.3). Considerable care must be exercised in the selection of a first-order decay coefficient for each COC in order to



SELECTION OF GROUNDWATER MODEL INPUT PARAMETERS

For use of Domenico groundwater solute transport model, select source term location, dimensions, and concentration as follows:

1) ***Groundwater Source Term Location***

The source term corresponds to a vertical source plane, normal to the direction of groundwater flow, located at the downgradient limit of the area serving as the principal source of constituent release to groundwater (e.g., affected unsaturated zone soils, NAPL plume, spill area, etc.). If the point of maximum plume concentration is significantly displaced from the initial suspected point of release, this plume "core" should be used as the source point for the groundwater ingestion pathway. However, the downgradient edge of the affected soil zone should be retained as the source location for the soil-to-groundwater leaching pathway. Distances to downgradient points of exposure (POEs) should then be measured from the applicable source location along the principal direction of groundwater flow.

2) ***Groundwater Source Term Width, S_w***

The width of the source term should be matched to the following dimensions:

i) for groundwater ingestion, the measured groundwater plume width, (as defined by RBSL), perpendicular to the principal direction of groundwater flow at the designated source term location.

ii) for soil-to-groundwater impacts, the maximum width of the affected soil zone (as defined by RBSL), perpendicular to the principal groundwater flow direction.

3) ***Groundwater Source Term Thickness, S_d***

The thickness of the source term should be determined by one of the following methods:

i) measure the vertical extent of the affected groundwater plume at the designated source term location, based on depth-specific groundwater sampling and testing; or

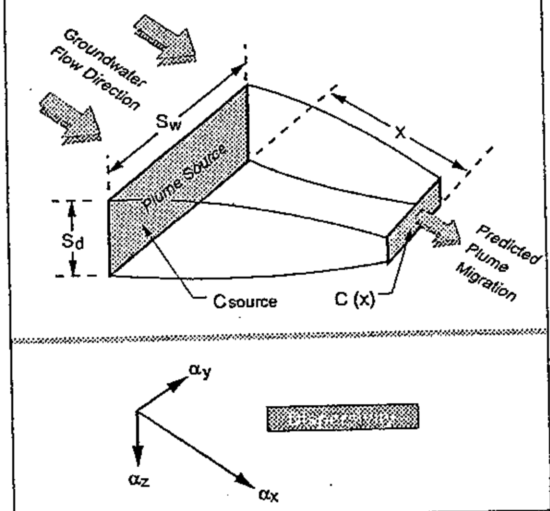
ii) for unconfined water-bearing unit, estimate mixing zone depth at the source location based on the observed magnitude of water table fluctuation.

4) ***Groundwater Source Term Concentration, C_{si}***

To calculate baseline risk levels, the user must also provide a groundwater source concentration C_{si} for each constituent of concern (COC). The vertical plane source acts as a constant source term, applying these input concentrations to all groundwater flowing through the source location. For input to the Domenico model, the source concentration of each COC may be matched to the average concentration (i.e., either mean or 95% UCL) measured across the plume width at the source location.

FIGURE B.3. DEFINITION OF DOMENICO MODEL SOURCE TERM

Equation LT-1: Lateral Groundwater Dilution Attenuation Factor



LT-1a: Solute Transport with First-Order Decay:

$$\frac{C(x)_i}{C_{si}} = \exp\left(\frac{x}{2\alpha_x}\left[1-\sqrt{1+\frac{4\lambda_i\alpha_x R_i}{v}}\right]\right) erf\left(\frac{S_w}{4\sqrt{\alpha_y x}}\right) erf\left(\frac{S_d}{2\sqrt{\alpha_z x}}\right)$$

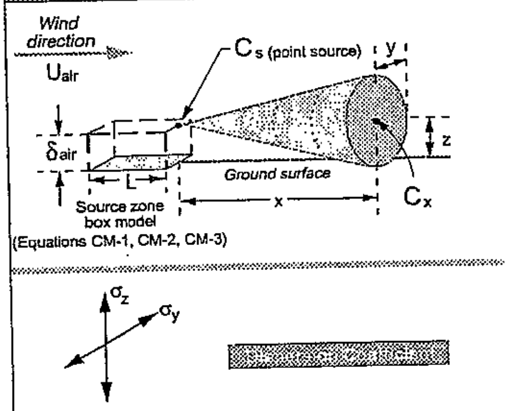
where: $v = \frac{K \cdot i}{\theta_e}$

LT-1b: Solute Transport with Biodegradation by Electron-Acceptor Superposition Method:

$$C(x)_i = \left[(C_{si} + BC_i)\, erf\left(\frac{S_w}{4\sqrt{\alpha_y x}}\right) erf\left(\frac{S_d}{2\sqrt{\alpha_z x}}\right)\right] - BC_i$$

where: $BC_i = BC_T \times \frac{C_{si}}{\Sigma C_{si}}$ and $BC_T = \Sigma \frac{C(ea)_n}{UF_n}$

Equation LT-2: Lateral Air Dispersion Factor



$$\frac{C(x)_i}{C_{si}} = \left(\frac{Q}{2\pi U_{air}\sigma_y\sigma_z}\right)\exp\left(-\frac{y^2}{2\sigma_y^2}\right)\left[\exp\left(-\frac{(z-\delta_{air})^2}{2\sigma_z^2}\right)+\exp\left(-\frac{(z+\delta_{air})^2}{2\sigma_z^2}\right)\right]$$

where: $Q = \frac{U_{air}(\delta_{air})(A)}{L}$

Definitions for Lateral Transport Equations

- $C(x)_i$ — Concentration of constituent *i* at distance x downstream of source (mg/L) or (mg/m^3)
- C_{si} — Concentration of constituent *i* in Source Zone (mg/L) or (mg/m^3)
- BC_i — Biodegradation capacity available for constituent *i*
- BC_T — Total biodegradation capacity of all electron acceptors in groundwater
- $C(ea)_n$ — Concentration of electron acceptor *n* in groundwater
- UF_n — Utilization factor for electron acceptor *n* (i.e., mass ratio of electron acceptor to hydrocarbon consumed in biodegradation reaction)
- x — Distance downgradient of source (cm)
- α_x — Longitudinal groundwater dispersivity (cm)
- α_y — Transverse groundwater dispersivity (cm)
- α_z — Vertical groundwater dispersivity (cm)
- θ_e — Effective soil porosity
- λ_i — First-order degradation rate (day^{-1}) for constituent *i*
- v — Groundwater seepage velocity (cm/day)
- K — Hydraulic conductivity (cm/day)
- R_i — Constituent retardation factor
- i — Hydraulic gradient (cm/cm)
- S_w — Source width (cm)
- S_d — Source depth (cm)
- δ_{air} — Ambient air mixing zone height (cm)
- Q — Air volumetric flow rate through mixing zone (cm^3/s)
- U_{air} — Wind Speed (cm/sec)
- σ_y — Transverse air dispersion coefficient (cm)
- σ_z — Vertical air dispersion coefficient (cm)
- y — Lateral distance from source zone (cm)
- z — Height of breathing zone (assumed equal to δ_{air}) (cm)
- A — Cross-sectional area of air emissions source (cm^2)
- L — Length of air emissions source parallel to wind direction (cm)

FIGURE B.4. LATERAL TRANSPORT EQUATIONS IN THE RBCA TOOL KIT avoid significantly over-predicting or under-predicting actual biodecay rates. An optional method for preliminary selection of decay coefficients is as follows:

Literature Values: Various published references are available regarding decay half-life values for hydrolysis and biodegradation. The chemical/toxicological database in the RBCA Tool Kit includes minimum published decay rate coefficients (representing maximum decay half-lives) for each chemical, and the user may select to use these or enter other values. These first-order decay coefficients are provided for informational purposes and may used for preliminary analyses. Note, however, that the use of minimum published decay rates will not necessarily ensure conservative modeling results (i.e., predict worst-case exposure concentrations and more stringent cleanup standards).

v) **Electron-Limited Biodegradation Rates.** As an alternative to a first-order decay function, the user may select a groundwater contaminant transport model incorporating a direct simulation of in-situ biodegradation processes. To account for stoichiometric constraints, such models commonly simulate solute transport of both organic and electron acceptors with an instantaneous reaction assumption. Given proper characterization of background concentrations of key electron acceptors, source zone COC concentrations, and groundwater flow parameters, these models can generally be relied upon to estimate biodegradation effects on organic plume concentrations at the POE, without the difficulty associated with selection of a site-specific, first-order decay rate. Note, however, that this method is not valid for modeling the sequential degradation of chlorinated compounds.

For this purpose, the RBCA Tool Kit includes a version of the Domenico solute transport model incorporating an electron acceptor superposition algorithm (see Equation LT-1b on Figure B.4), as employed in the BIOSCREEN model (Newell et al., 1996). Based on the biodegradation capacity of electron acceptors present in the groundwater system, this algorithm will correct the non-decayed groundwater plume concentrations predicted by the Domenico model for the effects of organic constituent biodegradation. This calculation procedure is illustrated in Figure B.5 and discussed in further detail below.

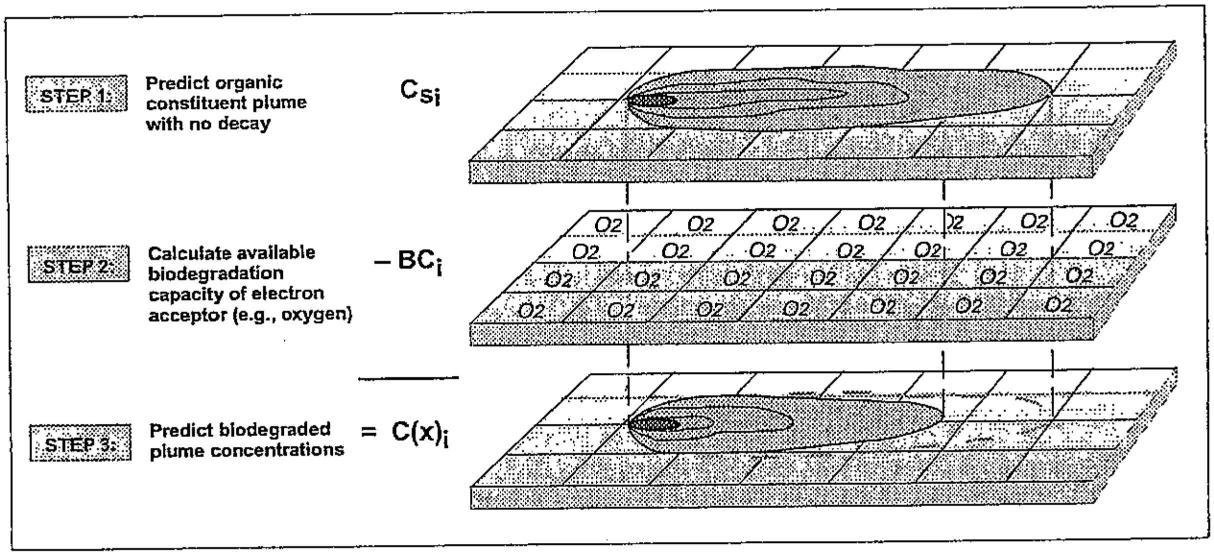


FIGURE B.5. ELECTRON ACCEPTOR SUPERPOSITION METHOD

Based on the stoichiometric equation for the biodegradation reaction, a *utilization factor*, representing the ratio of electron acceptor mass to hydrocarbon mass consumed during biodegradation, can be defined for each electron acceptor. Utilization factors for the principal electron acceptors relating to the degradation of BTEX present in shallow groundwater systems, as reported in the research literature, are summarized on Table B.1.

TABLE B.1 UTILIZATION FACTORS FOR SELECTED ELECTRON ACCEPTORS

ELECTRON ACCEPTOR	UTILIZATION FACTOR (gm/gm)
Oxygen	3.14
Nitrate	4.9
Ferrous Iron (for Ferric Iron)	21.8
Sulfate	4.6
Methane (for Carbon Dioxide)	0.78

Note: "Electron Acceptor" refers to actual electron acceptor or surrogate by-products. Utilization Factor represents the mass ratio of electron acceptor to BTEX quantity consumed (gm/gm) in biodegradation reaction within groundwater. The values listed in this table are for BTEX compounds only. Care should be exercised in selecting appropriate utilization factors for other non-chlorinated hydrocarbons.

Given these values, the potential BTEX mass removal or biodegradation capacity (BC_n) of a given electron acceptor *n* can then be estimated as the concentration of that electron acceptor ($C(ea)_n$) in the groundwater divided by its utilization factor (UF_n). The total biodegradation capacity of the groundwater mass mixing with the BTEX plume is the sum of the individual capacities for each of the principal electron acceptors (i.e., $BC_T = \Sigma BC_n$ for n = oxygen, nitrate, iron, sulfate, etc.). Note that, in this process, *electron acceptors* are defined as three easily measured electron acceptors (dissolved oxygen, nitrate, and sulfate) and surrogate by-products for two other difficult-to-quantify electron acceptors (ferrous iron instead of ferric iron and methane instead of carbon dioxide). The concentrations of the actual electron acceptors are measured in background wells, while the concentration of the by-products are measured in the source zone. For this calculation, using the background concentration of each electron acceptor (oxygen, nitrate, sulfate) from outside the plume will provide an upperbound estimate of BC_T. For a lowerbound estimate, the calculation may be based upon the difference in the electron acceptor concentrations (oxygen, nitrate, sulfate) measured inside and outside the plume area (i.e., $C(ea)_n$*-outside* minus $C(ea)_n$*-inside*), thereby accounting for non-utilization of a portion of the electron acceptor mass.

The total biodegradation capacity of the groundwater mass must be distributed among the various organic constituents present in the dissolved contaminant plume. Compared to the rate of plume transport, biodegradation reactions occur relatively instantaneously upon mixing of a readily degradable organic plume (e.g., monoaromatic hydrocarbons) with the background electron acceptor mass. Given the relatively uniform rate of biodecay of the organic compounds typically present in petroleum hydrocarbon products, the portion of the total biodegradation capacity available for removal of each constituent *i* (BC_i) can be estimated based on the mass percentage of each constituent in the plume (i.e., $BC_i = BC_T \cdot Cs_i/Cs_i$, where Cs_i = source concentration of constituent *i*). This assumption will prove reasonable for mixtures of all-readily degradable compounds, due to the relatively uniform biokinetic rates within these groups. However, within mixed degradable and non-degradable constituent plumes (e.g., benzene with dichloroethane), the readily degradable compounds will actually consume a disproportionate share of the biodegradation capacity.

If the user elects to use the electron acceptor superposition option, the RBCA Tool Kit will i) estimate the total biodegradation capacity (BC_T) of the groundwater mass based on the electron acceptor concentrations provided by the user, ii) allocate an available biodegradation capacity (BC_i) to each of the various dissolved organic constituents based on the concentration data provided by the user, and iii) correct the steady-state plume concentrations predicted by the Domenico solute transport model for the effects of biodegradation using Equation LT-1b (see Figure B.4).

Key assumptions used in the groundwater solute transport model and their effect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: LATERAL GROUNDWATER DAF	EFFECT ON CLEANUP STANDARD
• **Infinite Source:** Groundwater source term constant over time with no depletion.	↓
• **Vertical Dispersion:** Assumes one-directional (downward) vertical dispersion.	↓
• **Infinite Aquifer Thickness:** Neglects boundary effects on vertical dispersion.	↑
• **Dispersion Coefficient:** Fixed proportions assumed among longitudinal, transverse, and vertical dispersion coefficients.	-----
• **Receptor Location:** Downgradient receptor well assumed to be on plume centerline.	↓
• **Biodegradation Rate:** First-order of decay rate may be specified by user per site data.	↑

- ***ADF: Lateral Air Dispersion Factor (Equation LT-2)***
The RBCA Tool Kit includes a 3-dimensional Gaussian dispersion model to account for transport of air-borne contaminants from the source area to a downwind POE (see Equation LT-2 on Figure B.4). The model incorporates two conservative assumptions: i) a source zone height equivalent to the breathing zone and ii) a receptor located directly downwind of the source at all times. As indicated on Figure B.1, an effective pathway NAF value is calculated as the steady-state ratio between the ambient organic vapor or particulate concentration at the downwind POE and the source concentration in the on-site affected soil zone. The model requires input data for the affected soil zone dimensions and concentrations, wind speed, and horizontal and vertical air dispersion coefficients to compute the resulting COC concentrations in ambient air at the POE. Guidelines for estimating key input parameters are provided below:

i) **Air Source Term:** In the RBCA Tool Kit, the source term for the air dispersion model is matched to the ambient air vapor concentrations determined in accordance with the soil-to-air cross-media transfer equations CM-1, CM-2, and CM-3 shown on Figure B.2. Specifically, the source concentration for off-site vapor transport is equivalent to the vapor concentration exiting the box model for the surface soil and subsurface soil volatilization algorithms (see Figure B.2). The model assumes the source zone to be a point source (located in the center of the affected soil area) with the same mass flux as the entire affected soil zone. The off-site receptor is assumed to be located directly downwind of the source point for the full duration of the exposure period. To define the source term, the user must provide the same soil information as required for the volatilization factors (i.e., affected soil zone concentrations, dimensions, etc.).

Please note that for receptors located directly over or adjacent to the affected soil zone (i.e., inside the "mixing zone" for Equations CM-1, CM-2, or CM-3), the Gaussian dispersion model is not needed and can be shut off by entering a value of zero for the distance from the source to the off-site receptor in the RBCA Tool Kit.

ii) **Wind Speed:** Wind speed should be matched to the average annual wind speed through the mixing zone. The model assumes the wind direction to be in a straight line from the source to the specified POE at all times for the full duration of the exposure period. In the RBCA Tool Kit, a default wind speed value of 225 cm/sec (~ 5 mph) is assumed unless the user enters a site-specific value.

iii) **Air Dispersion Coefficients:** Estimating dispersion coefficients requires knowledge of the atmospheric stability class and the distance between the source and POE. Stability is an indicator of atmospheric turbulence and, at any one time, depends upon i) static stability (the change of temperature with height), ii) thermal turbulence (caused by ground heating), and iii) mechanical turbulence (a function of wind speed and roughness). The Pasquill-Gifford system for stability classification is summarized on Figure B.6. Corresponding horizontal and vertical dispersion coefficients for each class are provided on Figure B.7. Stability Class A, which represents extremely unstable air with a high potential for mixing, occurs under low wind conditions and high levels of incoming solar radiation. At the other extreme, Stability Classes E and F represent stable atmospheric conditions, with a lower potential for mixing, and occur with higher wind speeds and greater cloud cover (see DeVaull et al., 1994).

The stability class for a given site can vary with rapidly changing weather conditions. Long-term weather patterns can be characterized on the basis of STAR summaries, comprised of joint frequency distributions of stability class, wind direction, and wind speed, which are available from the National Climatic Data Center in Asheville, North Carolina. Comprehensive atmospheric dispersion models, such as the Industrial Source Complex Long-Term (ISCLT) model, can directly incorporate STAR data to predict constituent dispersion in any direction from the source area. However, due to the complexity and expense of this modeling effort, use of models such as the ISCLT would normally correspond to a Tier 3 evaluation under the RBCA process.

To facilitate a Tier 2 evaluation of downwind receptor impacts, the RBCA Tool Kit employs a simple Gaussian dispersion model to predict maximum exposure concentrations at the POE under steady-state conditions, incorporating the conservative receptor assumptions noted above. A reasonable estimate of downwind COC concentrations can be obtained by assuming a wind turbulence consistent with Stability Class C for the full exposure period. For most locations, Stability Class C (slightly unstable) is representative of average annual conditions over time and can be used to estimate typical dispersion coefficients. Note that, even when these average dispersion coefficients are employed, the exposure concentrations predicted by the RBCA Tool Kit model are likely to be conservative, given that the POE is assumed to be located directly downwind of the source zone at all times during the exposure period.

Key assumptions incorporated in this model and their affect on the SSTL calculation are as follows:

KEY ASSUMPTIONS: LATERAL AIR DISPERSION FACTOR	EFFECT ON CLEANUP STANDARD
• **Source Term:** Vapor source concentration based on steady-state, soil-to-air cross-media equations.	⇩
• **Default Stability Class:** Default dispersion coefficients matched to Class C stability classification (slightly unstable).	-----
• **Receptor Location:** Receptor assumed to be located directly downwind of source zone at all times during exposure period.	⇩

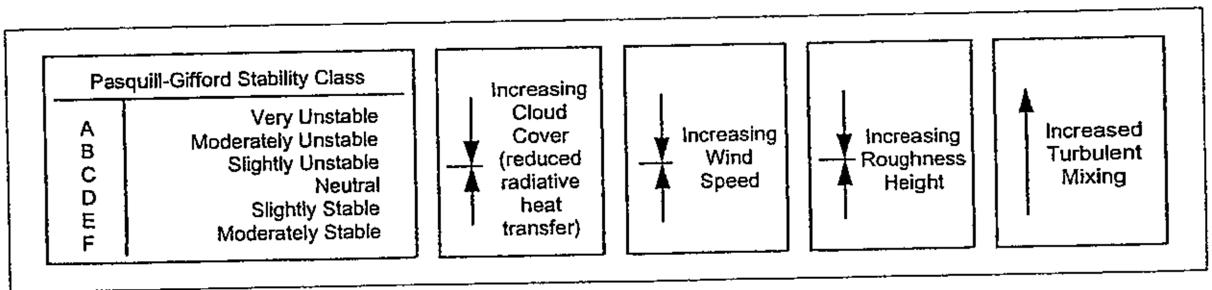


FIGURE B.6. STABILITY CLASSIFICATION FOR AIR TRANSPORT MODELING
SOURCE: DEVAULL ET AL, 1994

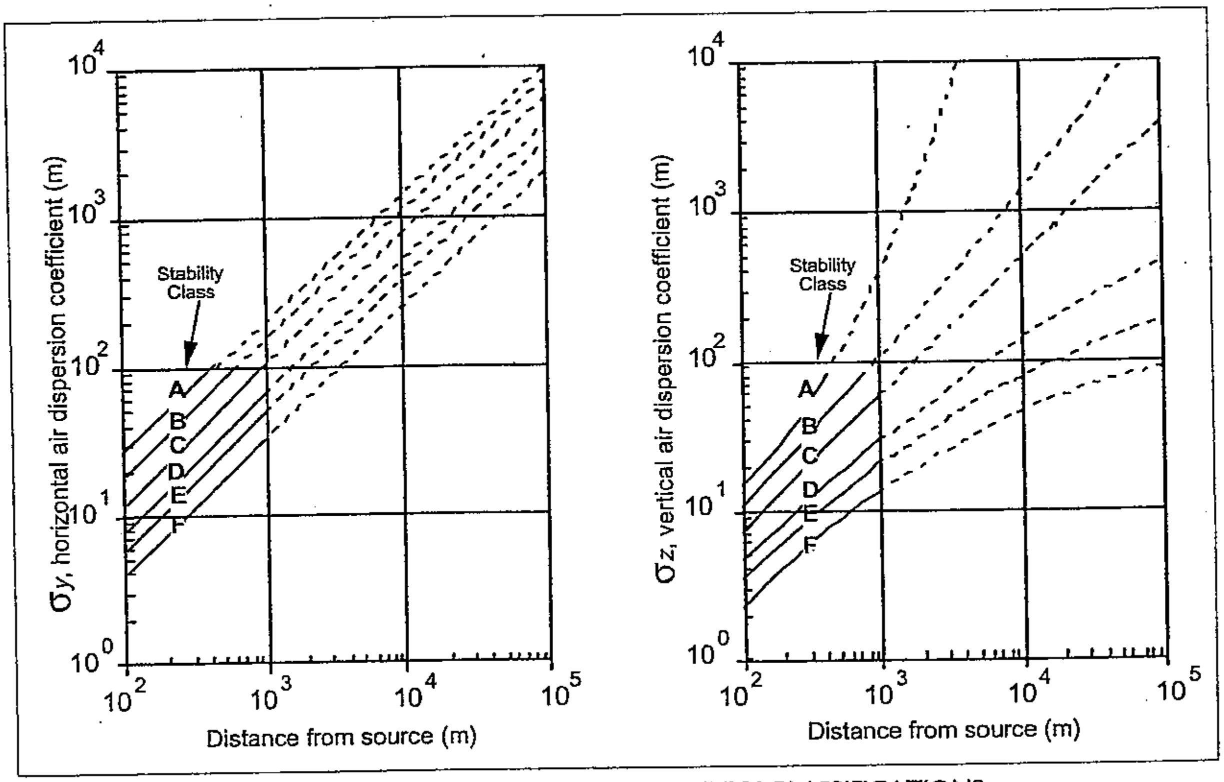


FIGURE B.7. DISPERSION COEFFICIENTS FOR AIR STABILITY CLASSIFICATIONS
SOURCE: EPA, 1988a

APPENDIX C

Chemical Specific Information for BTEX

User-Specified Custom Chemical Database

Chemical Name Benzene

CAS No. 71-43-2 Type A

Physical Properties

	Value	Reference
Molecular weight (g/mol)	78.1	PS
Solubility @ 20-25°C (mg/L)	1750	PS
Vapor pressure @ 20-25°C (mmHg)	95.2	PS
Henry's Law constant @ 20°C ○ (atm-m^3/mol) ◉ unitless (-)	0.22888633	PS
Ionization/dissociation constants (pH units): acid pKa -		
base pKb	-	
Sorption coefficient (log L/kg) ◉ log Koc ○ log Kd	1.77	PS
Diffusion coefficient in air (cm^2/s)	0.088	PS
Diffusion coefficient in water (cm^2/s)	0.0000098	PS

Miscellaneous Parameters

Analytical Detection Limits:

	Value	Reference
Groundwater (mg/L)	0.002	S
Soil (mg/kg)	0.005	S

First-Order Decay Half Lives (days):

	Value	Reference
Saturated	720	
Unsaturated	720	H
Bioconcentration Factor (-)	12.6	

Toxicity Data

	Value	Reference
EPA weight of evidence ☑ Carcinogen	A	
Oral slope factor (1/[mg/kg/day])	0.1	PS
Dermal slope factor (1/[mg/kg/day])	0.1	TX
Inhalation unit risk factor (1/[µg/m^3])	8.2857E-06	PS
Oral reference dose (mg/kg/day)	0.4	R
Dermal reference dose (mg/kg/day)	-	
Inhalation reference conc. (mg/m^3)	0.00595	R

Dermal Exposure

	Value	Reference
Dermal relative adsorption factor (-)	0.5	D
Dermal permeability coefficient (cm/hr)	0.021	
Lag time for dermal exposure (hr)	0.26	
Critical dermal exposure time (hr)	0.63	
Relative contribution of perm. coeff. (-)	0.013	

Regulatory Standards

	Value	Reference
Groundwater MCL (mg/L)	0.005	
Air PEL/TWA (mg/m^3)	3.25	
Aquatic life prot. criterion (mg/L)	-	

Commands and Options

Update Database | Close | Refs. | Restore Values | Print Sheet | Help

User-Specified Custom Chemical Database

Chemical Name Ethylbenzene

CAS No. 100-41-4 Type A

Physical Properties

Parameter	Value	Reference
Molecular weight (g/mol)	106.2	PS
Solubility @ 20-25°C (mg/L)	169	PS
Vapor pressure @ 20-25°C (mmHg)	10	PS
Henry's Law constant @ 20°C ○ (atm-m³/mol) ◉ unitless (-)	0.32497735	PS
Ionization/dissociation constants (pH units): acid pKa	-	
base pKb	-	
Sorption coefficient (log L/kg) ◉ log Koc ○ log Kd	2.56	PS
Diffusion coefficient in air (cm^2/s)	0.075	PS
Diffusion coefficient in water (cm^2/s)	0.0000078	PS

Miscellaneous Parameters

Analytical Detection Limits:

Parameter	Value	Reference
Groundwater (mg/L)	0.002	S
Soil (mg/kg)	0.005	S
First-Order Decay Half Lives (days): Saturated	228	
Unsaturated	228	H
Bioconcentration Factor (-)	1	

Toxicity Data

☐ Carcinogen

Parameter	Value	Reference
EPA weight of evidence	D	
Oral slope factor (1/[mg/kg/day])	-	
Dermal slope factor (1/[mg/kg/day])	-	
Inhalation unit risk factor (1/[µg/m³])	-	
Oral reference dose (mg/kg/day)	0.1	PS
Dermal reference dose (mg/kg/day)	0.097	TX
Inhalation reference conc. (mg/m³)	1	PS

Dermal Exposure

Parameter	Value	Reference
Dermal relative adsorption factor (-)	0.5	D
Dermal permeability coefficient (cm/hr)	0.074	
Lag time for dermal exposure (hr)	0.39	
Critical dermal exposure time (hr)	1.3	
Relative contribution of perm. coeff. (-)	0.14	

Regulatory Standards

Parameter	Value	Reference
Groundwater MCL (mg/L)	0.7	
Air PEL/TWA (mg/m³)	435	
Aquatic life prot. criterion (mg/L)	-	

Commands and Options

Update Database | Close | Refs. | Restore Values | Print Sheet | Help

User-Specified Custom Chemical Database

Chemical Name Toluene

CAS No. 108-88-3 Type A

Physical Properties

	Value	Reference
Molecular weight (g/mol)	92.4	5
Solubility @ 20-25°C (mg/L)	515	29
Vapor pressure @ 20-25°C (mmHg)	30	4
Henry's Law constant @ 20°C ○ *(atm-m^3/mol)* ◉ unitless (-)	0.26	A
Ionization/dissociation constants (pH units): acid pKa - ; base pKb	-	
Sorption coefficient (log L/kg) ◉ log Koc ○ log Kd	2.13	A
Diffusion coefficient in air (cm^2/s)	0.085	A
Diffusion coefficient in water (cm^2/s)	0.0000094	A

Miscellaneous Parameters

Analytical Detection Limits:

	Value	Reference
Groundwater (mg/L)	0.002	S
Soil (mg/kg)	0.005	S

First-Order Decay Half Lives (days):

	Value	Reference
Saturated	28	
Unsaturated	28	H
Bioconcentration Factor (-)	70	

Toxicity Data

	Value	Reference
EPA weight of evidence ☐ Carcinogen	D	
Oral slope factor (1/[mg/kg/day])	-	
Dermal slope factor (1/[mg/kg/day])	-	
Inhalation unit risk factor (1/[µg/m^3])	-	
Oral reference dose (mg/kg/day)	0.2	
Dermal reference dose (mg/kg/day)	0.16	TX
Inhalation reference conc. (mg/m^3)	0.4	

Dermal Exposure

	Value	Reference
Dermal relative adsorption factor (-)	0.5	D
Dermal permeability coefficient (cm/hr)	0.045	
Lag time for dermal exposure (hr)	0.32	
Critical dermal exposure time (hr)	0.77	
Relative contribution of perm. coeff. (-)	0.054	

Regulatory Standards

	Value	Reference
Groundwater MCL (mg/L)	1	
Air PEL/TWA (mg/m^3)	147	ACGIH
Aquatic life prot. criterion (mg/L)	-	

Commands and Options

Update Database | Close | Refs. | Restore Values | Print Sheet | Help

User-Specified Custom Chemical Database

Chemical Name Xylene (mixed isomers)

CAS No. 1330-20-7 Type A

Physical Properties

	Value	Reference
Molecular weight (g/mol)	106.2	5
Solubility @ 20-25°C (mg/L)	198	5
Vapor pressure @ 20-25°C (mmHg)	7	4
Henry's Law constant @ 20°C ○ *(atm-m³/mol)* ◉ unitless (-)	0.29	A
Ionization/dissociation constants (pH units): acid pKa -		
base pKb	-	
Sorption coefficient (log L/kg) ◉ log Koc ○ log Kd	2.38	A
Diffusion coefficient in air (cm^2/s)	0.072	A
Diffusion coefficient in water (cm^2/s)	0.0000085	A

Miscellaneous Parameters

Analytical Detection Limits:

	Value	Reference
Groundwater (mg/L)	0.005	S
Soil (mg/kg)	0.005	S

First-Order Decay Half Lives (days):

	Value	Reference
Saturated	360	
Unsaturated	360	H
Bioconcentration Factor (-)	1	

Toxicity Data

	Value	Reference
EPA weight of evidence ☐ Carcinogen	D	
Oral slope factor (1/[mg/kg/day])	-	
Dermal slope factor (1/[mg/kg/day])	-	
Inhalation unit risk factor (1/[µg/m³])	-	
Oral reference dose (mg/kg/day)	2	
Dermal reference dose (mg/kg/day)	1.84	TX
Inhalation reference conc. (mg/m³)	7	A

Dermal Exposure

	Value	Reference
Dermal relative adsorption factor (-)	0.5	D
Dermal permeability coefficient (cm/hr)	0.08	
Lag time for dermal exposure (hr)	0.39	
Critical dermal exposure time (hr)	1.4	
Relative contribution of perm. coeff. (-)	0.16	

Regulatory Standards

	Value	Reference
Groundwater MCL (mg/L)	10	
Air PEL/TWA (mg/m³)	434	ACGIH
Aquatic life prot. criterion (mg/L)	-	

Commands and Options

Update Database | Close | Refs. | Restore Values | Print Sheet | *Help*

User-Specified Custom Chemical Database

Chemical Name Methyl t-Butyl ether

CAS No. 1634-04-4 Type O

Physical Properties

	Value	Reference
Molecular weight (g/mol)	88.146	5
Solubility @ 20-25°C (mg/L)	48000	A
Vapor pressure @ 20-25°C (mmHg)	249	
Henry's Law constant @ 20°C ( ) (atm-m^3/mol) (●) unitless (-)	0.02379593	
Ionization/dissociation constants (pH units): acid pKa	-	
base pKb	-	
Sorption coefficient (log L/kg) (●) log Koc ( ) log Kd	1.08	A
Diffusion coefficient in air (cm^2/s)	0.07919474	6
Diffusion coefficient in water (cm^2/s)	9.4107E-05	7

Miscellaneous Parameters

Analytical Detection Limits:

	Value	Reference
Groundwater (mg/L)	-	
Soil (mg/kg)	-	

First-Order Decay Half Lives (days):

	Value	Reference
Saturated	360	
Unsaturated	180	H
Bioconcentration Factor (-)	1	

Toxicity Data

	Value	Reference
EPA weight of evidence ☐ Carcinogen		
Oral slope factor (1/[mg/kg/day])	-	
Dermal slope factor (1/[mg/kg/day])	-	
Inhalation unit risk factor (1/[µg/m^3])	-	
Oral reference dose (mg/kg/day)	0.01	31
Dermal reference dose (mg/kg/day)	0.008	TX
Inhalation reference conc. (mg/m^3)	2.9995	R

Dermal Exposure

	Value	Reference
Dermal relative adsorption factor (-)	0.5	
Dermal permeability coefficient (cm/hr)	-	
Lag time for dermal exposure (hr)	-	
Critical dermal exposure time (hr)	-	
Relative contribution of perm. coeff. (-)	-	

Regulatory Standards

	Value	Reference
Groundwater MCL (mg/L)	-	
Air PEL/TWA (mg/m^3)	60	NIOSH
Aquatic life prot. criterion (mg/L)	-	

Commands and Options

Update Database | Close | Refs. | Restore Values | Print Sheet | Help

CHEMICAL DATA FOR SELECTED COCs

Physical Property Data

Constituent	CAS Number	type	Molecular Weight (g/mole) MW	ref	Diffusion Coefficients In air (cm2/s) Dair	ref	Diffusion Coefficients In water (cm2/s) Dwat	ref	log (Koc) or log(Kd) (@ 20 - 25 C) log(L/kg)	partition	ref	Henry's Law Constant (@ 20 - 25 C) (atm-m3) mol	Henry's Law Constant (unitless)	ref	Vapor Pressure (@ 20 - 25 C) (mm Hg)	ref	Solubility (@ 20 - 25 C) (mg/L)	ref	acid pKa	base pKb	ref
Benzene*	71-43-2	A	78.1	PS	8.80E-02	PS	9.80E-06	PS	1.77	Koc	PS	5.55E-03	2.29E-01	PS	9.52E+01	PS	1.75E+03	PS	-	-	-
Toluene	108-88-3	A	92.4	5	8.50E-02	A	9.40E-06	A	2.13	Koc	A	6.30E-03	2.60E-01	A	3.00E+01	4	5.15E+02	29	-	-	-
Ethylbenzene	100-41-4	A	106.2	PS	7.50E-02	PS	7.80E-06	PS	2.56	Koc	PS	7.88E-03	3.25E-01	PS	1.00E+01	PS	1.69E+02	PS	-	-	-
Xylene (mixed isomers)	1330-20-7	A	106.2	5	7.20E-02	A	8.50E-06	A	2.38	Koc	A	7.03E-03	2.90E-01	A	7.00E+00	4	1.98E+02	5	-	-	-
Methyl t-Butyl ether	1634-04-4	O	88.146	5	7.92E-02	6	9.41E-05	7	1.08	Koc	A	5.77E-04	2.38E-02	-	2.49E+02	-	4.80E+04	A	-	-	-

* = Chemical with user-specified data

Site Name: L.C. Smith Trust   Completed By: David Conley   Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, Ca   Date Completed: 14-Dec-06

CHEMICAL DATA FOR SELECTED COCs

Toxicity Data

	Reference Dose (mg/kg/day)				Reference Conc. (mg/m3)		Slope Factors 1/(mg/kg/day)				Unit Risk Factor 1/(µg/m3)			
Constituent	Oral RfD_oral	ref	Dermal (mg/kg/day) RfD_dermal	ref	Inhalation RfC_Inhal	ref	Oral SF_oral	ref	Dermal 1/(mg/kg/day) SF_dermal	ref	Inhalation URF_Inhal	ref	EPA Weight of Evidence	Is Constituent Carcinogenic ?
Benzene*	4.00E-01	R	-	-	5.95E-03	R	1.00E-01	PS	1.00E-01	TX	8.29E-06	PS	A	TRUE
Toluene	2.00E-01	A,R	1.60E-01	TX	4.00E-01	A,R	-	-	-	-	-	-	D	FALSE
Ethylbenzene	1.00E-01	PS	9.70E-02	TX	1.00E+00	PS	-	-	-	-	-	-	D	FALSE
Xylene (mixed isomers)	2.00E+00	A,R	1.84E+00	TX	7.00E+00	A	-	-	-	-	-	-	D	FALSE
Methyl t-Butyl ether	1.00E-02	31	8.00E-03	TX	3.00E+00	R	-	-	-	-	-	-	-	FALSE

* = Chemical with user-specified

Site Name: L.C. Smith Trust

Site Location: 1620 South De

Miscellaneous Chemical Data

Constituent	Maximum Contaminant Level MCL (mg/L)	ref	Time-Weighted Average Workplace Criteria TWA (mg/m3)	ref	Aquatic Life Prot. Criteria AQL (mg/L)	ref	Biocon-centration Factor (L-wat/kg-fish)
Benzene*	5.00E-03	-	3.25E+00	-	-	-	12.6
Toluene	1.00E+00	56 FR 3526 (30 Jan 91)	1.47E+02	ACGIH	-	-	70
Ethylbenzene	7.00E-01	56 FR 3526 (30 Jan 91)	4.35E+02	PS	-	-	1
Xylene (mixed isomers)	1.00E+01	56 FR 3526 (30 Jan 91)	4.34E+02	ACGIH	-	-	1
Methyl t-Butyl ether	-	-	6.00E+01	NIOSH	-	-	1

* = Chemical with user-specified

Site Name: L.C. Smith Trust

Site Location: 1620 South De

CHEMICAL DATA FOR SELECTED COCs

Miscellaneous Chemical Data

Constituent	Dermal Relative Absorp. Factor (unitless)	Water Dermal Permeability Data: Dermal Permeability Coeff. (cm/hr)	Lag time for Dermal Exposure (hr)	Critical Exposure Time (hr)	Relative Contr of Derm Perm Coeff (unitless)	Water/Skin Derm Adsorp Factor (cm/event)	ref	Detection Limits: Groundwater (mg/L)	ref	Soil (mg/kg)	ref	Half Life (First-Order Decay) (days): Saturated	Unsaturated	ref
Benzene*	0.5	0.021	0.26	0.63	0.013	7.3E-2	D	0.002	S	0.005	S	720	720	H
Toluene	0.5	0.045	0.32	0.77	0.054	1.6E-1	D	0.002	S	0.005	S	28	28	H
Ethylbenzene	0.5	0.074	0.39	1.3	0.14	2.7E-1	D	0.002	S	0.005	S	228	228	H
Xylene (mixed isomers)	0.5	0.08	0.39	1.4	0.16	2.9E-1	D	0.005	S	0.005	S	360	360	H
Methyl t-Butyl ether	0.5	-	-	-	-	-	-	-	-	-	-	360	180	H

* = Chemical with user-specified

Site Name: L.C. Smith Trust

Site Location: 1620 South De

RBCA SITE ASSESSMENT

Input Parameter Summary

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca

Completed By: David Conley
Date Completed: 14-Dec-06

Job ID: W236

Exposure Parameters		Residential			Commercial/Industrial	
		Adult	(1-6yrs)	(1-16 yrs)	Chronic	Construc.
AT_c	Averaging time for carcinogens (yr)	70				
AT_n	Averaging time for non-carcinogens (yr)	30			25	1
BW	Body weight (kg)	70	15	35	70	
ED	Exposure duration (yr)	30	6	16	25	1
τ	Averaging time for vapor flux (yr)	30			25	1
EF	Exposure frequency (days/yr)	350			250	180
EF_D	Exposure frequency for dermal exposure	350			250	
IR_w	Ingestion rate of water (L/day)	2			1	
IR_s	Ingestion rate of soil (mg/day)	100	200		50	100
SA	Skin surface area (dermal) (cm^2)	5800		2023	5800	5800
M	Soil to skin adherence factor	1				
ET_{swim}	Swimming exposure time (hr/event)	3				
EV_{swim}	Swimming event frequency (events/yr)	12	12	12		
IR_{swim}	Water ingestion while swimming (L/hr)	0.05	0.5			
SA_{swim}	Skin surface area for swimming (cm^2)	23000		8100		
IR_{fish}	Ingestion rate of fish (kg/yr)	0.025				
FI_{fish}	Contaminated fish fraction (unitless)	1				

Complete Exposure Pathways and Receptors	On-site	Off-site 1	Off-site 2
Groundwater:			
Groundwater Ingestion	Commercial	Residential	Surf. Water
Soil Leaching to Groundwater Ingestion	Commercial	Residential	Surf. Water
Applicable Surface Water Exposure Routes:			
Swimming			Yes
Fish Consumption			Yes
Aquatic Life Protection			No
Soil:			
Direct Ingestion and Dermal Contact	None		
Outdoor Air:			
Particulates from Surface Soils	None	None	None
Volatilization from Soils	Time Wt. Avg.	Residential	None
Volatilization from Groundwater	Time Wt. Avg.	Residential	None
Indoor Air:			
Volatilization from Subsurface Soils	Time Wt. Avg.	NA	NA
Volatilization from Groundwater	Time Wt. Avg.	NA	NA

Receptor Distance from Source Media	On-site	Off-site 1	Off-site 2	(Units)
Groundwater receptor	0	100	20	(ft)
Soil leaching to groundwater receptor	0	100	70	(ft)
Outdoor air inhalation receptor	0	100	NA	(ft)

Target Health Risk Values		Individual	Cumulative
TR_{ab}	Target Risk (class A&B carcinogens)	1.0E-6	1.0E-5
TR_c	Target Risk (class C carcinogens)	1.0E-6	
THQ	Target Hazard Quotient (non-carcinogenic risk)	1.0E+0	1.0E+0

Modeling Options	
RBCA tier	Tier 2
Outdoor air volatilization model	Surface & subsurface models
Indoor air volatilization model	Johnson & Ettinger model
Soil leaching model	ASTM leaching model
Use soil attenuation model (SAM) for leachate?	Yes
Air dilution factor	3-D Gaussian dispersion
Groundwater dilution-attenuation factor	Domenico model w/ biodeg.

NOTE: NA = Not applicable

Surface Parameters		General	Construction	(Units)
A	Source zone area	1.1E+4	NA	(ft^2)
W	Length of source-zone area parallel to wind	3.0E+2	NA	(ft)
W_{gw}	Length of source-zone area parallel to GW flow	7.0E+1		(ft)
U_{air}	Ambient air velocity in mixing zone	6.4E+5		(ft/d)
δ_{air}	Air mixing zone height	6.6E+0		(ft)
P_e	Areal particulate emission rate	NA		(g/cm^2/s)
L_{ss}	Thickness of affected surface soils	5.0E+0		(ft)

Surface Soil Column Parameters		Value			(Units)
h_{cap}	Capillary zone thickness	9.5E-1			(ft)
h_v	Vadose zone thickness	7.0E+0			(ft)
ρ_s	Soil bulk density	1.7E+0			(g/cm^3)
f_{oc}	Fraction organic carbon	1.0E-2			(-)
θ_T	Soil total porosity	3.6E-1			(-)
K_{vs}	Vertical hydraulic conductivity	1.0E-1			(ft/yr)
k_v	Vapor permeability	1.1E-16			(ft^2)
L_{gw}	Depth to groundwater	8.0E+0			(ft)
L_s	Depth to top of affected soils	3.0E+0			(ft)
L_{base}	Depth to base of affected soils	8.0E+0			(ft)
L_{subs}	Thickness of affected soils	5.0E+0			(ft)
pH	Soil/groundwater pH	7.1E+0			(-)
		capillary	vadose	foundation	
θ_w	Volumetric water content	0.35	0.34	0.12	(-)
θ_a	Volumetric air content	0.01	0.02	0.26	(-)

Building Parameters		Residential	Commercial	(Units)
L_b	Building volume/area ratio	NA	9.84E+0	(ft)
A_b	Foundation area	NA	1.00E+2	(ft^2)
X_{crk}	Foundation perimeter	NA	4.00E+1	(ft)
ER	Building air exchange rate	NA	1.99E+1	(1/d)
L_{crk}	Foundation thickness	NA	4.92E-1	(ft)
Z_{crk}	Depth to bottom of foundation slab	NA	4.92E-1	(ft)
η	Foundation crack fraction	NA	1.00E-2	(-)
dP	Indoor/outdoor differential pressure	NA	0.00E+0	(psi)
Q_s	Convective air flow through slab	NA	0.00E+0	(ft^3/d)

Groundwater Parameters		Value	(Units)
δ_{gw}	Groundwater mixing zone depth	1.0E+1	(ft)
I_f	Net groundwater infiltration rate	2.0E+0	(in/yr)
U_{gw}	Groundwater Darcy velocity	3.3E+1	(ft/yr)
V_{gw}	Groundwater seepage velocity	1.6E+2	(ft/yr)
K_s	Saturated hydraulic conductivity	8.2E+3	(ft/yr)
i	Groundwater gradient	4.0E-3	(-)
S_w	Width of groundwater source zone	2.0E+1	(ft)
S_d	Depth of groundwater source zone	1.0E+1	(ft)
θ_{eff}	Effective porosity in water-bearing unit	2.0E-1	(-)
f_{oc-sat}	Fraction organic carbon in water-bearing unit	1.0E-3	(-)
pH_{sat}	Groundwater pH	7.1E+0	(-)
	Biodegradation considered?	1st Order	

Transport Parameters		Off-site 1	Off-site 2	Off-site 1	Off-site 2	(Units)
Lateral Groundwater Transport		Groundwater Ingestion		Soil Leaching to GW		
α_x	Longitudinal dispersivity	1.0E+1	2.0E+0	1.0E+1	7.0E+0	(ft)
α_y	Transverse dispersivity	3.3E+0	6.6E-1	3.3E+0	2.3E+0	(ft)
α_z	Vertical dispersivity	5.0E-1	1.0E-1	5.0E-1	3.5E-1	(ft)
Lateral Outdoor Air Transport		Soil to Outdoor Air Inhal.		GW to Outdoor Air Inhal.		
σ_y	Transverse dispersion coefficient	1.1E+1	NA	1.1E+1	NA	(ft)
σ_z	Vertical dispersion coefficient	7.6E+0	NA	7.6E+0	NA	(ft)
ADF	Air dispersion factor	1.8E+0	NA	3.3E+0	NA	(-)

Surface Water Parameters		Off-site 2	(Units)
Q_{sw}	Surface water flowrate	1800	(ft^3/d)
W_{pl}	Width of GW plume at SW discharge	100	(ft)
δ_{pl}	Thickness of GW plume at SW discharge	2	(ft)
DF_{sw}	Groundwater-to-surface water dilution factor	1.0E+2	(-)

RBCA SITE ASSESSMENT | **User-Specified COC Data**

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

CONSTITUENT	Representative COC Concentration			
	Groundwater		Soils (3 - 8 ft)	
	value (mg/L)	note	value (mg/kg)	note
Benzene*	2.2E-1	Average of	8.7E-1	Average of
Toluene	5.0E-3	all wells sampled	1.6E+0	all soil samples
Ethylbenzene	6.5E-3	on 10/9/06	6.6E-1	
Xylene (mixed isomers)	5.0E-3		7.5E+0	
Methyl t-Butyl ether	1.1E-2		3.6E-1	

*** = Chemical with user-specified data**

Site Name: L.C. Smith Trust

Site Location: 1620 South Delaware Street, San Mateo, Ca

Completed By: David Conley

Date Completed: 14-Dec-06

Job ID: W236

RBCA SITE ASSESSMENT | User-Specified COC Data

CONSTITUENT HALF-LIFE VALUES

CONSTITUENT	Saturated Zone Half-Life (days)	Unsaturated Zone Half-Life (days)
Benzene*	720	720
Toluene	28	28
Ethylbenzene	228	228
Xylene (mixed isomers)	360	360
Methyl t-Butyl ether	360	180

*** = Chemical with user-specified data**

Site Name: L.C. Smith Trust

Site Location: 1620 South Delaware Street, San Mateo, Ca

Completed By: David Conley

Date Completed: 14-Dec-06

Job ID: W236

APPENDIX D

RBCA Tier II Calculation Tables and Modeling Summary Tables

RBCA SITE ASSESSMENT | **Tier 2 Domenico Groundwater Modeling Summary**

Site Name: L.C. Smith Trust   Site Location: 1620 South Delaware Street, ξ Completed By: David Conley   Date Completed: 14-Dec-06

DOMENICO GROUNDWATER MODELING SUMMARY

OFF-SITE GROUNDWATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

SOILS LEACHING TO GROUNDWATER:

INGESTION / SURFACE WATER IMPACT	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc. limit reached? ("■" if yes) ; Time (yr)			
Constituents of Concern	Soil Conc. (mg/kg)	Off-site 1 (100 ft) Residential	Off-site 2 (70 ft) Surf. Water	Off-site 1 (100 ft) Residential	Off-site 2 (70 ft) Surf. Water	Off-site 1 (100 ft) Residential		Off-site 2 (70 ft) Surf. Water	
Benzene*	8.7E-1	5.7E-3	1.1E-2	8.5E-4	2.7E+0	■	5.5E-1	□	NA
Toluene	1.6E+0	6.7E-6	5.6E-5	7.3E+0	8.8E+3	□	NA	□	NA
Ethylbenzene	6.6E-1	1.3E-4	4.0E-4	3.7E+0	3.3E+3	□	NA	□	NA
Xylene (mixed isomers)	7.5E+0	6.3E-3	1.5E-2	7.3E+1	5.9E+4	□	NA	□	NA
Methyl t-Butyl ether	3.6E-1	5.1E-3	1.0E-2	3.7E-1	NC	□	NA	□	NA

NOTE: POE = Point of exposure

RBCA SITE ASSESSMENT | **Tier 2 Domenico Groundwater Modeling Summary**

Site Name: L.C. Smith Trust   Site Location: 1620 South Delaware Street, S Completed By: David Conley   Date Completed: 14-Dec-06

DOMENICO GROUNDWATER MODELING SUMMARY

OFF-SITE GROUNDWATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

GROUNDWATER:

INGESTION / SURFACE WATER IMPACT

	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc reaches limit? ("■" if yes) ; Time (yr)	
Constituents of Concern	Groundwater Conc. (mg/L)	Off-site 1 (100 ft) Residential	Off-site 2 (20 ft) Surf. Water	Off-site 1 (100 ft) Residential	Off-site 2 (20 ft) Surf. Water	Off-site 1 (100 ft) Residential	Off-site 2 (20 ft) Surf. Water
Benzene*	2.2E-1	3.3E-2	1.9E-1	8.5E-4	2.7E+0	■ 3.8E-1	□ NA
Toluene	5.0E-3	9.7E-7	6.6E-4	7.3E+0	8.8E+3	□ NA	□ NA
Ethylbenzene	6.5E-3	1.4E-4	3.6E-3	3.7E+0	3.3E+3	□ NA	□ NA
Xylene (mixed isomers)	5.0E-3	3.2E-4	3.7E-3	7.3E+1	5.9E+4	□ NA	□ NA
Methyl t-Butyl ether	1.1E-2	1.4E-3	9.5E-3	3.7E-1	NC	□ NA	□ NA

NOTE: POE = Point of exposure

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

SURFACE SOILS (3 - 5 ft):
VAPOR INHALATION

	1) Source Medium	2) NAF Value (m^3/kg) Receptor				3) Exposure Medium Outdoor Air: POE Conc. (mg/m^3) (1) / (2)			
	Soil Conc. (mg/kg)	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)
Constituents of Concern		Time Wt. Avg.	Construction Worker	Residential	None	Time Wt. Avg.	Construction Worker	Residential	None
Benzene*	8.7E-1	5.4E+4		1.0E+5		1.6E-5		8.3E-6	
Toluene	1.6E+0	7.6E+4		1.5E+5		2.0E-5		1.0E-5	
Ethylbenzene	6.6E-1	1.3E+5		2.5E+5		5.1E-6		2.6E-6	
Xylene (mixed isomers)	7.5E+0	1.0E+5		2.0E+5		7.2E-5		3.7E-5	
Methyl t-Butyl ether	3.6E-1	3.7E+4		8.0E+4		9.6E-6		4.5E-6	

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

SURFACE SOILS (3 - 5 ft):

VAPOR INHALATION (cont'd)

	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)				5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)			
	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)
Constituents of Concern	Time Wt. Avg.	Construction Worker	Residential	None	Time Wt. Avg.	Construction Worker	Residential	None
Benzene*			4.1E-1				3.4E-6	
Toluene			9.6E-1				1.0E-5	
Ethylbenzene			9.6E-1				2.5E-6	
Xylene (mixed isomers)			9.6E-1				3.5E-5	
Methyl t-Butyl ether			9.6E-1				4.3E-6	

* = Chemical with user-specified data

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr)

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

SUBSURFACE SOILS (5 - 8 ft):

VAPOR INHALATION

	1) Source Medium	2) NAF Value (m^3/kg) Receptor			3) Exposure Medium Outdoor Air: POE Conc. (mg/m^3) (1) / (2)		
Constituents of Concern	Soil Conc. (mg/kg)	On-site (0 ft) Time Wt. Avg.	Off-site 1 (100 ft) Residential	Off-site 2 (0 ft) None	On-site (0 ft) Time Wt. Avg.	Off-site 1 (100 ft) Residential	Off-site 2 (0 ft) None
Benzene*	8.7E-1	1.5E+5	2.6E+5		5.9E-6	3.3E-6	
Toluene	1.6E+0	2.9E+5	5.3E+5		5.3E-6	2.9E-6	
Ethylbenzene	6.6E-1	8.3E+5	1.5E+6		7.9E-7	4.4E-7	
Xylene (mixed isomers)	7.5E+0	5.4E+5	9.7E+5		1.4E-5	7.7E-6	
Methyl t-Butyl ether	3.6E-1	1.5E+4	3.2E+4		2.4E-5	1.1E-5	

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

SUBSURFACE SOILS (5 - 8 ft):

VAPOR INHALATION (cont'd)

	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)			5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)		
	On-site (0 ft)	Off-site 1 (100 ft)	Off-site 2 (0 ft)	On-site (0 ft)	Off-site 1 (100 ft)	Off-site 2 (0 ft)
Constituents of Concern	Time Wt. Avg.	Residential	None	Time Wt. Avg.	Residential	None
Benzene*		4.1E-1			1.4E-6	
Toluene		9.6E-1			2.8E-6	
Ethylbenzene		9.6E-1			4.2E-7	
Xylene (mixed isomers)		9.6E-1			7.4E-6	
Methyl t-Butyl ether		9.6E-1			1.1E-5	

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr)

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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

GROUNDWATER: VAPOR INHALATION

Exposure Concentration

	1) Source Medium	2) NAF Value (m^3/L) Receptor			3) Exposure Medium Outdoor Air: POE Conc. (mg/m^3) (1) / (2)		
Constituents of Concern	Groundwater Conc. (mg/L)	On-site (0 ft) Time Wt. Avg.	Off-site 1 (100 ft) Residential	Off-site 2 (0 ft) None	On-site (0 ft) Time Wt. Avg.	Off-site 1 (100 ft) Residential	Off-site 2 (0 ft) None
Benzene*	2.2E-1	7.5E+6	2.5E+7		2.9E-8	8.6E-9	
Toluene	5.0E-3	7.6E+6	2.6E+7		6.5E-10	2.0E-10	
Ethylbenzene	6.5E-3	8.8E+6	2.9E+7		7.4E-10	2.2E-10	
Xylene (mixed isomers)	5.0E-3	8.4E+6	2.8E+7		6.0E-10	1.8E-10	
Methyl t-Butyl ether	1.1E-2	8.9E+5	3.0E+6		1.2E-8	3.7E-9	

NOTE: NAF = Natural attenuation factor POE = Point of exposure

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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

GROUNDWATER: VAPOR INHALATION (cont'd)

Constituents of Concern	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)			5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)		
	On-site (0 ft) Time Wt. Avg.	Off-site 1 (100 ft) Residential	Off-site 2 (0 ft) None	On-site (0 ft) Time Wt. Avg.	Off-site 1 (100 ft) Residential	Off-site 2 (0 ft) None
Benzene*		4.1E-1			3.6E-9	
Toluene		9.6E-1			1.9E-10	
Ethylbenzene		9.6E-1			2.1E-10	
Xylene (mixed isomers)		9.6E-1			1.7E-10	
Methyl t-Butyl ether		9.6E-1			3.5E-9	

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr)

Site Name: L.C. Smith Trust
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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS

TOTAL PATHWAY EXPOSURE (mg/m^3)

(Sum average expsosure concentrations from soil and groundwater routes.)

	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)
Constituents of Concern	Time Wt. Avg.	Construction Worker	Residential	None
Benzene*			4.8E-6	
Toluene			1.3E-5	
Ethylbenzene			2.9E-6	
Xylene (mixed isomers)			4.3E-5	
Methyl t-Butyl ether			1.5E-5	

Site Name: L.C. Smith Trust
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Date Completed: 14-Dec-06
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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

CARCINOGENIC RISK

Constituents of Concern	(1) EPA Carcinogenic Classification	(2) Total Carcinogenic Exposure (mg/m^3)				(3) Inhalation Unit Risk Factor (µg/m^3)^-1	(4) Individual COC Risk (2) x (3) x 1000			
		On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)		On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)
		Time Wt. Avg.	Construction Worker	Residential	None		Time Wt. Avg.	Construction Worker	Residential	None
Benzene*	A			4.8E-6		8.3E-6			4.0E-8	
Toluene	D									
Ethylbenzene	D									
Xylene (mixed isomers)	D									
Methyl t-Butyl ether	-									
Total Pathway Carcinogenic Risk =									**4.0E-8**	

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca

Completed By: David Conley
Date Completed: 14-Dec-06

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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

OUTDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

TOXIC EFFECTS

	(5) Total Toxicant Exposure (mg/m^3)				(6) Inhalation Reference	(7) Individual COC Hazard Quotient (5) / (6)			
	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)	Conc. (mg/m^3)	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)
Constituents of Concern	Time Wt. Avg.	Construction Worker	Residential	None		Time Wt. Avg.	Construction Worker	Residential	None
Benzene*			1.1E-5		6.0E-3			1.9E-3	
Toluene			1.3E-5		4.0E-1			3.2E-5	
Ethylbenzene			2.9E-6		1.0E+0			2.9E-6	
Xylene (mixed isomers)			4.3E-5		7.0E+0			6.1E-6	
Methyl t-Butyl ether			1.5E-5		3.0E+0			5.0E-6	
Total Pathway Hazard Index =								**1.9E-3**	

Site Name: L.C. Smith Trust
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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

	CARCINOGENIC RISK			
Constituents of Concern	(1) EPA Carcinogenic Classification	(2) Total Carcinogenic Exposure (mg/m^3) Time Wt. Avg.	(3) Inhalation Unit Risk Factor (μg/m^3)^-1	(4) Individual COC Risk (2) x (3) x 1000 Time Wt. Avg.
Benzene*	A		8.3E-6	
Toluene	D			
Ethylbenzene	D			
Xylene (mixed isomers)	D			
Methyl t-Butyl ether	-			

Total Pathway Carcinogenic Risk =

Site Name: L.C. Smith Trust
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Completed By: David Conley
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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

	TOXIC EFFECTS		
	(5) Total Toxicant Exposure (mg/m^3)	(6) Inhalation Reference Concentration (mg/m^3)	(7) Individual COC Hazard Quotient (5) / (6)
Constituents of Concern	Time Wt. Avg.		Time Wt. Avg.
Benzene*		6.0E-3	
Toluene		4.0E-1	
Ethylbenzene		1.0E+0	
Xylene (mixed isomers)		7.0E+0	
Methyl t-Butyl ether		3.0E+0	

Total Pathway Hazard Index =

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

CARCINOGENIC RISK

Constituents of Concern	(1) EPA Carcinogenic Classification	(2) Maximum Carcinogenic Intake Rate (mg/kg/day)			(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3)		
		On-site (0 ft) Commercial	Off-site 1 Residential	Off-site 2 Surf. Water		On-site (0 ft) Commercial	Off-site 1 Residential	Off-site 2 Surf. Water
Benzene*	A	7.5E-4	3.8E-4		1.0E-1	7.5E-5	3.8E-5	
Toluene	D							
Ethylbenzene	D							
Xylene (mixed isomers)	D							
Methyl t-Butyl ether	-							

	On-site (0 ft) Commercial	Off-site 1 Residential	Off-site 2 Surf. Water
Total Pathway Carcinogenic Risk =	**7.5E-5**	**3.8E-5**	

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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

TOXIC EFFECTS

	(5) Maximum Toxicant Intake Rate (mg/kg/day)			(6) Oral Reference Dose (mg/kg/day)	(7) Individual COC Hazard Quotient (5) / (6)		
Constituents of Concern	On-site (0 ft) Commercial	Off-site 1 Residential	Off-site 2 Surf. Water		On-site (0 ft) Commercial	Off-site 1 Residential	Off-site 2 Surf. Water
Benzene*	2.1E-3	9.0E-4		4.0E-1	5.3E-3	2.2E-3	
Toluene	3.4E-4	1.8E-7		2.0E-1	1.7E-3	9.1E-7	
Ethylbenzene	6.4E-5	3.9E-6		1.0E-1	6.4E-4	3.9E-5	
Xylene (mixed isomers)	9.6E-4	1.7E-4		2.0E+0	4.8E-4	8.7E-5	
Methyl t-Butyl ether	3.8E-4	1.4E-4		1.0E-2	3.8E-2	1.4E-2	
Total Pathway Hazard Index =					**4.6E-2**	**1.6E-2**	

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Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

CARCINOGENIC RISK

Constituents of Concern	(1) EPA Carcinogenic Classification	(2) Maximum Carcinogenic Intake Rate (mg/kg/day) (a) via Ingestion — Off-site 2 Surface Water	(2) (b) via Dermal Contact — Off-site 2 Surface Water	(3) Slope Factor (mg/kg/day)^-1 (a) Oral	(3) Slope Factor (b) Dermal	(4) Individual COC Risk (2a)x(3a) + (2b)x(3b) Off-site 2 Surface Water
Benzene*	A	5.7E-8	6.5E-7	1.0E-1	1.0E-1	7.0E-8
Toluene	D					
Ethylbenzene	D					
Xylene (mixed isomers)	D					
Methyl t-Butyl ether	-					

* No dermal slope factor available--oral slope factor used.

Total Pathway Carcinogenic Risk = **7.0E-8**

Site Name: L.C. Smith Trust
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Completed By: David Conley

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RBCA SITE ASSESSMENT

TIER 2 PATHWAY RISK CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAYS ARE ACTIVE)**

TOXIC EFFECTS

Constituents of Concern	(5) Maximum Toxicant Intake Rate (mg/kg/day) (a) via Ingestion — Off-site 2 Surface Water	(5) Maximum Toxicant Intake Rate (mg/kg/day) (b) via Dermal Contact — Off-site 2 Surface Water	(6) Reference Dose (mg/kg/day) (a) Oral	(6) Reference Dose (mg/kg/day) (b) Dermal	(7) Individual COC Hazard Quotient (5a)/(6a) + (5b)/(6b) — Off-site 2 Surface Water
Benzene*	1.3E-7	1.5E-6	4.0E-1	4.0E-1*	4.1E-6
Toluene	4.6E-10	1.1E-8	2.0E-1	1.6E-1	7.3E-8
Ethylbenzene	2.5E-9	1.0E-7	1.0E-1	9.7E-2	1.1E-6
Xylene (mixed isomers)	1.1E-8	4.6E-7	2.0E+0	1.8E+0	2.6E-7
Methyl t-Butyl ether	7.0E-9	NC	1.0E-2	8.0E-3	7.0E-7

* No dermal reference dose available–oral reference dose used.

Total Pathway Hazard Index = **6.2E-6**

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

SOILS (3 - 8 ft): VAPOR

INTRUSION INTO ON-SITE BUILDINGS

Constituents of Concern	1) Source Medium	2) NAF Value (m^3/kg) Receptor	3) Exposure Medium Indoor Air: POE Conc. (mg/m^3) (1) / (2)	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)	5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)
	Soil Conc. (mg/kg)	Time Wt. Avg.	Time Wt. Avg.	Time Wt. Avg.	Time Wt. Avg.
Benzene*	8.7E-1	2.1E+3	4.1E-4		
Toluene	1.6E+0	4.2E+3	3.7E-4		
Ethylbenzene	6.6E-1	1.2E+4	5.5E-5		
Xylene (mixed isomers)	7.5E+0	7.8E+3	9.6E-4		
Methyl t-Butyl ether	3.6E-1	3.3E+2	1.1E-3		

* = Chemical with user-specified data

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr) NAF = Natural attenuation factor POE = Point of exposure

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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

GROUNDWATER: VAPOR INTRUSION INTO ON-SITE BUILDINGS

	Exposure Concentration				
	1) Source Medium	2) NAF Value (m^3/L) Receptor	3) Exposure Medium Indoor Air: POE Conc. (mg/m^3) (1) / (2)	4) Exposure Multiplier (EFxED)/(ATx365) (unitless)	5) Average Inhalation Exposure Concentration (mg/m^3) (3) X (4)
Constituents of Concern	Groundwater Conc. (mg/L)	Time Wt. Avg.	Time Wt. Avg.	Time Wt. Avg.	Time Wt. Avg.
Benzene*	2.2E-1	7.0E+3	3.1E-5		
Toluene	5.0E-3	7.2E+3	6.9E-7		
Ethylbenzene	6.5E-3	8.3E+3	7.8E-7		
Xylene (mixed isomers)	5.0E-3	7.9E+3	6.3E-7		
Methyl t-Butyl ether	1.1E-2	1.5E+3	7.2E-6		

NOTE: AT = Averaging time (days) EF = Exposure frequency (days/yr) ED = Exposure duration (yr) NAF = Natural attenuation factor POE = Point of exposure

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TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS

Constituents of Concern	TOTAL PATHWAY EXPOSURE (mg/m^3) *(Sum average expsosure concentrations from soil and groundwater routes.)* Time Wt. Avg.
Benzene*	
Toluene	
Ethylbenzene	
Xylene (mixed isomers)	
Methyl t-Butyl ether	

Site Name: L.C. Smith Trust Date Completed: 14-Dec-06
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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

SOILS (3 - 8 ft): LEACHING TO GW/ DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING	1) Source Medium	2) NAF Value (L/kg) Receptor	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2)
Constituents of Concern	Soil Conc. (mg/kg)	Off-site 2 (70 ft) Surface Water	Off-site 2 (70 ft) Surface Water
Benzene*	8.7E-1	8.1E+3	1.1E-4
Toluene	1.6E+0	2.8E+6	5.6E-7
Ethylbenzene	6.6E-1	1.7E+5	4.0E-6
Xylene (mixed isomers)	7.5E+0	5.0E+4	1.5E-4
Methyl t-Butyl ether	3.6E-1	3.6E+3	9.9E-5

NOTE: NAF = Natural attenuation factor POE = Point of exposure

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Site Location: 1620 South Delaware Street, San Mateo, Ca
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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

SOILS (3 - 8 ft): LEACHING TO GW/ DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING (cont'd)

Constituents of Concern	4) Exposure Multiplier [(IRxET+SAxZ)xEVxED]/(BWxAT) (L/kg/day) Off-site 2 (70 ft) Surface Water	5) Average Daily Intake Rate (mg/kg/day) (3) x (4) Off-site 2 (70 ft) Surface Water
Benzene*	3.7E-4	4.0E-8
Toluene	1.8E-3	1.0E-9
Ethylbenzene	3.0E-3	1.2E-8
Xylene (mixed isomers)	3.2E-3	4.7E-7
Methyl t-Butyl ether	7.0E-5	7.0E-9

AT = Averaging time (days)	ED = Exposure duration (yr)	EV = Event frequency (yr^-1)	SA = Skin exposure area (cm^2/day)
BW = Body weight (kg)	ET = Exposure time (hr)	IR = Ingestion rate (L/hr)	Z = Water/skin dermal adsorp. factor (cm)

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

SOILS (3 - 8 ft): LEACHING TO GW/ DISCHARGE TO SURFACE WATER/ FISH CONSUMPTION

Exposure Concentration

Constituents of Concern	1) Source Medium Soil Conc. (mg/kg)	2) NAF Value (L/kg) Receptor Off-site 2 (70 ft) Surface Water	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2) Off-site 2 (70 ft) Surface Water
Benzene*	8.7E-1	8.1E+3	1.1E-4
Toluene	1.6E+0	2.8E+6	5.6E-7
Ethylbenzene	6.6E-1	1.7E+5	4.0E-6
Xylene (mixed isomers)	7.5E+0	5.0E+4	1.5E-4
Methyl t-Butyl ether	3.6E-1	3.6E+3	9.9E-5

NOTE: NAF = Natural attenuation factor POE = Point of exposure

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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

SOILS (3 - 8 ft): LEACHING TO GW/ DISCHARGE TO SURFACE WATER/ FISH CONSUMPTION (cont'd) **Constituents of Concern**	4) Exposure Multiplier (IRxFIxBCFxED)/(BWxAT) (L/kg/day) Off-site 2 (70 ft) Surface Water	5) Average Daily Intake Rate (mg/kg/day) (3) x (4) Off-site 2 (70 ft) Surface Water
Benzene*	5.3E-6	5.6E-10
Toluene	6.8E-5	3.8E-11
Ethylbenzene	9.8E-7	3.9E-12
Xylene (mixed isomers)	9.8E-7	1.5E-10
Methyl t-Butyl ether	9.8E-7	9.7E-11

AT = Averaging time (days)	BDF = Bioconc. Factor (-)	FI = Affected fish fraction (-)
BW = Body weight (kg)	ED = Exposure duration (yr)	IR = Ingestion rate (kg/yr)

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Site Location: 1620 South Delaware Street, Sa Date Completed: 14-Dec-06

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

GROUNDWATER: DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING

Constituents of Concern	1) Source Medium Groundwater Conc. (mg/L)	2) NAF Value (unitless) Receptor Off-site 2 (20 ft) Surface Water	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2) Off-site 2 (20 ft) Surface Water
Benzene*	2.2E-1	1.1E+2	1.9E-3
Toluene	5.0E-3	7.7E+2	6.5E-6
Ethylbenzene	6.5E-3	1.8E+2	3.6E-5
Xylene (mixed isomers)	5.0E-3	1.4E+2	3.6E-5
Methyl t-Butyl ether	1.1E-2	1.2E+2	9.4E-5

NOTE: NAF = Natural attenuation factor POE = Point of exposure

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RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

GROUNDWATER: DISCHARGE TO SURFACE WATER / DERMAL CONTACT & INGESTION VIA SWIMMING (cont'd)	4) Exposure Multiplier [(IRxET+SAxZ)xEVxED]/(BWxAT) (L/kg/day)	5) Average Daily Intake Rate (mg/kg/day) (3) x (4)
Constituents of Concern	Off-site 2 (20 ft) Surface Water	Off-site 2 (20 ft) Surface Water
Benzene*	3.7E-4	7.0E-7
Toluene	1.8E-3	1.2E-8
Ethylbenzene	3.0E-3	1.1E-7
Xylene (mixed isomers)	3.2E-3	1.2E-7
Methyl t-Butyl ether	7.0E-5	6.6E-9

AT = Averaging time (days)	ED = Exposure duration (yr)	EV = Event frequency (yr^-1)	SA = Skin exposure area (cm^2/day)
BW = Body weight (kg)	ET = Exposure time (hr)	IR = Ingestion rate (L/hr)	Z = Water/skin dermal adsorp. factor (cm)

Site Name: L.C. Smith Trust Completed By: David Conley Job ID: W236
Site Location: 1620 South Delaware Street, San I Date Completed: 14-Dec-06

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

GROUNDWATER: DISCHARGE TO SURFACE WATER / FISH CONSUMPTION

	1) Source Medium	2) NAF Value (unitless) Receptor	3) Exposure Medium Surface Water: POE Conc. (mg/L) (1)/(2)
Constituents of Concern	Groundwater Conc. (mg/L)	Off-site 2 (20 ft) Surface Water	Off-site 2 (20 ft) Surface Water
Benzene*	2.2E-1	1.1E+2	1.9E-3
Toluene	5.0E-3	7.7E+2	6.5E-6
Ethylbenzene	6.5E-3	1.8E+2	3.6E-5
Xylene (mixed isomers)	5.0E-3	1.4E+2	3.6E-5
Methyl t-Butyl ether	1.1E-2	1.2E+2	9.4E-5

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

SURFACE WATER EXPOSURE PATHWAYS

GROUNDWATER: DISCHARGE TO SURFACE WATER / FISH CONSUMPTION (cont'd)

Constituents of Concern	4) Exposure Multiplier (IRxFIxBCFxED)/(BWxAT) (L/kg/day) Off-site 2 (20 ft) Surface Water	5) Average Daily Intake Rate (mg/kg/day) (3) x (4) Off-site 2 (20 ft) Surface Water	MAXIMUM PATHWAY INTAKE (mg/kg/day) *(Maximum intake of active pathways soil leaching & groundwater routes.)* Off-site 2 Surface Water
Benzene*	5.3E-6	1.0E-8	7.1E-7
Toluene	6.8E-5	4.5E-10	1.2E-8
Ethylbenzene	9.8E-7	3.5E-11	1.1E-7
Xylene (mixed isomers)	9.8E-7	3.6E-11	4.7E-7
Methyl t-Butyl ether	9.8E-7	9.2E-11	7.1E-9

AT = Averaging time (days)	BDF = Bioconcentration factor (-)	FI = Affected fish fraction (-)
BW = Body weight (kg)	ED = Exposure duration (yr)	IR = Ingestion rate (kg/yr)

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca

Completed By: David Conley
Date Completed: 14-Dec-06

Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 TRANSIENT DOMENICO ANALYSIS

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, C Date Completed: 14-Dec-06

Constiuent: Benzene*

Source Medium: Affected Groundwater

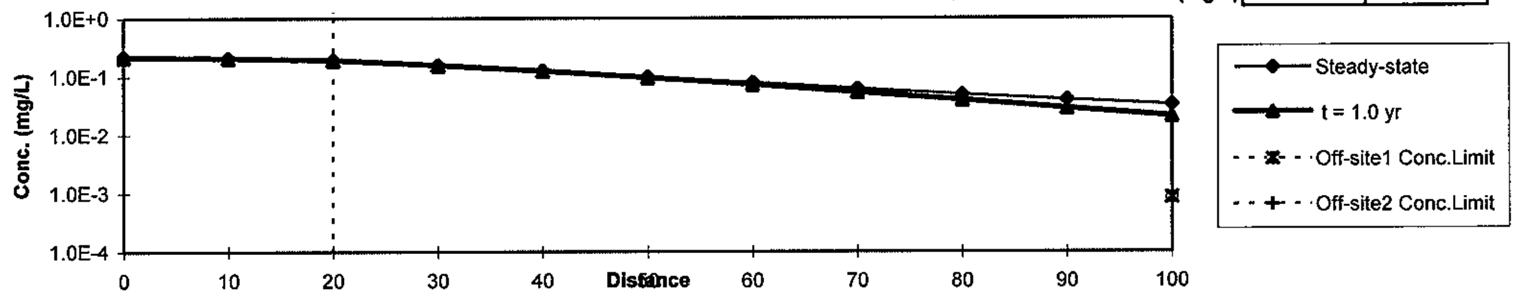
Biodegredation: 1st Order

Concentration vs. Distance from Source (for given time)

Time (yr) 1.0

Distance (ft)		0	10	20	30	40	50	60	70	80	90	100
t = 1.0 yr	Conc. (mg/L)	2.2E-1	2.1E-1	1.9E-1	1.6E-1	1.2E-1	9.6E-2	7.3E-2	5.4E-2	3.9E-2	2.9E-2	2.1E-2
Steady-state		2.2E-1	2.1E-1	1.9E-1	1.6E-1	1.3E-1	9.9E-2	7.8E-2	6.2E-2	5.0E-2	4.0E-2	3.3E-2

	Off-site1	Off-site2
	Residential	Surf. Water
	100	20
	2.1E-2	1.9E-1
	3.3E-2	1.9E-1
POE Concentration Limit (mg/L)	8.5E-4	2.7E+0



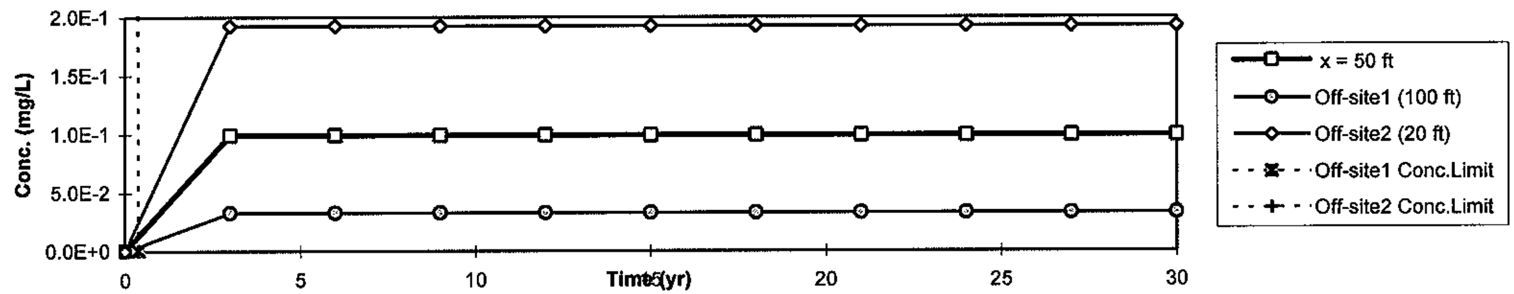
Concentration vs. Time (for given distance from source)

Distance (ft) 50

Time (yr)		0	3	6	9	12	15	18	21	24	27	30
x = 50 ft	Conc. (mg/L)	0.0E+0	9.9E-2	9.9E-2	9.9E-2	9.9E-2	9.9E-2	9.9E-2	9.9E-2	9.9E-2	9.9E-2	9.9E-2
Off-site1 (100 ft)		0.0E+0	3.3E-2	3.3E-2	3.3E-2	3.3E-2	3.3E-2	3.3E-2	3.3E-2	3.3E-2	3.3E-2	3.3E-2
Off-site2 (20 ft)		0.0E+0	1.9E-1	1.9E-1	1.9E-1	1.9E-1	1.9E-1	1.9E-1	1.9E-1	1.9E-1	1.9E-1	1.9E-1

Time to Reach Conc. Limit (yr)

Off-site1	0.4
Off-site2	NA



RBCA SITE ASSESSMENT

TIER 2 TRANSIENT DOMENICO ANALYSIS

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, C | Date Completed: 14-Dec-06

Constiuent: Toluene

Source Medium: Affected Groundwater

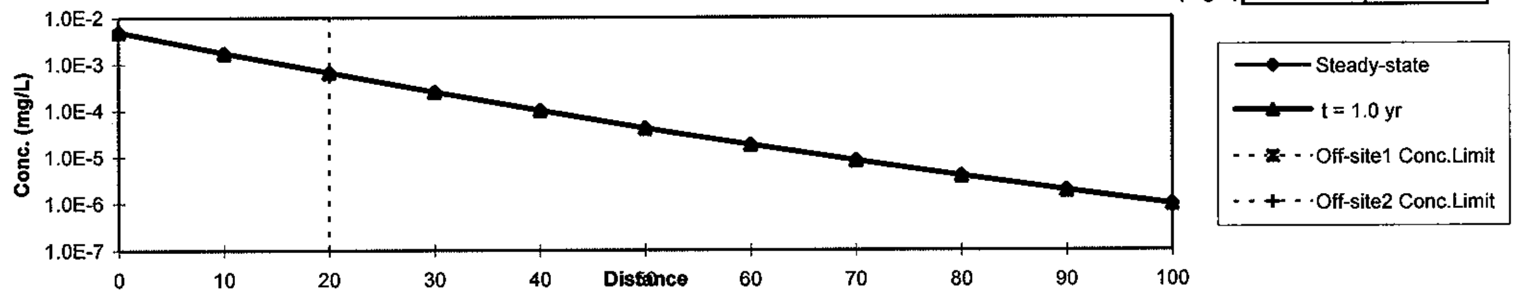
Biodegredation: 1st Order

Concentration vs. Distance from Source (for given time)

Time (yr) 1.0

Distance (ft)		0	10	20	30	40	50	60	70	80	90	100
t = 1.0 yr	Conc. (mg/L)	5.0E-3	1.7E-3	6.6E-4	2.5E-4	1.0E-4	4.1E-5	1.8E-5	8.2E-6	3.9E-6	1.9E-6	9.6E-7
Steady-state		5.0E-3	1.7E-3	6.6E-4	2.5E-4	1.0E-4	4.2E-5	1.8E-5	8.2E-6	3.9E-6	1.9E-6	9.7E-7

	Off-site1	Off-site2
	Residential	Surf. Water
	100	20
	9.6E-7	6.6E-4
	9.7E-7	6.6E-4
POE Concentration Limit (mg/L)	7.3E+0	8.8E+3



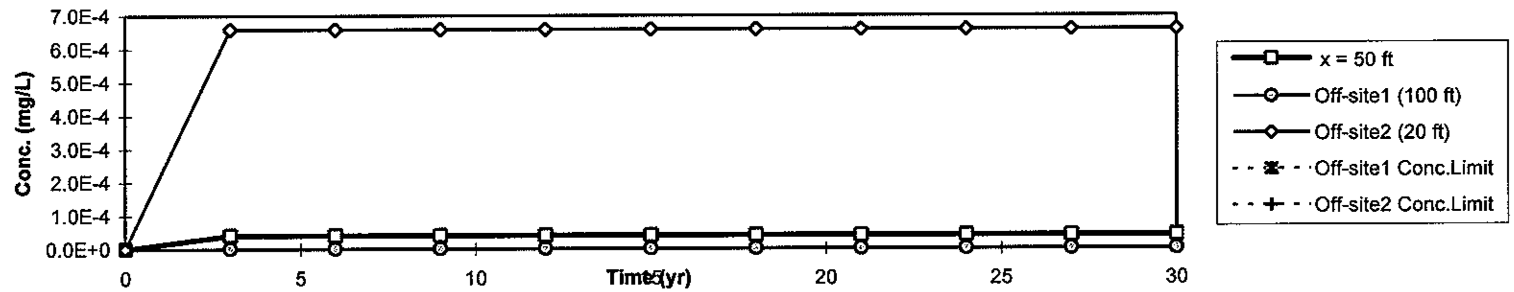
Concentration vs. Time (for given distance from source)

Distance (ft) 50

Time (yr)		0	3	6	9	12	15	18	21	24	27	30
x = 50 ft	Conc. (mg/L)	0.0E+0	4.2E-5	4.2E-5	4.2E-5	4.2E-5	4.2E-5	4.2E-5	4.2E-5	4.2E-5	4.2E-5	4.2E-5
Off-site1 (100 ft)		0.0E+0	9.7E-7	9.7E-7	9.7E-7	9.7E-7	9.7E-7	9.7E-7	9.7E-7	9.7E-7	9.7E-7	9.7E-7
Off-site2 (20 ft)		0.0E+0	6.6E-4	6.6E-4	6.6E-4	6.6E-4	6.6E-4	6.6E-4	6.6E-4	6.6E-4	6.6E-4	6.6E-4

Time to Reach Conc. Limit (yr)

Off-site1	NA
Off-site2	NA



RBCA SITE ASSESSMENT

TIER 2 TRANSIENT DOMENICO ANALYSIS

Site Name: L.C. Smith Trust
Completed By: David Conley
Job ID: W236
Site Location: 1620 South Delaware Street, San Mateo, C
Date Completed: 14-Dec-06

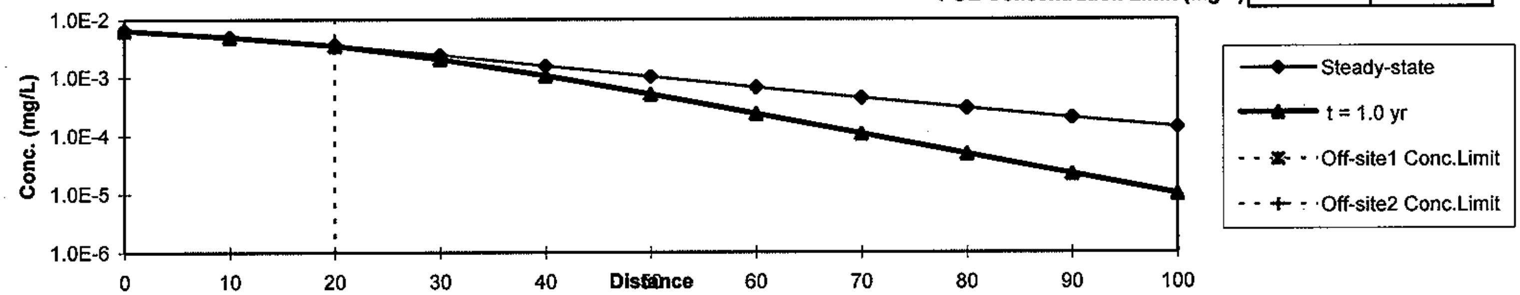
Constiuent: Ethylbenzene
Source Medium: Affected Groundwater
Biodegredation: 1st Order

Concentration vs. Distance from Source (for given time)

Time (yr) 1.0

Distance (ft)		0	10	20	30	40	50	60	70	80	90	100
t = 1.0 yr	Conc. (mg/L)	6.5E-3	5.0E-3	3.5E-3	2.1E-3	1.1E-3	5.1E-4	2.4E-4	1.1E-4	4.9E-5	2.2E-5	1.0E-5
Steady-state		6.5E-3	5.0E-3	3.6E-3	2.4E-3	1.6E-3	1.0E-3	6.7E-4	4.4E-4	3.0E-4	2.0E-4	1.4E-4

	Off-site1	Off-site2
	Residential	Surf. Water
	100	20
	1.0E-5	3.5E-3
	1.4E-4	3.6E-3
POE Concentration Limit (mg/L)	3.7E+0	3.3E+3



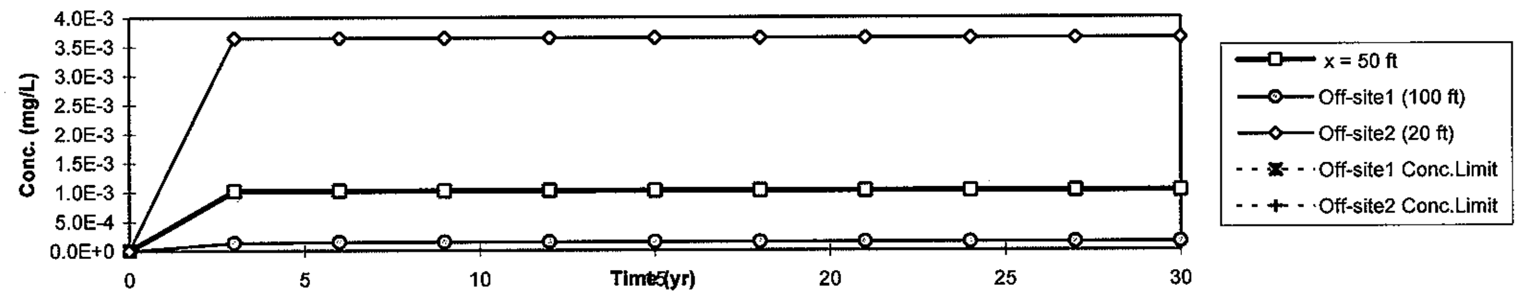
Concentration vs. Time (for given distance from source)

Distance (ft) 50

Time (yr)		0	3	6	9	12	15	18	21	24	27	30
x = 50 ft	Conc. (mg/L)	0.0E+0	1.0E-3	1.0E-3	1.0E-3	1.0E-3	1.0E-3	1.0E-3	1.0E-3	1.0E-3	1.0E-3	1.0E-3
Off-site1 (100 ft)		0.0E+0	1.3E-4	1.4E-4	1.4E-4	1.4E-4	1.4E-4	1.4E-4	1.4E-4	1.4E-4	1.4E-4	1.4E-4
Off-site2 (20 ft)		0.0E+0	3.6E-3	3.6E-3	3.6E-3	3.6E-3	3.6E-3	3.6E-3	3.6E-3	3.6E-3	3.6E-3	3.6E-3

Time to Reach Conc. Limit (yr)

Off-site1	NA
Off-site2	NA



RBCA SITE ASSESSMENT

TIER 2 TRANSIENT DOMENICO ANALYSIS

Site Name: L.C. Smith Trust — Completed By: David Conley — Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, C Date Completed: 14-Dec-06

Constiuent: Xylene (mixed isomers)

Source Medium: Affected Groundwater

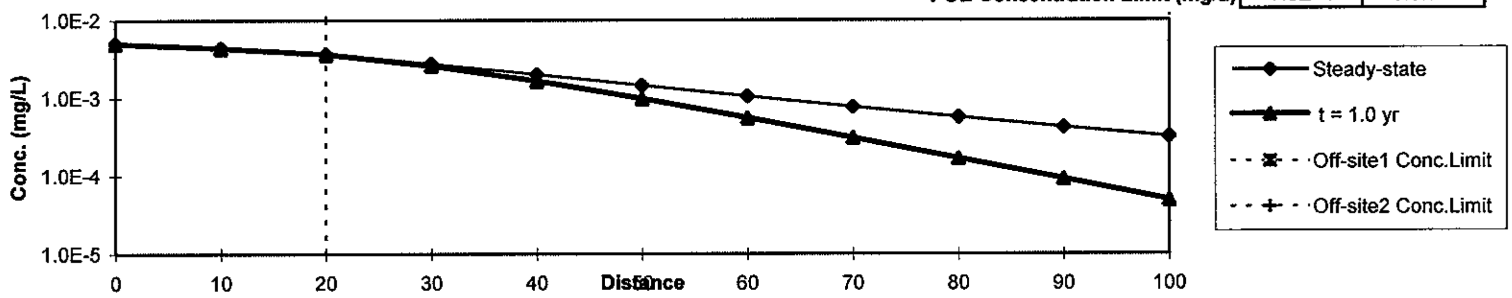
Biodegredation: 1st Order

Concentration vs. Distance from Source (for given time)

Time (yr) 1.0

Distance (ft)		0	10	20	30	40	50	60	70	80	90	100
t = 1.0 yr	Conc. (mg/L)	5.0E-3	4.4E-3	3.7E-3	2.6E-3	1.7E-3	9.9E-4	5.6E-4	3.1E-4	1.7E-4	9.2E-5	5.0E-5
Steady-state		5.0E-3	4.4E-3	3.7E-3	2.8E-3	2.0E-3	1.5E-3	1.1E-3	7.7E-4	5.7E-4	4.3E-4	3.2E-4

	Off-site1	Off-site2
	Residential	Surf. Water
	100	20
	5.0E-5	3.7E-3
	3.2E-4	3.7E-3
POE Concentration Limit (mg/L)	7.3E+1	5.9E+4



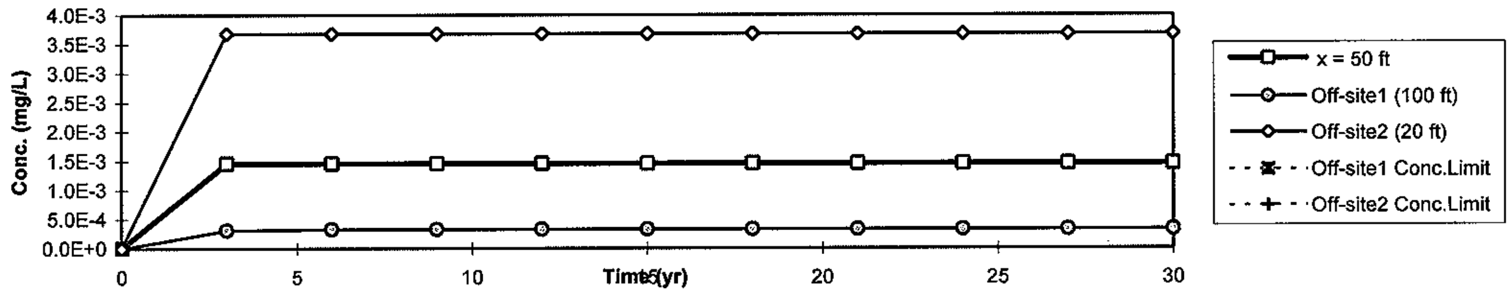
Concentration vs. Time (for given distance from source)

Distance (ft) 50

Time (yr)		0	3	6	9	12	15	18	21	24	27	30
x = 50 ft	Conc. (mg/L)	0.0E+0	1.5E-3	1.5E-3	1.5E-3	1.5E-3	1.5E-3	1.5E-3	1.5E-3	1.5E-3	1.5E-3	1.5E-3
Off-site1 (100 ft)		0.0E+0	3.1E-4	3.2E-4	3.2E-4	3.2E-4	3.2E-4	3.2E-4	3.2E-4	3.2E-4	3.2E-4	3.2E-4
Off-site2 (20 ft)		0.0E+0	3.7E-3	3.7E-3	3.7E-3	3.7E-3	3.7E-3	3.7E-3	3.7E-3	3.7E-3	3.7E-3	3.7E-3

Time to Reach Conc. Limit (yr)

Off-site1	NA
Off-site2	NA



RBCA SITE ASSESSMENT | **TIER 2 TRANSIENT DOMENICO ANALYSIS**

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, C Date Completed: 14-Dec-06

Constiuent: Methyl t-Butyl ether

Source Medium: Affected Groundwater

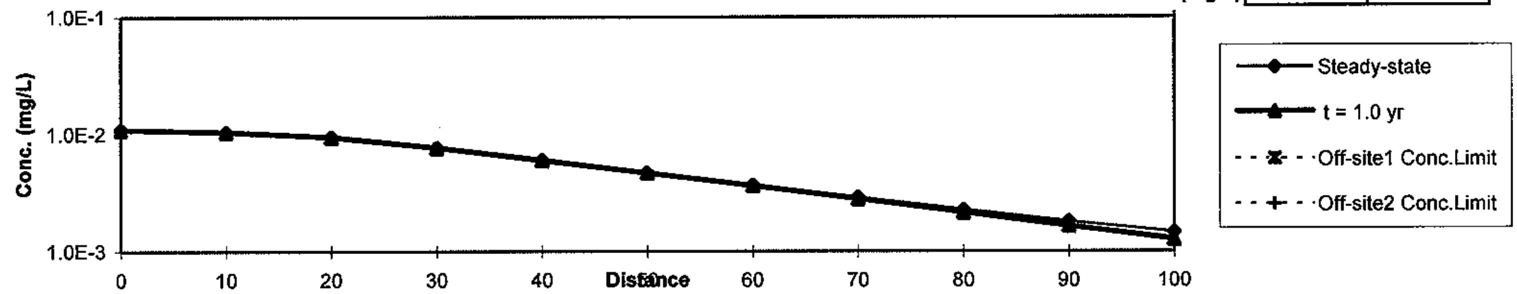
Biodegredation: 1st Order

Concentration vs. Distance from Source (for given time)

Time (yr) 1.0

Distance (ft)		0	10	20	30	40	50	60	70	80	90	100
t = 1.0 yr	Conc. (mg/L)	1.1E-2	1.0E-2	9.5E-3	7.7E-3	6.0E-3	4.7E-3	3.6E-3	2.8E-3	2.1E-3	1.6E-3	1.3E-3
Steady-state		1.1E-2	1.0E-2	9.5E-3	7.7E-3	6.0E-3	4.7E-3	3.7E-3	2.9E-3	2.3E-3	1.8E-3	1.4E-3

	Off-site1	Off-site2
	Residential	Surf. Water
	100	20
	1.3E-3	9.5E-3
	1.4E-3	9.5E-3
POE Concentration Limit (mg/L)	3.7E-1	#VALUE!



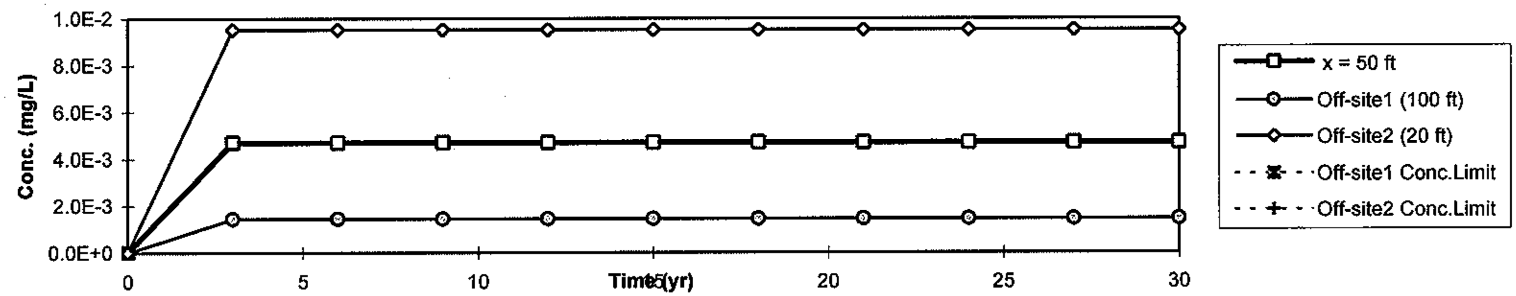
Concentration vs. Time (for given distance from source)

Distance (ft) 50

Time (yr)		0	3	6	9	12	15	18	21	24	27	30
x = 50 ft	Conc. (mg/L)	0.0E+0	4.7E-3	4.7E-3	4.7E-3	4.7E-3	4.7E-3	4.7E-3	4.7E-3	4.7E-3	4.7E-3	4.7E-3
Off-site1 (100 ft)		0.0E+0	1.4E-3	1.4E-3	1.4E-3	1.4E-3	1.4E-3	1.4E-3	1.4E-3	1.4E-3	1.4E-3	1.4E-3
Off-site2 (20 ft)		0.0E+0	9.5E-3	9.5E-3	9.5E-3	9.5E-3	9.5E-3	9.5E-3	9.5E-3	9.5E-3	9.5E-3	9.5E-3

Time to Reach Conc. Limit (yr)

Off-site1	NA
Off-site2	NA



RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

SOILS (3 - 8 ft): LEACHING TO GROUNDWATER INGESTION

	1) Source Medium	2) NAF Value (L/kg) Receptor			3) Exposure Medium Groundwater: POE Conc. (mg/L) (1)/(2)		
Constituents of Concern	Soil Conc. (mg/kg)	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (70 ft) Surf. Water	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (70 ft) Surf. Water
Benzene*	8.7E-1	2.3E+1	1.5E+2		3.8E-2	5.7E-3	
Toluene	1.6E+0	4.5E+1	2.3E+5		3.4E-2	6.7E-6	
Ethylbenzene	6.6E-1	1.1E+2	5.2E+3		5.9E-3	1.3E-4	
Xylene (mixed isomers)	7.5E+0	7.6E+1	1.2E+3		9.8E-2	6.3E-3	
Methyl t-Butyl ether	3.6E-1	9.3E+0	7.1E+1		3.9E-2	5.1E-3	

* = Chemical with user-specified data

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS

SOILS (3 - 8 ft): LEACHING TO GROUNDWATER INGESTION (cont'd)

	4) Exposure Multiplier (IRxEFxED)/(BWxAT) (L/kg-day)			5) Average Daily Intake Rate (mg/kg/day) (3) x (4)		
Constituents of Concern	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (70 ft) Surf. Water	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (70 ft) Surf. Water
Benzene*	3.5E-3	1.2E-2		1.3E-4	6.7E-5	
Toluene	9.8E-3	2.7E-2		3.4E-4	1.8E-7	
Ethylbenzene	9.8E-3	2.7E-2		5.8E-5	3.5E-6	
Xylene (mixed isomers)	9.8E-3	2.7E-2		9.6E-4	1.7E-4	
Methyl t-Butyl ether	9.8E-3	2.7E-2		3.8E-4	1.4E-4	

* = Chemical with user-specified data

NOTE: AT = Averaging time (days); BW = Body weight (kg); ED = Exposure duration (yr); EF = Exposure frequency (days/yr); IR = Ingestion rate (mg/day)

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley
Date Completed: 14-Dec-06
Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ **(CHECKED IF PATHWAY IS ACTIVE)**

GROUNDWATER: INGESTION

	1) Source Medium	2) NAF Value (unitless) Receptor			3) Exposure Medium Groundwater: POE Conc. (mg/L) (1)/(2)		
Constituents of Concern	Groundwater Conc. (mg/L)	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (20 ft) Surf. Water	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (20 ft) Surf. Water
Benzene*	2.2E-1	1.0E+0	6.6E+0		2.2E-1	3.3E-2	
Toluene	5.0E-3	1.0E+0	5.1E+3		5.0E-3	9.7E-7	
Ethylbenzene	6.5E-3	1.0E+0	4.6E+1		6.5E-3	1.4E-4	
Xylene (mixed isomers)	5.0E-3	1.0E+0	1.6E+1		5.0E-3	3.2E-4	
Methyl t-Butyl ether	1.1E-2	1.0E+0	7.6E+0		1.1E-2	1.4E-3	

NOTE: NAF = Natural attenuation factor POE = Point of exposure

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
Job ID: W236

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS

GROUNDWATER INGESTION (cont'd)

Constituents of Concern	4) Exposure Multiplier (IRxEFxED)/(BWxAT) (L/kg/day)			5) Average Daily Intake Rate (mg/kg/day) (3) x (4)		
	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (20 ft) Surf. Water	On-site (0 ft) Commercial	Off-site 1 (100 ft) Residential	Off-site 2 (20 ft) Surf. Water
Benzene*	3.5E-3	1.2E-2		7.5E-4	3.8E-4	
Toluene	9.8E-3	2.7E-2		4.9E-5	2.7E-8	
Ethylbenzene	9.8E-3	2.7E-2		6.4E-5	3.9E-6	
Xylene (mixed isomers)	9.8E-3	2.7E-2		4.9E-5	8.8E-6	
Methyl t-Butyl ether	9.8E-3	2.7E-2		1.1E-4	4.0E-5	

* = Chemical with user-specified data

NOTE: AT = Averaging time (days) ED = Exposure duration (yr) IR = Ingestion rate (mg/day)
BW = Body weight (kg) EF = Exposure frequency (days/yr)

Site Name: L.C. Smith Trust
Completed By: David Conley
Job ID: W236
Site Location: 1620 South Delaware Street, San Mateo, Ca
Date Completed: 14-Dec-06

RBCA SITE ASSESSMENT

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS

MAXIMUM PATHWAY INTAKE (mg/kg/day)
(Maximum Intake of active pathways soil leaching & groundwater routes.)

Constituents of Concern	On-site (0 ft) Commercial	Off-site 1 Residential	Off-site 2 Surf. Water
Benzene*	7.5E-4	3.8E-4	
Toluene	3.4E-4	1.8E-7	
Ethylbenzene	6.4E-5	3.9E-6	
Xylene (mixed isomers)	9.6E-4	1.7E-4	
Methyl t-Butyl ether	3.8E-4	1.4E-4	

* = Chemical with user-specified data

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca
Completed By: David Conley

Date Completed: 14-Dec-06
Job ID: W236

APPENDIX E

Calculated RBCA Tier II SSTLs Summary Tables

RBCA SITE ASSESSMENT

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, Ca | Date Completed: 14-Dec-06

SOIL (3 - 8 ft) SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-6
Target Hazard Quotient 1.0E+0

Groundwater DAF Option: Domenico - First Order (One-directional vert. dispersion)

SSTL Results For Complete Exposure Pathways ("X" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	X Soil Leaching to Groundwater Ingestion / Discharge to Surface Water			X Soil Vol. to Indoor Air	X Soil Volatilization to Outdoor Air				Surface Soil Inhalation, Ingestion, Dermal Contact		Applicable SSTL	SSTL Exceeded ?	Required CRF
			On-site (0 ft)	Off-site 1 (100 ft)	Off-site 2 (70 ft)	On-site (0 ft)	On-site (0 ft)		Off-site 1 (100 ft)	Off-site 2 (0 ft)	On-site (0 ft)				Only if "yes" left
CAS No.	Name	(mg/kg)	Commercial	Residential	Surf. Water	Time Wt. Avg.	Time Wt. Avg.	Construction Worker	Residential	None	None	Construction Worker	(mg/kg)	"■" if yes	
71-43-2	Benzene*	8.7E-1	6.6E-2	1.3E-1	2.2E+2	>1.4E+3	>1.4E+3	NA	3.1E+1	NA	NA	NA	6.6E-2	■	1.3E+1
108-88-3	Toluene	1.6E+0	>8.0E+2	>8.0E+2	>8.0E+2	>8.0E+2	>8.0E+2	NA	>8.0E+2	NA	NA	NA	>8.0E+2	☐	NA
100-41-4	Ethylbenzene	6.6E-1	>6.5E+2	>6.5E+2	>6.5E+2	>6.5E+2	>6.5E+2	NA	>6.5E+2	NA	NA	NA	>6.5E+2	☐	NA
1330-20-7	Xylene (mixed isomers)	7.5E+0	>5.2E+2	>5.2E+2	>5.2E+2	>5.2E+2	>5.2E+2	NA	>5.2E+2	NA	NA	NA	>5.2E+2	☐	NA
1634-04-4	Methyl t-Butyl ether	3.6E-1	9.5E+0	2.6E+1	NC	>1.5E+4	>1.5E+4	NA	>1.5E+4	NA	NA	NA	9.5E+0	☐	<1

* = Chemical with user-specified data

">" indicates risk-based target concentration greater than constituent residual saturation value. NA = Not applicable. NC = Not calculated.

RBCA SITE ASSESSMENT

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, Ca | Date Completed: 14-Dec-06

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6

Target Risk (Class C) 1.0E-6

Target Hazard Quotient 1.0E+0

Groundwater DAF Option: Domenico - First Order (One-directional vert. dispersion)

SSTL Results For Complete Exposure Pathways ("X" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	X Groundwater Ingestion / Discharge to Surface Water			X GW Vol. to Indoor Air	X Groundwater Volatilization to Outdoor Air			Applicable SSTL	SSTL Exceeded ?	Required CRF
			On-site (0 ft)	Off-site 1 (100 ft)	Off-site 2 (20 ft)	On-site (0 ft)	On-site (0 ft)	Off-site 1 (100 ft)	Off-site 2 (0 ft)			Only if "yes" left
CAS No.	Name	(mg/L)	Commercial	Residential	Surf. Water	Time Wt. Avg.	Time Wt. Avg.	Residential	None	(mg/L)	"■" if yes	
71-43-2	Benzene*	2.2E-1	2.9E-3	5.6E-3	3.0E+0	>1.8E+3	>1.8E+3	>1.8E+3	NA	2.9E-3	■	7.5E+1
108-88-3	Toluene	5.0E-3	2.0E+1	>5.2E+2	>5.2E+2	>5.2E+2	>5.2E+2	>5.2E+2	NA	2.0E+1	☐	<1
100-41-4	Ethylbenzene	6.5E-3	1.0E+1	1.7E+2	>1.7E+2	>1.7E+2	>1.7E+2	>1.7E+2	NA	1.0E+1	☐	<1
1330-20-7	Xylene (mixed isomers)	5.0E-3	>2.0E+2	>2.0E+2	>2.0E+2	>2.0E+2	>2.0E+2	>2.0E+2	NA	>2.0E+2	☐	NA
1634-04-4	Methyl t-Butyl ether	1.1E-2	1.0E+0	2.8E+0	NC	>4.8E+4	>4.8E+4	>4.8E+4	NA	1.0E+0	☐	<1

* = Chemical with user-specified data

">" indicates risk-based target concentration greater than constituent solubility value. NA = Not applicable. NC = Not calculated.

RBCA SITE ASSESSMENT | **Cumulative Risk Worksheet**

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, Ca | Date Completed: 14-Dec-06

CUMULATIVE RISK WORKSHEET

CONSTITUENTS OF CONCERN		Representative Concentration		Proposed CRF		Resultant Target Concentration	
CAS No.	Name	Soil (mg/kg)	Groundwater (mg/L)	Soil	GW	Soil (mg/kg)	Groundwater (mg/L)
71-43-2	Benzene*	8.7E-1	2.2E-1	4.4E+2	2.3E+3	2.0E-3	9.3E-5
108-88-3	Toluene	1.6E+0	5.0E-3	<1	<1	1.6E+0	5.0E-3
100-41-4	Ethylbenzene	6.6E-1	6.5E-3	<1	<1	6.6E-1	6.5E-3
1330-20-7	Xylene (mixed isomers)	7.5E+0	5.0E-3	NA	NA	7.5E+0	5.0E-3
1634-04-4	Methyl t-Butyl ether	3.6E-1	1.1E-2	<1	<1	3.6E-1	1.1E-2

Cumulative Values:

RBCA SITE ASSESSMENT | **Cumulative Risk Worksheet**

Site Name: L.C. Smith Trust   Site Name: L.C. Smith Trust   Completed By: David Conley   Job ID: W236

Site Location: 1620 South Delaware Street, San MaSite Location: 1620 South Delaware Street, San Mate Date Completed: 14-Dec-06

CUMULATIVE RISK WORKSHEET

Cumulative Target Risk: 1.0E-5   Target Hazard Index: 1.0E+0

ON-SITE RECEPTORS

CONSTITUENTS OF CONCERN		Outdoor Air Exposure: None		Indoor Air Exposure: None		Soil Exposure: None		Groundwater Exposure: Commercial	
		Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0	Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0	Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0	Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0
CAS No.	**Name**	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient
71-43-2	Benzene*							3.2E-8	2.3E-6
108-88-3	Toluene								1.7E-3
100-41-4	Ethylbenzene								6.4E-4
1330-20-7	Xylene (mixed isomers)								4.8E-4
1634-04-4	Methyl t-Butyl ether								3.8E-2
	Cumulative Values:	**0.0E+0**	**0.0E+0**	**0.0E+0**	**0.0E+0**	**0.0E+0**	**0.0E+0**	**3.2E-8**	**4.1E-2**

■ indicates risk level exceeding target risk

RBCA SITE ASSESSMENT | **Cumulative Risk Worksheet**

Site Name: L.C. Smith Trust   Site Name: L.C. Smith Trust   Completed By: David Conley   Job ID: W236

Site Location: 1620 South Delaware Street, San Ma Site Location: 1620 South Delaware Street, San Mate Date Completed: 14-Dec-06

CUMULATIVE RISK WORKSHEET

Cumulative Target Risk: 1.0E-5   Target Hazard Index: 1.0E+0

Groundwater DAF Option: Domenico - First Order

OFF-SITE RECEPTORS

CONSTITUENTS OF CONCERN		Outdoor Air Exposure:				Groundwater Exposure:			
		Residential (100 ft)		None		Residential (100 ft)		Surface Water (20 ft)	
		Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0	Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0	Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0	Target Risk: 1.0E-6 / 1.0E-6	Target HQ: 1.0E+0
CAS No.	**Name**	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient
71-43-2	Benzene*	8.9E-11	4.2E-6			1.6E-8	9.6E-7	3.0E-11	1.8E-9
108-88-3	Toluene		3.2E-5				9.1E-7		7.3E-8
100-41-4	Ethylbenzene		2.9E-6				3.9E-5		1.1E-6
1330-20-7	Xylene (mixed isomers)		6.1E-6				8.7E-5		2.6E-7
1634-04-4	Methyl t-Butyl ether		5.0E-6				1.4E-2		7.0E-7
	Cumulative Values:	**8.9E-11**	**5.0E-5**	**0.0E+0**	**0.0E+0**	**1.6E-8**	**1.4E-2**	**3.0E-11**	**2.1E-6**

■ indicates risk level exceeding target risk

RBCA SITE ASSESSMENT | **Baseline Risk Summary-All Pathways**

Site Name: L.C. Smith Trust
Site Location: 1620 South Delaware Street, San Mateo, Ca

Completed By: David Conley
Date Completed: 14-Dec-06

TIER 2 BASELINE RISK SUMMARY TABLE

	BASELINE CARCINOGENIC RISK					BASELINE TOXIC EFFECTS				
	Individual COC Risk		Cumulative COC Risk		Risk	Hazard Quotient		Hazard Index		Toxicity
EXPOSURE PATHWAY	Maximum Value	Target Risk	Total Value	Target Risk	Limit(s) Exceeded?	Maximum Value	Applicable Limit	Total Value	Applicable Limit	Limit(s) Exceeded?
OUTDOOR AIR EXPOSURE PATHWAYS										
Complete:	4.0E-8	1.0E-6	4.0E-8	1.0E-5	☐	1.9E-3	1.0E+0	1.9E-3	1.0E+0	☐
INDOOR AIR EXPOSURE PATHWAYS										
Complete:	NC	1.0E-6	NC	1.0E-5	☐	NC	1.0E+0	NC	1.0E+0	☐
SOIL EXPOSURE PATHWAYS										
Complete:	NA	NA	NA	NA	☐	NA	NA	NA	NA	☐
GROUNDWATER EXPOSURE PATHWAYS										
Complete:	7.5E-5	1.0E-6	7.5E-5	1.0E-5	■	3.8E-2	1.0E+0	4.6E-2	1.0E+0	☐
SURFACE WATER EXPOSURE PATHWAYS										
Complete:	7.0E-8	1.0E-6	7.0E-8	1.0E-5	☐	4.1E-6	1.0E+0	6.2E-6	1.0E+0	☐

CRITICAL EXPOSURE PATHWAY (Maximum Values From Complete Pathways)										
	7.5E-5	***1.0E-6***	***7.5E-5***	***1.0E-5***	■	***3.8E-2***	***1.0E+0***	***4.6E-2***	***1.0E+0***	☐
	Groundwater		***Groundwater***			***Groundwater***		***Groundwater***		

RBCA SITE ASSESSMENT | **Chemical-Specific Tier 2 Cleanup Summary**

Site Name: L.C. Smith Trust | Completed By: David Conley | Job ID: W236

Site Location: 1620 South Delaware Street, San Mateo, Ca | Date Completed: 14-Dec-06 |

Constituent: Benzene* **CAS No.: 71-43-2**

Site-Specific Target Level (SSTL) Concentrations

		On-site	Off-site1	Off-site2
Groundwater Ingestion				
Receptor Type / Distance (ft)		Commercial / 0	Residential / 100	Surf. Water / 20
$SSTL_{gw}$ (mg/L)	THQ = 1E+0	4.1E+1	9.6E+1	>1.8E+3
	TR = 1E-6	2.9E-3	5.6E-3	3.0E+0
Soil Leaching to Groundwater Ingestion				
Receptor Type / Distance (ft)		Commercial / 0	Residential / 100	Surf. Water / 70
$SSTL_s$ (mg/kg)	THQ = 1E+0	9.4E+2	>1.4E+3	>1.4E+3
	TR = 1E-6	6.6E-2	1.3E-1	2.2E+2
Surface Soil Ingestion and Dermal Contact				
Receptor Type / Distance (ft)		None	No Off-site Receptors	
$SSTL_{ss}$ (mg/kg)	THQ = 1E+0	NA		
	TR = 1E-6	NA		
Outdoor Air Inhalation				
Receptor Type / Distance (ft)		Time Wt. Avg. / 0	Residential / 100	None
$RBEL_{air}$ (μg/m³)	THQ = 1E+0	3.3E+3	6.2E+0	NA
	TR = 1E-6	3.3E+3	2.9E-1	NA
Soil Volatilization to Outdoor Air Inhalation				
Receptor Type / Distance (ft)		Time Wt. Avg. / 0	Residential / 100	None
$SSTL_s$ (mg/kg)	THQ = 1E+0	>1.4E+3	6.5E+2	NA
	TR = 1E-6	>1.4E+3	3.1E+1	NA
Groundwater Volatilization to Outdoor Air Inhalation				
Receptor Type / Distance (ft)		Time Wt. Avg. / 0	Residential / 100	None
$SSTL_{gw}$ (mg/L)	THQ = 1E+0	>1.8E+3	>1.8E+3	NA
	TR = 1E-6	>1.8E+3	>1.8E+3	NA
Indoor Air Inhalation				
Receptor Type / Distance (ft)		Time Wt. Avg. / 0	No Off-site Receptors	
$RBEL_{air}$ (μg/m³)	THQ = 1E+0	3.3E+3		
	TR = 1E-6	3.3E+3		
Soil Volatilization to Indoor Air Inhalation				
Receptor Type / Distance (ft)		Time Wt. Avg. / 0	No Off-site Receptors	
$SSTL_s$ (mg/kg)	THQ = 1E+0	>1.4E+3		
	TR = 1E-6	>1.4E+3		
Groundwater Volatilization to Indoor Air Inhalation				
Receptor Type / Distance (ft)		Time Wt. Avg. / 0	No Off-site Receptors	
$SSTL_{gw}$ (mg/L)	THQ = 1E+0	>1.8E+3		
	TR = 1E-6	>1.8E+3		

	Units	Residential	Commercial	Construction
Cross-Media Transfer Factors				
VF_{ss}	(kg-soil/m3-air)	1.7E-5	1.9E-5	NA
VF_{samb}	(kg-soil/m3-air)	6.8E-6	6.8E-6	NA
VF_{wamb}	(m3-wat/m3-air)	1.3E-7	1.3E-7	NA
VF_{sesp}	(kg-soil/m3-air)	NA	4.7E-4	NA
VF_{wesp}	(m3-wat/m3-air)	NA	1.4E-4	NA
LF	(kg-soil/L-wat)	All exposures: 4.3E-2		NA

	Units	On-Site	Off-Site1	Off-Site2
Lateral Transport Factors				
DAFgw	(-)	1.0E+0	6.6E+0	1.1E+0
DAFs/gw	(-)	1.0E+0	6.6E+0	3.5E+0

Chemical Parameters

	Units	Value	Reference
Physical Properties			
MW	(g/mol)	7.8E+1	PS
Sol	(mg/L)	1.8E+3	PS
P_{vap}	(mmHg)	9.5E+1	PS
H_{atm}	(atm-m³/mol)	5.6E-3	PS
pK_a	(log[mol/mol])	-	-
pK_b	(log[mol/mol])	-	-
$\log(K_{oc})$	(log[L/kg])	1.8E+0	PS
D_{air}	(cm²/sec)	8.8E-2	PS
D_{wat}	(cm²/sec)	9.8E-6	PS
Toxicity Data			
Wt of Evd.		A	
SF_o	(1/[mg/kg/day])	1.0E-1	PS
SF_d	(1/[mg/kg/day])	1.0E-1	TX
URF_i	(1/[μg/m³])	8.3E-6	PS
RfD_o	(mg/kg/day)	4.0E-1	R
RfD_d	(mg/kg/day)	-	-
RfC_i	(mg/m³)	6.0E-3	R
Dermal Exposure Parameters			
RAF_d	(mg/mg)	5.0E-1	D
K_p	(cm/hr)	2.1E-2	
tau_d	(hr/event)	2.6E-1	
t_{crit}	(hr)	6.3E-1	
B	(-)	1.3E-2	
Regulatory Standards			
MCL	(mg/L)	5.0E-3	*
TWA	(mg/m³)	3.3E+0	-
AQL	(mg/L)	-	-
Miscellaneous Parameters			
ADL_{gw}	(mg/L)	2.0E-3	S
ADL_s	(mg/kg)	5.0E-3	S
$t_{1/2,sat}$	(d)	7.2E+2	H
$t_{1/2,unsat}$	(d)	7.2E+2	H

* MCL ref = -

	Units	Value
Derived Parameters		
H	(L-wat/L-air)	2.3E-1
K_{sw}	(L-wat/kg-soil)	1.3E+0
C_{sat}	(mg/kg-soil)	1.4E+3
$C_{sat,vap}$	(μg/m³-air)	4.0E+8
$D_{eff,s}$	(cm²/sec)	1.1E-5
$D_{eff,crk}$	(cm²/sec)	6.9E-3
$D_{eff,cap}$	(cm²/sec)	1.0E-5
$D_{eff,ws}$	(cm²/sec)	1.1E-5
R_{sat}	(-)	1.5E+0
R_{unsat}	(-)	3.9E+0
Z	(cm/event)	7.3E-2

Notes: 1) NA = Not applicable; NC = Not calculated.

2) Definitions and references presented on page 6 of 6.

APPENDIX F

Selected Boring Logs

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

COORDINATES:
SURFACE ELEVATION: DATUM:

BORING NO.: **ASB-1** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL
						BROWN SANDY SILT (ML)		
						BROWN SILTY CLAY (CL) moist		
5			10 / 12 / 15		0.0			5
						BROWN, YELLOW-BROWN SANDY GRAVEL (GP) wet, loose		▽
10			12 / 24 / 24		0.0	BROWN GRAVELLY SAND (SP) saturated, loose, very coarse-grained sand		10

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch hollow stem auger
DRILLING EQUIPMENT: Portable Drill Rig
DRILLING STARTED: 11/6/03 ENDED: 11/6/03

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.
Job No.: 236.039
Appr.:
Date: 3/28/05

LOG OF BORING ASB-1
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-1

ENVIRONMENTAL BORING LOG AND WELL COMPLETION 20050328_LC SMITH_236.039.GPJ BACE.GDT 3/28/05

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-2** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL
0						BROWN CLAYEY SILT (ML) moist, medium stiff		
4.5			7			BROWN, RED-BROWN SANDY GRAVEL (GP) wet, loose		
5			12		0.0			▽ 5
			18					
9						RED-BROWN SAND (SP) saturated, medium dense, medium to coarse-grained sand		
10			8					10
			17		0.0			
			17					

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch hollow stem auger
DRILLING EQUIPMENT: 8X8
DRILLING STARTED: 11/6/03 ENDED: 11/6/03

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 3/28/05

LOG OF BORING ASB-2
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-2

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-3** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

SAMPLE INFORMATION						DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)			
						BROWN SANDY SILT (ML) moist, loose		
5			5 7 13		0.0	BROWN, RED-BROWN SANDY GRAVEL (GP) wet, loose		5 ∇

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch hollow stem auger
DRILLING EQUIPMENT: 8X8
DRILLING STARTED: 11/6/03 ENDED: 11/6/03

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 3/28/05

LOG OF BORING ASB-3
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-3

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-4** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

SAMPLE INFORMATION								
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL
						Asphalt		
						DARK GRAY CLAYEY SILT (ML) moist, soft, some sand		
						BROWN CLAYEY SILT (ML) damp, soft		
5			14 / 17 / 23		55.2	BLUE-GREEN STAINING IN VEINS SLIGHT ODOR OF GASOLINE		5
10			9 / 13 / 16		0.0			10
						BROWN SANDY SILT (ML) moist, soft, fine-grained sand		
15			10 / 13 / 19		0.2	BROWN SILTY CLAY (CL) damp, very stiff, some staining in veins, water in boring		∇ 15

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch hollow stem auger
DRILLING EQUIPMENT: 8X8
DRILLING STARTED: 4/19/04 ENDED: 4/19/04

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 3/28/05

LOG OF BORING ASB-4
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-4

ENVIRONMENTAL BORING LOG AND WELL COMPLETION 20050328_LC SMITH_236.039.GPJ BACE.GDT 3/28/05

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

COORDINATES:
SURFACE ELEVATION: DATUM:

BORING NO.: **ASB-5** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

SAMPLE INFORMATION						DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)			
						BROWN SILTY SAND (SM) damp, loose, with gravel		
						BROWN SILTY CLAY (CL) moist to wet, medium stiff, with some coarse-grained sand and gravel		
			3					
5			5					5
			7					
								∇
10								10

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch hollow stem auger
DRILLING EQUIPMENT: 8X8
DRILLING STARTED: 4/19/04 ENDED: 4/19/04

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 3/28/05

LOG OF BORING ASB-5
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-5

ENVIRONMENTAL BORING LOG AND WELL COMPLETION 20050328_LC SMITH_236.039.GPJ BACE.GDT 3/28/05

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-6** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

SAMPLE INFORMATION						DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)			
						DARK BROWN SANDY SILT (ML) damp, soft		
5			9 13 18			LIGHT BROWN SILTY CLAY (CL) moist, stiff, with some fine-grained sand		5
10								10

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch hollow stem auger
DRILLING EQUIPMENT: 8X8
DRILLING STARTED: 4/19/04 ENDED: 4/19/04

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 3/28/05

LOG OF BORING ASB-6
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-6

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-7** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

SAMPLE INFORMATION						DESCRIPTION	STRATA
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)		
						ASPHALT 3"	
						road base	
						ROAD BASE	
						BROWN SILTY SAND (SW) loose, damp	
						BLACK SILTY CLAY (CL) soft, damp	
						GREENISH GRAY SILTY CLAY (CL) soft, damp	
			10			BROWN AND REDDISH BROWN SILTY SAND (SM) sand medium to coarse grained, dense, moist, some blue-green stain	
5			17		7.7		
			24			BROWN SANDY SILT (ML) very dense, damp	
			7			Saturated	
10			7		5.4		
			9				

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/7/05 ENDED: 12/7/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB-7
LC Smith
1620 Delaware Street
San Mateo, California

PLATE **A-1**

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB- 8** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION
0						ASPHALT 3"
						BROWN SILTY CLAY (CL) soft, damp
						DARK GREENISH GREY SILTY CLAY (CL) soft, damp
						BROWN SANDY SILT (ML) some gravel, stiff, damp, blue green stain
5			11, 16, 23		5.6	
						BROWN SILT (ML) w/some very fine sand, dense, saturated (groundwater symbol ∇)
10			13, 9, 16		3.9	

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/7/05 ENDED: 12/7/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB- 8
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-2

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

COORDINATES:
SURFACE ELEVATION: DATUM:

BORING NO.: **ASB- 9** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION
						ASPHALT 3"
						BLACK SILT CLAY (CL) soft, damp
						BROWN SANDY SILT (ML) stiff, damp,sand fine grained, some blue-green stain
			4			
			6		5.4	
			10			(Stain pervasive)
5			8		7.2	
			14			
			18			BROWN SILTY SAND (SM) dense, damp, sand fine to coarse
			8			
			9			
			13			BROWN SILTY SAND (SM) dense, damp, some gravel, sand medium to very coarse
			5			
			11			
			17		3.6	
			12			BROWN GRAVELLY SAND (SW) loose, saturated
10			17		1.4	
			19			
			7			
			10			BROWN SILTY SAND (SM) with some sand, dense, saturated
			13		7.9	
			7			
			10			BROWN SILTY CLAY (CL) with some sand very stiff, moist
			13			
			11		4.1	BROWN SILTY SAND (SM) dense, wet
			17		2.3	
15						TD= 15'

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/7/05 ENDED: 12/7/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB- 9
LC Smith
1620 Delaware Street
San Mateo, California

PLATE **A-3**

ENVIRONMENTAL BORING LOG AND WELL COMPLETION 20050328_LC SMITH_236.039.GPJ BACE.GDT 6/12/06

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-10** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL
						ASPHALT 3'		
						BROWN SANDY GRAVEL (GW) loose, damp, (fill)		
						DARK GRAY SILTY CLAY (CL) soft, damp		
5			8 / 10 / 16			BROWN SILTY SAND (SM) some gravel, dense, damp, sand medium to coarse grained, gravel to 1/4"		5
10			12 / 18 / 28			BROWN SILTY SANDY GRAVEL (GP) loose, wet		∇ 10

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 6-inch Hollow stem auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/7/05 ENDED: 12/7/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 1/3/06

LOG OF BORING ASB-10
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-4

ENVIRONMENTAL BORING LOG AND WELL COMPLETION 20050328_LC SMITH_236.039.GPJ BACE.GDT 1/3/06

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-11** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

SAMPLE INFORMATION								
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA	
						ASPHALT 3"		
						REDDISH BROWN SANDY GRAVEL (GW) medium to coarse sand, gravel to 1/4", loose damp		
						BLACK SILTY CLAY (CL) medium stiff, damp		
5			8 9 17		284	BROWN AND GRAY MOTTLED SANDY GRAVEL (GW) sand coarse, gravel to 3/4", loose, moist, odor of petroleum		5
						BROWN SANDY GRAVEL (GW) loose, saturated		∇
10			17 21 9		3.5			10
						BROWN SILTY SAND (SM) fine to medium gravel, medium dense, wet		

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/8/05 ENDED: 12/8/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB-11
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-5

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-12** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION
						ASPHALT 2"
						RED SILTY SAND (SM) loose, damp, (fill)
						BLACK SILTY CLAY (CL) soft, damp
			4		452	GREEN GRAY SILTY SAND (SM) dense, damp, some staining, odor of gasoline
			5			
			6		146	
			3			
5			5		243	
			5			
			3			
			10			DARK BROWN SILTY SANDY GRAVEL (GW) gravel to1/4", sand medium to coarse, dense, wet, sewer odor, some black staining
			8		123	
			4			
			6			
			11			
			8		9.5	BROWN SILTY SAND (SM) some gravel dense, wet
			14			
10			19		9.9	
			7			BROWN SILTY SAND (SM) fine to medium sand, medium dense, saturated
			8			
			14			
			16			
			15		1.2	
			16			BROWN SILTY SAND (SM) fine to medium gravel, very dense, moist
			8		5.1	
			11			
			14		5.1	
15						TD= 15'

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 6-inch Hollow stem auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/7/05 ENDED: 12/7/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB-12
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-6

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-13** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION
0						ASPHALT 4"
						ROAD BASE
						DARK BROWN SILTY CLAY (CL) some sand, soft, damp
						BROWN SILTY SAND (SM) medium to very coarse grained,some gravel, dense, damp
5			14, 24, 36		52.5	
						BROWN SILTY SAND (SM) dense, damp, medium to coarse grained, saturated
10			13, 14, 17		6.6	
15			8, 12, 15		3.5	

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/6/05 ENDED: 12/6/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB-13
LC Smith
1620 Delaware Street
San Mateo, California

PLATE **A-7**

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-14** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA
						ASPHALT 2"	
						ROAD BASE	
						BLACK SILTY CLAY (CL) soft, moist	
						BROWN SILTY SAND (SM) loose, damp, sand medium to coarse grained	
5			10 16 18		33.1	BROWN SANDY SILT (ML) dense, damp, some staining and odor of gasoline	
10			10 10 11		7.4		

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/6/05 ENDED: 12/6/05

REMARKS
See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB-14
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-8

ENVIRONMENTAL BORING LOG AND WELL COMPLETION 20050328_LC SMITH_236.039.GPJ BACE.GDT 6/12/06

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-15** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

SAMPLE INFORMATION								
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA	
						ASPHALT 2"		
						DARK BROWN SILTY SAND (SM) medium dense, damp		
						BROWN SILTY SAND (SM) dense, damp, sand fine to coarse grained		
			13					
5			18		3.3			5
			22					
								▽
			14					
10			18		4.1			10
			18					

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/6/05 ENDED: 12/6/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB-15
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-9

ENVIRONMENTAL BORING LOG AND WELL COMPLETION 20050328_LC SMITH_236.039.GPJ BACE.GDT 6/12/06

BRUNSING ASSOCIATES, INC.
P.O. BOX 588
Windsor, CA. 95492
Telephone: (707) 838-3027
Fax: (707) 838-4420

BORING NO.: **ASB-16** SHEET 1 OF 1
PROJECT: **LC Smith**
LOCATION: **San Mateo, California**
PROJECT NO.: **236.039**
LOGGED BY: **DEC**

COORDINATES:
SURFACE ELEVATION: DATUM:

SAMPLE INFORMATION								
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	Recovery (%)	PID (ppm)	DESCRIPTION	STRATA	
						ASPHALT 2"		
						ROAD BASE		
						BROWN SANDY SILT (ML) loose, damp		
						DARK GREENISH GRAY SILTY CLAY (CL) soft, damp		
						BROWN CLAYEY SILT (ML) medium stiff, damp		
			9					
5			5		257			5
			5			GREENISH GRAY SILTY SAND (SM) fine grained, medium dense, wet, slight odor		
						BROWN SILTY SAND (SM) fine to medium sand, dense, wet		⊽
			12					
10			14		4.7			10
			15					

DRILLING CONTRACTOR: Clear Heart
DRILLING METHOD: 4-inch Solid auger
DRILLING EQUIPMENT: Deeprock Dr10K
DRILLING STARTED: 12/6/05 ENDED: 12/6/05

REMARKS

See key sheet for symbols and abbreviations used above.

BRUNSING ASSOCIATES, INC.

Job No.: 236.039
Appr.:
Date: 6/12/06

LOG OF BORING ASB-16
LC Smith
1620 Delaware Street
San Mateo, California

PLATE
A-10

BORING 1

DATE DRILLED 10/11/84

SURFACE ELEVATION

DEPTH IN FEET	DRY DENSITY, PCF	MOISTURE CONTENT, %	TYPE OF SAMPLER	SAMPLING RESISTANCE	SYMBOLS	DESCRIPTION
0	113	18	U	14	CL	REDDISH BROWN SILTY SANDY GRAVELLY CLAY
					CH/CL	BLACK SILTY CLAY (WITH TRACE GASOLINE ODOR)
5	115	18	U	54	CL	YELLOWISH BROWN SILTY SANDY CLAY (GASOLINE ODOR)
10	127	13	U	67	SM/SP	BROWN SILTY MEDIUM TO COARSE SAND WITH SOME GRAVEL AND CLAY BINDER (NO ODOR)
15	117	16	U	43	CL	YELLOWISH BROWN SILTY SANDY CLAY WITH SOME FINE GRAVEL (NO [illegible])
20	98	27	U	40		(GRADES TO VERY SILTY CLAY)
25	112	18	U	71	SM	BROWN SILTY SAND (NO ODOR)
30						

NOTES: 1. BORING COMPLETED AT A DEPTH OF 26.5 FT. ON 10/11/84

2. 2.0-INCH PVC OBSERVATION WELL INSTALLED TO A DEPTH OF 26.5 FEET; SLOTTED INTERVAL BETWEEN [illegible] FEET AND 15.0 FEET.

LOG OF BORING

Dames & Moore

BORING 2

DATE DRILLED 10/11/84

SURFACE ELEVATION

DEPTH IN FEET	DRY DENSITY, PCF	MOISTURE CONTENT, %	TYPE OF SAMPLER	SAMPLING RESISTANCE	SYMBOLS	DESCRIPTION
0	106	18	U	29	GC	ASPHALT PAVEMENT REDDISH BROWN SILTY CLAYEY GRAVEL
					CH/CL	BLACK SILTY CLAY (WITH SOME GASOLINE ODOR)
					ML	LIGHT GRAY CLAYEY GRAVELLY SILT (STRONG GASOLINE ODOR)
5	112	16	U	16	SM/SP	BROWN AND GRAY SILTY MEDIUM TO COARSE SAND WITH SOME GRAVEL AND CLAY BINDER (STRONG GASOLINE ODOR) (BECOMES VERY GRAVELLY)
10	122	15	U	68		
					CL	YELLOWISH BROWN SILTY SANDY CLAY WITH SOME FINE GRAVEL (NO ODOR)
15	117	16	U	39		
20	100	26	U	36		(GRADES SILTY)
25						
30						

NOTES: 1. BORING COMPLETED AT A DEPTH OF 21.5 FEET ON 10/11/84.

2. 2-INCH PVC OBSERVATION WELL INSTALLED TO A DEPTH OF 21.5 FEET; SLOTTED SECTION BETWEEN 15.0 AND 5.0 FEET

LOG OF BORING

Dames & Moore

BORING 3

DATE DRILLED 10/12/84

SURFACE ELEVATION

DEPTH IN FEET	DRY DENSITY, PCF	MOISTURE CONTENT, %	TYPE OF SAMPLER	SAMPLING RESISTANCE
0	107	11	U	31
5	111	15	U	32
10	133	11	U	53
15	109	20	U	31
20				
25				
30				

SAMPLES / SYMBOLS	DESCRIPTION
	ASPHALT PAVEMENT
GM/GC	REDDISH BROWN SILTY CLAYEY GRAVEL
SM/ML	BROWN VERY SILTY SAND (NO ODOR)
CH/CL	BLACK SILTY CLAY (WITH SOME GASOLINE ODOR)
SM/SP	BROWN AND GRAY SILTY GRAVELLY MEDIUM TO COARSE SAND WITH SOME CLAY FILLER (STRONG GASOLINE ODOR)
	(GRADES TO SILTY SANDY CLAYEY GRAVEL)
CL/ML	YELLOWISH BROWN VERY SILTY CLAY (NO ODOR)

NOTES: 1. BORING COMPLETED TO A DEPTH OF 16.5 FEET ON 10/12/84

2. 2-INCH PVC OBSERVATION WELL INSTALLED TO A DEPTH OF 16.5 FEET; SLOTTED SECTION BETWEEN 15.0 AND 5.0 FEET.

LOG OF BORING

Dames & Moore

BORING 4

DATE DRILLED 10/12/84

SURFACE ELEVATION

DEPTH IN FEET	DRY DENSITY, PCF	MOISTURE CONTENT, %	TYPE OF SAMPLER	SAMPLING RESISTANCE	SYMBOLS	DESCRIPTION
0	96	26	U	13	CL	DARK BROWN SILTY CLAY WITH SOME GRAVEL
					CH/CL	BLACK SILTY CLAY (NO ODOR)
					CL	YELLOWISH BROWN ANL GRAY SILTY SANDY CLAY (TRACE GASOLINE ODOR)
5	111	19	U	35		
10	105	23	U	35		(GRADES SILTY AND BROWN WITH GASOLINE ODOR)
15	112	18	U	33		(GRADES MORE SILTY WITH TRACE FINE GRAVEL. NO ODOR)
20						
25						
30						

NOTES: 1. BORING COMPLETED AT A DEPTH OF 16.5 FEET ON 10/12/84.

2. 2-INCH PVC OBSERVATION WELL INSTALLED TO A DEPTH OF 16.5 FEET; SLOTTED INTERVAL BETWEEN 15.0 AND 5.0 FEET.

LOG OF BORING

Dames & Moore

BORING B-5
DATE DRILLED 4-23-85
SURFACE ELEVATION

Depth in Feet	Dry Density, PCF	Moisture Content, %	Type of Sampler	Sampling Resistance	Samples	Symbols	Description
0							asphalt
							Base course gravels (Fill)
			Grab		☒	CL-CH	Black silty clay (some gasoline odor)
5					☒	CL	grades to greenish gray silty clay
					☒	CL	light brown silty clay, grades to sandy, silty clay (some gasoline odor)
			Grab		☒ ☒	ML	yellowish-brown sandy silt with some clay (no gas odor)
10						CL	green and brownish-gray mottled silty clay with minor sand (Strong gasoline odor)
			U		■	SM	Light brown silty sand with some clay (No gas odor)
15							Total Depth 14.5'
20							
25							
30							

LOG OF BORING

Dames & Moore

BORING B-6

DATE DRILLED 4-23-85

SURFACE ELEVATION

DEPTH IN FEET	DRY DENSITY, PCF	MOISTURE CONTENT, %	TYPE OF SAMPLER	SAMPLING RESISTANCE	SYMBOLS	DESCRIPTION
0						~~Asphalt~~
			U			Base Course gravel (some gas odor) (fill)
5					fill CL	Black silty clay with some gravel. (gas odor)
					CL	Brown and gray silty clay (slight gas odor)
			U		SM	light brown silty sand with some clay and minor gravel. (no gas odor)
					ML	yellowish brown silty sandy clay to clayey sandy silt. (no gas odor)
10					GC	Brown silty clayey gravel
					ML	yellowish brown and gray mottled sandy silt with some clay. (slight gas odor)
			U		ML	light brown sandy clayey silt. (no gas odor)
15					CL	yellowish brown and light gray mottled sandy silty clay. (no gas odor)
						Total Depth 15.5'
20						
25						
30						

LOG OF BORING

Dames & Moore

Plate 6B

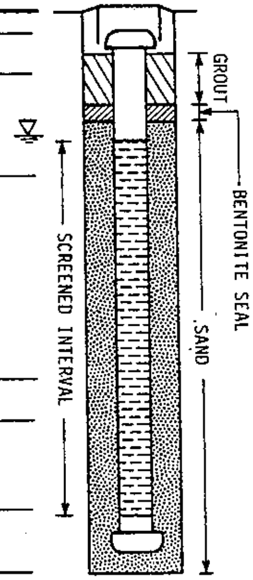
BORING B-7

DATE DRILLED 2/6/86

SURFACE ELEVATION

Depth (feet)	Type of Sampler	Resistance (Blows per Foot)	Symbols	Description
0				ASPHALTIC CONCRETE PAVEMENT
			CL	REDDISH BROWN SILTY SANDY GRAVELLY CLAY (FILL)
	U	21	CH/CL	DARK GRAY SILTY CLAY (MEDIUM STIFF) (GASOLINE ODOR)
5	U	26	SC/CH	GRAYISH-BROWN MOTTLED CLAYEY SAND WITH SCATTERED PEBBLES (MEDIUM DENSE) (SLIGHT GASOLINE ODOR)
				GRADES TO GRAY SILTY CLAY
10			GW	BROWN ROUNDED GRAVELS (LOOSE)
	U	37	ML	BROWN SANDY SILT WITH SCATTERED GRAVEL (DENSE)
	U	28	CL	BROWN FINE SANDY CLAY (MEDIUM DENSE)
15				
20				
25				
30				

DEPTH IN FEET



NOTES:

1. BORING COMPLETED AT A DEPTH OF 14.5 FEET ON 2/6/86.
2. 2-INCH PVC OBSERVATION WELL INSTALLED TO A DEPTH OF 14.0 FEET; SCREENED INTERVAL FROM 3.4 TO 13.0 FEET.

LOG OF BORING

Dames & Moore

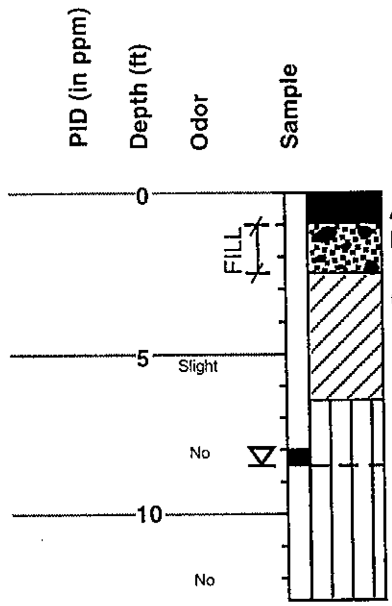
Plate 2

Log of Boring OSB-1

Equipment: MD-1, Direct Push

Drill Date: 12/13/96

Elevation: **Logged by:** MTE



Asphalt

Basecoarse, Sand and Gravel Mix

GRAYISH BLACK SILTY CLAY (CL)
medium stiff, slight moist, 10-15% silt

MEDIUM BROWN CLAYEY SILT (ML)
medium stiff, slight moist, 25% clay

MEDIUM BROWN CLAYEY SANDY SILT (ML)
medium dense, saturated, 10% clay, 25% fine to medium granined sand, trace 1/8" diameter gravels at 9' bsg

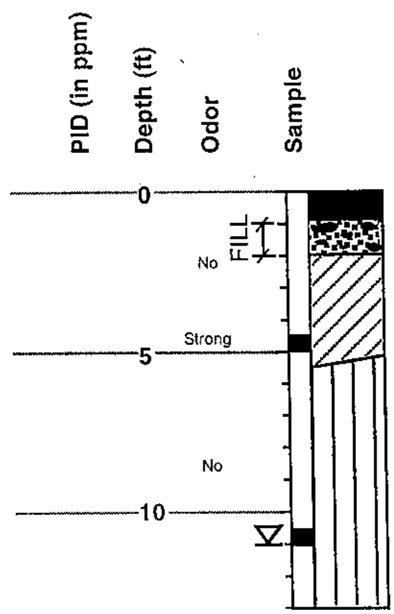
NOTES: (1) Groundwater encountered at 8.5'.

Log of Boring OSB-2

Equipment: MD-1, Direct Push

Drill Date: 12/13/96

Elevation: **Logged by:** MTE



Asphalt

Basecoarse, Sand and Gravel

GRAYISH BLACK SILTY GRAVELLY CLAY (CL)
medium stiff, slight moist to wet, 10-15% silt, 10-20% 1/8" to 1/4" diameter gravel

MEDIUM BROWN CLAYEY SILT (ML) mottled gray, brown and black
wet to saturated, 30% clay

NOTES: (1) Groundwater Encountered at 11.0'

LEGEND:

- Length Of Drive
- Sample Recovered
- Sample Retained

∇ Depth Groundwater First Encountered

PROJECT NO.: **236.13**		
DRAWN BY:	KPS	2/4/97
CHECKED BY:		
APPROVED BY:	[signature]	2/10/97
REVISED BY:		

BACE Environmental
A Division Of
Brunsing Associates, Inc.

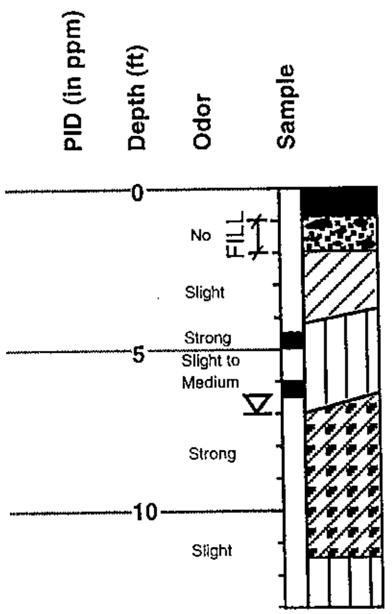
PLATE - A2
LOGS OF BORINGS OSB-1 AND OSB-2
1620 South Delaware Street
San Mateo, California

Log of Boring OSB-3

Equipment: MD-1, Direct Push

Drill Date: 12/13/96

Elevation: **Logged by:** MTE



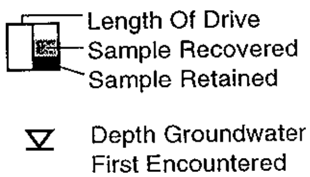
Asphalt
Basecoarse, Sand and Gravel
DARK BROWN & BLACK SILTY GRAVELLY CLAY (CL)
medium stiff, slight moist, 10-15% silt,
10-20% 1/8" diameter gravel
CLAYEY SILT (ML) mottled gray and brown
medium stiff,slight moist, 30-45% clay

SILTY CLAYEY GRAVEL (GC) mottled gray and brown
medium dense, saturated, 10-15% silt, 30% clay,
1/8" to 1/4" diameter gravel

MEDIUM BROWN SILT (ML)
medium stiff, slight moist

NOTES: (1) Groundwater Encountered at 7.0'

LEGEND:



PROJECT NO.: **236.13**			BACE Environmental *A Division Of* Brunsing Associates, Inc.	PLATE - A3 LOG OF BORING OSB-3 1620 South Delaware Street San Mateo, California
DRAWN BY:	KPS	1/4/97		
CHECKED BY:				
APPROVED BY:	[signature]	2/10/97		
REVISED BY:				

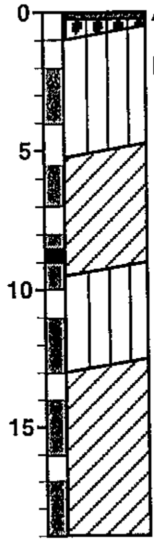
Log of Boring OSB-5

Equipment: Hydraulic Push

Drill Date: 11/19/97

Elevation: Not surveyed **Logged By:** MTE

PID (in ppm) | Odor | Blows/foot | Depth (ft) | Sample



Odor: Ø, Ø, Ø, Ø, Ø, Ø

ASPHALT AND GRAVEL BASEROCK

MEDIUM BROWN CLAYEY SILT (ML)
medium stiff, moist, 30% clay

MEDIUM BROWN SILTY CLAY (CL)
stiff, damp to moist, 30% silt

MEDIUM BROWN CLAYEY SILT (ML)
medium stiff, moist, 30% clay

MEDIUM BROWN SILTY CLAY (CL)
stiff, moist, 30% silt

NOTES:
(1) No caving
(2) No free water encountered

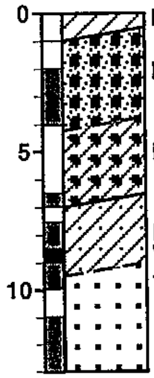
Log of Boring OSB-6

Equipment: Hydraulic Push

Drill Date: 11/19/97

Elevation: Not surveyed **Logged By:** MTE

PID (in ppm) | Odor | Blows/foot | Depth (ft) | Sample



Odor: Ø, Ø, Ø, Ø, Ø

BLACK CLAY (CL) soft, dry to moist, organic material

MEDIUM GRAY SANDY GRAVEL (GW)
dense, dry, 20-30% sand

DARK BROWN SILTY CLAYEY GRAVEL (GC)
medium dense, dry to moist, 10% silt, 15-20% clay

MEDIUM BROWN CLAYEY SAND (SC)
medium dense, dry to moist
water level 9.5', 11/19/97

MEDIUM BROWN GRAVELLY SAND (SP)
loose to medium dense, saturated

NOTES:
(1) No caving
(2) Free water encountered at 9.5'

LEGEND:

Sample Recovered
Sample Retained
Length Of Drive

Water level and date measured

PROJECT NO.: 236.15			**BACE Environmental** *A Division Of* **Brunsing Associates, Inc.**	**PLATE A-2** **Logs of Borings OSB-5 & OSB-6** 1620 South Delaware Street San Mateo, California
DRAWN BY:	BDM	3/13/98		
CHECKED BY:				
APPROVED BY:	[signature]	3/19/98		
REVISED:				

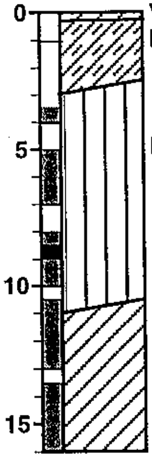
Log of Boring OSB-7

Equipment: Hydraulic Push

Drill Date: 11/19/97

Elevation: Not surveyed **Logged By:** MTE

PID (in ppm)	Odor	Blows/foot	Depth (ft)
	Ø		0–5
	Ø		5
	Ø		
	Ø		10
	Ø		15



VEGETATION AND TOPSOIL

DARK BROWN TO BLACK ORGANIC CLAY (OH)
soft, moist

MEDIUM BROWN CLAYEY SILT (ML)
medium stiff, moist, 40% clay

MEDIUM BROWN SILTY CLAY (CL)
medium stiff, saturated, 40% silt
becomes 20% gravel at 15'

NOTES:
(1) No caving
(2) No free water encountered

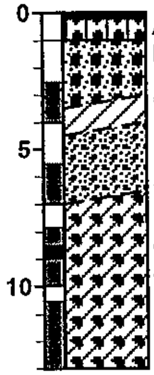
Log of Boring OSB-8

Equipment: Hydraulic Push

Drill Date: 11/19/97

Elevation: Not surveyed **Logged By:** MTE

PID (in ppm)	Odor	Blows/foot	Depth (ft)
	Ø		0–5
	Ø		10+



ASPHALT AND BASEROCK

PINK-GRAY GRAVEL (GW)
very dense, dry

BLACK GRAVELLY CLAY (CL)
medium dense, dry, 10% gravel

ORANGE GRAY GRAVELLY SAND (SW)
medium dense, dry, 20% gravel

water level 9.5', 11/19/97

MEDIUM BROWN CLAYEY GRAVEL (GC)
medium dense, moist, 20% clay

NOTES:
(1) No caving
(2) Free water encountered at 9.5'

LEGEND:

Sample Recovered
Sample Retained
Length Of Drive

Water level and date measured

PROJECT NO.:	236.15	
DRAWN BY:	BDM	3/13/98
CHECKED BY:		
APPROVED BY:	Dmo	3/19/98
REVISED:		

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A Division Of
Brunsing Associates, Inc.

PLATE A-3
Logs of Borings OSB-7 & OSB-8
1620 South Delaware Street
San Mateo, California

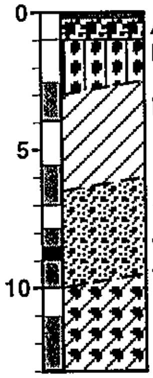
Log of Boring OSB-9

Equipment: Hydraulic Push

Drill Date: 11/19/97

Elevation: Not surveyed **Logged By:** MTE

PID (in ppm)	Odor	Blows/foot	Depth (ft) / Sample
	Ø		
	Ø		
	Gas Odor		
	Slight		



ASPHALT AND BASEROCK

MEDIUM BROWN SILTY SANDY GRAVEL (GM)
medium dense, dry, 20% silt, 30% sand

MEDIUM BROWN GRAVELLY CLAY (CL)
medium stiff, damp to moist, 20% weathered gravel

MOTTLED GRAY AND BROWN GRAVELLY SAND (SW)
medium dense, moist, 20-30% gravel
water level 9.5', 11/19/97

MEDIUM BROWN CLAYEY GRAVEL (GC)
medium dense, saturated, 20% clay

NOTES:
(1) No caving
(2) Free water encountered at 9.5'

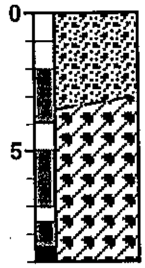
Log of Boring OSB-10

Equipment: Hydraulic Push

Drill Date: 11/19/97

Elevation: Not surveyed **Logged By:** MTE

PID (in ppm)	Odor	Blows/foot	Depth (ft) / Sample
	Ø		
	Ø		
	Ø		
	Ø		



GRAY GRAVELLY SAND (SW)
loose, moist

MEDIUM GRAY CLAYEY GRAVEL (GC)
dense, dry to damp, 40-50% clay

NOTES:
(1) No caving
(2) No free water encountered
(3) Practical drilling refusal at 9.0'

LEGEND:

- Sample Recovered
- Sample Retained
- Length Of Drive
- Water level and date measured

PROJECT NO.: 236.15		
DRAWN BY:	BDM	3/13/98
CHECKED BY:		
APPROVED BY:	DMD	3/19/98
REVISED:		

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PLATE A-4
Logs of Borings OSB-9 & OSB-10
1620 South Delaware Street
San Mateo, California

BORING HP-1

DATE DRILLED: 4/17/89

Depth in Feet	Sampler Type	Sampling Resistance	Symbols	Description
0				ASPHALT
	SPT	4	SW	REDDISH-BROWN COARSE SAND with some gravel [FILL]
			CL	BROWN GRAVELLY CLAY
	SPT	7	CL	BLACK SILTY CLAY with abundant organic material (moist) (soft)
	SPT	8		Grades brown with gray mottling, fine gravel and increasing silt
5			SM	BROWN SILTY SAND with minor clay and orange mottling (wet) (loose)
	SPT	13	GC	BROWN CLAYEY MEDIUM GRAVEL with sand and orange mottling (wet) (medium dense)
	SPT	17		Grades sandier with subrounded gravel up to 1-inch in diameter
10				
15				
20				
25				
30				
35				

NOTES:
1. Boring completed at a depth of 10.0 feet on 4/17/89.
2. Hydropunch driven to 15.5 feet and pulled back to 11.5 feet.
3. Borehole backfilled with cement/bentonite grout on 4/17/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

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LOG OF BORING

Dames & Moore

BORING HP-2

DATE DRILLED: 4/17/89

DEPTH IN FEET	SAMPLING: SAMPLER TYPE	SAMPLING: SAMPLING RESISTANCE
0		
	SPT	5
5		
	SPT	14
10	SPT	13
15		
20		
25		
30		
35		

SAMPLES	SYMBOLS	DESCRIPTION
		ASPHALT
■	CL	DARK GRAY SILTY CLAY with occasional organics and brownish-orange specks (moist) (medium stiff)
	CL	GRAY SILTY CLAY with minor sand and rounded gravel; occasional brownish-orange streaks (moist to wet) (medium stiff)
■	ML/CL	BROWN CLAYEY SILT TO SILTY CLAY with scattered rounded fine gravel and gray mottling (moist) (stiff)
■	ML	BROWN TO BROWNISH-YELLOW CLAYEY SILT with minor fine sand and black streaks (wet) (medium dense)

NOTES:
1. Boring completed at a depth of 11.5 feet on 4/17/89.
2. Hydropunch driven to 16.0 feet and pulled back to 11.5 feet.
3. Borehole backfilled with cement/bentonite grout on 4/17/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

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LOG OF BORING

Dames & Moore

BORING HP-3

DATE DRILLED: 4/18/89

DEPTH IN FEET	SAMPLER TYPE	SAMPLING RESISTANCE	SYMBOLS	DESCRIPTION
0				4" CONCRETE with 6" coarse sand base (FILL)
	SPT	5	CL	DARK GRAY SILTY CLAY with minor fine sand and scattered organics (moist to wet) (soft) Grades light gray with orange mottling, sandier with scattered fine angular gravel
5			CL	BROWN SANDY SILTY CLAY with subangular gravel (moist to wet) (medium soft)
	SPT	16	ML	BROWN CLAYEY SAND with angular gravel up to 1/2-inch in diameter (wet) (medium dense)
10	SPT	22		Grades with increasing gravel and less clay; gravel up to 1-inch in diameter
15				
20				
25				
30				
35				

NOTES:
1. Boring completed at a depth of 11.5 feet on 4/18/89.
2. Hydropunch driven to 15.5 feet and pulled back to 12.5 feet.
3. Borehole backfilled with cement/bentonite grout on 4/18/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

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LOG OF BORING

Dames & Moore

BORING HP-6

DATE DRILLED: 4/18/89

DEPTH IN FEET	SAMPLER TYPE	SAMPLING RESISTANCE
0		
	SPT	5
5		
	SPT	19
10		
15		
20		
25		
30		
35		

SAMPLES	SYMBOLS		DESCRIPTION
			ASPHALT
■		CL	BROWN SILTY CLAY with minor sand and gravel (moist) (medium stiff)
		SW	BROWNISH-YELLOW GRAVELLY SILTY SAND with some subangular gravel up to 1/2-inch (moist to wet) (medium dense)
■			Grades with increasing gravel and less silt (wet)

NOTES:

1. Boring completed at a depth of 7.5 feet on 4/18/89.
2. Hydropunch driven to 11.0 feet and pulled back to 9.0 feet.
3. Borehole backfilled with cement/bentonite grout on 4/18/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

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LOG OF BORING

Dames & Moore

BORING HP-7

DATE DRILLED: 4/18/89

DEPTH IN FEET	SAMPLER TYPE	SAMPLING RESISTANCE	SYMBOLS	DESCRIPTION
0				ASPHALT
			ML	DARK BROWN CLAYEY SILT with some sand, gravel (moist) (medium dense)
	SPT	6	CL	GRAY SANDY SILTY CLAY with trace angular gravel and orange mottling (moist) (medium stiff)
5	SPT	20	SM	DARK BROWN SILTY GRAVELLY SAND, angular gravel up to 1-inch in diameter (moist to wet) (medium dense)
				Grades with gravel
10	SPT	19		
15				
20				
25				
30				
35				

NOTES:
1. Boring completed at a depth of 11.5 feet on 4/18/89.
2. Hydropunch driven to 15.5 feet and pulled back to 12.5 feet.
3. Borehole backfilled with cement/bentonite grout on 4/18/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

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LOG OF BORING

Dames & Moore

BORING HP-8

DATE DRILLED: 4/18/89

DEPTH IN FEET	SAMPLER TYPE	SAMPLING RESISTANCE	SAMPLES	SYMBOLS	DESCRIPTION
0					ASPHALT
	SPT	5	■	ML	BROWN CLAYEY SILT with sand and minor gravel (moist) (medium dense) Grades clayier with orange mottling and scattered organics
5	SPT	12	■	SC	BROWNSIH-GRAY CLAYEY SAND with trace gravel and dark gray staining at 7.0 feet. Strong gasoline odor Color becomes gray
10	SPT	11	■	ML	BROWNISH-YELLOW SANDY SILT with clay and minor orange mottling (wet) (medium dense)
15					
20					
25					
30					
35					

NOTES:
1. Boring completed at a depth of 11.5 feet on 4/18/89.
2. Hydropunch driven to 15.5 feet and pulled back to 12.5 feet.
3. Borehole backfilled with cement/bentonite grout on 4/18/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

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BY w/9 PAGES 23

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LOG OF BORING
Dames & Moore

2826-027-043

PLATE 11

001

BORING HP-9

DATE DRILLED: 4/19/89

DEPTH IN FEET	SAMPLER TYPE	SAMPLING RESISTANCE
0		
	SPT	7
5	SPT	10
	SPT	10
10		
15		
20		
25		
30		
35		

SYMBOLS		DESCRIPTION
	GC	BROWN SILTY GRAVEL (loose) (dry) [FILL]
	ML	MOTTLED YELLOWISH-BROWN AND RED CLAYEY SILT with scattered roots (dry)
	CL	DARK TO LIGHT GRAY CLAY with trace fine gravel, scattered roots (dry) Grades with yellow-brown mottling, some silt
	ML	YELLOW-BROWN CLAYEY SILT with some sand and fine gravel (wet) Grades with orange mottling and fine sand

NOTES:
1. Boring completed at a depth of 10.0 feet on 4/19/89.
2. Hydropunch driven to 15.5 feet and pulled back to 11.5 feet.
3. Borehole backfilled with cement/bentonite grout on 4/19/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

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LOG OF BORING

Dames & Moore

BORING HP-10A

DATE DRILLED: 4/19/89

DEPTH IN FEET	SAMPLER TYPE	SAMPLING RESISTANCE	SAMPLES	SYMBOLS	DESCRIPTION
0					CONCRETE
				ML/GC	REDDISH-BROWN CLAYEY SILT AND GRAVEL (dry to slightly moist) [FILL]
				CL	DARK GRAY TO YELLOWISH-BROWN SILTY CLAY with trace gravel (moist to wet)
5					Grades with increasing gravel
				ML	YELLOW-BROWN CLAYEY SILT with trace fine sand and fine gravel (wet)
10	SPT	5/6"			
15					
20					
25					
30					
35					

NOTES:

1. Boring completed at a depth of 11.0 feet on 4/19/89.
2. Hydropunch driven to 15.0 feet and pulled back to 11.0 feet (no sample recovered).
3. Hydropunch driven to 16.0 feet and pulled back to 13.0 feet (no sample recovered).
4. Borehole backfilled with cement/bentonite grout on 4/19/89.
5. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
6. Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
7. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

DRAFT

LOG OF BORING

Dames & Moore

BORING HP-11A

DATE DRILLED: 4/20/89

DEPTH IN FEET	SAMPLING: SAMPLER TYPE	SAMPLING: SAMPLING RESISTANCE	SAMPLES	SYMBOLS	DESCRIPTION
0					CONCRETE
				ML/GC	REDDISH-BROWN CLAYEY SILT AND GRAVEL (dry) [FILL]
				CL	LIGHT GRAY SILTY CLAY with yellowish-brown mottling, trace of fine gravel and sand (moist) Grades with yellowish-brown color and increasing sand and gravel
5					
				ML/SC	YELLOW-BROWN SANDY SILT with some clay interbedded with clayey sand; trace fine gravel (wet)
10					
15					
20					
25					
30					
35					

NOTES:
1. Boring completed at a depth of 11.0 feet on 4/20/89.
2. Hydropunch driven to 15.0 feet and pulled back to 11.0 feet (no sample recovered).
3. Borehole backfilled with cement/bentonite grout on 4/20/89.
4. Sampling resistance is measured in blows per foot required to drive the sampler 12 inches with a 140 lb. hammer falling 30 inches after sampler has been seated 6 inches.
5 Boring log indicates interpreted subsurface conditions only at the location and the time the boring was drilled.
6. For an explanation of terms used see the Soils Classification Chart and Key to Test Data, Plate 15.

LOG OF BORING

Dames & Moore

2826-027-043

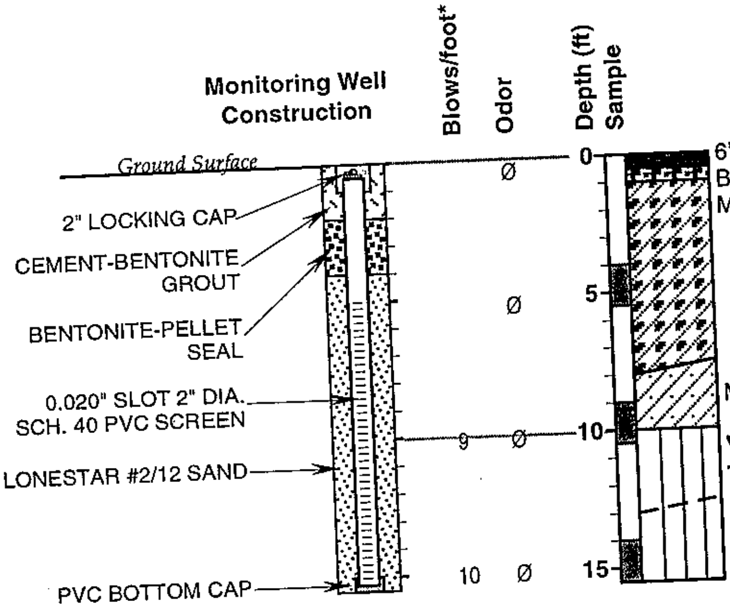
PLATE 14

Log of Boring MW-1

Equipment: 8" Hollow-Stem Augers

Drill Date: 12/11/97

Elevation: **Logged By:** MTE



6" ASPHALTIC CONCRETE (AC)

BROWN SILTY SANDY GRAVEL (GP) dense, moist

MEDIUM BROWN CLAYEY SANDY GRAVEL (GC)
medium dense, moist, 15% clay, 30% medium to coarse-grained sand

MEDIUM BROWN CLAYEY SAND (SC)
medium dense, saturated, 30% clay

BROWN-RED SANDY SILT (ML)
medium stiff, saturated, 10% to 20% very fine-grained sand
water level 11.45', 12/11/97

MOTTLED GRAY AND BROWN SILT (ML)
medium stiff, saturated

NOTES:
(1) No caving
(2) Free water encountered at 11.45'

LEGEND:

Sample Recovered
Sample Retained
Length Of Drive

* Equivalent "Standard Penetration" blow counts

Water level and date measured

PROJECT NO.: **236.15**		
DRAWN BY:	BDM	2/23/98
CHECKED BY:		
APPROVED BY:	DMO	3/19/98
REVISED:		

BACE Environmental
A Division Of
Brunsing Associates, Inc.

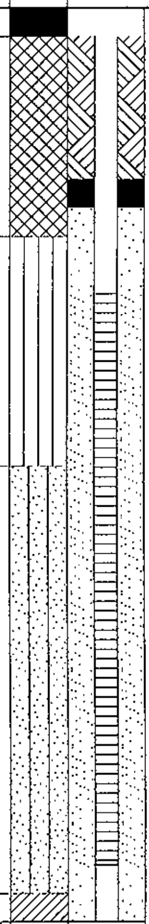
PLATE A-5
MW-1 Log And Well Completion Detail
1620 South Delaware Street
San Mateo, California

[...]G ASSOCIATES, INC.
[...]X 588
[...]or, CA. 95492
phone: (707) 838-3027
[...]: (707) 838-4420

BORING NO.: **MW-2** SHEET 1 OF 1
PROJECT: **L.C. SMITH**
LOCATION: **1620 S. Delaware St., San Mateo, CA**
PROJECT NO.: **236.19**

COORDINATES:
CASING ELEVATION: **Unknown** DATUM: **To be surveyed**
LOGGED BY: **MTE** DATE COMPLETED: **09/04/01**

SAMPLE INFORMATION									
DEPTH FEET	LAB SAMPLE	SAMPLE TYPE	BLOW COUNTS	TEMP (F)	ODOR	DESCRIPTION	STRATA	WELL CONSTRUCTION DETAIL	ELEVATION FEET
0					0	ASPHALT			
						SANDY SILTY CLAYEY GRAVEL (FILL)			
						MOTTLED GRAYISH BROWN CLAYEY SILT (ML) moist, soft			
5					0				5
						1st water encountered at about 8 feet blow ground surface		▽	
10					0				10
						BROWN SILTY SANDY (SM) saturated, loose			
15					0				15
						GRAY CLAY (CL) stiff, wet			
						T.D @ 16 feet below ground surface			



DRILLING CONTRACTOR: Gregg Drilling, Inc
DRILLING METHOD: 8-inch Hollow Stem Augers
DRILLING EQUIPMENT:
DRILLING STARTED: 09/04/01

REMARKS

See Plate A1 for symbols and abbreviations used above.

Brunsing Associates, Inc.

Job No.: 236.19
Appr.:
Date: 10/3/01

LOG OF BORING MW-2
L.C. SMITH
1620 S. Delaware Street
San Mateo, California

PLATE A2

ENVIRONMENTAL MULTIPLE CHAMBER WITH TEMP 23619~1.GPJ BACE.GDT 10/3/01

APPENDIX G

References

APPENDIX C: REFERENCES

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